

2023 INSPECTION & TEST PLAN

STATIC DATA					
Plant	Manitou	Eq#	62066330	Manufacturer	Universal Industries
LSD	01-30-044-26W3	Tag #	T-107	Serial #	95 01 17 8944

Summary

Due	Method	Completed by	Certification
2023	Visual internal (VI)	API 653 Certified AGST Inspector	API 653
2023	Visual external (VE)	API 653 Certified AGST Inspector	API 653
2023	Ultrasonic testing (UT)	NDE contractor – UT technician	CGSB level 1 or 2
2023	Magnetic Flux Leakage (MFL)	NDE contractor – MFL technician	As Per API 653 Annex G

Preparation

- Ensure safe access to all areas of the tank internal and external.
- Tank to be internally clean and dry on floor, first course and up the 2nd shell as high as possible.
- Ensure all nozzles and couplings are cleaned out and dry for visual inspection.

Notes

- Inspection to be done in accordance with attached HUSKY TASKLIST QNATANK-7

VI & VE

Notes

- Visual inspection to be completed by API 653 Above ground storage tank inspector

MFL & UT

Notes

- MFL examination of the floor to be completed by qualified technician as per API 653 Annex G
- MFL indications to be examined with UT and measurements to be mapped
- UT on Tank shell to be completed every 2' around the circumference, from 6" elevation to the top leg of the floor to shell weld.
- Add measurements and locations to CML Map.
- CML's must be scanned, and the minimum thickness is to be recorded
- If corrosion is found, technician must comment on the nature of the corrosion (e.g., localized corrosion, pitting, etc.)
- Any questions regarding the scope of examination please call Terry Neufeld 780-818-8468

Area	Thickness	Action Required
Nominal Thickness	Floor: 0.250"; Shell: 0.250" Roof: 0.188"	None
Minimum Required Thickness	Floor: 0.100" (API 653 Table 4.4)	UT - flag RED
	Shell: 0.100"	
Alert Thickness	Floor: 0.140"	UT - flag YELLOW

**QNATANK-7 10Y Code Inspection Tank 2000 to 10,000 bbl,
Fully Coated**

This task list is not all inclusive and does not limit any additional inspection or examination or limit the areas to be examined. The inspector may use any additional reasonable means deemed necessary to determine the integrity of the tank for code compliance and suitability for continued service

External Inspection

All deficiencies are to be recorded and photographs taken
All evidence of corrosion is to be mapped and depth measured with pit or depth gauge

Ladders, stairways and platforms

1) Handrails, inspect for
pitting, holes and paint condition
condition of attachment welds
condition of mid rails and toe boards
condition of safety drop bars for corrosion, operation, and length
hazardous opening between the rolling ladder handrail and gauging platform when roof is in lowest position

2) Platform frame inspect for
corrosion and paint failure
corrosion and cracking of attachment welds
reinforcing pads where supports are attached to the shell and roof
thinning and holes in the deck plate or distortion of the grating
seal welds on flat-surface to flat-surface junctures

3) Deck plate and grating, inspect for
corrosion, holes and paint failure
scale build-up on plate to frame weld
thinning of bars and failure of welds on grating

All deficiencies to be noted. Unsafe conditions to be brought to the attention of Operations for immediate repair.

Unsafe items are not to be used during inspection.

Foundation and site

- 1) Foundation inspect for
measure foundation levelness and bottom elevations.
type of foundation
cavities under foundation and vegetation against bottom of the tank.
verify that runoff rainwater drains away from the tank
settlement around perimeter of tank.
areas where leaching of oil has left rock filler exposed
- 2) Site and dike inspect for
condition of the dike
drainage away from the tank and associated piping and manifolds
operation of dike drains
buildup of trash, vegetation, and other inflammables.

Shell and appurtenances

- 1) Shells inspect for
paint failures, pitting, and corrosion
corrosion and thinning at the bottom angle area where the floor and shell are attached
dents, bulges or buckling
- 2) External floating roof tank inspect for
Grooving, corrosion, pitting, and coating failure.
- 3) Windgrider (floating roof tanks) inspect for
corrosion damage on windgrider and handrail
pitting on support welds
reinforcing pads welded to the shell
- 4) Manways and nozzles, inspect for
cracks or signs of leakage on the weld joints at nozzles, manway, reinforcing plates
shell dimpling around nozzles
flange leaks around manways and nozzles,
sealing of insulation around manway flange and nozzles.
Inadequate manway flange and cover thickness on mixer manways
- 5) Tank piping manifolds, inspect for
leak around valves, piping and flanges

fire fighting system components
anchored piping that could damage the tank shell or bottom
connections during earth movements
adequate thermal pressure relief of piping to the tank
operation of regulators for tanks with purge gas systems
leaks around sample connections
damage and check accuracy of temperature indicators

If deficiencies are noted additional inspection of associated piping or support system is required to determine cause and recommended resolution

6) Autogauge system, inspect for
leaks around the tape guide and lower sheave housing
damage to autogauge head
proper movement of the tape
condition of the board and legibility of board type
autogauges
freedom of movement of the marker and float

All deficiencies to be noted and brought to the attention of Operations for immediate repair.

7) Shell mounted sample station inspect for
function of valves and plugged lines including drain line
and return to tank line
leaks around circulation pump and operating problems
damaged bracing or supports for sampling system and piping

8) Heater, inspect for
presence of product in condensate drain line from steam
type heater
leaks around bolting flange for heater inlets

9) Mixer, inspect for
proper mounting of flange and support
leakage
condition of power lines and connections to mixer

10) Swing lines inspect for
proper winch operation
cable tightness when raising and lowering the swing line
condition of the cable and winch
operation of the indicator.

11) Foam lines inspect for

broken connections
corrosion
proper fittings

12) Overflow vents and lines inspect for
screens are clean
corrosion
no plugs in lines
broken connections
freeze damage

13) Shell insulation, inspect for
cracks or leaks in the insulation weather coat
wet insulation under the weather coat
corrosion under insulation by removing sample areas
Roof and appurtenances

NOTE: For safety, before accessing the roof, check with an ultrasonic instrument near the edge of the roof for thinning. Verify the roof thickness is sufficient for safe support. (Corrosion normally attacks the deck plate at the edge of a fixed roof and at the rafters in the center of the roof first)

1) Deck plate inspect for,
paint failure, pitting, holes and corrosion product on the roof deck

2) Deck drainage, inspect for
indications of standing water

3) Level of floating roof inspect for
levelness of the floating roof

4) Roof insulation, inspect for
cracks or leaks in the insulation weather coat
wet insulation under the weather coat
corrosion under insulation by removing sample areas

5) Floating roof seal systems inspect for
condition of the roof seals
proper operation of the roof seal systems
s protruding bolts or rivet heads against the shell
flexibility, resilience, cracks or tears of wedge type
wiper seals.

- 6) Sample hatch inspect for
condition and functioning of the sample hatch cover
condition of the seal inside of the hatch cover
corrosion and plugging on thief and gauge hatch cover
marked and tab stating hold off distance (where sample hatch is used to gauge product level
condition of any internal lining of the sample hatch
 - 7) Gaugewell inspect for
thinning of the visible portion of the well, size of slots
and cover condition
hold off marker and tab for legibility
condition of roof guide and rollers on gauge well for
floating roofs
distance from gauge well to tank shell at different levels
if accessible
 - 8) Fixed roof scaffold support inspect for
corrosion, wear and structural soundness
 - 9) Roof mounted vent (internal floating roof) inspect for
condition of the screens, locking pins and pivot pins
 - 10) Emergency roof drains, inspect for
proper material and operation
 - 11) Pressure / Vacuum breakers, inspect for
proper operation, size, number, and type
- All deficiencies to be noted and brought to the attention of Operations for immediate repair.
- 12) Rim Vents, inspect for
condition of the screen on the cover
plating off or removal of the vents
 - 13) Pontoon inspection hatches, inspect for
indications of leakage
proper operation of lock down covers and vent piping if
equipped

External NDE

- 1) Complete ultrasonic thickness survey in accordance with tank UT circuit drawing

2) Perform additional ultrasonic, liquid penetrant or magnetic particle inspection necessary to verify tank condition and integrity at identified areas of mechanical damage, blistering, cracks or corrosion.

Internal Inspection

All deficiencies are to be recorded and photographs taken
All evidence of corrosion is to be mapped and depth measured with pit or depth gauge

General

1) Ensure tank has been high pressure washed or steamed to remove residual product to Class 3 cleanliness.

2) Shell inspect for
coating damage, deterioration, and disbonding
banding and peaking of shell welds
vertical grooving and coating damage on floating roof tanks
roundness and out of plumb

3) Floor inspect for
corrosion of floor underside
coating damage, deterioration and disbonding
voids under the bottom
indications of leakage
floor to shell edge settlement
condition of doubler plates for floating roof legs

4) Roof inspect for
coating damage, deterioration, and disbonding
broken welds in clips, brackets and braces

5) Roof support structure inspect for
coating damage on columns and rafters
broken welds in clips, brackets and braces
loose or twisted columns and rafters

6) Internal heaters inspect for
broken or damaged piping
debris accumulation
corrosion of components
coating damage from overheating

7) Internal mixers inspect for
proper installation and orientation
clearance at blade tips from floor or other obstruction
erosion of coating at mixer location

8) Piping and sumps inspect for
corrosion and coating condition
pluggage
holes
distortion at shell to pipe connection

9) Floating roof inspect for
pontoon condition
seal condition
deck plating underside condition
loose or missing components
damaged legs

Internal NDE

1) Perform ultrasonic thickness checks of internal nozzle
projections, coils and permanent internals exhibiting
corrosion and metal loss.

2) Perform additional NDE per vessel's last inspection
report recommendations

3) Perform additional ultrasonic, liquid penetrant or
magnetic particle inspection necessary to verify vessel
condition and integrity at identified areas of mechanical
damage, blistering, cracks or corrosion.

4) Perform holiday testing of coating.

Tank welding repairs were completed by Pipemaster Oilfield
Services. Coating repairs were completed by Coatings 2000.
Tank can be placed on a 5 year interval.

62066330

Tracker/RBMI Entry 10/11/18sv

John Neupog

**ABOVE GROUND STORAGE TANK
API STANDARD 653
OUT-OF-SERVICE
FINAL INSPECTION REPORT
RANGER INSPECTION™
JOB # 22996
(Revision 1)**

HUSKY ENERGY

**MARSDEN BATTERY
LSD: 01-30-044-26 W4M**

TANK # T-107

INSPECTION DATE: SEPTEMBER 19 / 2018

Prepared by:



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FITNESS FOR SERVICE

Based on the findings of this inspection, Tank # T-107 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.

Kyle Christensen

API Standard 653 Inspector

Certification # 83500

EXECUTIVE SUMMARY

The following is a summary of the major findings of the out-of-service inspection performed on Tank # T-107:

BOTTOM

- 1.) A Magnetic Flux Leakage (MFL) scan was performed on accessible areas of the tank bottom plate. No indications of underside material loss were identified. The MFL threshold for the scan was approximately 0.030 inch.
- 2.) Forty-six (46) areas of coating failure were identified and marked on the tank bottom plate.
- 3.) The bottom plate was visually examined for topside pitting. Fourteen (14) areas of isolated pitting up to 0.150 inch deep were identified.

SHELL-TO-BOTTOM WELD

- 1.) A limited visual inspection was performed on the shell-to-bottom weld externally, as the bottom plate projection and shell-to-bottom weld were covered by insulation and flashing. Accessible external areas were observed to be in acceptable condition at the period of this inspection
- 2.) The internal weld was observed to have some coating failures and areas of pitting at the period of this inspection.

FOUNDATION

- 1.) The foundation was visually examined from accessible areas. The tank is sitting on an elevated earth and gravel pad, contained within a steel ring. It was found that the tank is sitting below grade; therefore rain water is not directed away from the bottom plate.
- 2.) The shared tank berm was full of water at the time of inspection.

SHELL

- 1.) A limited visual inspection was performed on the external shell plate due to the shell being covered by insulation and flashing.
- 2.) The internal shell plate was visually examined. No significant deformation was observed. Seven (7) coating failures were identified and marked on the shell plate.
- 3.) Random ultrasonic (UT) thickness readings were taken on the first course shell plate. No material loss was observed or recorded. Refer to Table A - Manual UT Shell Plate Readings – Course # 1, for additional data.
- 4.) One (1) area of shell pitting was observed, the pit was recorded at 0.090 inch deep.

NOZZLES AND APPURTENANCES

- 1.) The tank nozzles and appurtenances were visually examined.
- 2.) The internal pipe support reinforcing pads and welds were observed to be severely corroded.

FIXED ROOF

- 1.) The fixed roof support structure was visually evaluated internally from accessible areas. No areas of concern were identified.

REPAIR RECOMMENDATIONS

BOTTOM

- 1.) Four (4) patch plates are recommended on the bottom plate to cover topside pits.
- 2.) Three (3) areas of the bottom plate butt welds are recommended to be ground out and re-welded.
- 3.) The old center column reinforcing pad is recommended to be gouged out and the bottom plate underneath be evaluated for corrosion.
- 4.) It is recommended that all coating failures on the bottom plate be repaired.

SHELL-TO-BOTTOM WELD

- 1.) It is recommended that all coating failures on the internal shell-to-bottom weld be repaired.

FOUNDATION

- 1.) It is recommended that the foundation be reworked to allow for water to be directed away from the bottom of the tank.
- 2.) It is recommended that the water be drained from the berm.

SHELL

- 1.) It is recommended that all coating failures on the internal shell plate be repaired.

NOZZLES AND APPURTENANCES

- 1.) It is recommended that four (4) of the pipe support reinforcing pads be removed and evaluated for further corrosion of the bottom plate. New pipe supports and reinforcing pads should then be welded to the bottom of the tank.

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-107 is 23 years old.

RESULTS WITHOUT REPAIRS			RESULTS AFTER RECOMMENDED REPAIRS	
RT_{BC}	0.220	inch	0.220	inch
RT_{ip}	0.100	inch	0.190	inch
O_r	5	years	5	years
StP_r	0.030	inch/yr	0.000	inch/yr
UP_r	0.0013	inch/yr	0.0013	inch/yr
MRT	Hole through	inch	0.183	inch
Required Thickness at O_r	0.100	inch	0.100	inch

The approximate threshold for 0.250 inch plate with a coating 18 to 28 mils thick is 0.030 inch. Therefore, as per API 653 4.4.5.1 NOTE 1, assumed corrosion of 0.030 inch was used as the basis for the calculations above.

A repair threshold of 0.110 inch was established using the above calculations. All areas of material loss resulting in a minimum thickness below the threshold were identified for repair in the repair recommendations on the previous page.

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1. INTRODUCTION

Husky Energy contracted with Ranger Inspection™ to provide API Standard 653 inspection services for the above ground storage tank 107 as per the Husky Energy representative Mr. Luke Newport.

Ranger Inspection™ job number 22996.

The tank is located at the Marsden Battery, LSD: 01-30-044-26 W3M.

This report documents the findings of the out-of-service examinations performed on September 19 / 2018 and provides an evaluation of the inspection results per the applicable criteria of API Standard 653.

Ranger Inspection™ provided the following personnel:

Kyle Christensen

Project Manager / API Inspector / Report Author / AutoCAD Draftsperson
API 653 Certification # 83500

Trevor Aniejurengho

Technician

Jennifer Thompson

Technical Report Writer / AutoCAD Draftsperson

2. JOB DESCRIPTION

RANGER JOB NUMBER:	<ul style="list-style-type: none"> • 22996
RANGER TAG NUMBER:	<ul style="list-style-type: none"> • 12515
TANK NUMBER:	<ul style="list-style-type: none"> • T-107
TANK LOCATION:	<ul style="list-style-type: none"> • Marsden Battery • LSD: 01-30-044-26 W3M
TANK OWNER:	<ul style="list-style-type: none"> • Husky Energy
CUSTOMER CONTACT:	<ul style="list-style-type: none"> • Luke Newport • Asset Integrity Inspector • Technical Services • Safety, Engineering & Procurement • Husky Energy • 4335 – 44 Street • Lloydminster SK S9V 0Z8 • Phone: 306-820-4346 • Fax: 306-825-1176 • Cell: 780-872-8104 • Email: luke.newport@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"> • September 19 / 2018
REVISION DATE:	<ul style="list-style-type: none"> • September 21 / 2018
LAST INSPECTION:	<ul style="list-style-type: none"> • July 5 / 2013
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"> • Kyle Christensen • Certification # 83500

3. TANK DESCRIPTION

Nameplate Details	TANK NUMBER / ID:	<ul style="list-style-type: none"> 62066330 T-107
	RANGER TAG NUMBER:	<ul style="list-style-type: none"> 12515
	MANUFACTURER:	<ul style="list-style-type: none"> Universal Industries LTD
	MANUFACTURER SERIAL:	<ul style="list-style-type: none"> 95 01 17 8944
	TANK OWNER / OPERATOR:	<ul style="list-style-type: none"> Husky Energy
	NAMEPLATE PRESENT:	<ul style="list-style-type: none"> Yes
	DESIGN STD:	<ul style="list-style-type: none"> API 650, Edition – 1993
	YEAR BUILT:	<ul style="list-style-type: none"> 1995
	TANK LOCATION:	<ul style="list-style-type: none"> Marsden Battery LSD: 01-30-044-26 W3M
	SERVICE:	<ul style="list-style-type: none"> As per Husky Energy
	DIAMETER:	<ul style="list-style-type: none"> 21' 6"
	HEIGHT:	<ul style="list-style-type: none"> 32' 7/16"
	NOMINAL CAPACITY:	<ul style="list-style-type: none"> 2000 bbl
	DESIGN PRESSURE:	<ul style="list-style-type: none"> ATM

Tank Geometry	FOUNDATION DETAIL:	<ul style="list-style-type: none"> Elevated earth and gravel pad, contained in a steel ring 			
	BOTTOM PLATES:	<ul style="list-style-type: none"> Bottom Plate Projection = Inaccessible due to insulation Weld Detail = Butt welded Nominal Plate Thickness = 0.250 inch 			
	SHELL PLATES:	<ul style="list-style-type: none"> Weld Detail = Butt welded 			
	SHELL COURSE HEIGHTS:	Course	Height (inches)	Material Grade	Thickness (inches)
		1	96	Unknown	0.188
		2	96	Unknown	0.188
		3	96	Unknown	0.188
		4	96	Unknown	0.188
	FIXED ROOF:	<ul style="list-style-type: none"> Weld Detail = Butt welded Plate Thickness = 0.188 inch 			
	FIXED ROOF ACCESS:	<ul style="list-style-type: none"> Ladder 			

Coating Details	BOTTOM PLATE COATING:	<ul style="list-style-type: none"> Internal coating = Epoxy
	SHELL PLATE COATING:	<ul style="list-style-type: none"> Internal coating = Epoxy External coating = Insulation, Paint
	FIXED ROOF PLATE COATING:	<ul style="list-style-type: none"> Internal coating = Epoxy External coating = Insulation, Paint

4. INSPECTION INTERVAL

The following inspection intervals are based on completion of required repairs as outlined in this report, and in accordance to applicable standards.

ROUTINE IN-SERVICE INSPECTIONS

The external condition of tank T-107 shall be monitored by close visual inspection from the ground on a routine basis and shall be performed by personnel knowledgeable of the storage facility operations, the tank, and the characteristics of the product stored. This inspection interval shall not exceed one month (Refer to Inspection Frequency Considerations below).

EXTERNAL INSPECTION

A visual external inspection shall be performed on tank T-107 by an Authorized Inspector at an interval not to exceed 5 years (2023) (Refer to Inspection Frequency Considerations below). In-service Ultrasonic evaluation of the shell may be scheduled to correspond with the external inspection interval. In-service evaluation of the tank settlement shall be performed to monitor the existing tank settlement and any changes due to continued tank settlement. In-service inspection requirements and maintenance shall be performed on tank T-107 at periods not exceeding the recommended practices as per API Standard 653 to assure continued tank integrity. Tanks may be in operation during this period.

INTERNAL INSPECTION

The recommended period until next formal internal inspection on tank T-107 is 5 years (2023) based on the observations and data of this inspection as outlined in this report. The tank owner / operator shall conduct a formal internal inspection and complete API Standard 653 inspection performed by an Authorized Inspector at this period of inspection.

INSPECTION FREQUENCY CONSIDERATIONS

Factors and consideration determining inspection frequency on tank T-107 include, but are not limited to: change in operating mode, service, jurisdictional requirements, routine in-service inspection results, owner / operator requirements. Refer to API Standard 653 "Inspection Frequency Considerations".

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.	• None observed
✓			5	Inspect for slipping hazards on the bottom and roof decks.	• None observed
✓			6	Inspect structural welds on access ways and clips.	• Acceptable
✓			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.	• None observed
✓ = 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: Tank ID



Photograph #2: Nameplate



Photograph #3: Tank Product



Photograph #4: Tank Overview



Photograph #5: Tank Overview

6. BOTTOM

6.1 BOTTOM CHECKLIST

✓	✗	N/A	#	Description	Comments
✓			1	Nominal bottom plate thickness.	• 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	• 0.285 inch including coating
	✗		3	Maximum product side pit depth on bottom plates.	• Before Repairs = 0.150 inch • After Repairs = 0.060 inch
✓			4	Coating thickness and detail on bottom plates. (Fiberglass or Epoxy).	• Epoxy
	✗		5	Inspect coating for holes, disbonding, deterioration, and discoloration.	• Forty-six (46) coating failures were identified on the bottom plate
✓			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.	• MFE performed
	✗		7	Measure the depth of pitting and describe the pitting appearance. (sharp edged, lake type, dense, scattered, etc.)	• Lake type
	✗		8	Mark areas requiring patching or further inspection.	• Refer to Bottom Plate Layout drawing
		N/A	9	Mark locations for turning coupons for inspection.	• None required
	✗		10	Inspect all welds for corrosion and leaks, particularly the shell-to-bottom weld.	• Three areas of significant weld corrosion
✓			11	Inspect sketch plates for corrosion.	• None observed
		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.	• N/A
✓			13	Locate and mark voids under the bottom.	• Acceptable
		N/A	14	Record bottom data on a layout sketch using the existing bottom plates as a grid. List the number and sizes of patches required.	• N/A
✓ = In Compliance / Acceptable				✗ = Out of Compliance / Area of Concern	N/A = Not Applicable

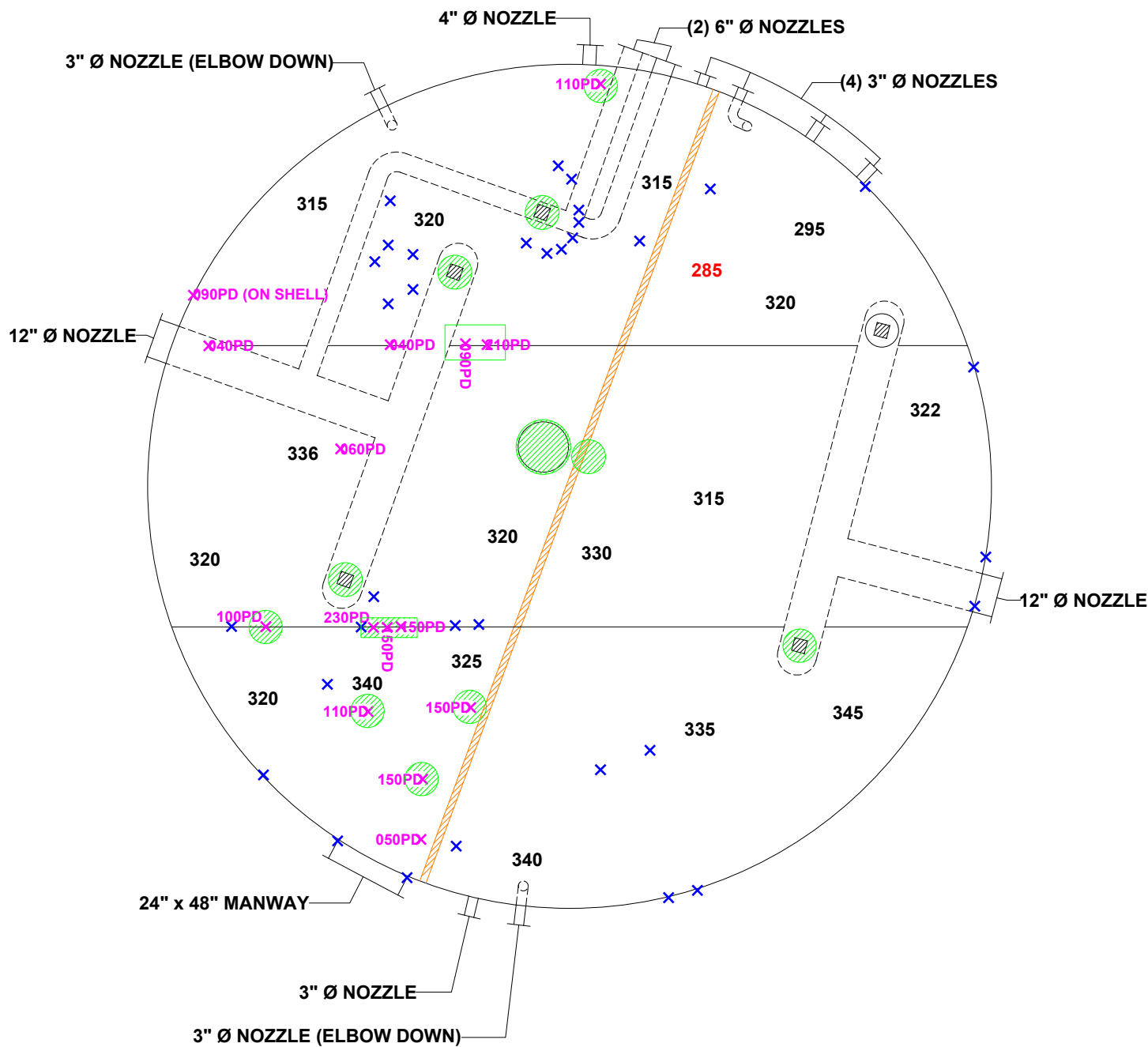
Continuation of the Bottom Checklist

✓	✕	N/A	#	Description	Comments
		N/A	15	Vacuum test the bottom lap welds.	• N/A
		N/A	16	Hammer test or ultrasonically examine any slightly discolored spots or damp areas.	• N/A
	✕		17	Check for reinforcing pads under all bottom attached clips, brackets, and supports.	• Corroded
		N/A	18	Inspect floating roof leg pads for pitting or cutting, and excessive dimpling (indicating excessive loading).	• N/A
		N/A	19	Check the column bases of fixed roof supports for adequate pads and restraining clips.	• N/A
		N/A	20	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.	• N/A
		N/A	21	Check area beneath swing line cable for indications of cable cutting or dragging.	• N/A
		N/A	22	Mark old oil and air test connection for removal and patching.	• N/A
		N/A	23	Identify and report low areas on the bottom that do not drain adequately.	• N/A
✓			24	Bottom plate slope (Flat, cone-up, cone-down).	• Flat
		N/A	25	Cathodic protection present.	• N/A
✓ = 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 PIT DEPTH READINGS ARE
MEASURED IN
THOUSANDTHS OF AN INCH
- (4.) ALL UT READINGS
INCLUDE A COATING ALLOWANCE
OF 0.040 - 0.060 INCH

LEGEND:

= MINIMUM ULTRASONIC (UT)
THICKNESS READING
INCLUDING COATING


= RANDOM ULTRASONIC (UT)
THICKNESS READING
INCLUDING COATING

 = COATING FAILURE

 = BAFFLE WALL

 = RECOMMENDED REPAIR

 = PIPE SUPPORT

 = PIT AND COATING FAILURE
(PD = PIT DEPTH)

 = INTERNAL PIPING

RANGER INSPECTION™			
TITLE:		BOTTOM PLATE LAYOUT	
CUSTOMER:		HUSKY ENERGY	
TANK NO:	T-107	JOB NO:	22996
LOCATION: MARSDEN BATTERY			
SIZE:	21.5' Ø	DATE:	SEP. 19 / 18
DRAWN BY:	KAC	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: Bottom Plate Overview



Photograph #7: Bottom Plate Overview



Photograph #8: Old Center Column



Photograph #9: Center Column Reinforcing Pad Corrosion



Photograph #10: Bottom Plate Pit



Photograph #11: Bottom Plate Weld Corrosion



Photograph #12: Bottom Plate Weld Corrosion

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).	• Visually acceptable
✓			2	Shared or Single cell berm.	• Shared cell
		N/A	3	Condition of sloped berm walls.	• N/A
		N/A	4	Condition of concrete berm.	• N/A
✓			5	Condition of secondary liner.	• As per Husky Energy
✓			6	Elevation of tank above grade of foundation.	• Acceptable
		N/A	7	Condition of asphalt skirt.	• N/A
		N/A	8	Inspect the bottom-to-foundation seal, if present.	• N/A
		N/A	9	Clean off the bottom angle area and inspect for corrosion and thinning on plate and weld.	• Inaccessible due to insulation
B. Concrete Ring					
		N/A	10	Inspect for broken concrete, spalling, and cracks; particularly under backup bars used in welding butt-welded annular rings under the shell.	• N/A
		N/A	11	Trough present around perimeter of bottom plate?	• N/A
		N/A	12	Inspect drain openings in ring, back of waterdraw basins and top surface of ring for indications of bottom leakage.	• N/A
		N/A	13	Inspect for cavities under foundation and vegetation against bottom of tank.	• N/A
		N/A	14	Check that runoff rainwater from the shell drains away from the tank.	• N/A
C. Asphalt					
		N/A	15	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	16	Look for areas where leaching of oil has left rock filler exposed, which indicates hydrocarbon leakage.	• N/A
D. Oiled Dirt or Sand					
		N/A	17	Check for settlement into the base which would direct runoff rain water under the tank rather than away from it.	• N/A
✓ = In – Compliance / Acceptable				✘ = Out of Compliance / Area of Concern	N/A = Not Applicable

Continuation of the Foundation Checklist

✓	✘	N/A	#	Description	Comments
E. Rock					
✓			18	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.	<ul style="list-style-type: none"> MFE and UT performed
F. Site Drainage					
	✘		19	Check site for drainage away from the tank and associated piping and manifolds.	<ul style="list-style-type: none"> Inadequate drainage
✓			20	Check operating condition of the dike drains.	<ul style="list-style-type: none"> As per Husky Energy
G. Housekeeping					
✓			21	Inspect the area for buildup of trash, vegetation, and other inflammables.	<ul style="list-style-type: none"> 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 #13: Foundation Overview



Photograph #14: Foundation Overview



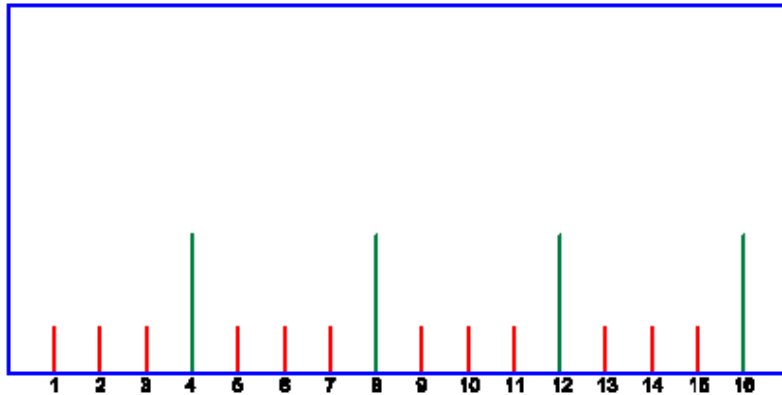
Photograph #15: Foundation and Berm Overview – Full of Water

8. SHELL

8.1 SHELL CHECKLIST

✓	✘	N/A	#	Description	Comments
✓			1	THICKNESS RANGE RECORDED: (Through Coating)	<ul style="list-style-type: none"> Course # 1: 0.230 to 0.245 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"> Insulated Paint
✓			4	Bulging / shell plate deformation.	<ul style="list-style-type: none"> None observed
✓			5	Peaking and banding.	<ul style="list-style-type: none"> None observed
		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
✓			7	Measure the depth of pitting on each course.	<ul style="list-style-type: none"> None observed
	✘		8	Inspect existing protective coatings for damage, deterioration, and disbonding.	<ul style="list-style-type: none"> Seven (7) coating failures identified and marked
✓			9	Visually inspect the shell plates and seams for indications of leakage.	<ul style="list-style-type: none"> None observed
✓ = In – Compliance / Acceptable				✘ = Out of Compliance / Area of Concern	N/A = Not Applicable

8.2 SHELL ULTRASONIC THICKNESS READINGS



LEGEND:

| = 12 INCH UT SCRUB

| = 36 INCH UT SCRUB

□ = SHELL PLATE

■ = UT READING NUMBER

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 18 TO 28 MILS						
Plate No./ID	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
1	0.231	0.234	0.237	0.244	0.233	0.242	0.242	0.243	0.243	0.232	0.241	0.233	0.245	0.231	0.237	0.232
2	0.236	0.237	0.234	0.245	0.235	0.234	0.238	0.242	0.231	0.230	0.231	0.242	0.230	0.233	0.235	0.245
Minimum:		0.230														
Maximum:		0.245														

Notes:

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

8.3 SHELL PLATE PHOTOGRAPHS

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



Photograph #16: External Shell Overview



Photograph #17: External Shell Overview



Photograph #18: Internal Shell Overview



Photograph #19: Internal Shell Overview

9. NOZZLES AND APPURTENANCES

9.1 NOZZLES AND APPURTENANCES PHOTOGRAPHS

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



Photograph #20: Manway



Photograph #21: Nozzles



Photograph #22: Nozzle



Photograph #23: Nozzles



Photograph #24: Nozzles



Photograph #25: Nozzle



Photograph #26: Internal Manway



Photograph #27: Internal Nozzles



Photograph #28: Internal Nozzle



Photograph #29: Internal Nozzles



Photograph #30: Internal Nozzle



Photograph #31: Internal Nozzles



Photograph #32: Internal Nozzles



Photograph #33: Internal Nozzle



Photograph #34: Internal Nozzle



Photograph #35: Pipe Support Reinforcing Pad Corrosion



Photograph #36: Pipe Support Reinforcing Pad Corrosion



Photograph #37: Pipe Support Reinforcing Pad Corrosion

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 Old coating hanging off of interior
		N/A	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"> N/A
		N/A	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"> Under insulation
		N/A	4	Inspect protective coating for breaks, disbondment, and deterioration.	<ul style="list-style-type: none"> Under insulation
		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					
		N/A	7	Visually inspect for paint failure, holes, pitting, and corrosion product on the roof deck.	<ul style="list-style-type: none"> Under insulation
C. Roof Deck Drainage					
		N/A	8	Look for indication of standing water. (Significant sagging of fixed roof deck indicates potential rafter failure).	<ul style="list-style-type: none"> Under insulation
D. Roof Insulation					
✓			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"> Visually acceptable
		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

10.2 FIXED ROOF PHOTOGRAPHS

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



Photograph #38: Fixed Roof Overview

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 September 19 / 2018.

ULTRASONIC

The ultrasonic (UT) equipment utilized for the inspection was an Olympus Epoch600 Flaw Detector, serial number 130543806, calibration date February 1 / 2018.

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.