

The Inspection survey report will be evaluated and any repairs required (guided by DOT pipeline requirements) will be performed prior to lease turnover for the Redstick pipeline.

# ROCOMBO INSPECTION SERVICE

## MFL-A/XT

Shell Pipeline Company, LP.

36" Crude Oil Pipeline  
Sugarland to Bayou Choctaw (Redstick Crude System)

September 2018

<b>Report Date</b>	November 26, 2018
<b>ROSEN Project Number</b>	0-1000-13737
<b>ROSEN Line Name</b>	36" SUG-BAY
<b>Revision No.</b>	0

Client: Shell Pipeline Company, LP.  
 ROSEN Project No.: 0-1000-13737  
 ROSEN Line Name: 36" SUG-BAY  
 Inspection Type: MFL-A/XT  
 Date of Inspection: September 12, 2018  
 Revision No.: 0

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**Client:** Shell Pipeline Company, LP.  
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# 1 INTRODUCTION

This Inline Inspection Survey Report describes the pipeline inspection carried out by ROSEN in the 36" Sugarland to Bayou Choctaw (Redstick Crude System) segment in September of 2018. This report has been distributed as follows:

<b>Shell Pipeline Company, LP.</b>	Mr. Eric Schwartz	1 copy
	Mr. Scott Olson	1 copy
<b>ROSEN</b>	Central File	1 copy

The inspection activities included the following:

- In-Line Combined Metal Loss and Geometry Assessment (RoCombo MFL-A/XT)
- Preparation and submission of the Preliminary Inline Inspection Survey Report
- Preparation and submission of the Inline Inspection Survey Report

The data is automatically searched for pipeline anomalies using ROSEN Automated Feature Search Software (AFS). Thereafter, data evaluation personnel interactively verify the results utilizing proprietary software. All results are stored in database files (dbf). More information regarding this process can be found in the Technical Reference.

This Inline Inspection Survey Report includes the results of all inspection runs performed by ROSEN in the pipeline during these inspection activities. The recorded RoCombo MFL-A/XT distance is used as the master distance for reporting all inspection results. All anomalies that meet or exceed the reporting thresholds established for this project are listed in this report.

All distances are given in imperial units. Upstream distances are designated with a minus sign (-). All anomalies are referenced to the upstream girth weld.

The center distance of the first valve in the launcher station has been set to 0.00 feet to aid in field measurement efforts.

A Management Summary is provided in Section 2. Detailed inspection results are given in Section 4. All technical information, including Terms and Definitions, Performance Specifications, and Dig Procedures, are provided on the accompanying media.

ROSEN thanks Shell Pipeline Company, LP. for the assistance and cooperation received during the course of this project.

## 2 MANAGEMENT SUMMARY

This section describes the general condition of the inspected pipeline. For more detailed findings please refer to Section 4.

### 2.1 Management Summary Statement

The results of the inspection activities indicate this line segment is mainly affected by manufacturing anomalies. Neither metal loss anomalies with a calculated wall loss of 80% or greater, nor metal loss anomalies with an ERF (0.85dL) of 1 or greater, have been reported.

Fourteen (14) deformation anomaly – dent locations have been reported, of these, five (5) have been detected with metal loss.

Five (5) anomalies have been classified as girth weld anomaly.

There are nine (9) manufacturing related signals reported that are not indicative of metal loss. These are most likely due to laminations and/or pipe grade.

There is seven (7) indications in the data reported as extra metal. These signals are indicative of extra metal either attached or in close proximity to the pipe.

## 2.2 Inspection Findings Summary

The findings of the inspection activities performed in this line segment are listed below.

### 2.2.1 Lists of Most Severe Anomalies

This list contains anomalies according to the following rules:

Liquid Service Pipeline

#### Group 1

- a) Metal loss greater than ( $>$ ) 70%
- b) PBurst less than ( $<$ ) 1.1 times MOP
- c) Top side deformation (above 8 to 4 O'clock) with metal loss, cracking or stress riser
- d) Top side deformation (above 8 to 4 O'clock) greater than ( $>$ ) 6%

#### Group 2

- a.1) Top side deformation (above 8 to 4 O'clock) greater than ( $>$ ) 3% for pipe diameters 12" (NPS) and larger
- a.2) Top side deformation (above 8 to 4 O'clock) greater than or equal to ( $\geq$ ) 0.250" for pipe diameters less than 12" (NPS)
- b) Bottom side deformation (below 4 to 8 O'clock) with metal loss, cracking or stress riser

#### Group 3

- a.1) Deformation (any orientation) greater than ( $>$ ) 2% for pipe diameters 12" (NPS) and larger that affects the curvature at a girth weld or longitudinal seam
- a.2) Deformation (any orientation) greater than or equal to ( $\geq$ ) 0.250" in pipe diameter less than 12" (NPS) that affects a girth weld or longitudinal seam
- b) Top side deformation (above 8 to 4 O'clock) greater than ( $>$ ) 2% in pipe diameters 12" (NPS) and larger
- c) Bottom side deformation (below 4 to 8 O'clock) greater than ( $>$ ) 6%
- d) PSafe less than ( $<$ ) MOP
- e) An area of general metal loss with predicted metal loss greater than ( $>$ ) 50% (width greater than ( $>$ ) 2/3 of the circumference for a length greater than ( $>$ ) 1 pipe joint)
- f.1) Metal loss greater than ( $>$ ) 50% at foreign line crossings
- f.2) Metal loss greater than ( $>$ ) 50% in an area with widespread circumferential metal loss (width greater than ( $>$ ) 2/3 of the circumference)
- f.3) Metal loss greater than ( $>$ ) 50% in an area that could affect a girth weld, within the HAZ of a weld
- g) Potential crack
- h) Metal loss of or along a pipe longitudinal seam weld
- i) Gouge and groove greater than ( $>$ ) 12.5% of pipe wall thickness
- f) Deformation (any orientation) greater than ( $>$ ) 1% in pipe diameters 20" (NPS) and larger that does not meet any of the other Group 1 or Group 2 requirements

#### Group 4

Deformation (any orientation) greater than ( $>$ ) 1% that does not meet any of the Group 1, 2, or 3 requirements listed above.

# 36" Sugarland to Bayou Choctaw



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Client: Shell Pipeline Company, L.P.  
 ROSEN Proj. No.: 0-1000-13737  
 ROSEN Line Name: 36" SUG-BAY  
 Inspection Type: MFL-A/XT  
 Date of Inspection: September 12, 2018  
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## Most Severe Anomalies

Log Distance ft	Tool	Event	comment	Orientation	Wall Loss %	ID Reduction %	Length in	Width in	INT/EXT	RPR 100% SMYS	ERF 0.85dL	to Upstream Weld ft	Height ft
52031.07	XT	deformation w/ metal loss		07:27	19	1.8	10.67	7.81	not assigned			20.08	0.00
53452.59	XT	deformation w/ metal loss	Metal Loss less than 15%	05:35		1.4	6.94	6.43	not assigned			21.61	0.00
75768.01	XT	deformation w/ metal loss	Metal Loss less than 10%	06:04		1.0	10.71	10.05	not assigned			20.62	0.00
85700.27	XT	deformation w/ metal loss	Metal Loss less than 15%	06:26		1.4	5.54	7.74	not assigned			10.81	0.00
115475.33	XT	deformation w/ metal loss		06:06	27	1.0	43.55	13.65	not assigned			23.82	0.00
81664.43	XT	deformation		04:13		1.1	8.09	3.62	not assigned			11.42	0.00
81802.99	XT	deformation		10:33		1.1	9.67	3.89	not assigned			30.64	0.00
89541.30	XT	deformation		06:01		1.4	14.34	8.76	not assigned			11.91	0.00
93161.99	XT	deformation		05:51		1.2	13.74	7.96	not assigned			3.48	0.00
101425.15	XT	deformation		05:27		1.1	7.96	6.07	not assigned			31.72	0.00
102370.63	XT	deformation		05:42		1.4	8.43	5.70	not assigned			2.13	0.00
120875.83	XT	deformation		05:56		1.6	6.48	4.76	not assigned			14.44	0.00
166431.04	XT	deformation		06:07		1.7	27.68	13.43	not assigned			2.75	0.00
174030.92	XT	deformation		01:53		1.1	2.94	3.30	not assigned			9.51	0.00

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Quantity Total	Description
0	Group 1
5	Group 2
9	Group 3
0	Group 4

Note: Please Refer to Shell Document 3TS-002 Rev. 06/08/2018 for the classifications of group 1 through group 4.

The complete lists of all Group anomalies can be found on the following pages.

Please Note: There are no (0) anomalies to report for Group 1 and Group 4; therefore, there are no lists included for these groups.

**2.2.2**

**Deformation Anomalies**

The following were identified during the survey:

Quantity	Description
14	Total number of deformation anomalies reported.
0	Number of deformation anomalies with a reported reduction $\geq$ 6%.
0	Number of deformation anomalies with a reported reduction $\geq$ 6% on top of pipe (8:00 clockwise to 4:00).
0	Number of deformation anomalies with a reported reduction $\geq$ 3% but less than 6%.
0	Number of deformation anomalies with a reported reduction $\geq$ 3% but less than 6% on top of pipe (8:00 clockwise to 4:00).
0	Number of deformation anomalies with a reported reduction $\geq$ 2% but less than 3%.
0	Number of deformation anomalies with a reported reduction $\geq$ 2% but less than 3% on top of pipe (8:00 clockwise to 4:00).
14	Number of deformation anomalies with a reported reduction $<$ 2%.
5	Number of deformation anomalies detected with metal loss.
0	Number of deformation anomalies at or on a girth weld or long seam (when detectable).

### 2.2.3 Summary and Statistical Data

The following have been identified during the survey:

	Total	Internal	External	N/A
Metal Loss	74990	74853	130	7
Axial Grooving	4053	4045	6	2
Axial Slotting	0	0	0	0
Circumferential Grooving	1112	1092	20	0
Circumferential Slotting	15745	15727	18	0
General	1176	1155	17	4
Pinhole	0	0	0	0
Pitting	52904	52834	69	1
15%-19%	45613	45530	76	7
20%-29%	24386	24344	42	0
30%-39%	4576	4565	11	0
40%-49%	415	414	1	0
50%-59%	0	0	0	0
60%-69%	0	0	0	0
70%-79%	0	0	0	0
≥ 80%	0	0	0	0
Total Deformations			14	
Deformations w/Metal Loss			5	
Deformations < 2%			14	
Deformations 2% - 3%			0	
Deformations > 3%			0	

### 2.2.4 Manufacturing/Construction/Girth Weld Anomalies

The following have been identified during the survey:

Description	Number of Indications
Manufacturing Indications	9
Girth Weld Indications	5
Long Seam Weld Indications	0
Close Metal Objects	7

**2.2.5 Anomalies Within Casings**

The following have been identified during the survey:

Description	Number of Casings
Casings identified	25
Eccentric casings	0
Casings containing $\geq 50\%$ metal loss	0
Casings containing 20% - 50% metal loss	821
Casings containing deformation anomalies	0

**2.2.6 Pipeline Appurtenances**

The following have been identified during the survey:

Description	Number of Appurtenances
Valves	9
Tees	4
Taps	25
Flanges	2
Pipe support	0

**2.2.7 Repairs**

The following have been identified during the survey:

Description	Number of Repairs
Full Encirclement Sleeves	26
Half Wrap Repairs	0
Patch Repairs	0
Marked Composite Repair Wraps	0
Other Existing Repairs	0

## 2.3 Depth Distribution of All Metal Loss Anomalies

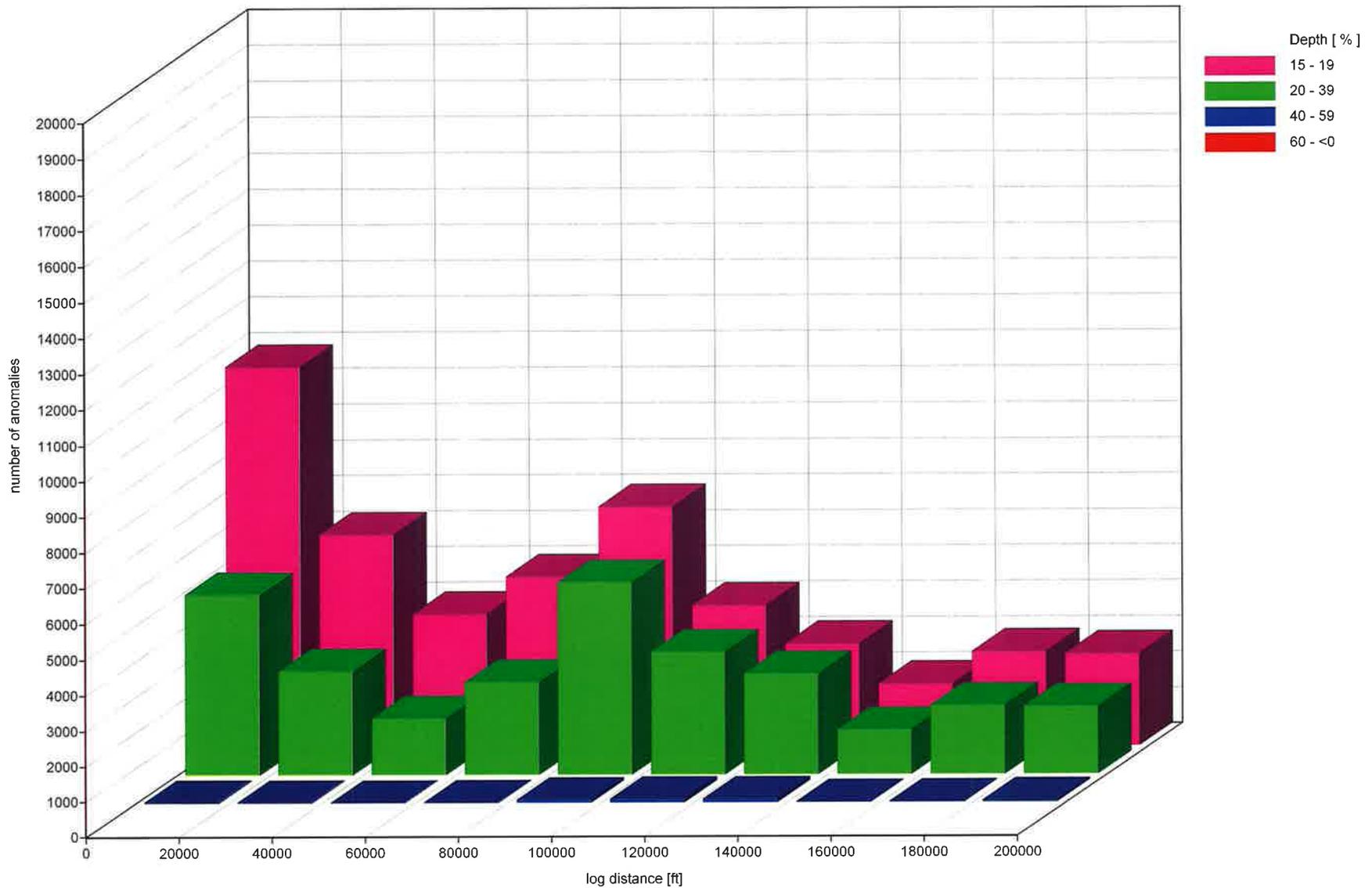
This graph includes all metal loss anomalies that meet or exceed the reporting threshold. It displays the number of anomalies versus pipeline length in increments of 20000 feet.

The metal loss anomalies are grouped into four (4) categories as follows:

- depth 15 – 19 %
- depth 20 – 39 %
- depth 40 – 59 %
- depth ≥ 60 %

# 36" Sugarland to Bayou Choctaw

MFL-A/XT - Depth Distribution Of All Metal Loss Anomalies



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## 2.4 O'clock Position of All Metal Loss Anomalies

This plot shows the o'clock orientation of all reported metal loss anomalies versus pipeline length in increments of 20000 feet. The o'clock position is given as the leading upper corner of the anomaly rectangle looking in the downstream direction of the pipeline.

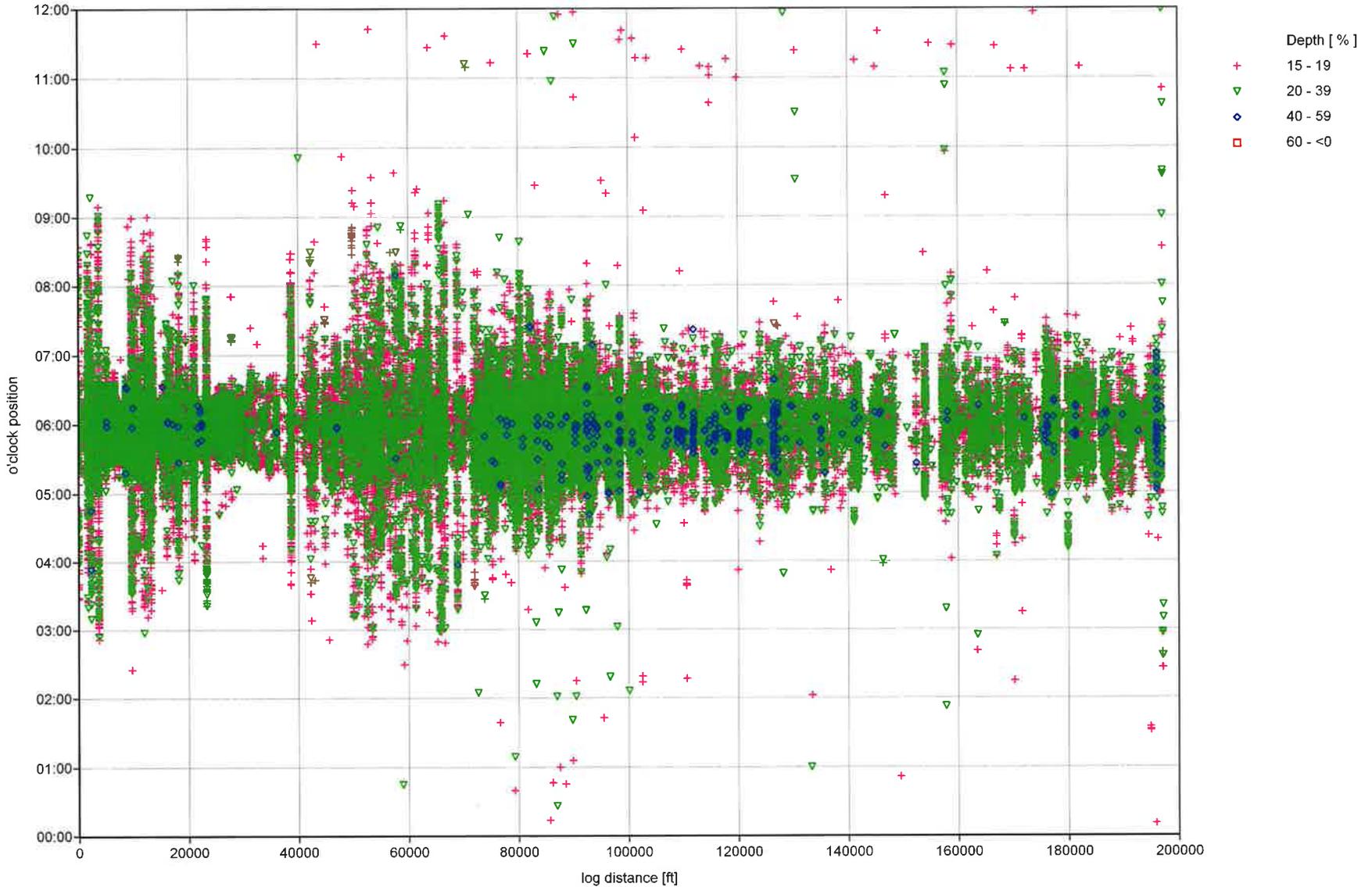
# 36" Sugarland to Bayou Choctaw



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MFL-A/XT - O'clock Position Of All Anomalies



## 2.5 Inspection Parameters

This section summarizes the parameters applicable to the in-line inspection activities carried out in this pipeline section.

### 2.5.1 Pipeline Information

nominal diameter (NPS) [inches]	36.00
type of pipe	Not Provided
grade	X-52, X-60
nominal wall thickness [inches]	0.312, 0.438, 0.500
MAOP [PSI]	335
design pressure [PSI]	540, 759, 1000*
SMYS [PSI]	52000, 60000
minimum bend radius	1.5D
length [miles]	37.20
built in	1997, 2008
pipeline product	Crude Oil
inspection history	TDW, ROSEN – 2013

\*Note: Design pressures were calculated in accordance with the ANSI/ASME B31.4 standard code using a 60% SMYS.

### 2.5.2 Line Questionnaire / Pipeline Information

Pipeline information as received from the client can be found on the following pages.

### 2.5.3 Data Quality Summary

The data recorded during the RoCombo MFL-A/XT inspection survey, performed on September 12, 2018, was accepted and will be used for evaluation purposes. During the RoCombo MFL-A/XT survey, all sensors were operational. The tool velocity during the RoCombo MFL-A/XT inspection survey was mainly within the pre-agreed ranges. Generally, in areas where the velocity is out of range, the ROSEN standard accuracy might not be achieved. Over the complete line length of the RoCombo MFL-A/XT inspection survey, the magnetization level was mainly within the pre-agreed specification of 10 – 30 kA/m. Please refer to Section 3 for more information.

# Pipeline Overview

Project **0-1000-11740 Shell 2011 - 2013 Msa No. 060310CAP**  
 Pipeline **36SUGBAY Sugarland-Bayou Choctaw (Redstick Crude System)**  
 Section

PIPELINE LOCATION		
	LAUNCHER	RECEIVER
Station name:	Sugarland	Bayou Choctaw
Geo. location:	Baton Rouge, LA	Baton Rouge, LA
Region:		Louisiana
Country:	United States	United States
Traction:	On shore	On shore

PIPELINE RECORDS	
Year installed:	
Pipeline is operational:	
Weld record books are available:	
As-built-drawings are available:	
There is a known damage:	

PIGGING HISTORY	
Cleaning pigs:	
Gauging pigs:	
Intelligent pigs:	TDW
Previous inspection company	
Previous inspection reference	
Features investigated	
Pipeline modified	
Same inspection direction	

MECHANICAL OVERVIEW					
Pipeline diameter:	36"	Pipeline length:	37.2 mi	Nom. outside dia.:	36 inch
WT min.:	0.25 inch	WT nom.:	0.38 inch	WT max.:	0.38 inch
min. ID:	35.25 inch	at location:			
max. ID:	35.5 inch	at location:			
min. ID bend:	35.42 inch	constant ID:	NO		
min. bend radius:	1.5 D				

MEDIUM DESCRIPTION			
Medium	Oil	Detailed Medium	Crude
Phase Flow	1		
Paraffin	Low		
Salt Water	0.0 %		
H2S	0 ppm		
CO2	0 %		
FeCO	0.0 %		
Slug Flow			
		<b>Hazardous material in debris:</b>	
		Mercury	No
		Pyrophoric dust	No
		Low Scale Activity	No
		OtherHazardousContent	

# Pipeline Overview

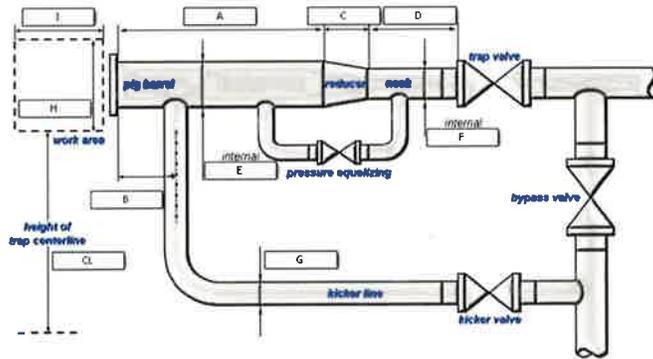
Project **0-1000-11740 Shell 2011 - 2013 Msa No. 060310CAP**  
 Pipeline **36SUGBAY Sugarland-Bayou Choctaw (Redstick Crude System)**  
 Section

## OPERATING CONDITIONS

	during inspection	possible minimum	possible maximum
Temperature:	60 °F	55 °F	65 °F
Flowrate:	159840 bpd	144000 bpd	168000 bpd
Pressure at Launcher:	285 psi	240 psi	500 psi
Pressure at Receiver:	285 psi	240 psi	500 psi
Speed at Launcher:	1.47 ft./s	1.32 ft./s	1.54 ft./s
Speed at Receiver:	1.47 ft./s	1.32 ft./s	1.54 ft./s
Default Propellant Medium:	Oil	Detailed Default Propellant Medium:	Crude

## TRAPS

	Angle fr. horiz	A	B	C	D	E internal	F internal	G	H	I	height of trap c/l
Launcher:	90°	150 inch	24 inch	24 inch	30 inch	39 inch	35 inch	0 inch	99999 inch	99999 inch	0 inch
Receiver:	90°	100 inch	24 inch	24 inch	100 inch	39 inch	35 inch	0 inch	99999 inch	99999 inch	0 inch



	Launcher:	Receiver:
Pressure equalizing:	Yes	Yes
Shutdown valve:	Yes	Yes
Closure type:		
Construction method:	flanged	flanged
Reducer type:	excentric	excentric
Reducer bore aligned:	Unknown	Unknown

E (external):	40 inch	40 inch
F (external):	36 inch	36 inch
WT pig barrel:	0 inch	0 inch
WT neck:	0 inch	0 inch
H unlimited:	Yes	Yes
I unlimited:	Yes	Yes
Orientation:	Horizontal	Horizontal

## OVERVIEW

Name	Qty	Type	Installation Type	Tract	Location Start	End	Range Dimension	Country - Region	Location
Sugarland	1	Launcher		ON				United States	Baton Rouge, LA
Bayou Choctaw	1	Receiver		ON				United States - Louisiana	Baton Rouge, LA

## DESIGN SPECIFICATIONS

internal coating	None	MAOP	0 psi
external coating		SMYS	
wallthickness		SUTS	
material type	unknown	material details	
weld type		weld details	
design pressure	0 psi	joint length	
design factor			

# Pipeline Overview

Project **0-1000-11740 Shell 2011 - 2013 Msa No. 060310CAP**  
 Pipeline **36SUGBAY Sugarland-Bayou Choctaw (Redstick Crude System)**  
 Section

MORE DESIGN SPECIFICATIONS											
Name	Internal Coating	External Coating	Grade	WT	Type of line pipe	Joint Length	Design Pressure	Design Factor	MAOP	SMYS	SUTS

MARKERING REFERENCES			
AGM required:	Yes	Accessible (weather):	Yes
Close to roads:	Yes	Properly marked:	Yes
Special References:	No		

KNOWN REFERENCES

#### 2.5.4

#### Data Analysis Parameters

The following parameters were observed during the analysis activities. The reporting thresholds applied to this line segment are as follows, as per Shell Pipeline Company, LP. criteria:

- for joint anomalies (--J--):  $\geq 15\%$  wall loss ; 1% OD Reduction (RoCombo MFL-A/XT)
- for close to weld anomalies (-C---):  $\geq 15\%$  wall loss ; 1% OD Reduction (RoCombo MFL-A/XT)
- for weld anomalies (W----):  $\geq 15\%$  wall loss ; 1% OD Reduction (RoCombo MFL-A/XT)

An interaction rule was applied to individual corrosion anomalies in the event they were in close proximity to one another. The interaction rule applied was based on the 1" axially by 6t circumferentially, as per Shell Pipeline Company, LP. criteria. Additionally, a pressure based corrosion assessment has been performed on the findings based on the RStreng Case 2 (0.85dL) Code. These results have been expressed in the form of an Estimated Repair Factor (ERF) and Rupture Pressure Ratio (RPR) and have been calculated only for anomalies with a calculated wall of  $\geq 15\%$  to  $\leq 80\%$  as per client request. Please refer to the Technical Reference for more information regarding this calculation.

Manual analysis has been performed for metal loss signals calculating  $\geq 40\%$  wall loss. Metal loss signals calculating 15-19% are subject to automatic analysis.

### **3 INSPECTION ACTIVITIES AND DATA QUALITY**

#### **3.1 Pre-Inspection Activities**

Not Applicable

##### **3.1.1 Cleaning and Gauging Pig Data Sheet**

Not Applicable

### 3.2 RoCombo MFL-A/XT Inspection

The pipeline was inspected with the In-Line Combined Metal Loss and Geometry Assessment (RoCombo MFL-A/XT). One (1) RoCombo MFL-A/XT run was performed during the inspection.

ROSEN Inspection Survey Technician Kolawole Ayodele performed the field activities.

Please note the following RoCombo MFL-A/XT run survey information:

#### Inspection Conditions

Inspection Direction	Sugarland to Bayou Choctaw
Launching Date/Time	September 5, 2018 / 08:43 PM
Receiving Date/Time	September 12, 2018 / 06:28 PM
Duration	165 hours, 45 minutes
Average Tool Velocity	1.96 feet per second
Maximum Tool Velocity	3.80 feet per second
Propellant	Crude Oil
Pressure (max.)	526 PSI
Temperature	103°F

#### Tool Condition after the Run

Cup Wear	None
Debris	None
Damage	None

#### Recorded Data

Start of Data Recording	-47.545 feet
End of Data Recording	197170.63 feet (37.35 miles)
Recorded Tool Rotation	Acceptable

#### Marker Information (Above Ground Markers)

A total of twenty-three (23) markers were set and nineteen (19) were successfully established during the RoCombo MFL-A/XT inspection survey.

The data recorded during the RoCombo MFL-A/XT inspection survey, performed on September 12, 2018, was accepted and will be used for evaluation purposes. During the RoCombo MFL-A/XT survey, all sensors were operational. The tool velocity during the RoCombo MFL-A/XT inspection survey was mainly within the pre-agreed ranges. Generally, in areas where the velocity is out of range, the ROSEN standard accuracy might not be achieved. Over the complete line length of the RoCombo MFL-A/XT inspection survey, the magnetization level was mainly within the pre-agreed specification of 10 – 30 kA/m. Please refer to the following pages for more information.

**3.2.1 RoCombo MFL-A/XT Data Sheet, Tool Release for Service Certificate, and Pre-Run Onsite Check Certificate**

The standard tool data sheet, Tool Release for Service Certificate, and the Pre-Run Onsite Check Certificate for the ROSEN RoCombo MFL-A/XT used during this survey are attached hereafter.

**3.2.2 RoCombo MFL-A/XT Tool Velocity**

The RoCombo MFL-A/XT tool used during this survey was programmed to operate within a velocity range of 0.33 feet per second to 16.41 feet per second. During the inspection, the velocity of the tool is constantly monitored. Based on this data, the following graph displays the minimum and maximum velocity of the tool during the survey, in per joint intervals.

**3.2.3 RoCombo MFL-A/XT Relative Tool Top Position**

The following graph displays the rotation of the RoCombo MFL-A/XT tool during the survey. The rotational position, provided in degrees, is measured counter-clockwise looking in the downstream direction.

**3.2.4 RoCombo MFL-A/XT Tool Temperature**

The RoCombo MFL-A/XT Tool Temperature graph displays the recorded temperature encountered during the survey. Because the temperature probe is housed inside the tool, it takes approximately 30 minutes for the probe to register the actual product temperature.

**3.2.5 RoCombo MFL-A/XT Magnetization Level**

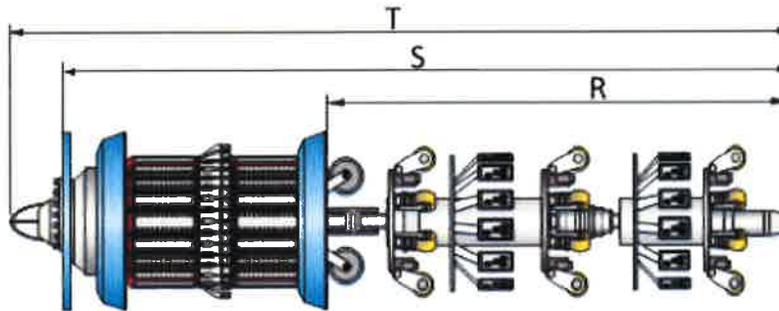
The RoCombo MFL-A/XT Magnetization Level graph displays the recorded magnetization level on the pipe wall during the inspection in per joint intervals. Please refer to the Technical Reference for further information.

**Tool Data Sheet**  
19-Jun-2018

**36" MFL-A/XT Tool**  
**CDP36"1.5V27.00**  
for RoCombo Inspection Services

**Technical Data**

On board Service	Technology	Sensor details
Metal loss detection and sizing	MFL-A	576 MFL Channels
Geometry and dent analysis	XT	252 Channels
Route mapping and strain analysis	Mapping	Low Bias IMU



**Operational Specifications**

Max. Inspection Range with Gyro	621 miles
Max. Inspection Range w/o Gyro	621 miles
Max. Inspection Time with Gyro	218.0 h
Max. Inspection Time w/o Gyro	270.0 h
Velocity Range	0.33 - 16.41 ft/s
Max. Operating Pressure	1450 psi
Min. Operating Pressure	435 psi
Product Temperature Range with Gyro	32 - 131 °F
Product Temperature Range w/o Gyro	32 - 149 °F
Max. Product Speed for Speed Control Pigs	n/a

**Mechanical Specifications**

Tool Length (T)	169.69 inch
Launch Length (S)	156.97 inch
Rear Sealing Length (R)	107.91 inch
Max. Operational Weight	n/a
Max. Transport Tool Weight	n/a

**Measurement Specifications**

Wall Thickness Range*	0.31 - 1.10 inch
Magnetization Level	10 - 30 kA/m
Max. Internal Coating / Cladding	n/a

**Pipeline Requirements**

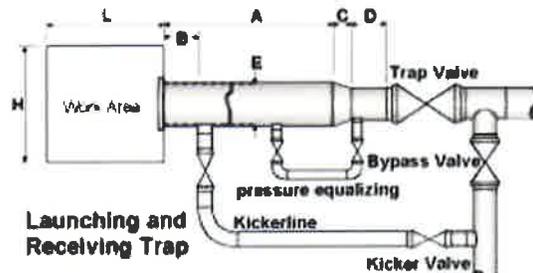
Min. Bend Radius	1.5 D
Min. Bore in Straight Pipe	31.50 inch
Min. Bore in 3D Bend	32.09 inch
Min. Bore in 1.5D Bend	33.15 inch

\* Higher wall thickness can be inspected at different specifications

Straight Pipe in-between Back to Back Bends	84.84 inch
Max. ID Step Changes	1.57 inch
Unbarred Tee Size	n/a

**Launcher and Receiver Requirements**

Trap Dimensions	Launcher (minimum)	Receiver (minimum)	
A	169.69	169.69	inch
B	15.75	28.46	inch
C	24.00	24.00	inch
D	20.59	169.69	inch
E	38	38	inch
H	209.06	209.06	inch
L	209.06	209.06	inch



**DISCLAIMER:**

- The information contained herein is for illustration purposes only. Nothing in this document should be construed as a guarantee or warranty. ROSEN reserves the right to modify any information, specifications or the Inspection Tool contained herein as it sees fit to best meet the customer's needs.  
 - The qualification of an in-line inspection tool is derived by activities in accordance to API 1163 "In-line Inspection Systems Qualification"  
 - The Inspection Tool will be prepared according to information obtained from the customer prior to its utilization and is based on our current knowledge and experience. All technical information in this

# TOOL RELEASE FOR SERVICE

## Project Information

Client: SHELL PIPELINE  
ROSEN Project No.: 0-1000-13737  
Object Name(s):  
ROSEN object name: 36SUGBAY  
Object name (pipeline): SUGARLAND-BAYOU CHOCTAW (REDSTICK CRUDE SYSTEM)

## Tool Information

Service Name: RoCombo MFL-A/XT Service  
Tool ID: C34-1.L + X34-1.B  
Tool Configuration: CDP36"1.5V27.00

## Test Performed

## Results

Confirm suitability of selected Tool Type	passed
Verification of Tool run simulation for full functionality	passed
Confirm adequate battery life and data storage capacity for the length of pipeline	passed
Confirm Mechanic Tool assembly	passed
Confirm Electronic Tool assembly	passed
Confirm Tool Parameters verified against operational requirements	passed
Confirm Visual Tool Inspection	passed
Confirm NORM readings below limits	passed
Verification of tool calibration	confirmed

## Tool Validation and documentation

This certificate is to certify that the above listed Tool Validation and documentation was conducted according to ROSEN procedures and technical instructions and meets the requirements of API Standard 1163, In-line Inspection System qualification and Certification. Each test procedure was completed in its entirety and available for review at ROSEN USA, Houston, Texas. The NORMs limit according to the ROSEN standards is 150 CPM.

## Checked by

Date 31 AUG 2018 Signature Final Test Technician

**Garrett  
Novak**

Digitally signed by Garrett Novak  
DN: dc=net, dc=RosenInspection, ou=Rosen  
Organization, ou=United States Group,  
ou=OPCO Houston, ou=Maintenance,  
ou=Electronic Assembly, cn=Garrett Novak,  
email=gnovak@roseninspection.net  
Date: 2018.08.31 19:28:12 -0500

## Certificate Number:

31 AUG 2018 0-1000-13737 SUGARLAND-BAYOU CHOCTAW (REDSTICK CRUDE SYSTEM)

# PRE-RUN ONSITE CHECK

## Project Information

Client: Shell  
ROSEN Project No.: 0-1000-13737  
Object Name(s):  
ROSEN object name: 36SUGBAY  
Object name (pipeline): Sugarland - Bayou Choctaw( Redstick Crude System

## Tool Information

Service Name: RoCombo MFL-A/XT Service  
Tool ID: CDX  
Tool Configuration: CDP36"1.5V27.00

## Test Performed

## Results

Confirm suitability of selected Tool Type	passed
Confirm adequate battery life and data storage capacity for the length of pipeline	passed
Confirm Mechanic Tool assembly	passed
Confirm Electronic Tool assembly	passed
Confirm Tool Parameters verified against operational requirements	passed
Confirm Visual Tool Inspection	passed
Confirm applicable Tool adjustment were executed	passed
Confirm NORM readings below limits	passed
Verification of tool calibration	confirmed

## Tool Validation and documentation

This certificate is to certify that the above listed Tool Validation and documentation was conducted according to ROSEN procedures and technical instructions and meets the requirements of API Standard 1163, In-line Inspection System qualification and Certification. Each test procedure was completed in its entirety and available for review at ROSEN USA, Houston, Texas. The NORMs limit according to the ROSEN standards is 150 CPM.

## Checked by

Date 05-Sept-2018 Signature Field Service Technician

Kolawole Ayodele

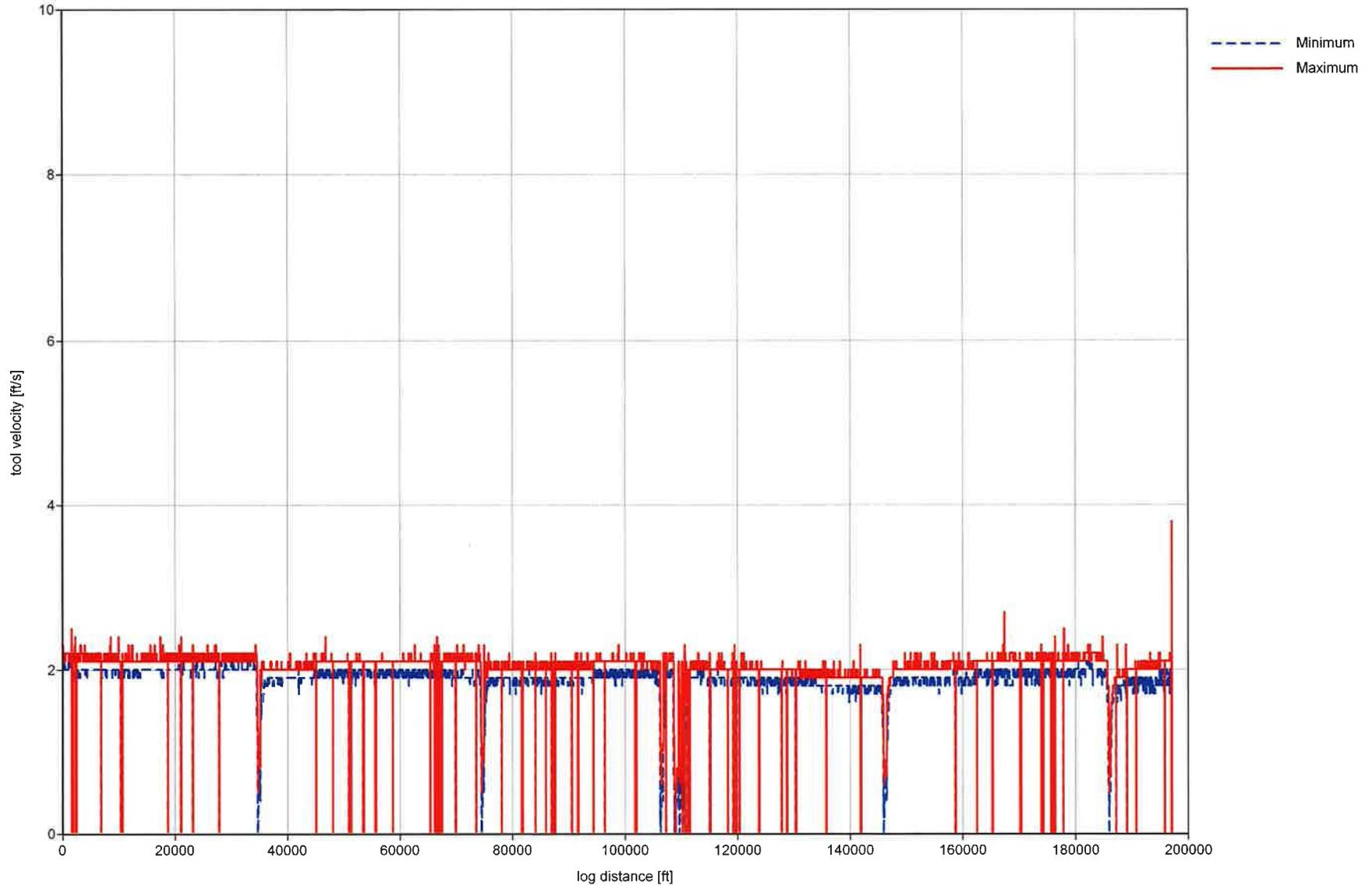
Digitally signed by Kolawole Ayodele  
DN: cn=Kolawole Ayodele, o=Rosen, ou=PIO,  
email=kayodele@rosen-group.com, c=US  
Date: 2018.09.13 21:11:23 -0500

## Certificate Number:

05-Sept-2018 0-1000-13737 Sugarland - Bayou Choctaw( Redstick Crude System

# 36" Sugarland to Bayou Choctaw

MFL-A/XT - Tool Velocity



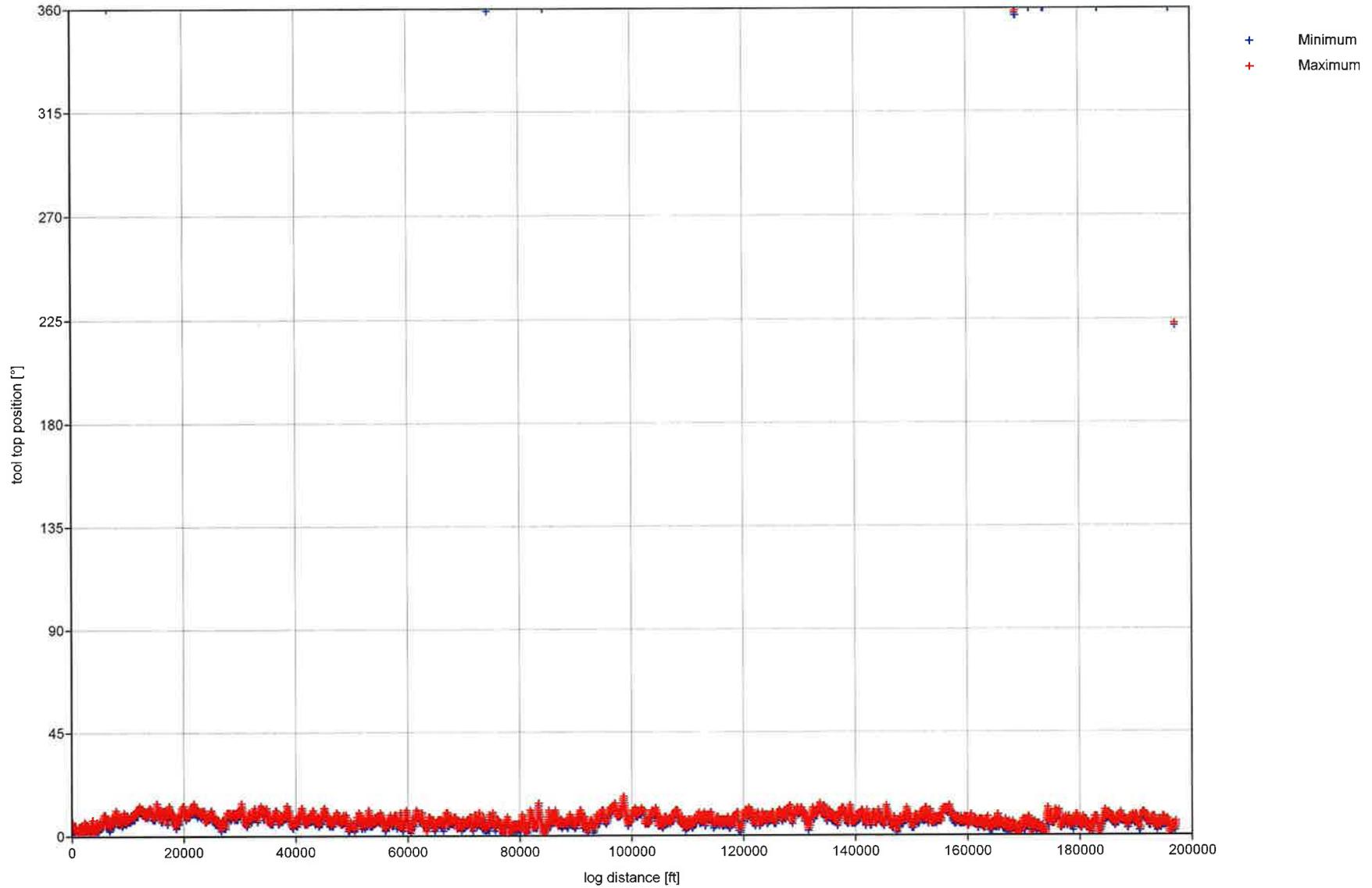
# 36" Sugarland to Bayou Choctaw



empowered by technology

Client: Shell Pipeline Company, L.P.  
ROSEN Proj. No.: 0-1000-13737  
ROSEN Line Name: 36" SUG-BAY  
Inspection Type: MFL-A/XT  
Date of Inspection: September 12, 2018  
Revision No.: 0

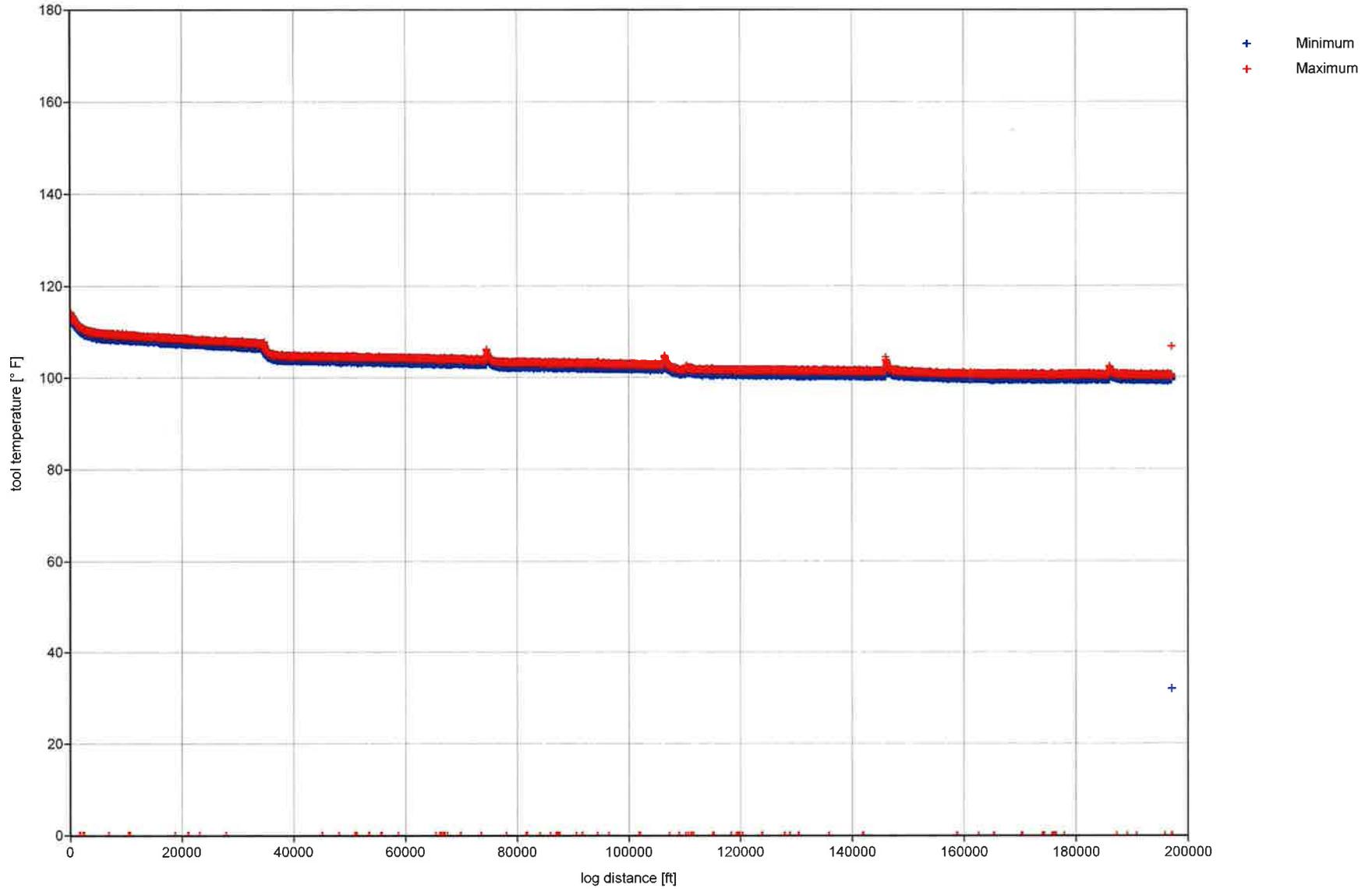
MFL-A/XT - Relative Tool Top Position



# 36" Sugarland to Bayou Choctaw

Client: Shell Pipeline Company, L.P.  
ROSEN Proj. No.: 0-1000-13737  
ROSEN Line Name: 36" SUG-BAY  
Inspection Type: MFL-A/XT  
Date of Inspection: September 12, 2018  
Revision No.: 0

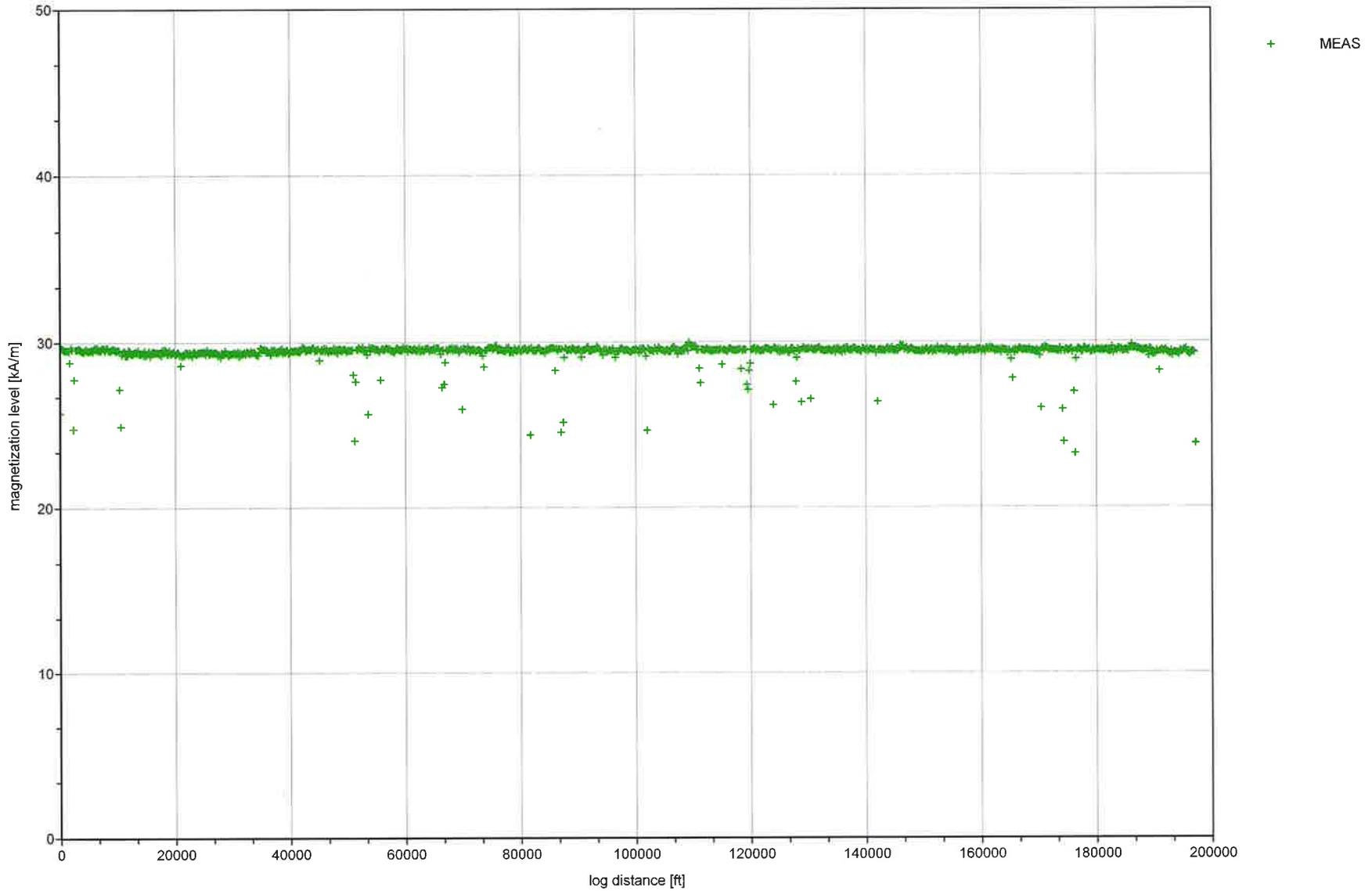
MFL-A/XT - Tool Temperature



# 36" Sugarland to Bayou Choctaw

Client: Shell Pipeline Company, L.P.  
ROSEN Proj. No.: 0-1000-13737  
ROSEN Line Name: 36" SUG-BAY  
Inspection Type: MFL-A/XT  
Date of Inspection: September 12, 2018  
Revision No.: 0

MFL-A/XT - Magnetization Level



## 4 DETAILED INSPECTION RESULTS

The detailed results of the inspection activities are presented in the following formats:

- Special Graphs
- Shell Special Charts
- List of Anomalies
- Client List
- Individual Sentenced Feature Reports (ISFR)

All distances are expressed in feet [ft]. Upstream distances are designated with a minus (-). All pipeline anomalies are referenced to the upstream girth weld.

Any anomaly or pipeline feature that does not qualify for ROSEN Metal Loss Performance Specifications due to its type, geometry, location, and/or run conditions is provided for informational purposes only. For more information regarding qualified indications, please refer to provided Performance Specification document.

## 4.1 Special Graphs

ROSEN provides several anomaly graphs to present a quick overview of the reported anomaly distribution over the length of the pipeline.

### 4.1.1 Given MOP, Pdesign, and Theoretical Safe Pressure Graph

This graph shows the Theoretical Safe Operating Pressure (Psafetheo), calculated on the basis of the RStreng Case 2 (0.85dL) code, and together with the client specified Maximum Operating Pressure (MOP) and Design Pressure (PDESIGN). Please refer to the Technical Reference for more information regarding the Theoretical Safe Operating Pressure calculation.

### 4.1.2 ERF Distribution Graph

Following the RStreng Case 2 (0.85dL) code, an ERF calculation has been performed for those locations identified as being caused by corrosion with a calculated wall thickness loss of 15 – 80%. For all other metal loss anomalies, no ERF values have been calculated. This plot indicates all metal loss anomalies for which an ERF has been calculated. For values where the Psafetheo lies below the MAOP, the ERF value is greater than one (1).

In this graph, the anomalies are displayed versus line distance in six (6) different groups:

ERF\_085 ≤ 0.599  
0.60 ≤ ERF\_085 < 0.799  
0.80 ≤ ERF\_085 < 0.899  
0.90 ≤ ERF\_085 < 0.999  
1.00 ≤ ERF\_085 < 1.300  
ERF\_085 > 1.300

### 4.1.3 Metal Loss Graphs

These graphs show metal loss anomalies, for which an internal/non-internal distinction was made, versus pipeline distance. The o'clock position is given as looking downstream.

- Depth Distribution of Internal Metal Loss Anomalies
- Depth Distribution of External Metal Loss Anomalies
- O'clock Position of Internal Metal Loss Anomalies
- O'clock Position of External Metal Loss Anomalies

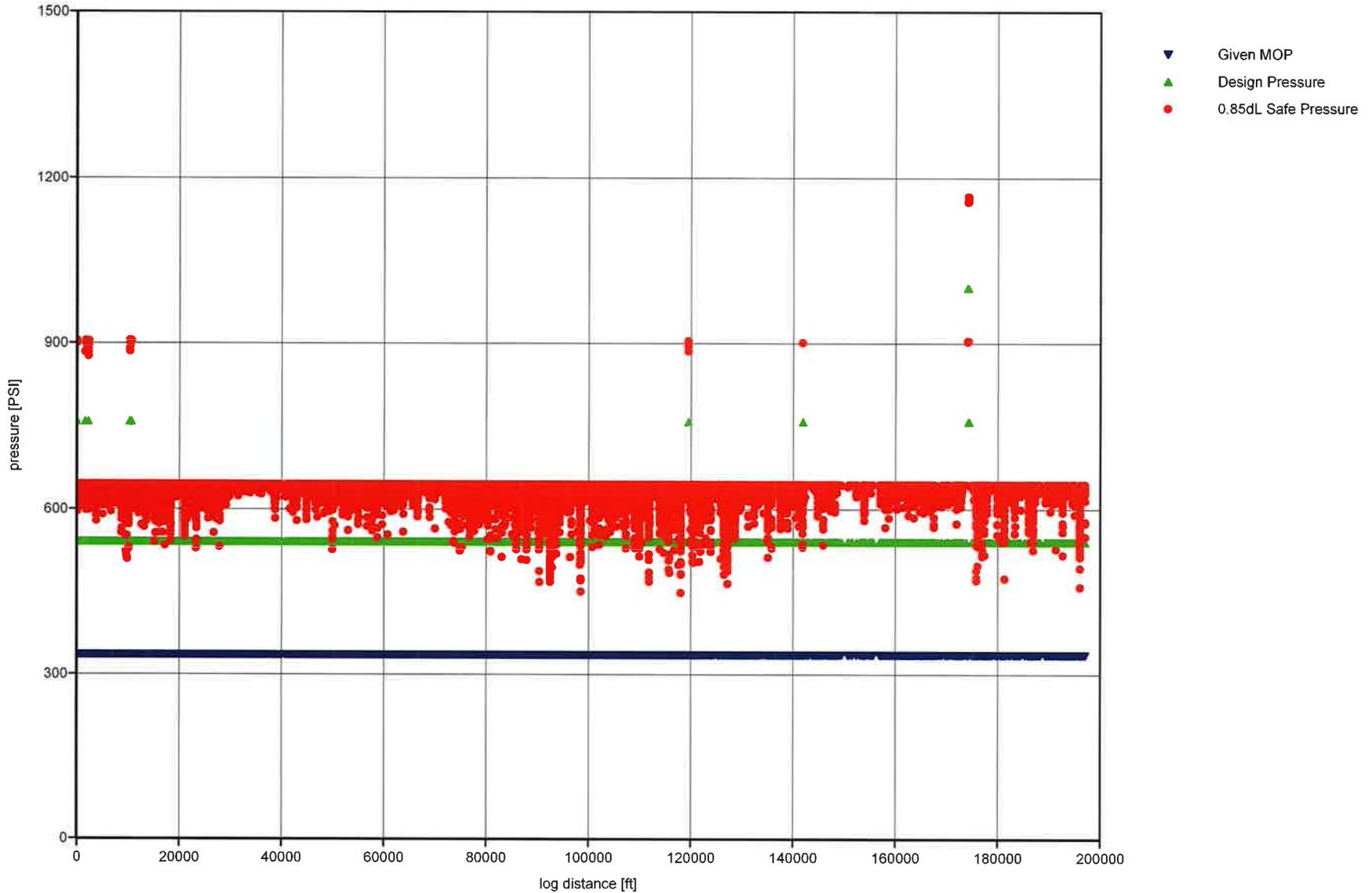
### 4.1.4 Anomaly Relative to Closest Weld Distance Graph

This plot shows the relative distances of all reported anomalies to the closest circumferential girth weld versus pipeline length.

# 36" Sugarland to Bayou Choctaw

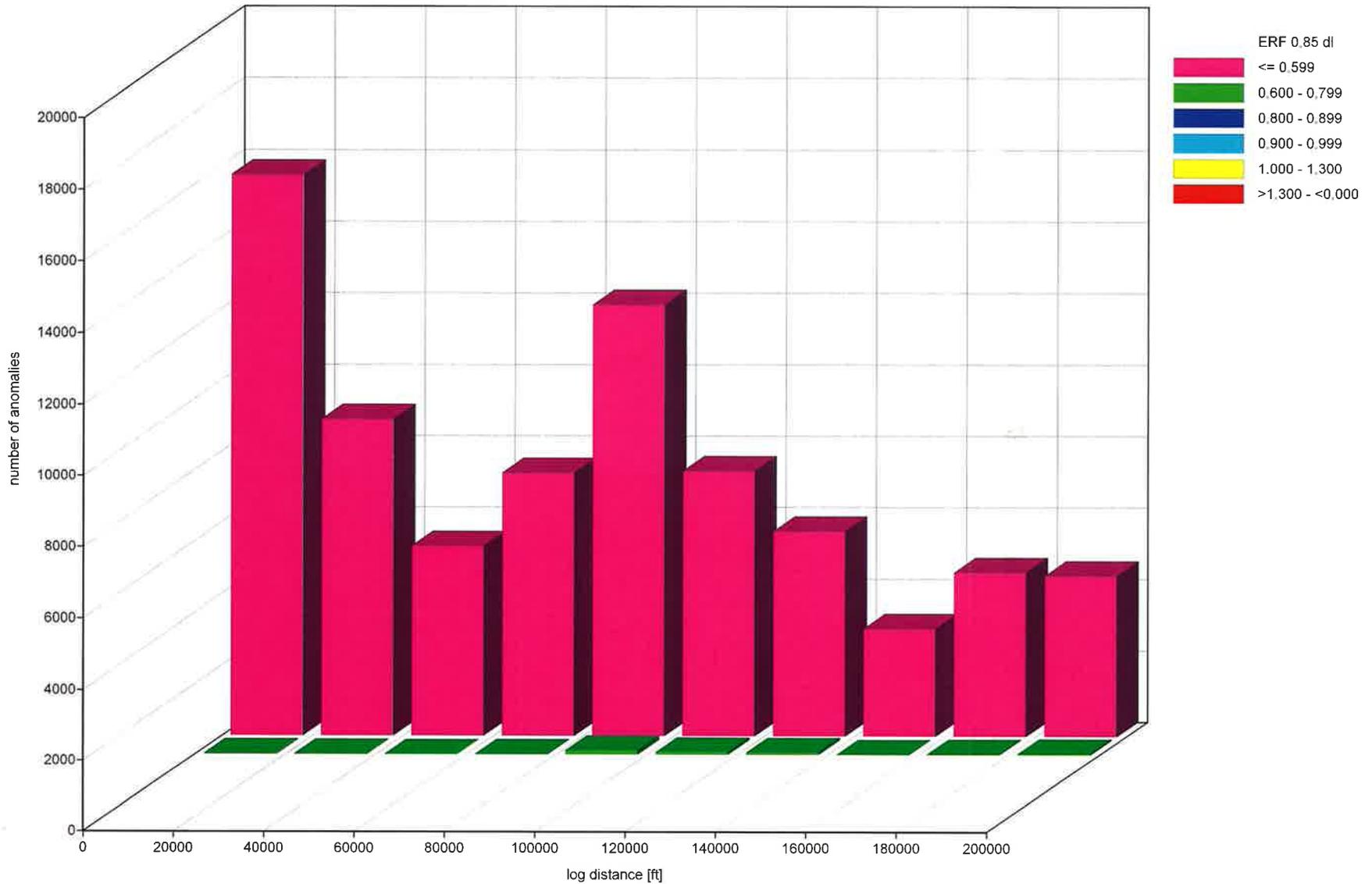
Client: Shell Pipeline Company, L.P.  
ROSEN Proj. No.: 0-1000-13737  
ROSEN Line Name: 36" SUG-BAY  
Inspection Type: MFL-A/XT  
Date of Inspection: September 12, 2018  
Revision No.: 0

MFL-A/XT - MOP, DESP, & 0.85dL Theoretical Safe Pressure



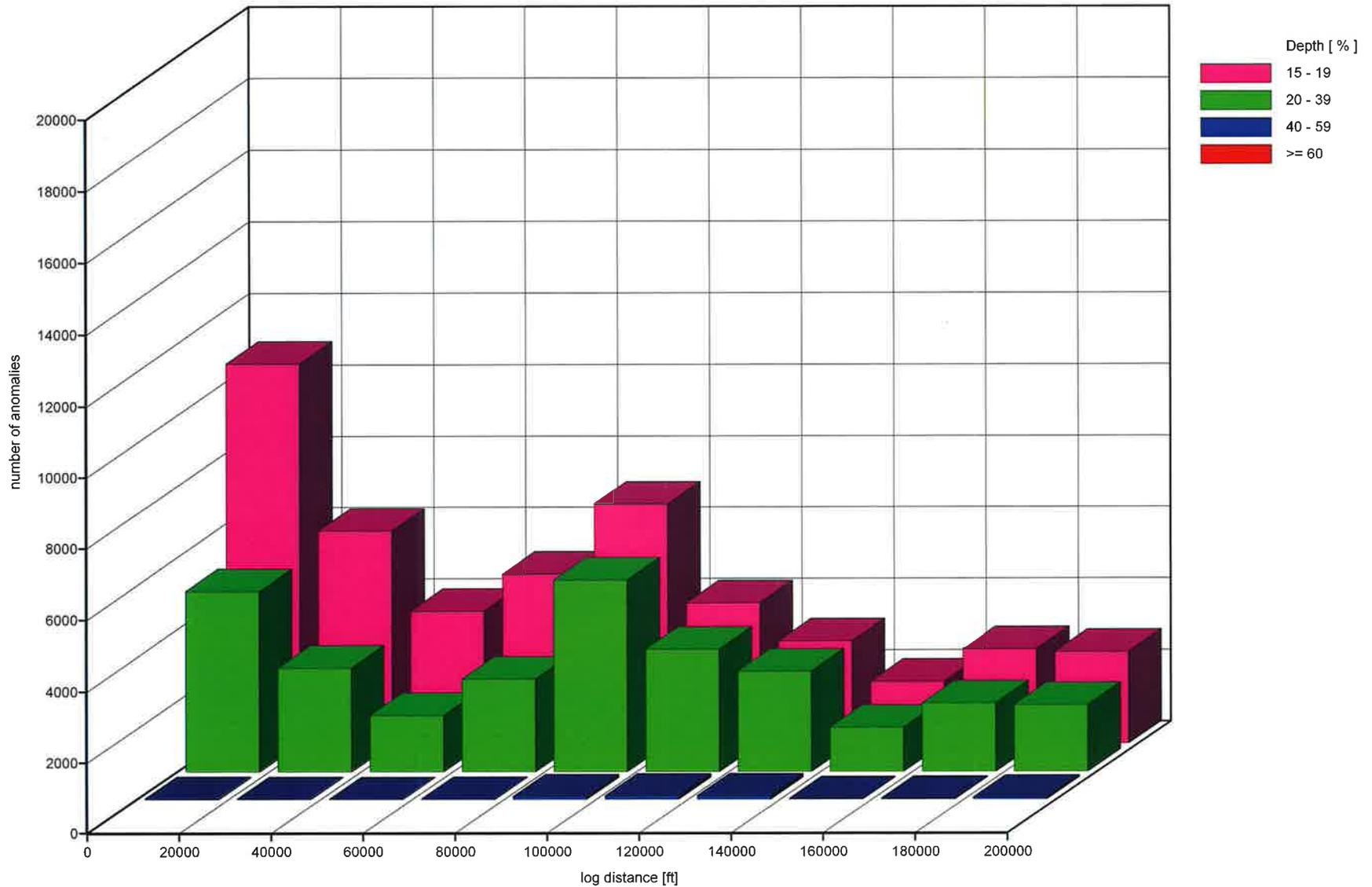
# 36" Sugarland to Bayou Choctaw

MFL-A/XT - ERF Distribution Of All Anomalies



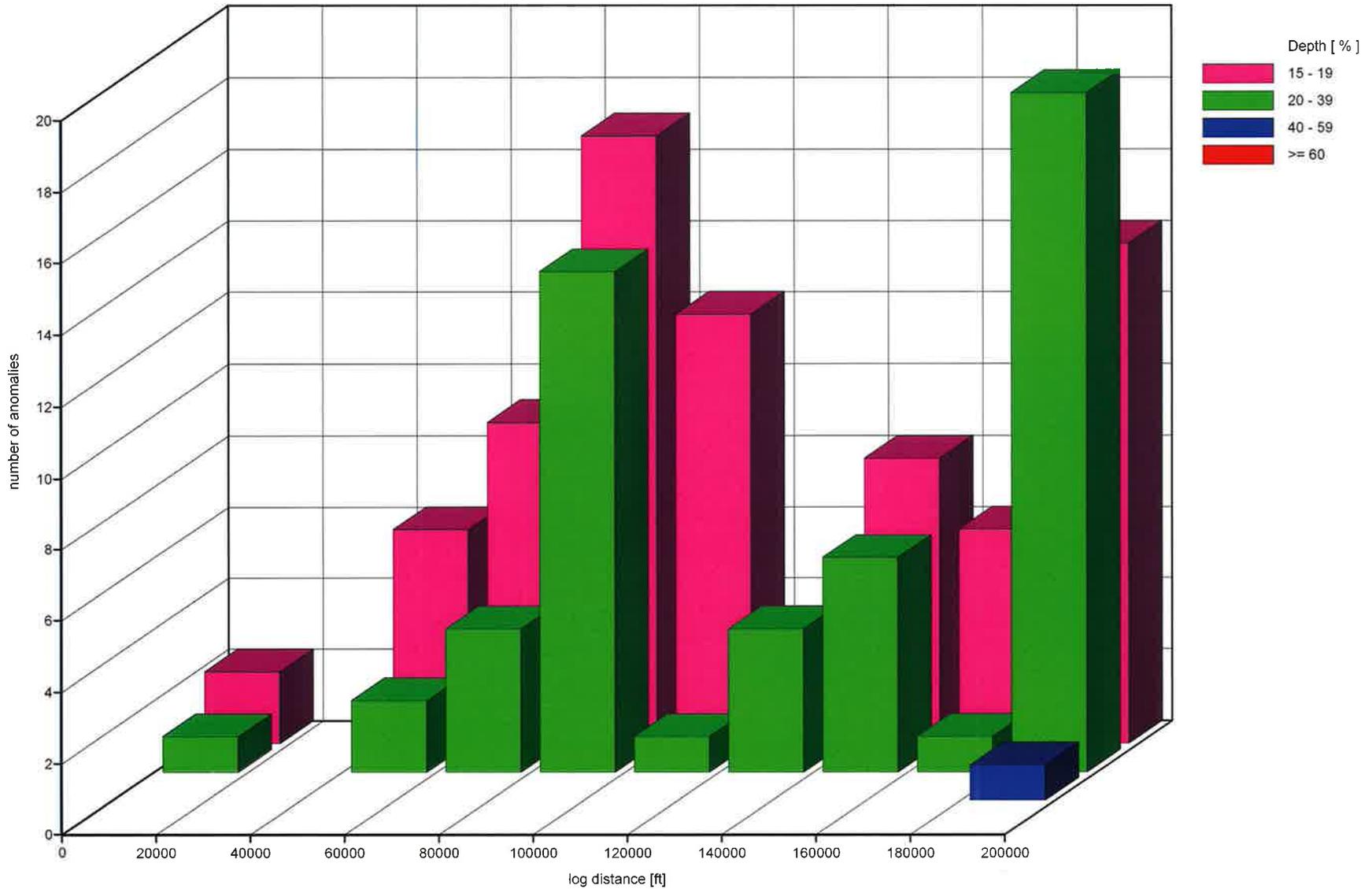
# 36" Sugarland to Bayou Choctaw

MFL-A/XT - Depth Distribution Of Internal Anomalies



# 36" Sugarland to Bayou Choctaw

MFL-A/XT - Depth Distribution Of External Anomalies



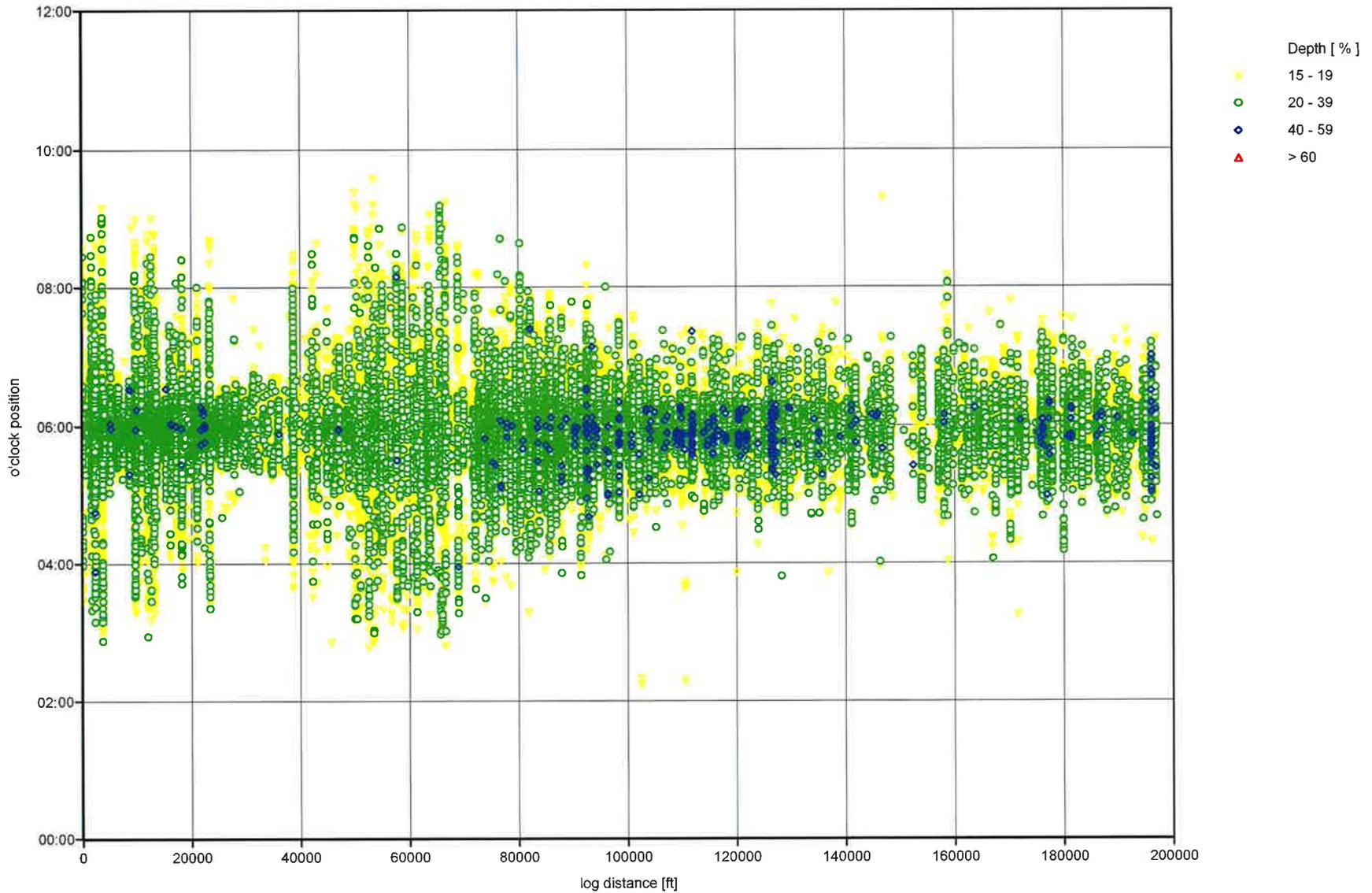
# 36" Sugarland to Bayou Choctaw



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Client: Shell Pipeline Company, L.P.  
ROSEN Proj. No.: 0-1000-13737  
ROSEN Line Name: 36" SUG-BAY  
Inspection Type: MFL-A/XT  
Date of Inspection: September 12, 2018  
Revision No.: 0

MFL-A/XT - O'clock Position Of Internal Anomalies



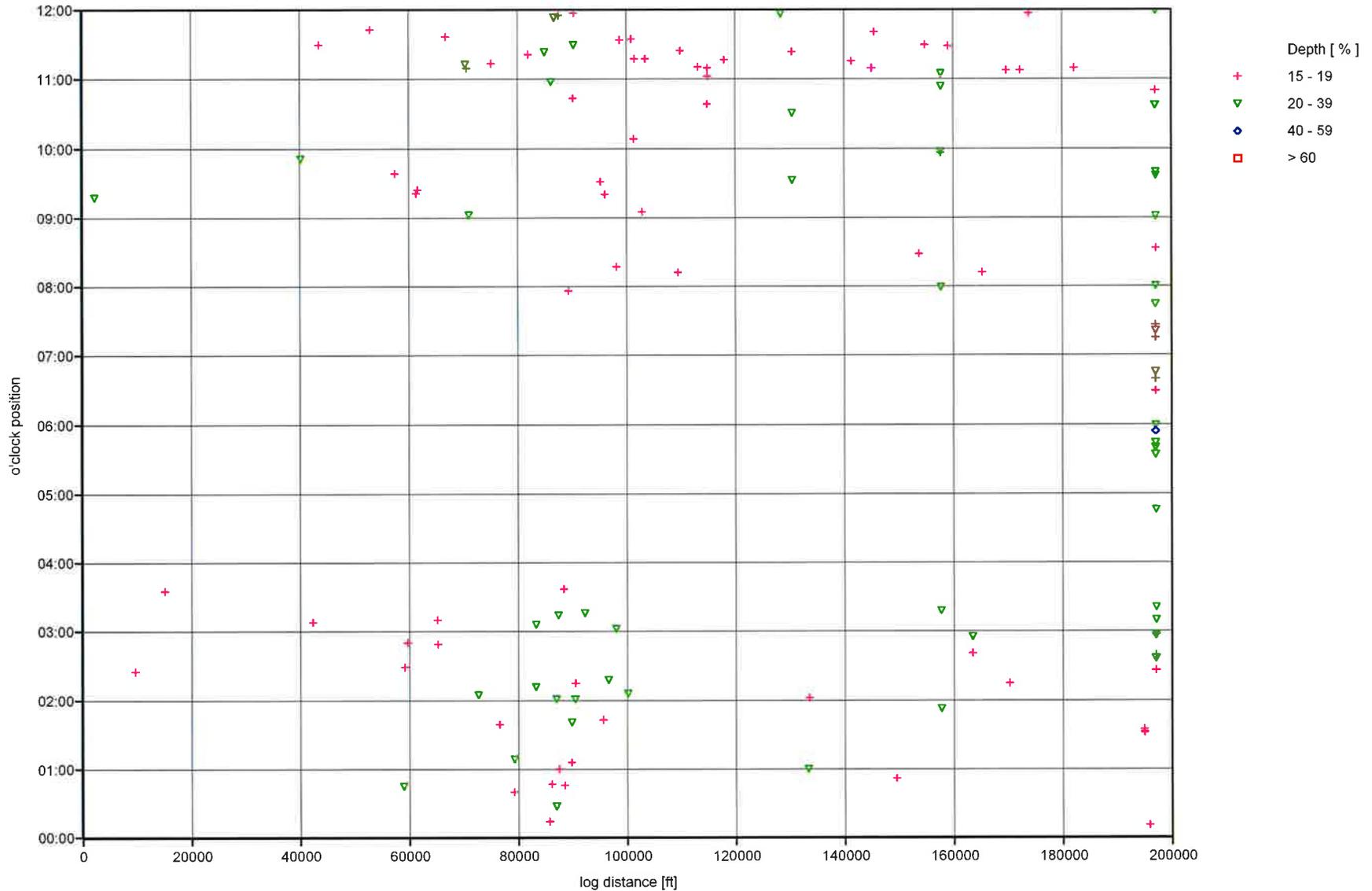
# 36" Sugarland to Bayou Choctaw



empowered by technology

Client: Shell Pipeline Company, L.P.  
ROSEN Proj. No.: 0-1000-13737  
ROSEN Line Name: 36" SUG-BAY  
Inspection Type: MFL-A/XT  
Date of Inspection: September 12, 2018  
Revision No.: 0

MFL-A/XT - O'clock Position Of External Anomalies



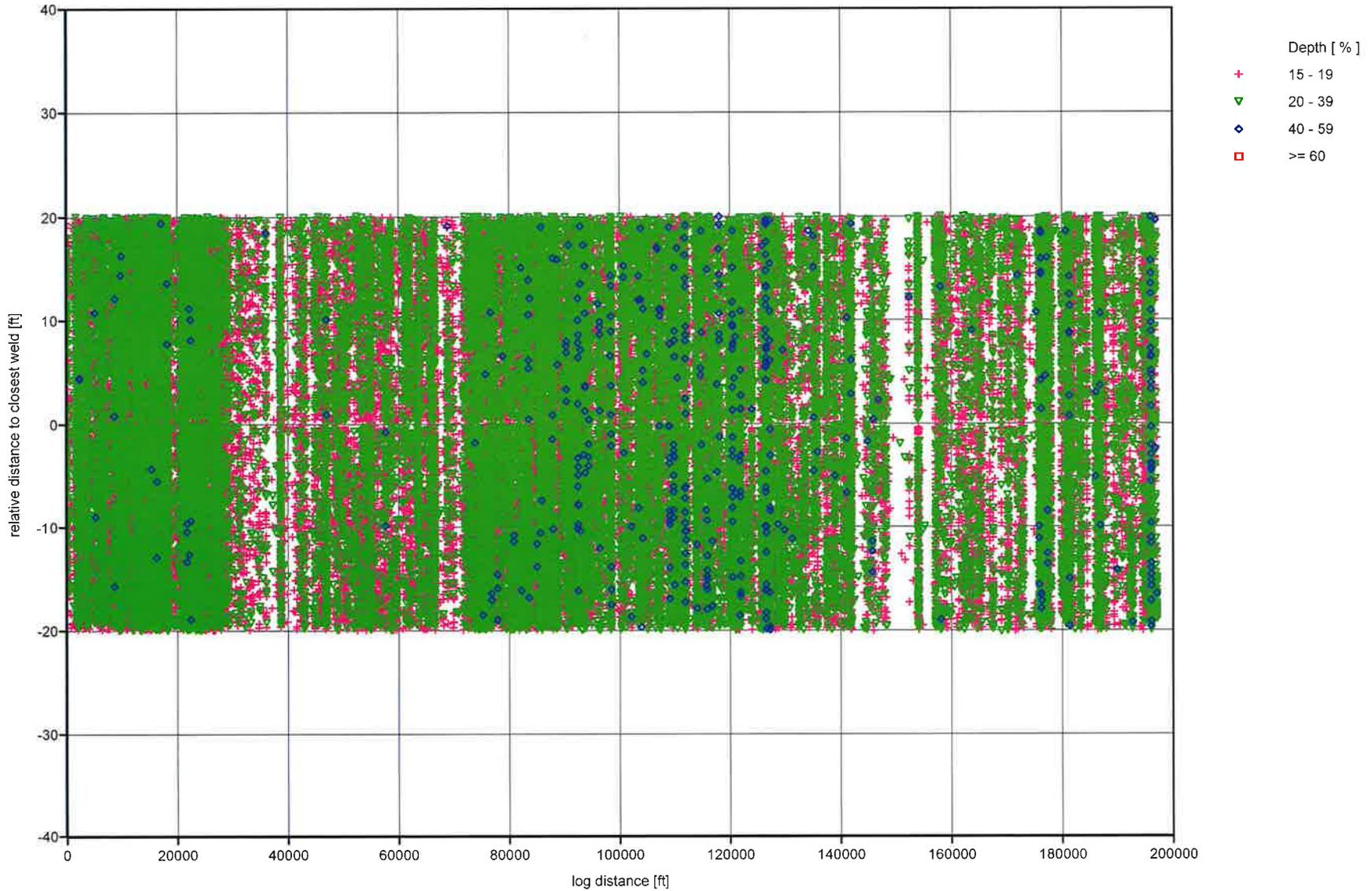
# 36" Sugarland to Bayou Choctaw



empowered by technology

Client: Shell Pipeline Company, L.P.  
ROSEN Proj. No.: 0-1000-13737  
ROSEN Line Name: 36" SUG-BAY  
Inspection Type: MFL-A/XT  
Date of Inspection: September 12, 2018  
Revision No.: 0

MFL-A/XT - Anomaly Relative To Closest Weld Distance



## 4.2 Shell Special Charts

These charts have been created and formatted in accordance with Shell Pipeline Company, LP. specifications.

### 4.2.1 RoCombo MFL-A/XT Metal Loss Distribution Graphs

These graphs show the following metal loss anomaly information for the RoCombo MFL-A/XT tool in five mile sections:

- RoCombo MFL-A/XT Distribution of All Metal Loss Anomalies
- RoCombo MFL-A/XT Metal Loss Distribution > 40%
- RoCombo MFL-A/XT Metal Loss Distribution > 60% | Not Applicable

Note: No anomalies reported qualify for these graphs; therefore, these graph are not applicable.

### 4.2.2 RoCombo MFL-A/XT ERF Distribution Graphs

These graphs show the following ERF information for the RoCombo MFL-A/XT tool in five mile sections:

- RoCombo MFL-A/XT ERF Distribution > 0.8 | Not Applicable
- RoCombo MFL-A/XT ERF Distribution > 1.0 | Not Applicable
- RoCombo MFL-A/XT ERF Distribution > 1.2 | Not Applicable

Note: No anomalies reported qualify for these graphs; therefore, these graphs are not applicable.

### 4.2.3 Deformation Distribution Graphs

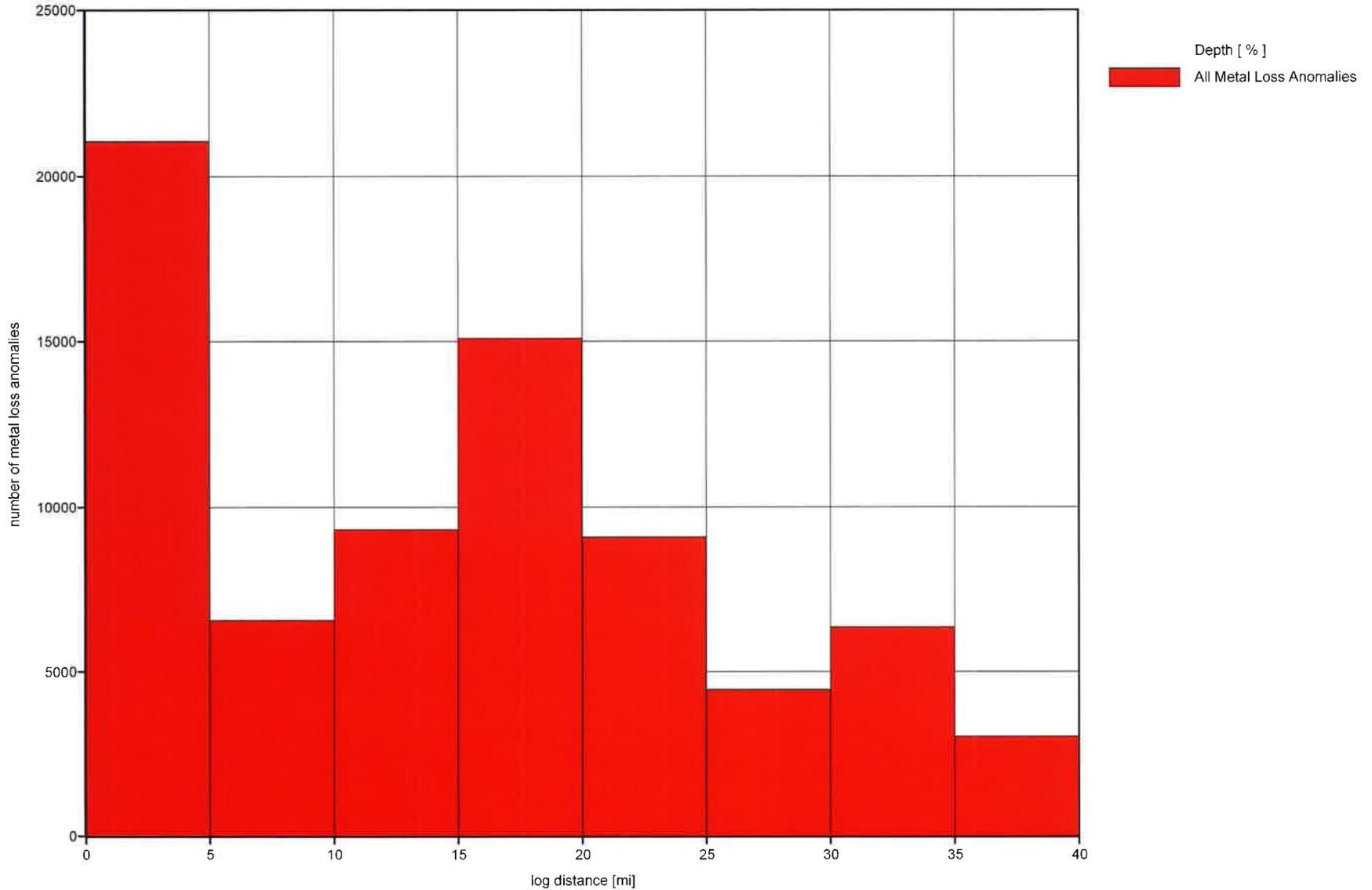
These graphs show the following deformation information in five mile sections:

- RoCombo MFL-A/XT Distribution of Deformation Anomalies
- RoCombo MFL-A/XT Distribution of Deformation Anomalies 1% to 3%
- RoCombo MFL-A/XT Distribution of Deformation Anomalies > 3% | Not Applicable

Note: No anomalies reported qualify for these graphs; therefore, these graphs are not applicable.

# 36" Sugarland to Bayou Choctaw

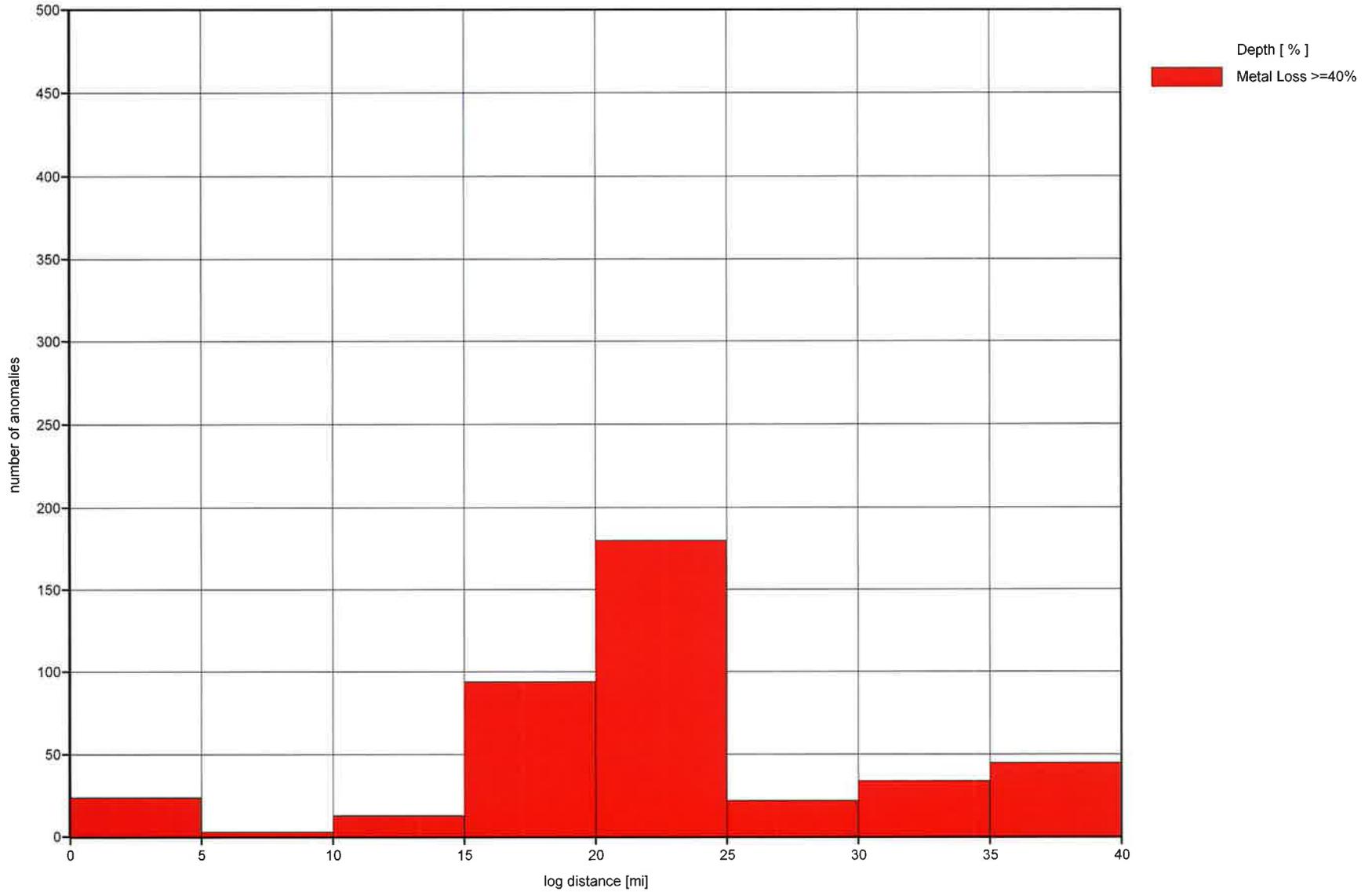
MFL-A/XT - Distribution Of All Metal Loss Anomalies



# 36" Sugarland to Bayou Choctaw

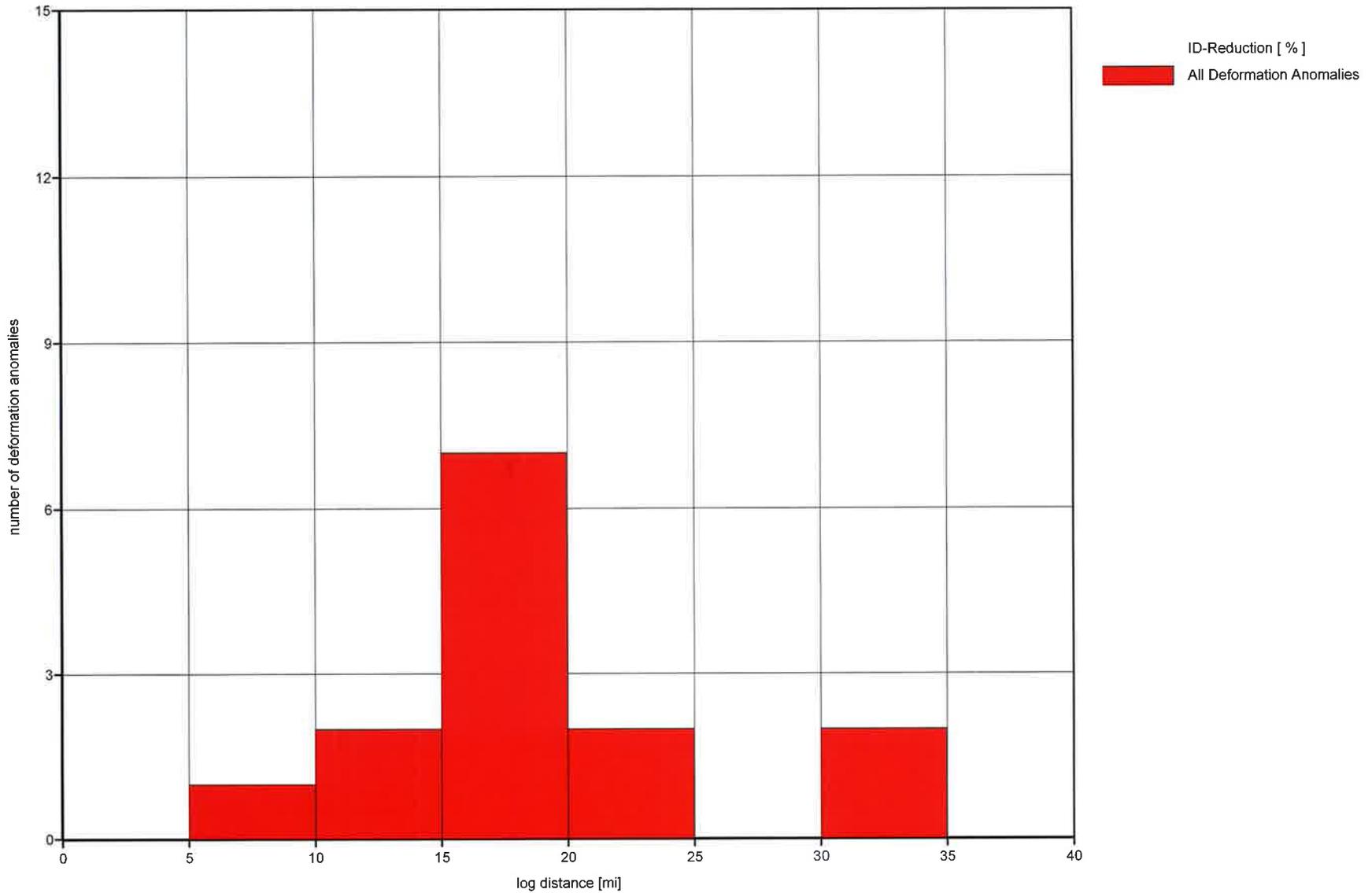
Client: Shell Pipeline Company, L.P.  
ROSEN Proj. No.: 0-1000-13737  
ROSEN Line Name: 36" SUG-BAY  
Inspection Type: MFL-A/XT  
Date of Inspection: September 12, 2018  
Revision No.: 0

MFL-A/XT - Metal Loss Distribution  $\geq 40\%$



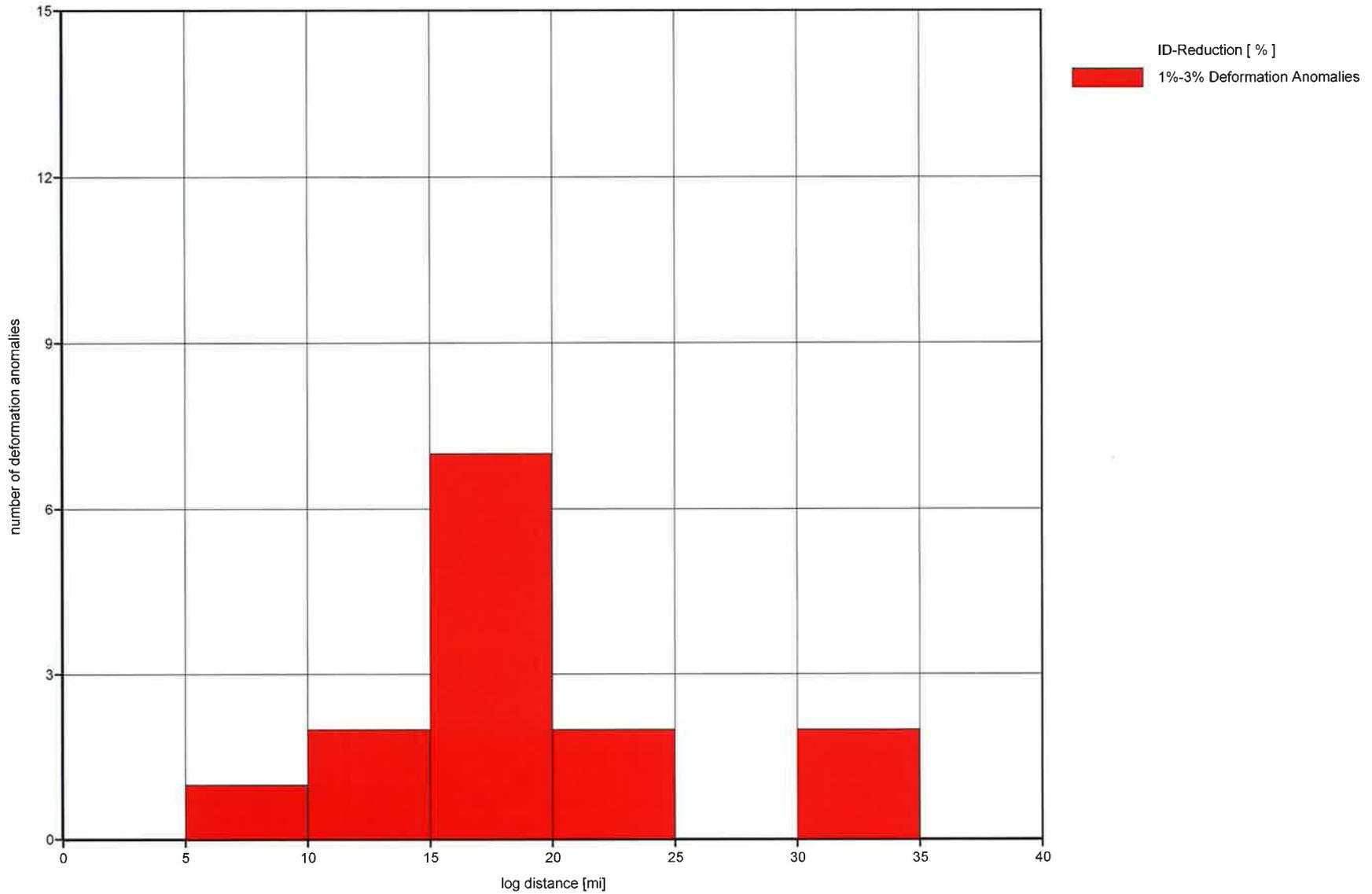
# 36" Sugarland to Bayou Choctaw

## Distribution of Deformation Anomalies



# 36" Sugarland to Bayou Choctaw

Distribution of Deformation Anomalies 1% to 3%



## 4.3 List of Anomalies

The List of Anomalies contains all anomalies that were identified during the evaluation process. All anomalies above the reporting threshold of greater than or equal to 15% metal loss and greater or equal to 1% outside reduction for RoCombo MFL-A/XT are included.

In case of close proximity to other anomalies, several single anomalies have been summarized into clusters. The coordinates of the cluster refer to the start point of the cluster, and the depth of the cluster refers to the maximum anomaly depth in the cluster.

The list includes the following information:

- . Feature number
- . Pipeline feature
- . Internal/External/Mid-Wall Indication
- . Odometer (feet)
- . Station number 9feet0
- . Distance to upstream weld (feet)
- . Distance to downstream weld (feet)
- . Joint length (feet)
- . Defect joint number
- . Upstream reference name (valve name, AGM #, etc)
- . Distance to U/S reference (feet)
- . Downstream reference name (valve name, AGM #, etc)
- . Distance to D/S reference (feet)
- . Pipe outer diameter (inches)
- . Wall thickness (inches)
- . Pipe grade
- . Anomaly depth (%)
- . Anomaly depth (inches)
- . Anomaly length (inches)
- . Anomaly width (inches)
- . Anomaly/feature orientation (O'clock)
- . MOP (psi) or MAOP (psi)
- . Remaining strength calculations (Modified B31.G)
  - . PBURST (psi)
  - . PSAFE (psi)
- . Internal design pressure (psi)
- . ERF (MOP/ PSAFE)
- . RPR (PBURST /100% SMYS)
- . Group number and category
- . POF Category
- . ILI vendor comments
- . Latitude
- . Longitude
- . Height

Note: Due to the high number of anomalies, the following list is included only in electronic format and contains only the columns selected for printing purposes, as requested by Shell Pipeline Company, LP. For a complete list please refer to the ROSOFT media provided.

## 4.4 Client List

The Client List contains all anomalies, installations, welds, and markers that were identified during the evaluation process. All anomalies above the reporting threshold of greater than or equal to 15%.

The list includes the following information:

- . Feature number
- . Pipeline feature
- . Internal/External/Mid-Wall Indication
- . Odometer (feet)
- . Station number (feet)
- . Distance to upstream weld (feet)
- . Distance to downstream weld (feet)
- . Joint length (feet)
- . Defect joint number
- . Upstream reference name (valve name, AGM #, etc)
- . Distance to U/S reference (feet)
- . Downstream reference name (valve name, AGM #, etc)
- . Distance to D/S reference (feet)
- . Pipe outer diameter (inches)
- . Wall thickness (inches)
- . Pipe grade
- . Long seam orientation
- . Anomaly depth (%)
- . Anomaly depth (inches)
- . Dent depth (%)
- . Dent depth (inches)
- . Anomaly length (inches)
- . Anomaly width (inches)
- . Anomaly/feature orientation (O'clock)
- . ILI vendor comments
- . MOP (psig) or MAOP (psi)
- . Remaining strength calculations (Modified B31.G)
  - . PBURST (psi)
  - . PSAFE (psi)
- . Internal design pressure (psi)
- . ERF (MOP/ PSAFE)
- . RPR (PBURST /100% SMYS)
- . Group number and category
- . POF Category
- . Latitude
- . Longitude
- . Height

Note: The following list, included only in electronic format, contains only the columns selected for printing purposes, as requested by Shell Pipeline Company, LP. For a complete list please refer to the ROSOFT media provided.

## 4.5 Individually Sentenced Feature Reports (ISFRs)

ISFRs for Groups 1, 2, 3, and 4 have been prepared according to the priority rules defined in Shell Document 3TS-002 Rev. July 2018.

Each ISFR includes the following:

- Anomaly Location Sheet

Note: No anomalies reported qualify for Group 1 or Group 4; therefore, no ISFRs have been included for these groups.

**ISFR No. 1** at log distance 52031.07 feet refers to a deformation with metal loss anomaly with a total length/width of 10.67 inches x 7.81 inches, a maximum calculated depth of 19%, and a diameter reduction of 1.8%.

**ISFR No. 2** at log distance 53452.59 feet refers to a deformation with metal loss anomaly, commented with 'Metal Loss less than 15%', with a total length/width of 6.94 inches x 6.43 inches, and a diameter reduction of 1.4%.

**ISFR No. 3** at log distance 75768.01 feet refers to a deformation with metal loss with metal loss anomaly, commented with 'Metal Loss less than 10%', with a total length/width of 10.71 inches x 10.05 inches, and a diameter reduction of 1.0%.

**ISFR No. 4** at log distance 85700.27 feet refers to a deformation with metal loss anomaly, commented with 'Metal Loss less than 15%', with a total length/width of 5.54 inches x 7.74 inches, and a diameter reduction of 1.4%.

**ISFR No. 5** at log distance 115475.33 feet refers to a deformation with metal loss anomaly with a total length/width of 43.55 inches x 13.65 inches, a maximum calculated depth of 27%, and a diameter reduction of 1.0%.

**ISFR No. 6** at log distance 81664.43 feet refers to a deformation anomaly with a total length/width of 8.09 inches x 3.62 inches, and a diameter reduction of 1.1%.

**ISFR No. 7** at log distance 81802.99 feet refers to a deformation anomaly with a total length/width of 9.67 inches x 3.89 inches, and a diameter reduction of 1.1%.

**ISFR No. 8** at log distance 89541.30 feet refers to a deformation anomaly with a total length/width of 14.34 inches x 8.76 inches, and a diameter reduction of 1.4%.

**ISFR No. 9** at log distance 93161.99 feet refers to a deformation anomaly with a total length/width of 13.74 inches x 7.96 inches, and a diameter reduction of 1.2%.

**ISFR No. 10** at log distance 101425.15 feet refers to a deformation anomaly with a total length/width of 7.96 inches x 6.07 inches, and a diameter reduction of 1.1%.

Client: Shell Pipeline Company, LP  
ROSEN Project No.: 0-1000-13737  
ROSEN Line Name: 36" SUG-BAY  
Inspection Type: MFL-A/XT  
Date of Inspection: September 12, 2018  
Revision No.: 0

**ISFR No. 11** at log distance 102370.63 feet refers to a deformation anomaly with a total length/width of 8.43 inches x 5.70 inches, and a diameter reduction of 1.4%.

**ISFR No. 12** at log distance 120875.83 feet refers to a deformation anomaly with a total length/width of 6.48 inches x 4.76 inches, and a diameter reduction of 1.6%.

**ISFR No. 13** at log distance 166431.04 feet refers to a deformation anomaly with a total length/width of 27.68 inches x 13.43 inches, and a diameter reduction of 1.7%.

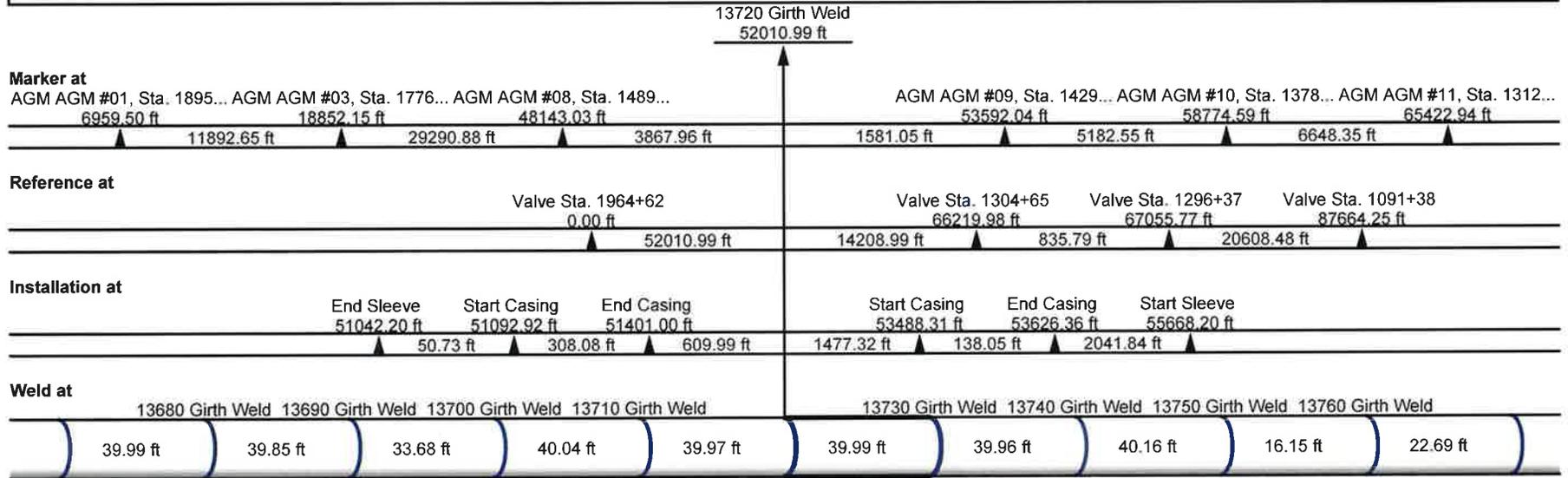
**ISFR No. 14** at log distance 174030.92 feet refers to a deformation anomaly with a total length/width of 2.94 inches x 3.30 inches, and a diameter reduction of 1.1%.

# 36" Sugarland to Bayou Choctaw

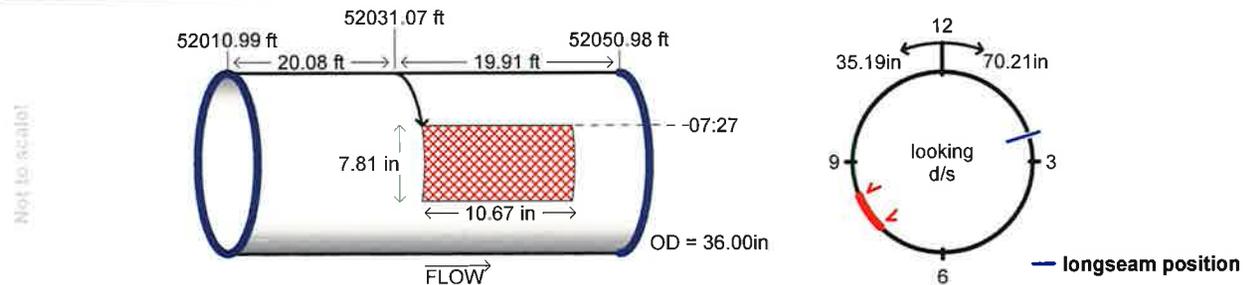
Client: Shell Pipeline Company, L.P.  
 ROSEN Proj. No.: 0-1000-13737  
 ROSEN Line Name: 36" SUG-BAY  
 Inspection Type: MFL-A/XT  
 Date of Inspection: September 12, 2018  
 Revision No.: 0

Individually Sentenced Feature Report (ISFR)  
 Weld and Anomaly Location Sheet

## Weld Location



## Anomaly Location



## Anomaly Information

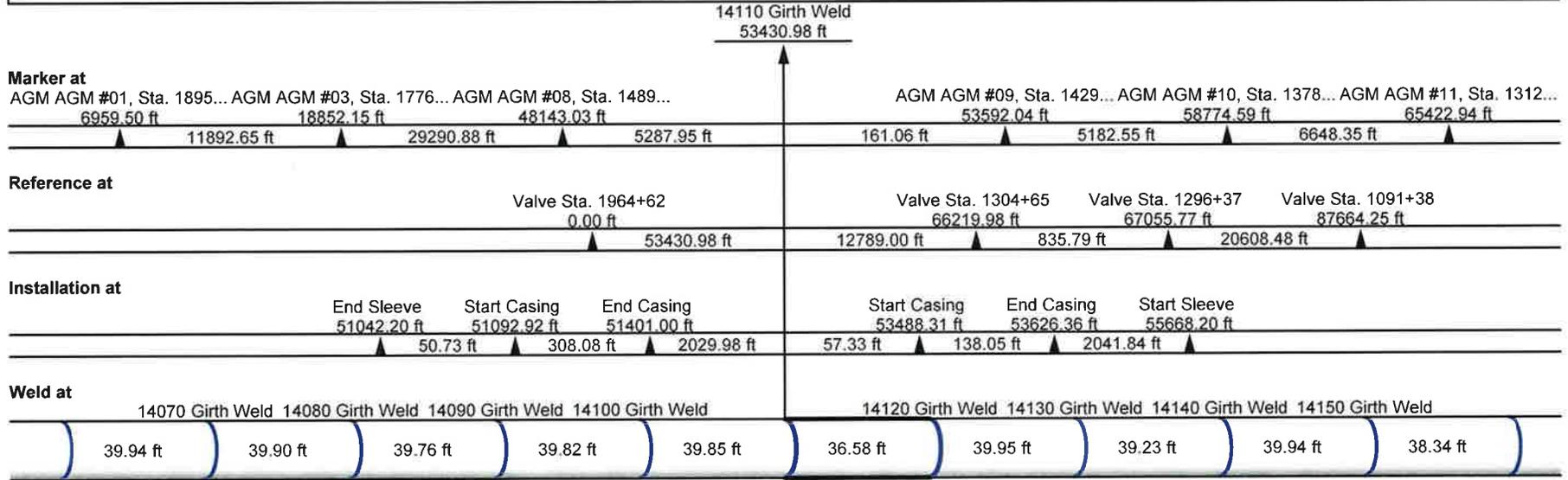
Log Dist. : 52031.07 ft    O'clock : 07:27    Event : deformation w/ metal loss    Internal : not assigned    Depth : 19 %/0.059 in/0.648 in    ID-Reduction : 1.8 %    Length : 10.67 in  
 Width : 7.81 in    Seam Orient. : 02:26    to TDC : -41.22 in    APPROX. MAP : 144677 ft    Height : 0.00 ft

# 36" Sugarland to Bayou Choctaw

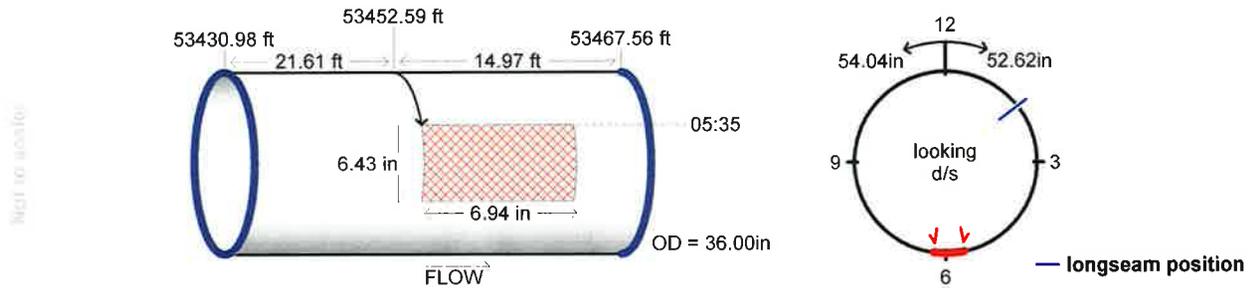
Client: Shell Pipeline Company, L.P.  
 ROSEN Proj. No.: 0-1000-13737  
 ROSEN Line Name: 36" SUG-BAY  
 Inspection Type: MFL-A/XT  
 Date of Inspection: September 12, 2018  
 Revision No.: 0

Individually Sentenced Feature Report (ISFR)  
 Weld and Anomaly Location Sheet

## Weld Location



## Anomaly Location



## Anomaly Information

Log Dist. : 53452.59 ft    O'clock : 05:35    Event : deformation w/ metal loss    Internal : not assigned    Depth : 0.504 in    ID-Reduction : 1.4 %    Length : 6.94 in  
 Width : 6.43 in    Comment : Metal Loss less than 15%    Seam Orient. : 01:45    to TDC : 54.57 in    APPROX. MAP : 143121 ft    Height : 0.00 ft

# 36" Sugarland to Bayou Choctaw

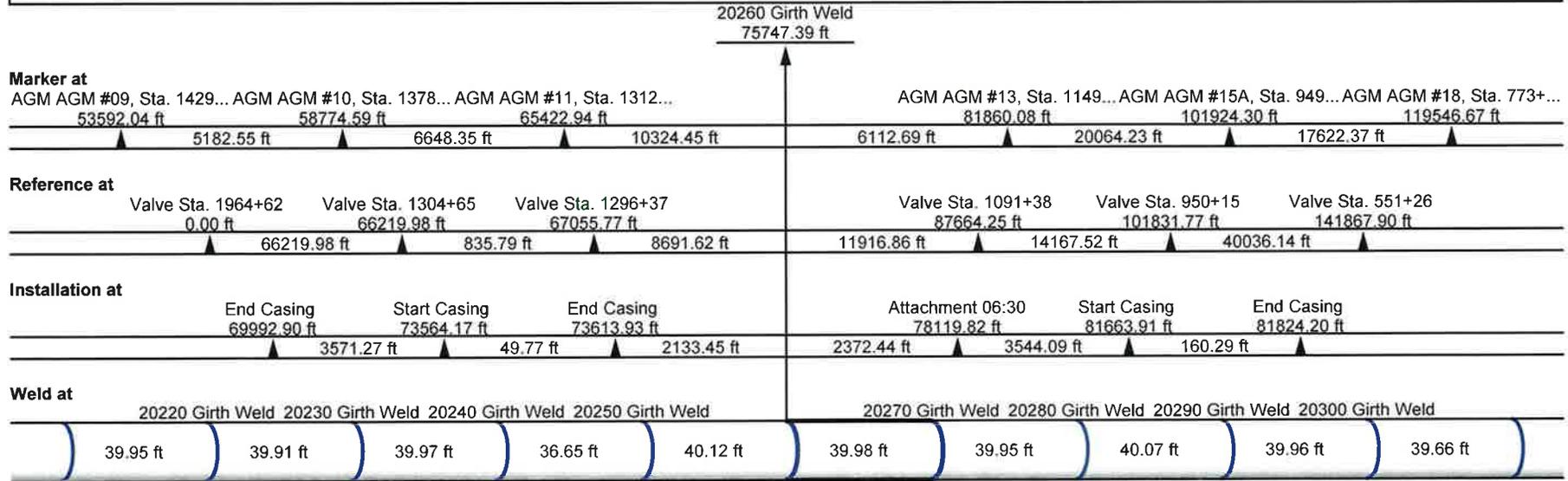


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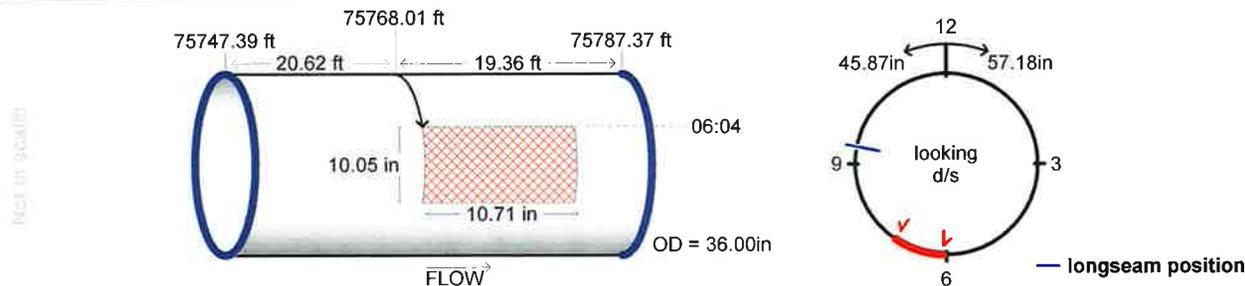
Client: Shell Pipeline Company, L.P.  
 ROSEN Proj. No.: 0-1000-13737  
 ROSEN Line Name: 36" SUG-BAY  
 Inspection Type: MFL-A/XT  
 Date of Inspection: September 12, 2018  
 Revision No.: 0

Individually Sentenced Feature Report (ISFR)  
 Weld and Anomaly Location Sheet

## Weld Location



## Anomaly Location



## Anomaly Information

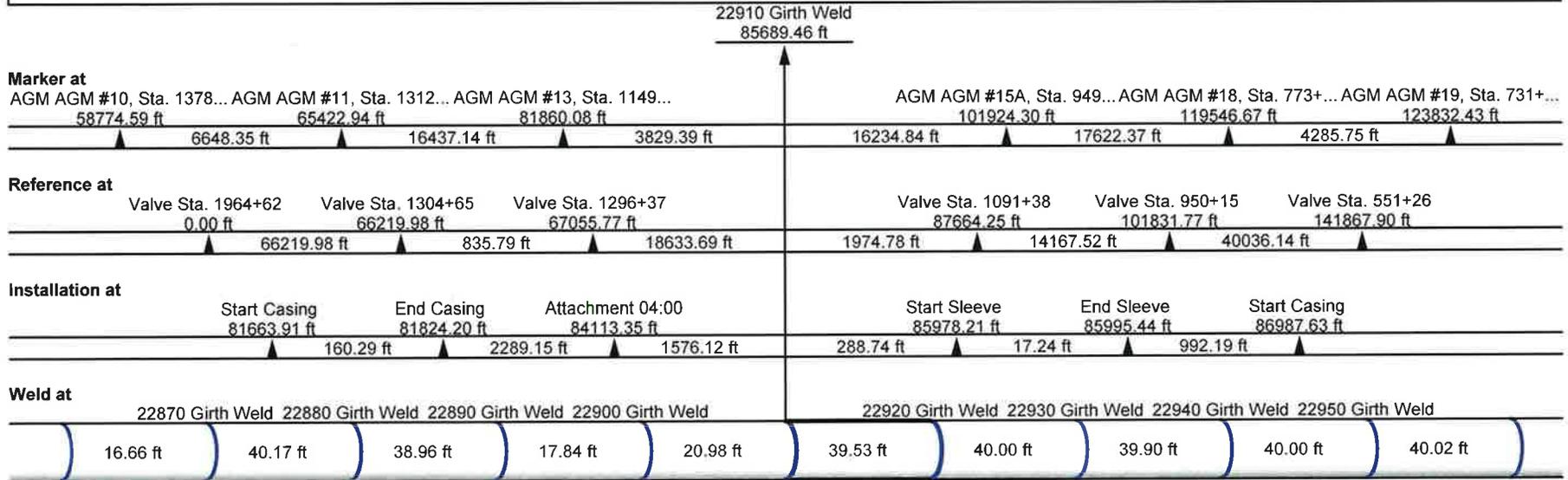
Log Dist. : 75768.01 ft O'clock : 06:04 Event : deformation w/ metal loss Internal : not assigned Depth : 0.360 in ID-Reduction : 1.0 % Length : 10.71 in  
 Width : 10.05 in Comment : Metal Loss less than 10% Seam Orient. : 09:23 to TDC : -55.35 in APPROX. MAP : 121021 ft Height : 0.00 ft

# 36" Sugarland to Bayou Choctaw

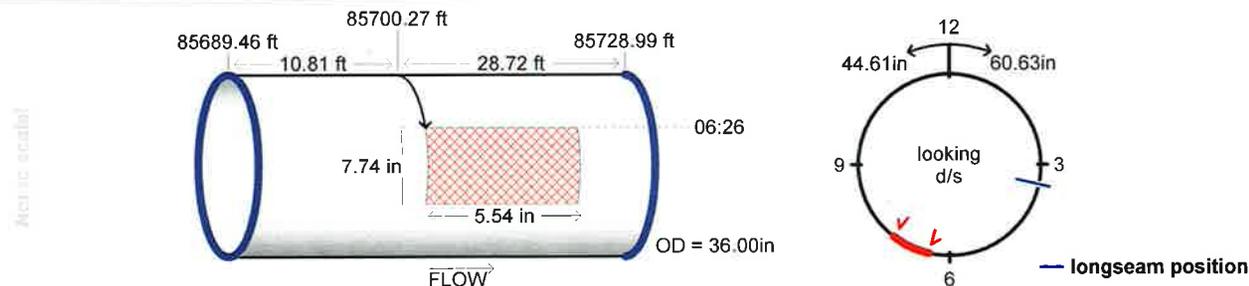
Client: Shell Pipeline Company, L.P.  
 ROSEN Proj. No.: 0-1000-13737  
 ROSEN Line Name: 36" SUG-BAY  
 Inspection Type: MFL-A/XT  
 Date of Inspection: September 12, 2018  
 Revision No.: 0

Individually Sentenced Feature Report (ISFR)  
 Weld and Anomaly Location Sheet

## Weld Location



## Anomaly Location



## Anomaly Information

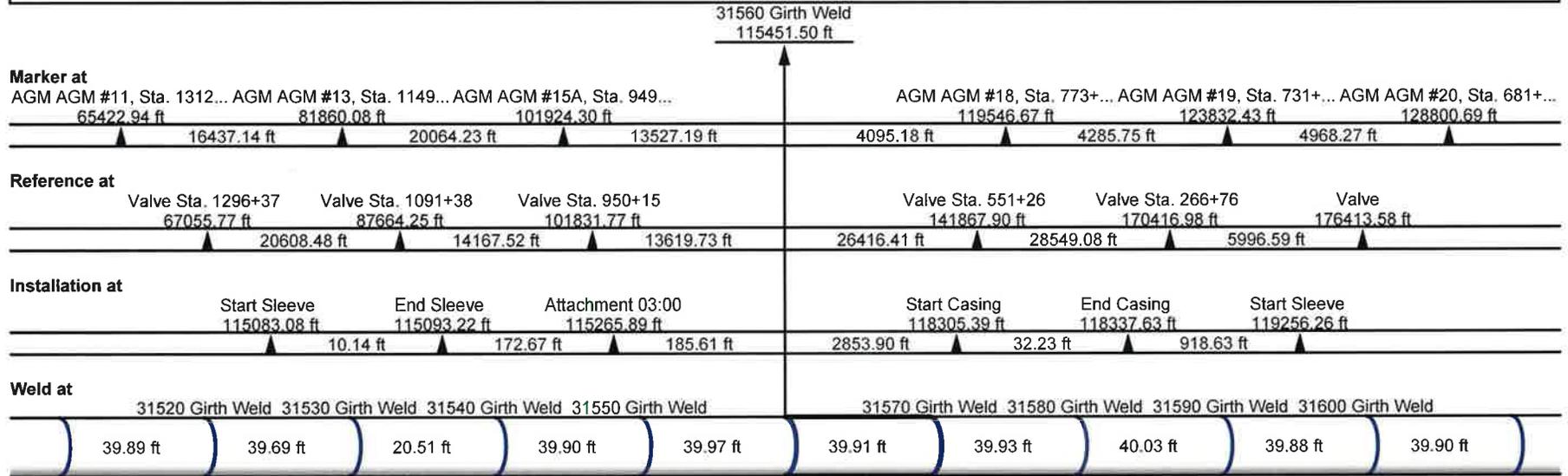
Log Dist. : 85700.27 ft    O'clock : 06:26    Event : deformation w/ metal loss    Internal : not assigned    Depth : 0.504 in    ID-Reduction : 1.4 %    Length : 5.54 in  
 Width : 7.74 in    Comment : Metal Loss less than 15%    Seam Orient. : 03:27    to TDC : -50.83 in    APPROX. MAP : 111121 ft    Height : 0.00 ft

# 36" Sugarland to Bayou Choctaw

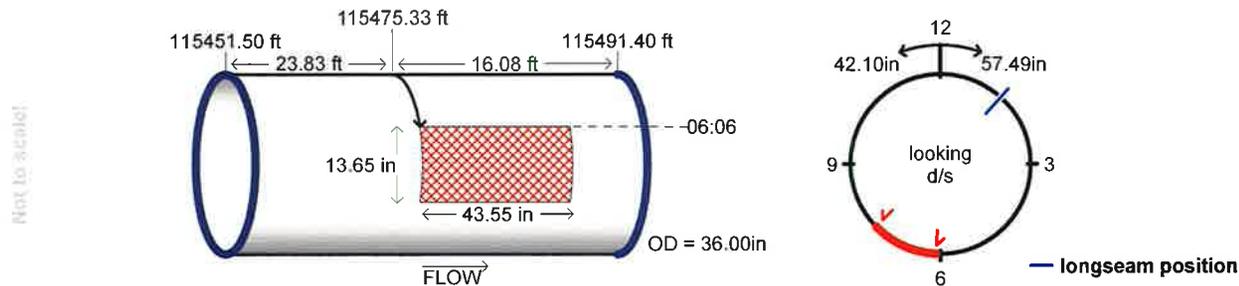
Client: Shell Pipeline Company, L.P.  
 ROSEN Proj. No.: 0-1000-13737  
 ROSEN Line Name: 36" SUG-BAY  
 Inspection Type: MFL-A/XT  
 Date of Inspection: September 12, 2018  
 Revision No.: 0

Individually Sentenced Feature Report (ISFR)  
 Weld and Anomaly Location Sheet

## Weld Location



## Anomaly Location



## Anomaly Information

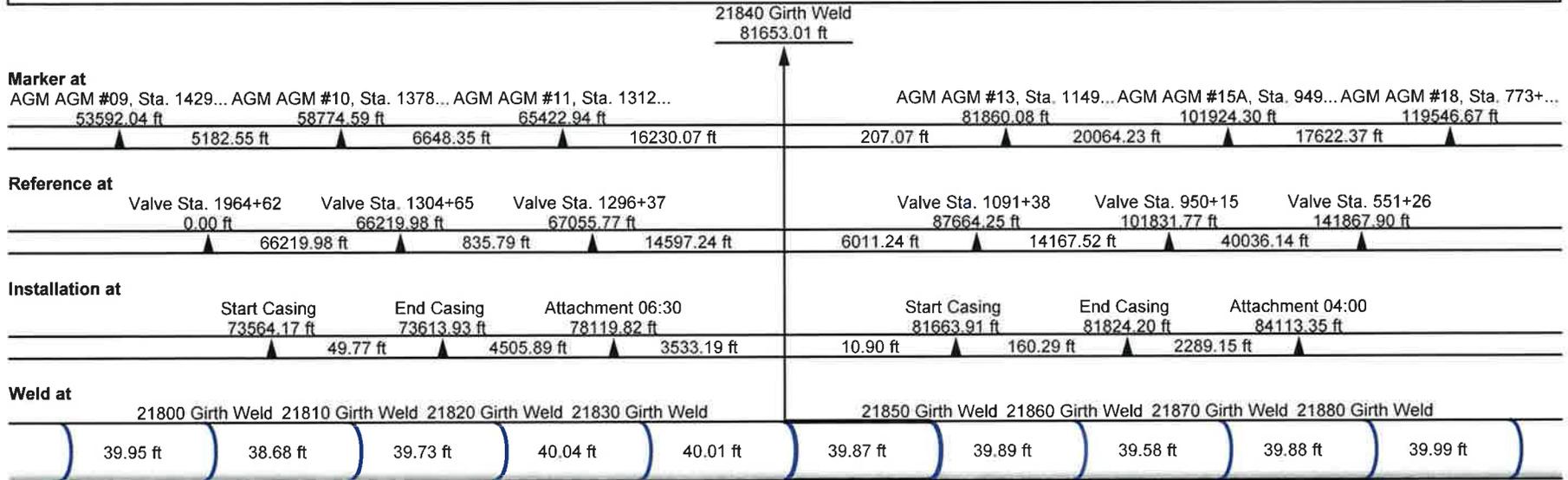
Log Dist. : 115475.33 ft    O'clock : 06:06    Event : deformation w/ metal loss    Internal : not assigned    Depth : 27 %/0.084 in/0.360 in    ID-Reduction : 1.0 %    Length : 43.55 in  
 Width : 13.65 in    Seam Orient. : 01:24    to TDC : 54.92 in    APPROX. MAP : 81420 ft    Height : 0.00 ft

# 36" Sugarland to Bayou Choctaw

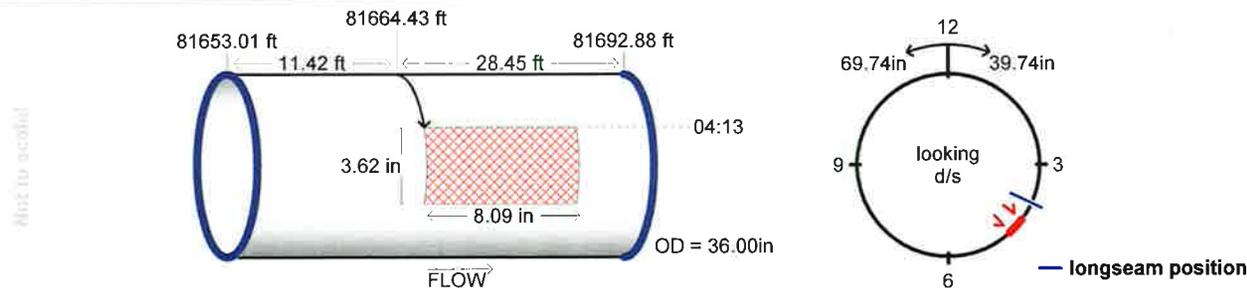
Client: Shell Pipeline Company, L.P.  
 ROSEN Proj. No.: 0-1000-13737  
 ROSEN Line Name: 36" SUG-BAY  
 Inspection Type: MFL-A/XT  
 Date of Inspection: September 12, 2018  
 Revision No.: 0

## Individually Sentenced Feature Report (ISFR) Weld and Anomaly Location Sheet

### Weld Location



### Anomaly Location



### Anomaly Information

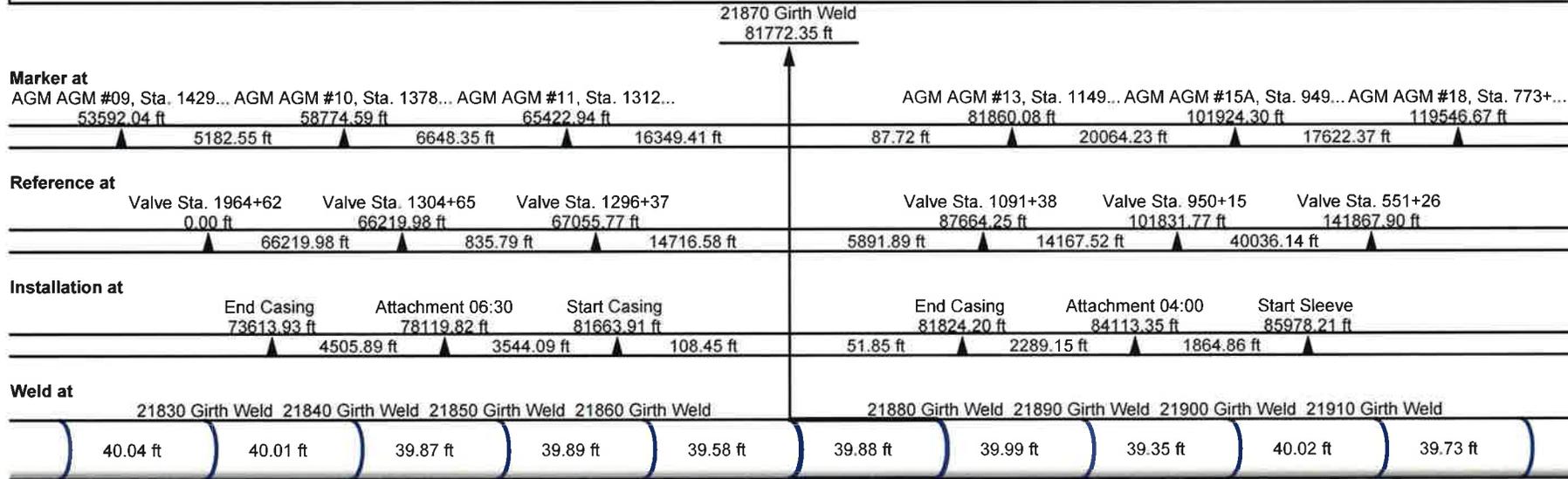
Log Dist. : 81664.43 ft    O'clock : 04:13    Event : deformation    Internal : not assigned    Depth : 0.396 in    ID-Reduction : 1.1 %    Length : 8.09 in    Width : 3.62 in  
 Seam Orient. : 03:50    to TDC : 38.96 in    APPROX. MAP : 115190 ft    Height : 0.00 ft

# 36" Sugarland to Bayou Choctaw

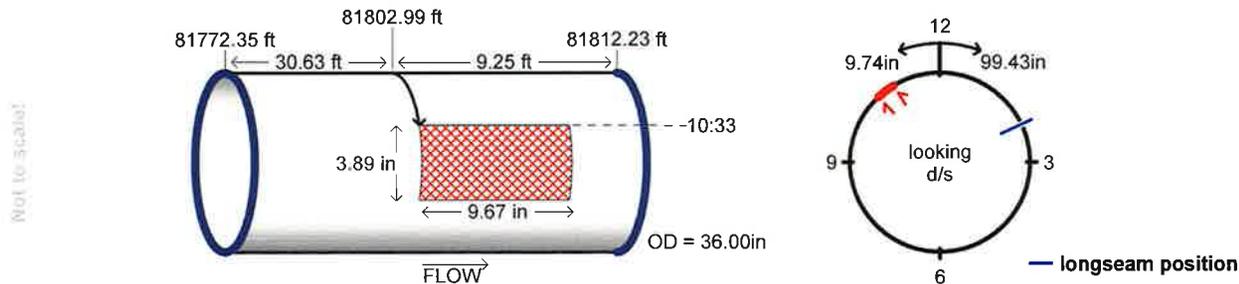
Client: Shell Pipeline Company, L.P.  
 ROSEN Proj. No.: 0-1000-13737  
 ROSEN Line Name: 36" SUG-BAY  
 Inspection Type: MFL-A/XT  
 Date of Inspection: September 12, 2018  
 Revision No.: 0

Individually Sentenced Feature Report (ISFR)  
 Weld and Anomaly Location Sheet

## Weld Location



## Anomaly Location



## Anomaly Information

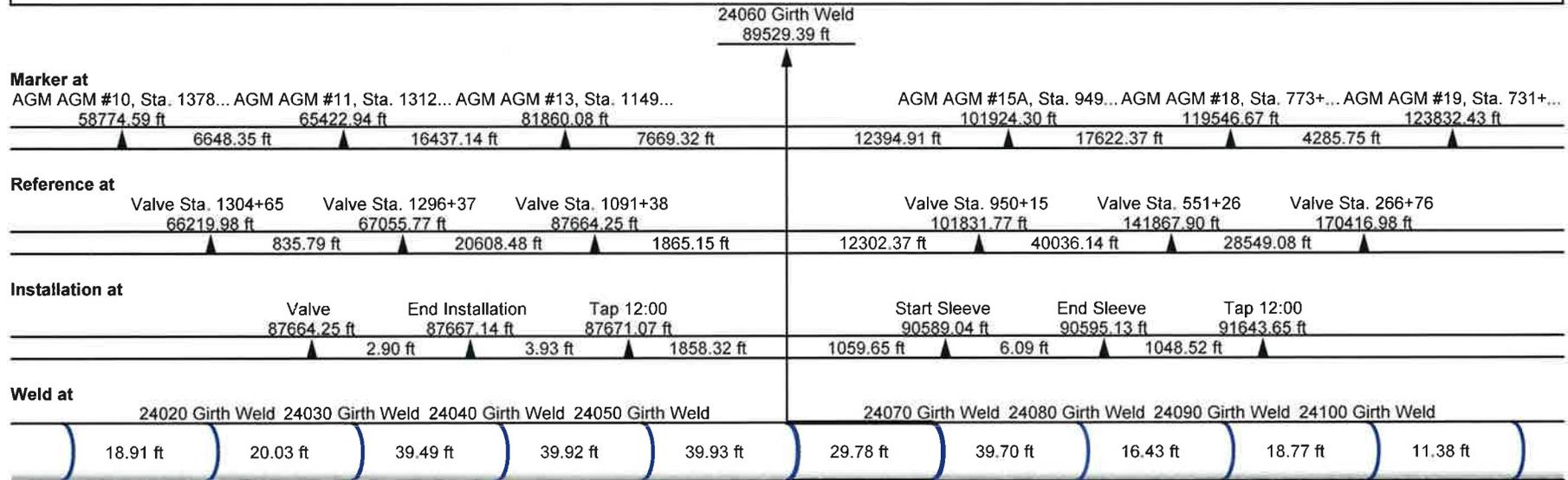
Log Dist. : 81802.99 ft    O'clock : 10:33    Event : deformation    Internal : not assigned    Depth : 0.396 in    ID-Reduction : 1.1 %    Length : 9.67 in    Width : 3.89 in  
 Seam Orient. : 02:10    to TDC : -13.13 in    APPROX. MAP : 115053 ft    Height : 0.00 ft

# 36" Sugarland to Bayou Choctaw

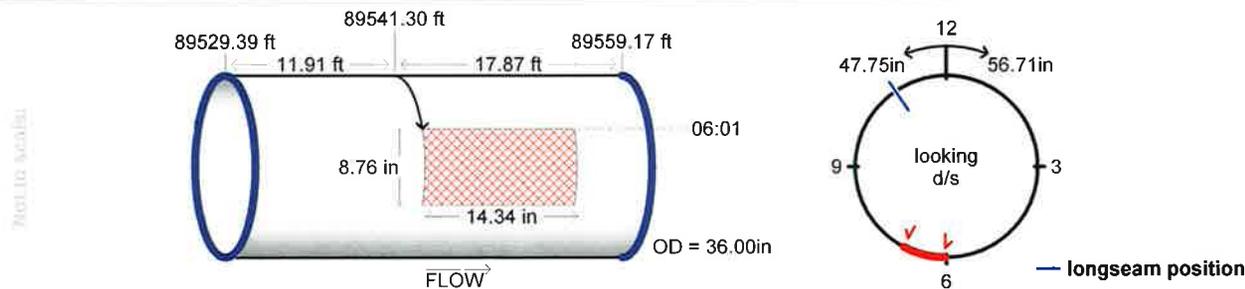
Client: Shell Pipeline Company, L.P.  
 ROSEN Proj. No.: 0-1000-13737  
 ROSEN Line Name: 36" SUG-BAY  
 Inspection Type: MFL-A/XT  
 Date of Inspection: September 12, 2018  
 Revision No.: 0

## Individually Sentenced Feature Report (ISFR) Weld and Anomaly Location Sheet

### Weld Location



### Anomaly Location



### Anomaly Information

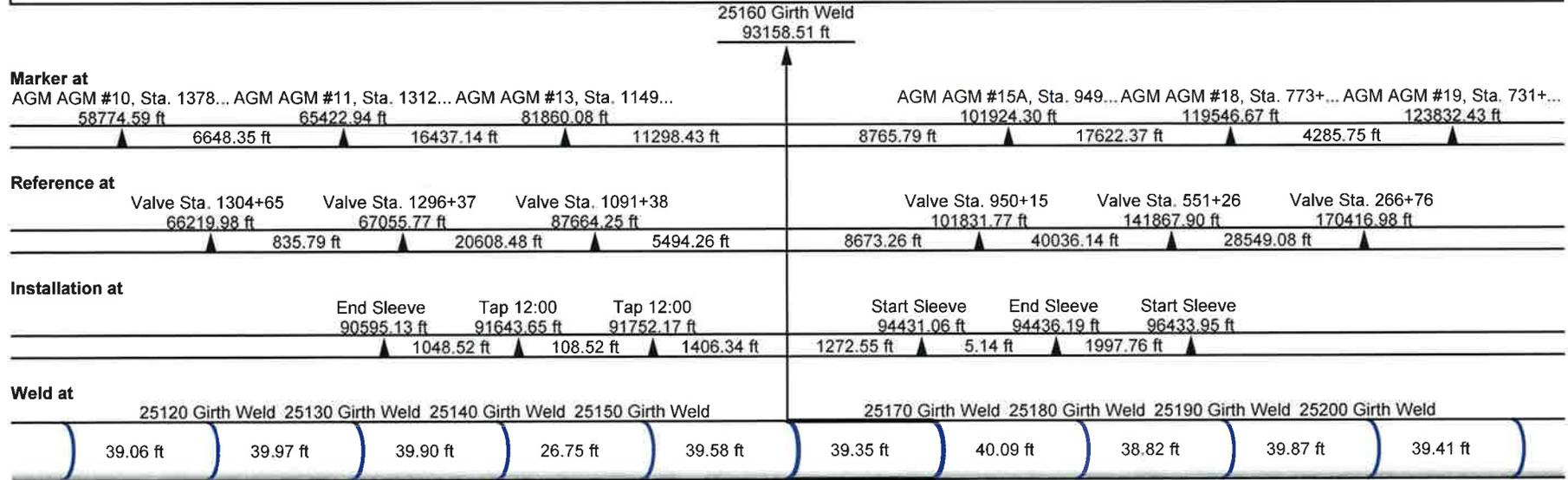
Log Dist. : 89541.30 ft    O'clock : 06:01    Event : deformation    Internal : not assigned    Depth : 0.504 in    ID-Reduction : 1.4 %    Length : 14.34 in    Width : 8.76 in  
 Seam Orient. : 10:52    to TDC : -55.23 in    APPROX. MAP : 107267 ft    Height : 0.00 ft

# 36" Sugarland to Bayou Choctaw

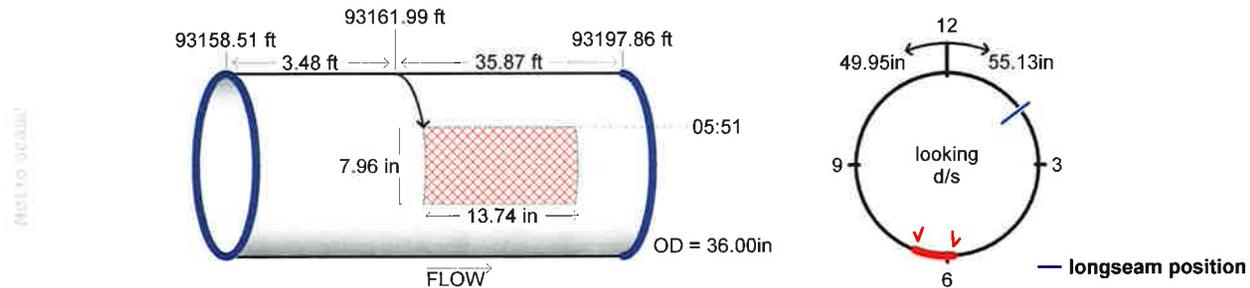
Client: Shell Pipeline Company, L.P.  
 ROSEN Proj. No.: 0-1000-13737  
 ROSEN Line Name: 36" SUG-BAY  
 Inspection Type: MFL-A/XT  
 Date of Inspection: September 12, 2018  
 Revision No.: 0

Individually Sentenced Feature Report (ISFR)  
 Weld and Anomaly Location Sheet

## Weld Location



## Anomaly Location



## Anomaly Information

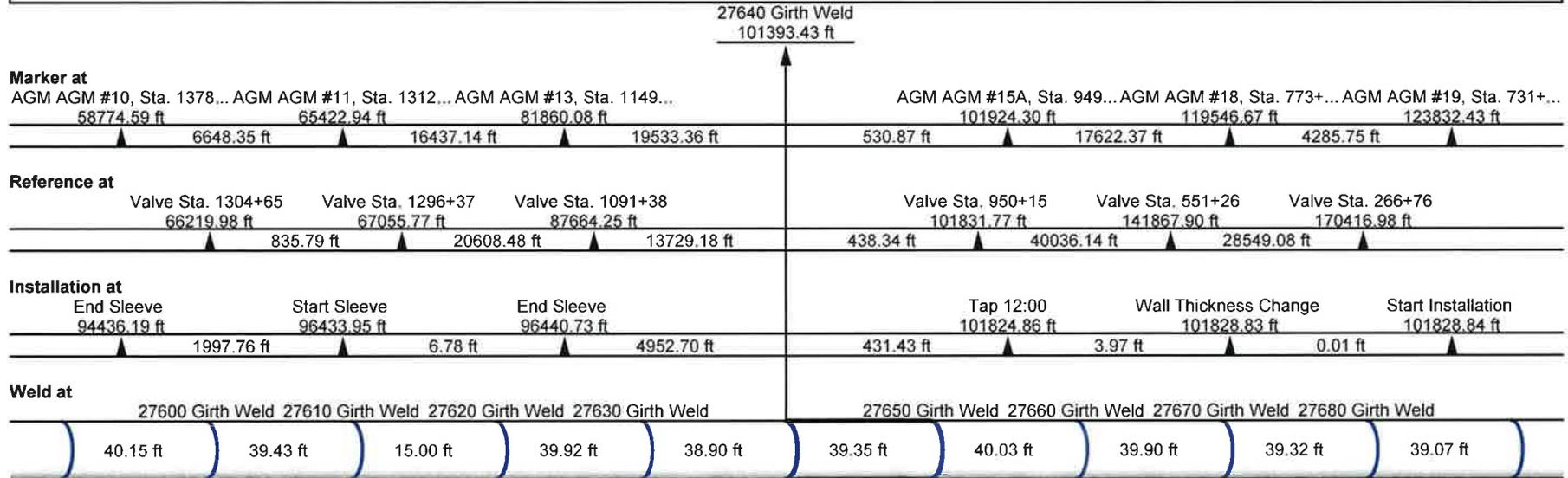
Log Dist. : 93161.99 ft    O'clock : 05:51    Event : deformation    Internal : not assigned    Depth : 0.432 in    ID-Reduction : 1.2 %    Length : 13.74 in    Width : 7.96 in  
 Seam Orient. : 01:46    to TDC : 53.06 in    APPROX. MAP : 103658 ft    Height : 0.00 ft

# 36" Sugarland to Bayou Choctaw

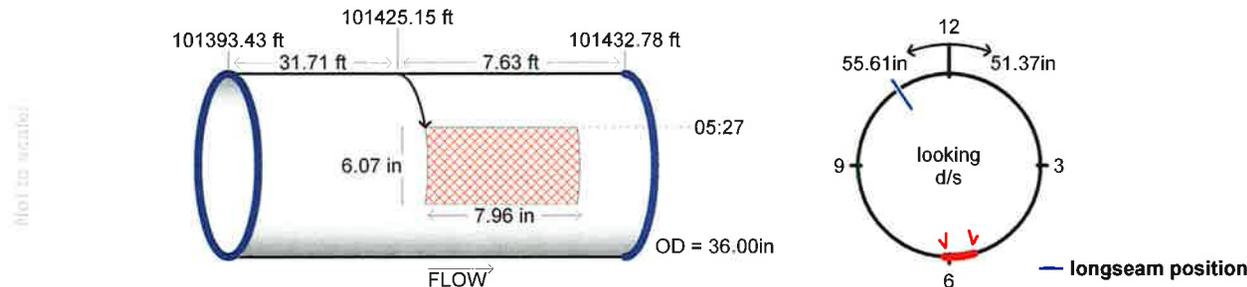
Client: Shell Pipeline Company, L.P.  
 ROSEN Proj. No.: 0-1000-13737  
 ROSEN Line Name: 36" SUG-BAY  
 Inspection Type: MFL-A/XT  
 Date of Inspection: September 12, 2018  
 Revision No.: 0

Individually Sentenced Feature Report (ISFR)  
 Weld and Anomaly Location Sheet

## Weld Location



## Anomaly Location



## Anomaly Information

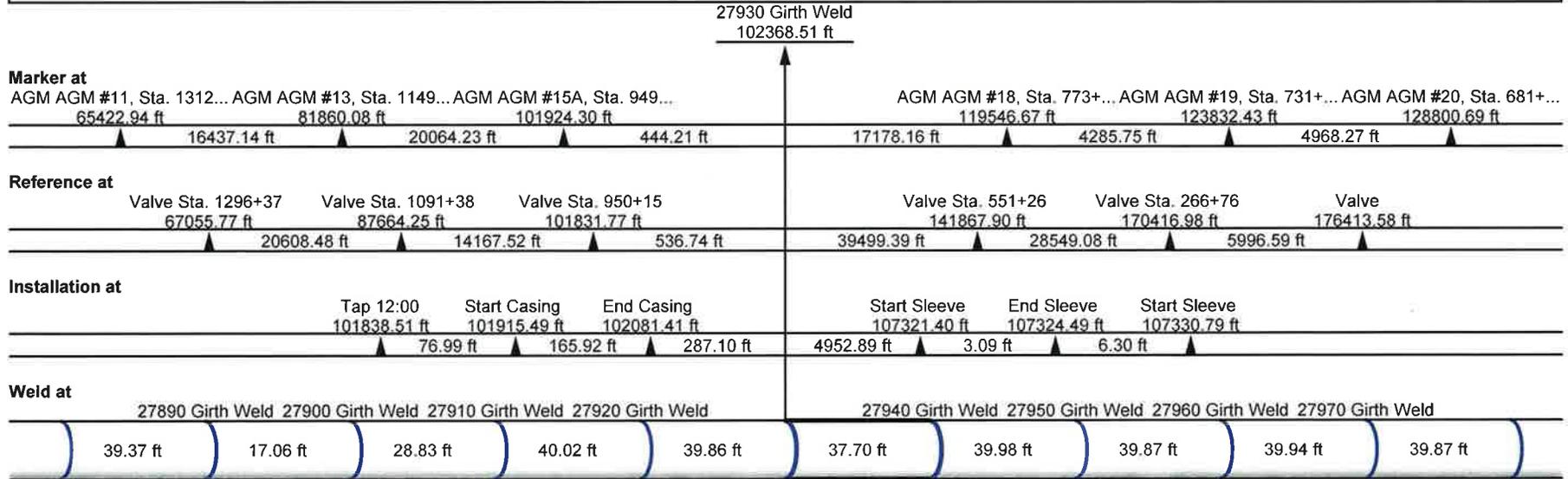
Log Dist. : 101425.15 ft    O'clock : 05:27    Event : deformation    Internal : not assigned    Depth : 0.396 in    ID-Reduction : 1.1 %    Length : 7.96 in    Width : 6.07 in  
 Seam Orient. : 10:52    to TDC : 53.00 in    APPROX. MAP : 95420 ft    Height : 0.00 ft

# 36" Sugarland to Bayou Choctaw

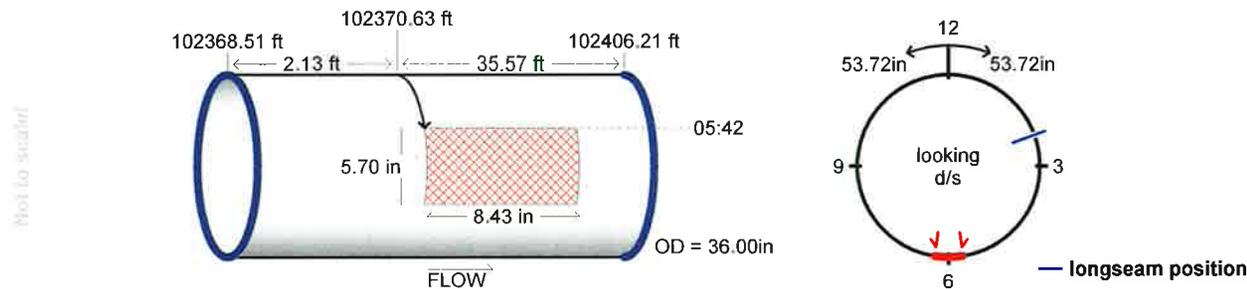
Client: Shell Pipeline Company, L.P.  
 ROSEN Proj. No.: 0-1000-13737  
 ROSEN Line Name: 36" SUG-BAY  
 Inspection Type: MFL-A/XT  
 Date of Inspection: September 12, 2018  
 Revision No.: 0

Individually Sentenced Feature Report (ISFR)  
 Weld and Anomaly Location Sheet

## Weld Location



## Anomaly Location



## Anomaly Information

Log Dist. : 102370.63 ft    O'clock : 05:42    Event : deformation    Internal : not assigned    Depth : 0.504 in    ID-Reduction : 1.4 %    Length : 8.43 in    Width : 5.70 in  
 Seam Orient. : 02:20    to TDC : 52.68 in    APPROX. MAP : 94474 ft    Height : 0.00 ft

# 36" Sugarland to Bayou Choctaw

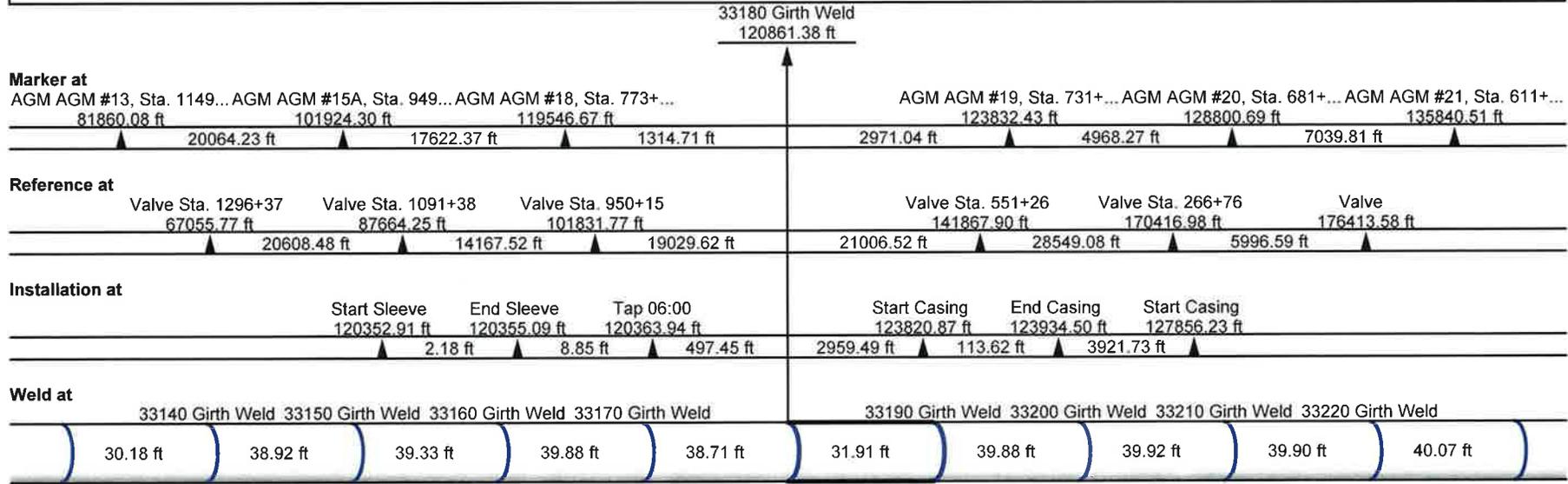


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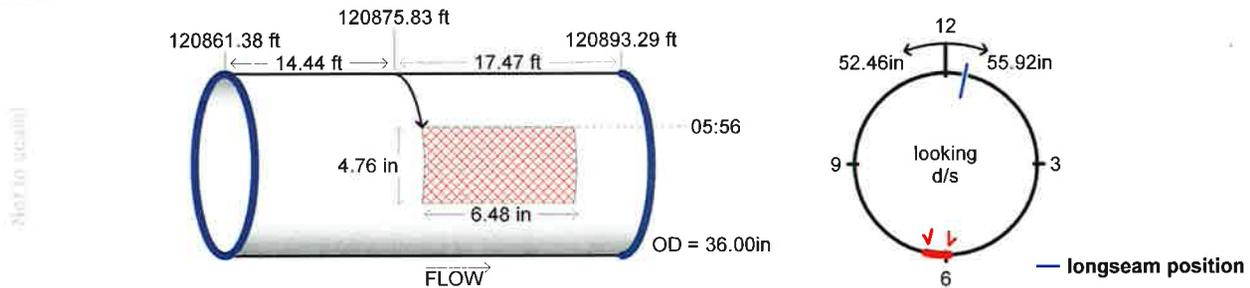
Client: Shell Pipeline Company, L.P.  
 ROSEN Proj. No.: 0-1000-13737  
 ROSEN Line Name: 36" SUG-BAY  
 Inspection Type: MFL-A/XT  
 Date of Inspection: September 12, 2018  
 Revision No.: 0

Individually Sentenced Feature Report (ISFR)  
 Weld and Anomaly Location Sheet

## Weld Location



## Anomaly Location



## Anomaly Information

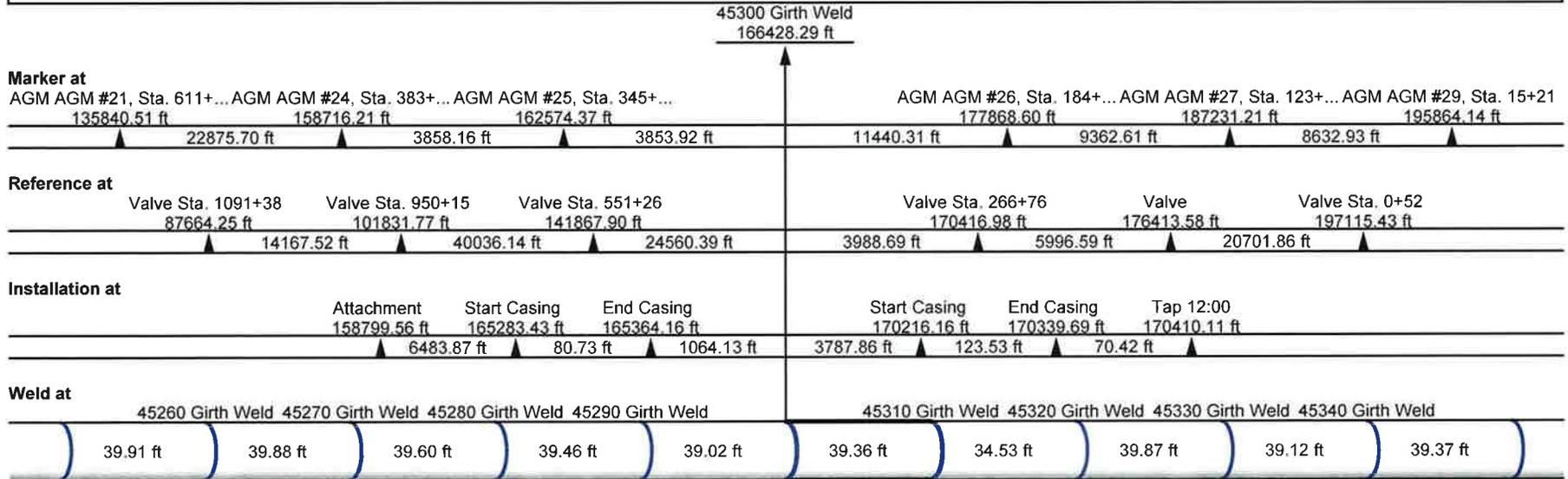
Log Dist. : 120875.83 ft    O'clock : 05:56    Event : deformation    Internal : not assigned    Depth : 0.576 in    ID-Reduction : 1.6 %    Length : 6.48 in    Width : 4.76 in  
 Seam Orient. : 12:24    to TDC : 55.51 in    APPROX. MAP : 76043 ft    Height : 0.00 ft

# 36" Sugarland to Bayou Choctaw

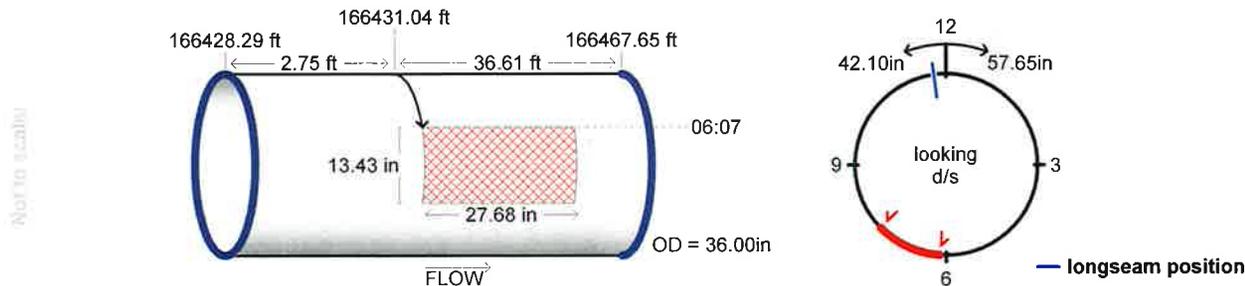
Client: Shell Pipeline Company, L.P.  
 ROSEN Proj. No.: 0-1000-13737  
 ROSEN Line Name: 36" SUG-BAY  
 Inspection Type: MFL-A/XT  
 Date of Inspection: September 12, 2018  
 Revision No.: 0

Individually Sentenced Feature Report (ISFR)  
 Weld and Anomaly Location Sheet

## Weld Location



## Anomaly Location



## Anomaly Information

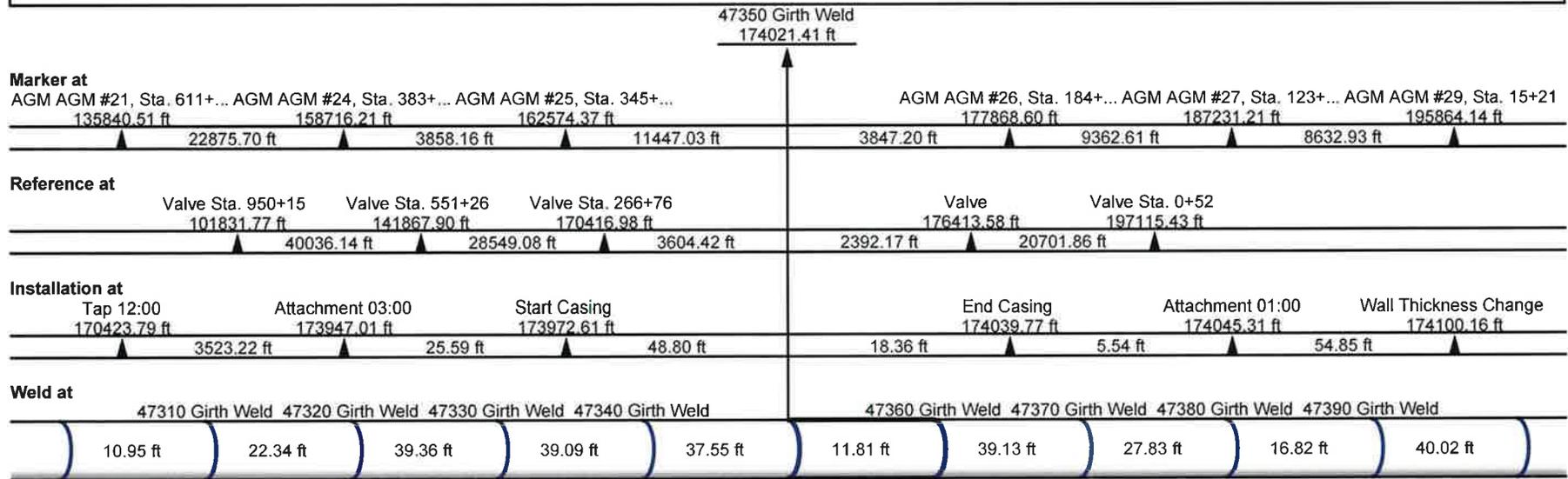
Log Dist. : 166431.04 ft    O'clock : 06:07    Event : deformation    Internal : not assigned    Depth : 0.612 in    ID-Reduction : 1.7 %    Length : 27.68 in    Width : 13.43 in  
 Seam Orient. : 11:44    to TDC : 56.33 in    APPROX. MAP : 30668 ft    Height : 0.00 ft

# 36" Sugarland to Bayou Choctaw

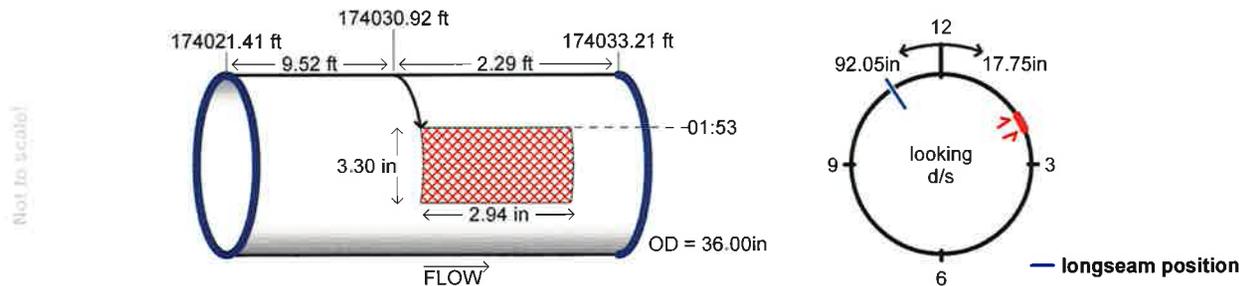
Client: Shell Pipeline Company, L.P.  
 ROSEN Proj. No.: 0-1000-13737  
 ROSEN Line Name: 36" SUG-BAY  
 Inspection Type: MFL-A/XT  
 Date of Inspection: September 12, 2018  
 Revision No.: 0

Individually Sentenced Feature Report (ISFR)  
 Weld and Anomaly Location Sheet

## Weld Location



## Anomaly Location



## Anomaly Information

Log Dist. : 174030.92 ft    O'clock : 01:53    Event : deformation    Internal : not assigned    Depth : 0.396 in    ID-Reduction : 1.1 %    Length : 2.94 in    Width : 3.30 in  
 Seam Orient. : 10:55    to TDC : 18.10 in    APPROX. MAP : 22668 ft    Height : 0.00 ft

## **5 ATTACHMENTS**

### **5.1 Site Inspection Report/Survey Completion Report/Post Run Documentation**

ROSEN Project Manager Zachary Wilford submitted the Site Survey Report to Shell Pipeline Company, LP., on September 15, 2018, to the attention of Mr. Eric Schwartz. A copy of this report is attached hereafter.

### **5.2 Preliminary Inline Inspection Survey Report**

ROSEN Client Lead Elvin Padilla submitted the Preliminary Inline Inspection Survey Report to Shell Pipeline Company, LP. on October 12, 2018. A copy of this report is also attached hereafter.

### **5.3 Above Ground Marker Sheets**

The onsite marker location sheets are attached hereafter.

### **5.4 Modified Specifications**

The Modified Specifications document can be found attached hereafter.

### **5.5 ROSEN Personnel Qualification Statements**

The ROSEN Personnel Qualification Statements are attached hereafter.

### **5.6 Inspection Verification Results**

To date, inspection verification results have not been received.

### **5.7 Electronic Media**

The ROSOFT Client Software data for this line are included. Please refer to the ROSOFT Manual for information regarding installation of this data and operation of the ROSOFT Data Management Software.

# Site Survey Report

ROSEN USA Project Number 0-1000-13737

---

## Shell - 2018



### **36" Sugarland to Bayou Choctaw (Redstick Crude System) 36SUGBAY**

CDX Run 1  
Launch Date: 9/5/2018  
Launch Time: 8:43am  
Receive Date: 9/12/2018  
Receive Time: 6:28pm

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Client: Shell Pipeline  
 ROSEN Project No: 0-1000-13737  
 ROSEN Line Name: 36SUGBAY  
 Inspection Type: CDX  
 Inspection Date: 5-Sept-18



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## Site Survey Report

Field Technician: **Kola Ayodele** Project Manager: **Zachary Wilford**  
 Report prepared by: **Zach Wilford** Report submitted to: **Eric Schwartz**  
 Submission Date: **15-Sept-18**

Preliminary Survey Criteria	Standard Requirements	Inspection Findings	Acceptance
Distance [miles]	37.2	37.3	Yes
Launcher / Receiver	Launcher and Receiver Recorded	Launcher and Receiver Recorded	Yes
Max. Velocity [mph]	< 6.7	Max 1.7 Avg. 1.2	Yes
Tool Condition	No Damage or Heavy Wear	No Damage or Heavy Wear	Yes
Pipeline Debris	Light	None	Yes
Total Missing Data [ft]	< 16.4	0	Yes
AGM Coverage	TBD	TBD	TBD

Geometry Data Check	Standard Specifications	Inspection Findings	Acceptance
Sensor Coverage	>95%	100%	Yes

Metal Loss Data Check	Standard Specifications	Inspection Findings	Acceptance
Magnetization Level [kA/m]	10 - 30	Avg. 27.4	Yes
Sensor Loss [Adjacent Sensors]	<6	0	Yes
Sensor Coverage	>95%	100%	Yes

XYZ Data Check	Acceptance
Gyro Acceleration	N/A
Gyro Angular Velocity	N/A

### Additional Information

All preliminary data indicates a successful survey. Data set has been submitted to our data analysts where it will be processed for further review and prepared for preliminary and final reporting.

*The above information has been compiled to provide a preliminary assessment of data quantity/quality upon completion of the onsite process. This is performed at a level which allows for confident decision making related to survey acceptance and demobilization. This provided information pertains to acceptance or non-acceptance of the collected data for the next stage; Data Evaluation. Additional discussions and/or dealing with the above mentioned between ROSEN and the customer may be required to elaborate or clarify. This information is also not the final confirmation of tool condition and data quantity/quality. Those two items will be further assessed and finalized at the ROSEN USA facility. If required, additional information will be made available.*

# ROCOMBO INSPECTION SERVICE

## MFL-A/XT

Shell Pipeline Company, L.P.

36" Crude Oil Pipeline  
Sugarland to Bayou Choctaw (Redstick Crude System)

September 2018

<b>Preliminary Report Date</b>	October 12, 2018
<b>Revision Number</b>	0
<b>Project Number</b>	0-1000-13737
<b>Line Name</b>	36" SUG-BAY

**Client:** Shell Pipeline Company, L.P.  
**ROSEN Project No.:** 0-1000-13737  
**ROSEN Line Name:** 36" SUG-BAY  
**Inspection Type:** MFL-A/XT  
**Date of Inspection:** September 12, 2018  
**Revision No.:** 0

**ROSEN USA**  
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 USA

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[www.rosen-group.com](http://www.rosen-group.com)

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MFL-A/XT Prepared / Checked by:

*Elvin Padilla*  
 Elvin Padilla (Evaluation Lead)

Approved by:

*Zach Wilford*  
 Zachary Wilford (Project Manager)

0	10/12/2018	8	Prelim. Report	EP	EP	ZW
<b>Rev.</b>	<b>Date</b>	<b>Pages</b>	<b>Description</b>	<b>Prepared by</b>	<b>Checked by</b>	<b>Approved by</b>

Client: Shell Pipeline Company, L.P.  
ROSEN Project No.: 0-1000-13737  
ROSEN Line Name: 36" SUG-BAY  
Inspection Type: MFL-A/XT  
Date of Inspection: September 12, 2018  
Revision No.: 0

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3	PIPELINE INSPECTION PARAMETERS	4
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## 1 DATA RECORDED AND QUALITY

In September of 2018, one (1) in-line combined metal loss and geometry analysis (RoCombo MFL-A/XT) inspection survey was performed by ROSEN in the 36-inch crude oil pipeline segment Sugarland to Bayou Choctaw (Redstick Crude System).

The data recorded during the RoCombo MFL-A/XT inspection survey, performed on September 12, 2018, was accepted and will be used for evaluation purposes. During the RoCombo MFL-A/XT survey, all sensors were operational.

The tool velocity during the RoCombo MFL-A/XT inspection survey was mainly within the pre-agreed ranges. Generally, in areas where the velocity is out of range, the ROSEN standard accuracy might not be achieved. For further details, please refer to the enclosed 'MFL-A/XT – Tool Velocity' graph.

Over the complete line length of the RoCombo MFL-A/XT inspection survey, the magnetization level was mainly within the pre-agreed specification of 10 – 30 kA/m. For further details, please refer to the enclosed 'MFL-A/XT – Magnetization Level' graph.

A total of twenty-three (23) markers were set and nineteen (19) were successfully established during the RoCombo MFL-A/XT inspection survey. For further details, please refer to the enclosed 'Markers' list.

The total line length recorded by the RoCombo MFL-A/XT tool is 197218.17 ft. (37.35 mi.).

## 2 GENERAL LINE CONDITION STATEMENT

At this stage in the evaluation process, there are no metal loss anomalies > 70%, no metal loss anomalies with a PBurst < MOP \* 1.1, no topside dents detected with metal loss, and no top side dents > 6% to report as per the preliminary reporting thresholds requested by Shell Pipeline Company, LP.

Please note the final data analysis and anomaly calculations could result in minor deviations from this preliminary inline inspection survey report.

## 3 PIPELINE INSPECTION PARAMETERS

Shell Pipeline Company LP, via the Technical Questionnaire, has provided the following information:

Pipe Type	Not provided
Pipe Grade	X-52, X-60
Wall Thickness	0.312", 0.438", 0.500"
MAOP	335 PSI
Design Pressure	540, 759, 1000 PSI*

\*Note: Design pressures will be calculated in accordance with the ANSI/ASME B31.4 standard code.

Please confirm values for all fields provided. In addition, please provide any other information that may apply to the pipeline segment. These values will be used in completing the Inline Inspection Survey Report.

## 4 REMAINING PROCEDURES

Metal Loss evaluation procedures remaining:

- Anomaly validation for remaining suspect signals
- Application of Interaction and Anomaly Assessment Criteria
- Verification of Interaction and Anomaly Assessment Results

Basic evaluation procedures remaining:

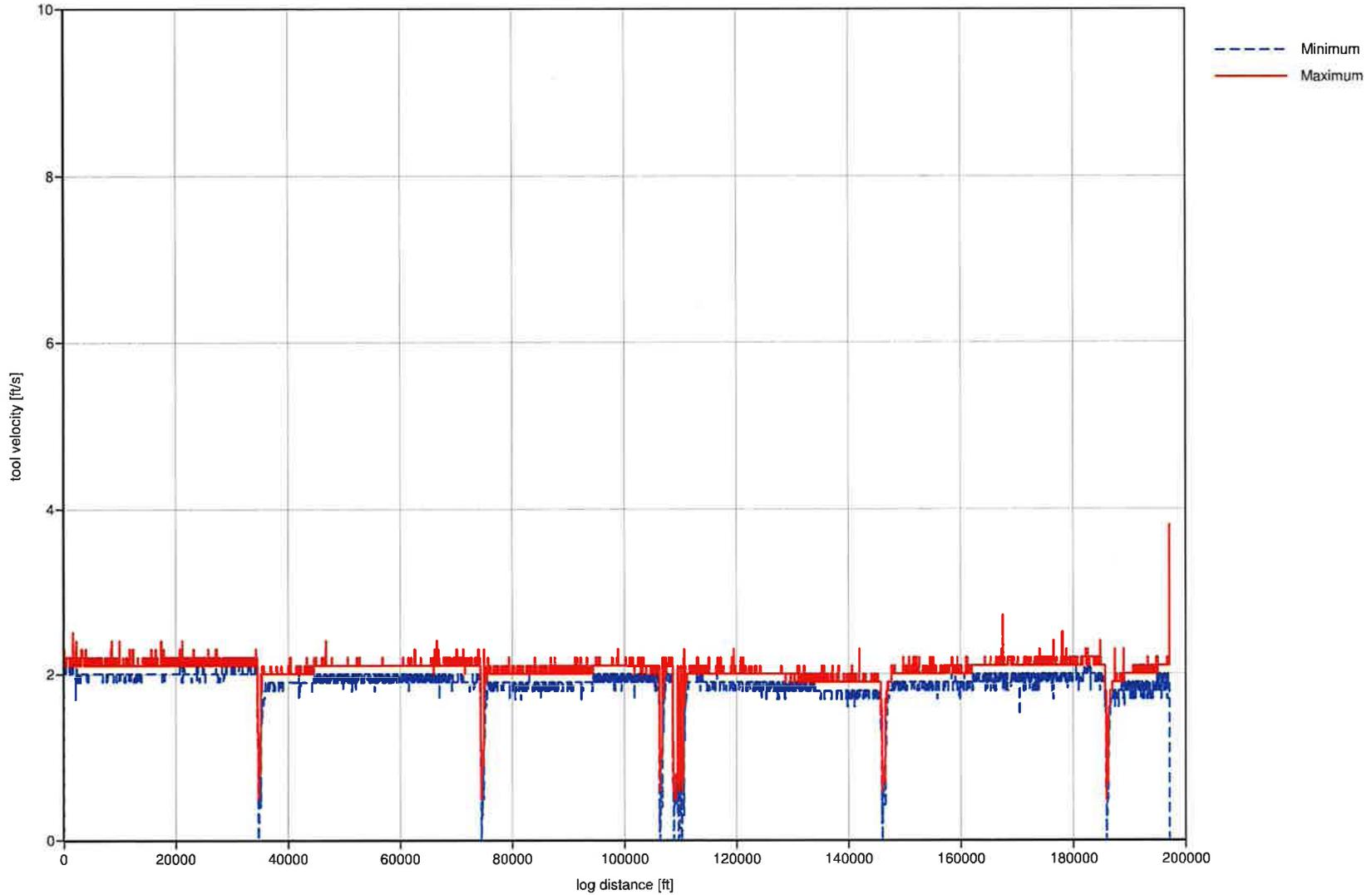
- Perform Final Calculation
- Verification of Results
- Generation of Rocombo MFL-A/XT Inline Inspection Survey Report/ROSOFT

## 5 ENCLOSURES

MFL-A/XT – Tool Velocity Graph (1 page)  
MFL-A/XT – Magnetization Level Graph (1 page)  
Markers List (1 page)

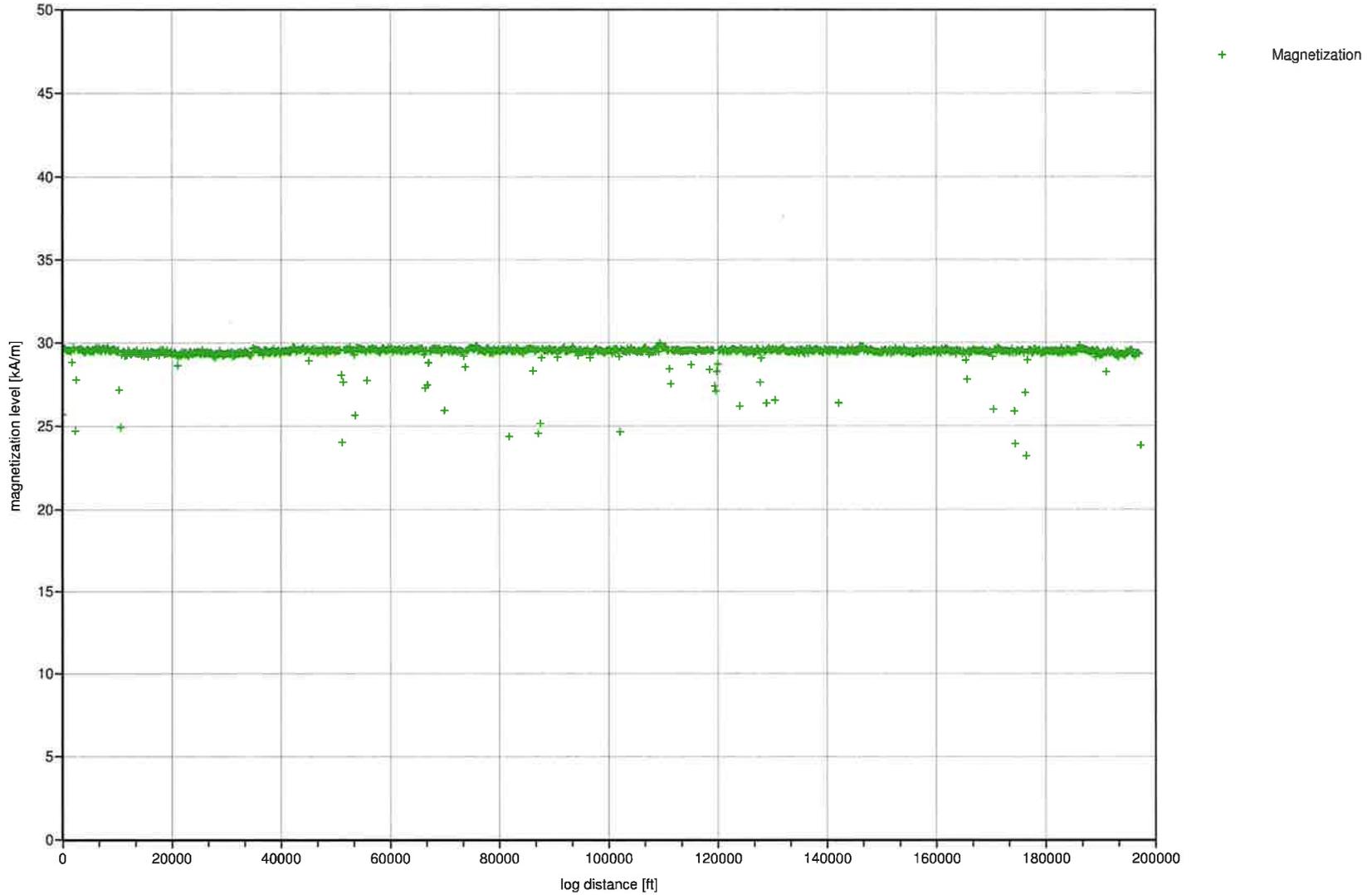
# 36" Sugarland to Bayou Choctaw

MFL-A/XT - Tool Velocity



# 36" Sugarland to Bayou Choctaw

MFL-A/XT - Magnetization Level



# Above Ground Marker Location Sheet

Tech Use	Dat Use
<input checked="" type="checkbox"/> HIT	<input type="checkbox"/> HIT
<input type="checkbox"/> MISS	<input type="checkbox"/> MISS



Launcher

EPD3       ITX       BM7       BM10

Pipeline Company: Shell  
 Pipeline Segment: 36SUGBAY  
 Marker Crew ID: Rosen  
 Marker Device #: 2241  
 GPS Passage time from benchmarker: 1:44:17  
 Passage Date from benchmarker(dd/mm/yy): 9/6/2018  
 Tool BR sync local time: 14:35:00      Date: 9/5/2018  
 Tool On local time: 15:55:00  
 Tool launch local time: 20:43:00  
 GPS Position of Marker  
 Longitude / W: 90°51'31.41"  
 Latitude / N: 30°00'28.19"

Filled out by Service Technician ONLY

ITX Null Point Passage Time: N/A

**1 Valve Underground MSL SELECT THE TYPE OF LAUNCHER!**

Magnet Clock Position	12 o'clock	All values in inches
Distance from Magnet to Center of Trap Valve	_____	<b>Blue = Optional</b>
Distance from BenchMarker to Center of Trap Valve	51 "	<b>Red = Required</b>

This section fills automatically from the red boxes below

Trap Door	Reducer Start	Nominal	Magnet	Trap Valve
---- 226 "	-----	-----  135 "	-----  313 "	-----

Trap Valve	BM
---- 51 "	-----

AGM Missed Reason: \_\_\_\_\_

Comments: \_\_\_\_\_

## 36" Redstick Pipeline Pig Run - september 9, 2018

Flow Rate:	8,000	Bbls/Hr						Barrels:	50,000	Bbls	39715	Ft	
	44,916.48	Cu Ft/Hr							280,728.00	Cu Ft	7.522	Miles	
Pipe Dia.:	36	Inches						Pipe Dia.:	36	Inches			
	37,322.09	Cu Ft/Mile							7.07	Sq Ft			
Est. Speed:	1.203	Miles/Hr		LAUNCH TIME:				9/5/18 8:45 PM		TOTAL P/L LENGTH: ####			
				ESTIMATED PIG SPEED(MPH):				1.203		ESTIMATED END TIME: ####			
AGM	Station	Distance (feet)	Dist. (miles)	Time To Next AGM (minutes)	Est. Time of Arrival	Calc. Pig Speed (MPH)	Calc. Time To Next AGM (minutes)	Calc. Time of Arrival	Actual Time To Next AGM (minutes)	Actual Time of Arrival	Box No. 1	Box No. 2	Hit/Miss
Launcher	0+00	0	0.000	65.51	8:45 PM	1.20	65.51	8:45:00 PM	#VALUE!	9/5/18 8:45pm	2241		Hit
AGM 1	1895+03.0	6,935.29	1.314	62.35	9:50 PM	-	-	-	-	9/5/18 9:39pm	1795		Hit
AGM 2	1832+73.0	6,600.97	1.250	49.58	10:52 PM	-	-	-	#VALUE!				
AGM 3	1776+54.0	5,248.60	0.994	24.49	11:42 PM	-	-	-	-	9/5/18 11:14pm		1806	Hit
AGM 4	1751+48.0	2,592.28	0.491	55.84	12:06 AM	-	-	-	-				
AGM 5	1691+85.0	5,911.03	1.120	64.40	1:02 AM	-	-	-	-				
AGM 6	1624+18.0	6,817.41	1.291	73.15	2:07 AM	-	-	-	-				
AGM 7	1545+89.0	7,743.76	1.467	57.78	3:20 AM	-	-	-	#VALUE!				
AGM 8	1489+35.0	6,116.58	1.158	51.21	4:18 AM	-	-	-	-	9/7/18 8:14pm	1806		Hit
AGM 9	1429+68.0	5,421.04	1.027	48.70	5:09 AM	-	-	-	-		2233		Hit
AGM 10	1378+93.0	5,155.20	0.976	62.57	5:58 AM	-	-	-	-		3327		Hit
AGM 11	1312+75.0	6,623.93	1.255	7.47	7:00 AM	-	-	-	-		3342		Hit
MLV BC-8	1304+65.0	791.31	0.150	7.77	7:08 AM	-	-	-	-				
MLV BC-7	1296+37.0	822.36	0.156	61.79	7:15 AM	-	-	-	-				
AGM 12	1231+06.0	6,541.20	1.239	77.63	8:17 AM	-	-	-	#VALUE!		1807	1930	
AGM 13	1149+97.0	8,218.39	1.557	54.01	9:35 AM	-	-	-	-	9/9/18 8:21am	3525		Hit
MLV BC-6	1091+38.0	5,718.00	1.083	39.73	10:29 AM	-	-	-	-				
AGM 14	1049+24.0	4,206.25	0.797	40.40	11:08 AM	-	-	-	-				
AGM 15	1006+40.0	4,276.38	0.810	53.00	11:49 AM	-	-	-	-				
MLV BC-5	950+15.0	5,610.60	1.063	29.18	12:42 PM	-	-	-	-				
AGM 15A	949+19.0	94.50	0.018	78.77	1:11 PM	-	-	-	#####		2245		Hit
AGM 16	888+32.0	6,183.27	1.171	78.77	1:11 PM	-	-	-	#####		1905		
AGM 17	857+29.0	3,089.20	0.585	78.77	1:11 PM	-	-	-	#####		1807		
AGM 18	773+64.0	8,339.27	1.579	39.99	2:30 PM	-	-	-	-	9/9/18 3:14 AM	3342		Hit
AGM 19	731+04.0	4,233.31	0.802	46.70	3:10 PM	-	-	-	-		1930		Hit
AGM 20	681+58.0	4,943.47	0.936	66.20	3:57 PM	-	-	-	-		2233		Hit
AGM 21	611+77.0	7,007.84	1.327	56.75	5:03 PM	-	-	-	-		3327		Hit
MLV BC-4	551+26.0	6,007.79	1.138	33.07	5:59 PM	-	-	-	-				
AGM 22	516+30.0	3,500.78	0.663	64.75	6:33 PM	-	-	-	-		1859	3324	
AGM 23	447+76.0	6,854.27	1.298	60.74	7:37 PM	-	-	-	-				
AGM 24	383+46.0	6,429.88	1.218	36.09	8:38 PM	-	-	-	-			1138	Hit
AGM 25	345+30.0	3,820.30	0.724	73.65	9:14 PM	-	-	-	-			1109	Hit
MLV BC-3	266+76.0	7,797.30	1.477	76.09	10:28 PM	-	-	-	-				
AGM 26	184+12.0	8,054.94	1.526	57.42	11:44 PM	-	-	-	-		1905		Hit
AGM 27	123+53.0	6,078.36	1.151	40.54	12:41 AM	-	-	-	-			2245	Hit
AGM 28	80+57.0	4,291.80	0.813	61.43	1:22 AM	-	-	-	-				
AGM 29	15+21.0	6,503.74	1.232	14.13	2:23 AM	-	-	-	-			3342	Hit
Receiver	00+52.0	1,495.50	0.283		2:37 AM	-	-	-	-			2241	Hit

## Above Ground Marker Location Sheet

Tech Use	Dat Use
<input checked="" type="checkbox"/> HIT	<input type="checkbox"/> HIT
<input type="checkbox"/> MISS	<input type="checkbox"/> MISS



Receiver

EPD3       ITX       BM7       BM10

Pipeline Company: Shell  
 Pipeline Segment: 36SUGBAY  
 Marker Crew ID: Rosen  
 Marker Device #: 2241  
 GPS Passage time from benchmarker: 23:27:52  
 Passage Date from benchmarker(dd/mm/yy): 9/12/2018  
 Tool receive local time: 18:28  
 Tool off local time: 10:29  
 Tool AR sync local time: 11:09      Date: 9/13/2018  
GPS Position of Marker  
 Longitude / W: 91°18'19.85"  
 Latitude / N: 30°18'59.81"

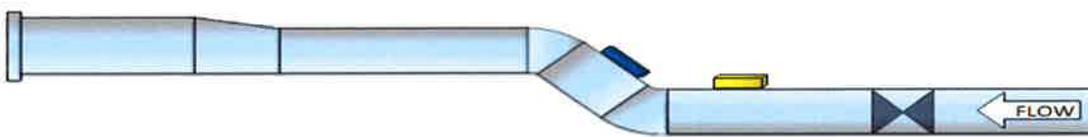
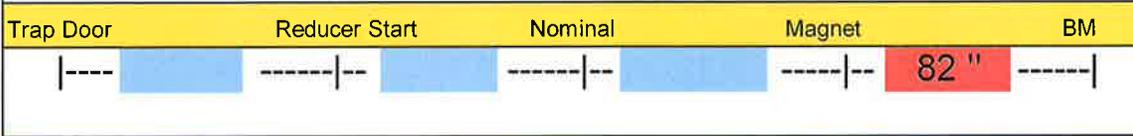
Filled out by Service Technician ONLY

ITX Null Point Passage Time: N/A

1 Valve Underground SELECT THE TYPE OF RECEIVER!

Magnet Clock Position	<u>12 o'clock</u>	All values in inches
Distance from Magnet to Center of Trap Valve	<u>305 "</u>	<b>Blue = Optional</b>
Distance from BenchMarker to Center of Trap Valve	<u>223 "</u>	<b>Red = Required</b>

This section fills automatically from the red boxes below



AGM Missed Reason: \_\_\_\_\_

Comments: \_\_\_\_\_

**ROCORN MFL-A**  
**IN-LINE HIGH RESOLUTION METAL LOSS**  
**DETECTION AND SIZING WITH AXIAL**  
**MAGNETIC FLUX LEAKAGE TECHNOLOGY**

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# 1 INTRODUCTION

This document defines the ROSEN accuracy specifications for the Axial Magnetic Flux Leakage in-line inspection service, RoCorr MFL-A. The scope of this technology is to detect circumferential oriented, volumetric wall loss anomalies, like general metal loss, pitting, axial and circumferential grooving, and circumferential slotting anomalies.

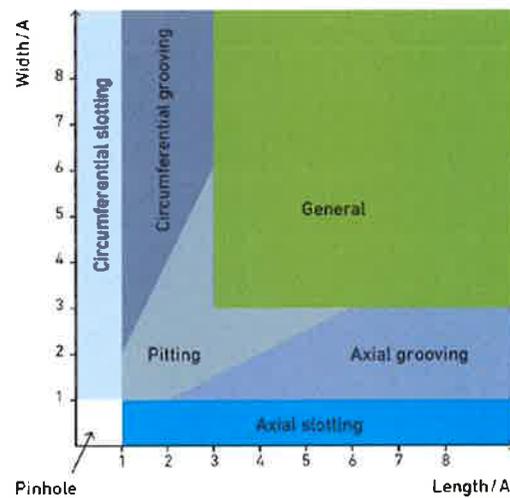
It follows well established definitions applicable specifically to pipeline inspection, mainly found in "Specifications and Requirements for Intelligent Pig Inspection of Pipelines" formulated by the Pipeline Operators Forum (POF) and "Qualification of Performance Specifications" by the American Petroleum Institute Standard (API Standard 1163).

Further information about a particular in-line inspection tool can be provided as part of a particular inspection. This information will be compliant with POF and API requirements and will be derived from the specific pull-test certificate and the individual tool data sheet.

## 2 ANOMLY DIMENSION CLASSES

Magnetic Flux Leakage (MFL) is an indirect method. It uses and is being affected by more than one physical property. The influence of the defect shape on the sizing accuracy is parameterized by dimension classes, which depend on the length and width of the anomaly.

All reported metal loss anomalies are being classified according to these dimension classes as per the following POF specification graphic.



**Note** A = wall thickness or 10 mm (0.39"), whichever value is greater

### 3 DETECTION AND SIZING CAPABILITIES

#### 3.1 Detection and Sizing Accuracy for Anomalies in Body of Pipe

	General metal loss	Pitting	Axial grooving	Circumf. grooving	Circumf. slotting*
Depth at POD = 90%	0.10t	0.10t	0.10t	0.10t	0.15t
Depth sizing accuracy at 80% certainty	±0.10t	±0.10t	±0.15t	±0.10t	±0.10t
Width sizing accuracy at 80% certainty	±15 mm (±0.59")	±12 mm (±0.47")	±12 mm (±0.47")	±12 mm (±0.47")	±15 mm (±0.59")
Length sizing accuracy at 80% certainty	±15 mm (±0.59")	±10 mm (±0.39")	±10 mm (±0.39")	±10 mm (±0.39")	±10 mm (±0.39")
Depth sizing accuracy at 90% certainty	±0.13t	±0.13t	±0.20t	±0.13t	±0.13t
Width sizing accuracy at 90% certainty	±19 mm (±0.75")	±15 mm (±0.59")	±15 mm (±0.59")	±15 mm (±0.59")	±19 mm (±0.75")
Length sizing accuracy at 90% certainty	±19 mm (±0.75")	±13 mm (±0.51")	±13 mm (±0.51")	±13 mm (±0.51")	±13 mm (±0.51")

\* Min(L,W) ≥ ½A

#### 3.2 Detection and Sizing Accuracy for Anomalies in Girth Weld or Heat Affected Zone

Within ± 2A of the weld (A = Max (wt, 10 mm / 0.39")) detection and sizing are affected by the weld. The extent of this effect depends on weld quality and the weld impact on the tool dynamics. During passage of the magnetic yoke over a weld sizing accuracy might be affected slightly.

	General metal loss	Pitting	Axial grooving	Circumf. grooving	Circumf. slotting*
Depth at POD = 90%	0.10t	0.15t	0.15t	0.15t	0.15t
Depth sizing accuracy at 80% certainty	±0.15t	±0.15t	±0.15t	±0.15t	±0.15t
Width sizing accuracy at 80% certainty	±25 mm (±0.98")	±22 mm (±0.87")	±22 mm (±0.87")	±22 mm (±0.87")	±25 mm (±0.98")
Length sizing accuracy at 80% certainty	±25 mm (±0.98")	±20 mm (±0.79")	±20 mm (±0.79")	±20 mm (±0.79")	±20 mm (±0.79")

\* Min(L,W) ≥ ½A

### 3.3 Detection and Sizing Accuracy for linear (crack-like) Anomalies

	Circumferential slotting
Depth at POD = 90% of crack with $W \geq 25$ mm (0.98") [W = circumferential extension of the crack]*	0.25t
Minimal volumetric crack opening	1 mm (0.04")
Depth sizing accuracy at 80% certainty	$\pm 0.25t$
Width sizing accuracy at 80% certainty	$\pm 20$ mm ( $\pm 0.79$ " )

\* Provided that the S/N ratio of the MFL amplitude is  $\geq 5$

### 3.4 Wall Thickness Measurement

$\pm 1$  mm ( $\pm 0.04$ " ) or  $\pm 0.10t$ , whichever value is greater at 80% certainty.

## 4 LOCATION AND ORIENTATION CAPABILITIES

Axial position accuracy from reference marker	1:1000 (1 m on 1000 m marker distance) (1 ft. on 1000 ft. marker distance)
Axial position from closest weld	$\pm 0.1$ m ( $\pm 4$ " )
Accuracy of circumferential position	$\pm 5^\circ$
Accuracy of distance to upstream girth weld	$\pm 0.2$ m ( $\pm 8$ " )
Accuracy of distance from trap valve	1% of line length

The axial positioning accuracy specified is given at 90% certainty and is based on following conditions:

- Distance between u/s and d/s marker/reference point < 2000 m (6500 ft.).
- Actual above ground distance to both u/s and d/s marker/reference points to be measured and correlated.
- Negligible difference between pipeline and soil contour.

## 5 DEFINITIONS, REQUIREMENTS AND NOTES

### 5.1 Anomaly Detection and Sizing Capabilities

The given accuracy values were derived from statistical analysis of sizing results originated by straightforward standard procedures. The sizing results were compared with a large number of known anomaly events.

#### Definitions

- Specifications are only valid for longitudinally welded pipes.
- Parameter  $t$  is defined as follows:
  - Wall thickness  $\geq 5$  mm (0.2"):  $t$  = wall thickness
  - Wall thickness  $< 5$  mm (0.2"):  $t$  = 5 mm (0.2")
- The depth sizing and the wall thickness evaluation are independent, i.e. the percentage depth is based on the actual wall and not on the calculated.
- The accuracy relevant dimension classification is derived from the shape of the most significant contributing part of a defect, e.g. a deep pit embedded in shallow general corrosion.
- Maximum axial sampling interval: 2.5 mm (0.1")
- Maximum circumferential primary sensor spacing (circumferential center to center distance): 5.9 mm (0.2")
- Maximum circumferential secondary sensor spacing (circumferential center to center distance): 10.9 mm (0.4")

#### Requirements

- Data is recorded within the parameters as specified in the respective Tool Data Sheet.
- The required minimum magnetization for tabled specifications is 10 kA/m.
- The according valid pipe wall material is grade API 5L grade B up to API 5L grade X65 or equivalent grades.
- These specifications are valid generally where no more data were missing than:
  - Primary survey channel loss  $\leq 5\%$
  - Primary adjacent survey channel gap  $< 60$  mm (2.4")
  - In case of more data loss the data quality must be approved by procedure.
- The proper inspection tool velocity is normally between 0.1 m/s (0.33 ft./s) and 3 m/s (9.8 ft./s) but might be restricted by well known MFL methodological conditions<sup>1+2</sup>. In some cases specifications for non standard inspection tools vary.

#### Notes

- Specifications given above are valid where:
  - both yokes and sensors were located in the same straight pipe body and the magnetic field not affected by installations neither internal nor external
  - pipes have smooth surface
  - pipes are sufficiently clean, i.e. MFL sensors have contact with pipe wall, the odometer wheels were not blocked and the spring-supported magnet yokes are not hindered in their movement
- Above 3 m/s (9.8 ft./s) mechanical influences caused by e.g. weld roots, pipe roughness and dirt might affect the accuracy.
- Anomalies shallower than the specified detection threshold or smaller than the specified dimension classes will be reported as analyzed.
- The accuracy will not be kept in areas where tool acceleration exceeds 3 m/s<sup>2</sup> (9.8 ft./s<sup>2</sup>).

1 R.J. Davis J.B. Nestleroth. The effects of velocity on magnetic flux leakage inspection of gas pipelines. GRI Topical Report GRI-95/0008, Gas Research Institute, June 1996

2 Dieter Meinert. Motivation for a speed limitation on an MFL tool. Internal report, RTRC Germany, October 2002.

## 5.2 Anomalies in longitudinal welded pipe

In general the detection and sizing accuracy for anomalies in the long seam area or the heat affected zone is the same as in the pipe body, provided the noise level is not excessive.

## 5.3 Anomalies in spiral welded pipe

The detection and sizing accuracy for anomalies in spiral weld area and the heat affected zone is the same as stated in 4.2 Detection and Sizing Accuracy for Girth Weld or Heat Affected Zone.

## 5.4 Anomalies in seamless pipe

In general the detection and sizing accuracy for anomalies in seamless pipe depends on the actual noise level of the pipe material concerned. For low noise seamless pipe the specification for longitudinal welded pipe is valid, for higher noise levels the influence on specified values might be significant.

- The detection threshold and sizing accuracy will be as stated above plus typically 0 ... 0.10t.
- Length and width sizing accuracy as stated above plus typically 0 ... 10 mm (0.39").

# 6 IDENTIFICATION OF ANOMALIES

Probability of Identification

Anomaly	Yes POI > 90%	No POI < 50%	May be 50% ≤ POI ≤ 90%
Internal/non-internal1	X		
Ext./midwall discrimination		X	
Additional metal/material	Debris, magnetic	X	
	debris, non-magnetic		X
	touching metal to metal	X	
Anode Anomaly			X
	arc strike		X
	artificial defect	X	
	blister	X	
	buckle global		
	buckle local		
	buckle propagation		
	corrosion	X	
	corrosion cluster	X	
	corrosion related to CRA		
	circumferential crack		
	axial crack		X
	axial cluster		
	dent2	X	
	dent kinked		
dent plain			
dent smooth			
dent with metal loss2	X		

Anomaly		Yes POI > 90%	No POI < 50%	May be 50% ≤ POI ≤ 90%
	gouge			X
	gouge cluster			X
	grinding			X
	girth weld crack			X
	girth weld anomaly	X		
	lamination			X
	longitudinal weld crack		X	
	longitudinal weld anomaly			X
	mill anomaly - grinding			X
	mill anomaly lamination			X
	mill anomaly lap			X
	mill anomaly non-metallic inclusion			X
	mill anomaly cluster	X		
	ovality	X		
	pipe mill anomaly	X		
	ripple/wrinkle	X		
	SCC		X	
	spalling	X		
	spiral weld crack			X
	spiral weld anomaly	X		
	<b>Eccentric pipeline casing</b>	X		
	<b>Change in wall thickness</b>	X		
	<b>CP connection/anode</b>	X		
	<b>External support</b>	X		
	<b>Ground anchor</b>	X		
	<b>Off take</b>	X		
	<b>Pipeline fixture</b>	X		
	<b>Reference magnet</b>	X		
	<b>Repair</b>			
	welded sleeve begin/end	X		
	composite sleeve begin/end		X	
	weld deposit begin/end	X		
	coating begin/end		X	
	crack arrestor begin/end		X	
	<b>Tee</b>	X		
	<b>Valve</b>	X		
	<b>Weld</b>			
	bend	X		
	diameter change	X		
	wall thickness change (pipe/pipe connection)	X		
	adjacent tapering	X		
	longitudinal weld			X
	spiral weld	X		

Anomaly	Yes POI > 90%	No POI < 50%	May be 50% ≤ POI ≤ 90%
not identifiable seam			X
seamless	X		

<sup>1</sup> The internal/non internal discrimination may be reduced for anomalies smaller than 20 mm (0.79") extent (width) and 20% depth.

<sup>2</sup> POI greater 90% reached in combination with geometry inspection.

## 7 ABBREVIATIONS

<b>A</b>	Wall Thickness or 10 mm (0.39"), whichever value is greater
<b>API</b>	American Petroleum Institute
<b>CP</b>	Cathodic Protection
<b>CRA</b>	Corrosion Resistant Alloy
<b>HIC</b>	Hydrogen Induced Cracking
<b>ID</b>	Internal Diameter
<b>L</b>	Length
<b>MFL</b>	Magnetic Flux Leakage
<b>MFL-A</b>	Axial Magnetic Flux Leakage
<b>POD</b>	Probability of Detection
<b>POF</b>	Pipeline Operators Forum
<b>POI</b>	Probability of Identification
<b>RoCorr MFL-A</b>	Axial Magnetic Flux Leakage Metal Loss ILI Tool
<b>SCC</b>	Stress Corrosion Cracking
<b>t</b>	Wall Thickness
<b>W</b>	Width
<b>wt</b>	Wall Thickness

# **ROGEO XT** **IN-LINE HIGH RESOLUTION GEOMETRY AND** **DENT ANALYSIS**

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# 1 INTRODUCTION

This document defines the ROSEN accuracy specifications for in-line inspection (ILI) activities performed with the ROSEN Extended Geometry Tool (RoGeo XT). This specification follows well established definitions applicable specifically to pipeline inspection, mainly found in "Specifications and Requirements for Intelligent Pig Inspection of Pipelines" formulated by the Pipeline Operators Forum (POF) and "Qualification of Performance Specifications" by the American Petroleum Institute Standard (API Standard 1163).

Further information about a particular in-line inspection tool can be provided as part of a particular inspection project. This information will be compliant with POF and API requirements and will be derived from the specific pull-test certificate and the individual tool data sheet.

# 2 DETECTION AND SIZING CAPABILITIES

## 2.1 OD-Changes, Ovalities and Dents

Internal diameter changes, ovalities and dents will be detected, localized and identified. In case of detecting dents, the information will be given in depth [%] of pipeline OD<sup>2</sup>. Information on accuracies is given in the table below.

Feature	OD [inch]	Accuracy <sup>1</sup>	Detection threshold	
<b>OD<sup>2</sup> changes</b>		0.8 mm (0.03")	0.8 mm (0.03")	
<b>Ovalities<sup>3</sup></b>	Ovality	0.5 %	0.5 %	
	Length	15.0 mm (0.59")		
	Orientation	12°		
<b>Dents<sup>4</sup></b>	Depth	<10"	±0.5 %	1.0%
		10"-16"	±0.5 %	0.8%
		18"-28"	±0.3 %	0.5%
		30"-38"	±0.2 %	0.3%
		40"-48"	±0.15 %	0.2%
	Length	±7.6 mm (±0.30")		
Width	±25.4 mm (±1.00")			
Orientation	12°			
<b>Roof topping</b>	Depth	±0.8 mm (±0.03")	0.8 mm (0.03")	
<b>Pipe Expansions</b>	Depth	±1.5 mm (±0.06")	1.5 mm (0.06")	

<sup>1</sup> Values are given for a certainty level of 80 %

<sup>2</sup> Or ID, respectively

<sup>3</sup> According to POF

<sup>4</sup> Including wrinkles and buckles

## 2.2 Bends

Component	Detection Threshold	Accuracy <sup>1</sup>
Bend radius	Up to 30 D	±15 %
Bend orientation		±10°
Bend angle		±5°

<sup>1</sup> Values are given for a certainty level of 80 %

## 2.3 XYZ Mapping

Every RoGeo XT tool can be equipped with an XYZ Mapping system to generate three-dimensional geographical pipeline coordinates. For further information please refer to the XYZ HiRes Mapping specifications.

## 3 LOCATION AND ORIENTATION CAPABILITIES

Axial position accuracy from reference marker	1:1000 (1 m on 1000 m marker distance) (1 ft. on 1000 ft. marker distance)
Axial position from closest weld	±0.1 m (±4")
Accuracy of circumferential position	±5°
Accuracy of distance to upstream girth weld	±0.2 m (±8")
Accuracy of distance from trap valve	1% of line length

The axial positioning accuracy specified is given at 90% certainty and is based on following conditions:

- Distance between u/s and d/s marker/reference point < 2000 m (6560 ft.).
- Actual above ground distance to both u/s and d/s marker/reference points to be measured and correlated.
- Negligible difference between pipeline and soil contour.

## 4 SYSTEM CAPABILITIES

Sampling	a) Axial sampling	2.5 mm (0.10")
	b) Circumferential sampling	15.0 mm (0.59")
Circumferential coverage		100 %
Probability of detection		95 %

# 5

## IDENTIFICATION OF ANOMALIES

Probability of Identification (POI) in accordance with geometry ILI tools.

Anomaly		Yes POI > 90%	No POI < 50%	May be 50% ≤ POI ≤ 90%
<b>Int./ext./mid wall discrimination</b>			X	
<b>Additional metal/material</b>	Debris, magnetic	X		
	debris, non-magnetic	X		
	touching metal to metal		X	
<b>Anode</b>			X	
<b>Anomaly</b>	arc strike <sup>1</sup>	(X)		X
	artificial defect <sup>2</sup>	X		
	blister		X	
	buckle global	X		
	buckle local	X		
	buckle propagation	X		
	corrosion		X	
	corrosion cluster		X	
	corrosion related to CRA		X	
	circumferential crack		X	
	axial crack		X	
	axial cluster		X	
	dent kinked	X		
	dent plain	X		
	dent smooth	X		
	gouge <sup>1</sup>	(X)		X
	gouge cluster <sup>1</sup>	(X)		X
	grinding <sup>1</sup>	(X)		X
	girth weld crack		X	
	girth weld anomaly		X	
	longitudinal weld crack		X	
	longitudinal weld anomaly		X	
	mill anomaly - grinding		X	
	mill anomaly lamination		X	
	mill anomaly lap		X	
	mill anomaly non-metallic inclusion		X	
	mill anomaly cluster		X	
	ovality	X		
	ripple/wrinkle	X		
	SCC		X	
	spalling		X	
	spiral weld crack		X	
	spiral weld anomaly		X	
<b>Eccentric pipeline casing</b>			X	
<b>Change in wall thickness</b>		X		
<b>CP connection/anode</b>			X	
<b>External support</b>			X	
<b>Ground anchor</b>			X	
<b>Off take</b>		X		

Anomaly		Yes POI > 90%	No POI < 50%	May be 50% ≤ POI ≤ 90%
Pipeline fixture			X	
Reference magnet			X	
Repair	welded sleeve begin/end		X	
	composite sleeve begin/end		X	
	weld deposit begin/end		X	
	coating begin/end		X	
	crack arrestor begin/end		X	
Tee		X		
Valve		X		
Weld	bend	X		
	diameter change	X		
	wall thickness change (pipe/pipe connection)	X		
	adjacent tapering	X		
	longitudinal weld			X
	spiral weld	X		
	seamless			X

<sup>1</sup>POI greater than 90 % reached in combination with an ID anomaly

<sup>2</sup>If internal (and greater than 25 mm (1.0") diameter)

## 6

### NOTES CONCERNING PERFORMANCE SPECIFICATIONS

The specifications provided for RoGeo XT are applicable where run conditions, tool velocity, pipe grade, pipe cleanliness, sensor operation and data recorded are within the established parameters for the specific RoGeo XT used. These parameters are provided in the Tool Specification Sheet included in each Inspection Survey Report. Variations from the established parameters may result in reduced data quality or modification of the performance specifications.

## 7 ABBREVIATIONS

d/s	Downstream
ID	Internal Diameter
ILI	In-Line Inspection
OD	Outer Diameter
RoGeo XT	ROSEN Extended Geometry Tool
Tie-Point	Used reference/marker point with XYZ coordinates
u/s	Upstream
wt	Wall Thickness
XYZ	Easting, northing, height, latitude, longitude, height coordinates

# Personnel Qualification Statement

## PERSONAL DATA

Name	Kolawole Ayodele
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## PROFESSIONAL DATA

Position	Field Operations
Company	ROSEN USA, Inc.
Employment since	14-May-2012

## Qualifications

Name	<b>Geometry Tool Operator L2</b>	
Date of Initial Certification	11-Nov-13	(4032-6)
Date of Certification	18-Nov-16	(4032-10)
Date of Expiration	30-Nov-19	

Name	<b>Axial MFL Tool Operator L2</b>	
Date of Initial Certification	11-Nov-13	(4032-7)
Date of Certification	18-Nov-16	(4032-11)
Date of Expiration	30-Nov-19	

Name	<b>Transverse MFL Tool Operator L2</b>	
Date of Initial Certification	11-Nov-13	(4032-8)
Date of Certification	18-Nov-16	(4032-12)
Date of Expiration	30-Nov-19	

Name	<b>Mapping Tool Operator L2</b>	
Date of Initial Certification	11-Nov-13	(4032-9)
Date of Certification	18-Nov-16	(4032-13)
Date of Expiration	30-Nov-19	

## STATEMENT

This statement confirms that the training, examination and certification were completed in accordance to ASNT ILI PQ-2017 and API 1163.

# Personnel Qualification Statement

## PERSONAL DATA

Name	Elvin Padilla Viguera
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## PROFESSIONAL DATA

Position	Data Analyst Evaluation Office
Company	ROSEN USA, Inc.
Employment since	09-Jul-2007

## Qualifications

Name	<b>Geometry Data Analyst L2</b>	
Date of Certification	04-May-17	(2149-12)
Date of Expiration	31-May-20	

Name	<b>Axial MFL (CDP) Data Analyst L2</b>	
Date of Initial Certification	01-Feb-11	(2149-7)
Date of Certification	20-Apr-18	(2149-15)
Date of Expiration	30-Apr-21	

## STATEMENT

This statement confirms that the training, examination and certification were completed in accordance to ASNT ILI PQ-2017 and API 1163.

# Personnel Qualification Statement

## PERSONAL DATA

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Name Arthur Prayther

## PROFESSIONAL DATA

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Position Coordinator Evaluation

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Company ROSEN USA, Inc.

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Employment since 07-Sep-2002

## Qualifications

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Name **Axial MFL (CDP) Data Analyst L3**

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Date of Initial Certification 01-Mar-06 (200083-3)

---

Date of Certification 22-Mar-17 (200083-9)

---

Date of Expiration 30-May-20

---

Name **Geometry Data Analyst L3**

---

Date of Initial Certification 01-Mar-06 (200083-1)

---

Date of Certification 19-May-17 (200083-8)

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Date of Expiration 31-May-20

## STATEMENT

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This statement confirms that the training, examination and certification where completed in accordance to ASNT ILI PQ-2017 and API 1163.

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# Personnel Qualification Statement

## PERSONAL DATA

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Name	Zachary Wilford
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## PROFESSIONAL DATA

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Position	ROSEN Project Manager
Company	ROSEN USA, Inc.
Employment since	23-Feb-2015

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## STATEMENT

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This statement confirms that the training, examination and certification were completed in accordance to ASNT ILI PQ-2017 and API 1163.

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