Line 5 Straits of Mackinac (East Leg)
Enbridge Energy Limited Partnership
20 inch Crude Oil Pipeline

Executive Summary

A full survey of the Enbridge Energy Limited Partnership Line 5 Straits of Mackinac (East Leg) pipeline was successfully completed by GE Oil & Gas, PII Pipeline Solutions on the 9th of May 2008.

A total of 139 metal loss features have been detected on the inspection survey of which the deepest was 35%. These are distributed throughout the pipeline. Approximately 10% of the total number of spools have metal loss reported within them.

These heve the appearance of mill/manufacturing faults.

A CaliPPer inspection of the pipeline was completed by GE Oil & Gas, PII Pipeline Solutions on the 9th of May of 2008. The Calipper survey information is included in this report and details of the dents identified in both inspection surveys can be found in the dent report section.

Note: The girth welds for this inspection have been matched to the previous survey performed in March of 2003 under contract number 101211_20H. Girth welds approved by Collin Taylor on the 9th of July 2008.

Analyst	Certification Level	Date Certified
Anna-Marie Lutz	L1	March 2008
Angeles Martinez	L2	September 2007
Jason Fisk	L2	April 2008

We should hereby like to express our appreciation for the assistance and co-operation which we received from Enbridge Energy Limited Partnership in the course of this project.

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Martha Vega-Smith	Company Representative	Enbridge Energy Limited Partnership	1
Central File		GE Oil & Gas, PII Pipeline Solutions	1

ENBDNR0000743

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ENBDNR0000744

Inspection Summary

This section presents a summary of inspection operation 109170_20B which was conducted for Enbridge Energy Limited Partnership in the Line 5 Straits of Mackinac (East Leg), 20 inch nominal diameter, 4.133 miles, Crude Oil pipeline.

The pipeline was inspected by the GE Oil & Gas, PII Pipeline Solutions magnetic inspection vehicle on the 9th of May of 2008.

This was a reinspection of the pipeline with a previous inspection having been carried out by GE Oil & Gas, PII Pipeline Solutions on the 24th of March 2003.

1.1. Metal Loss

A total of 139 metal loss features have been detected on the inspection survey of which the deepest was 35%. These are distributed throughout the pipeline. Approximately 10% of the total number of spools have metal loss reported within them.

These have the appearance of mill/manufacturing faults.

Mill/manufacturing faults will have been present in the pipeline since it was commissioned. It can be difficult to achieve the normal sizing accuracy for mill/manufacturing faults depending on whether these metal loss features are the result of hot working or cold working of the pipe steel. Consequently, it should be noted that the sizing accuracy specified for corrosion in the Inspection System Performance Specification (Appendix G) contained in the contract may not be applicable to mill/manufacturing faults.

Detailed inspection sheets for 15 of these metal loss features are provided in Section 2. Summaries of all the metal loss features are presented in Section 3.1.

1.2. Pipeline Anomalies

The following is a summary of any pipeline anomalies which have been detected on the inspection survey:

ferrous metal objects:	0
eccentric pipeline casings:	0
dents:	13
girth weld anomalies:	0
shell repairs:	0
patch repaired spools:	0

More information on pipeline anomalies is given in the anomaly reports presented in Sections 3.2.2 to 3.2.6.

1.3. Inspection Quality

Inspection data was obtained for the full length (4.133 miles) of the pipeline.

The quality of the inspection data is satisfactory and this has enabled a comprehensive assessment of the pipeline to be carried out.

The following is a summary of any pipeline anomalies, which have been detected on the inspection survey:

PIPELINE ANOMALIES	DATA FROM 2003	DATA FROM 2008	COMMENT
External Metal Loss	0	0	No change from previous inspection.
Internal Metal Loss	0	0	No change from previous inspection.
External Manufacturing Faults	78	78	No change from previous inspection.
Internal Manufacturing Faults	61	61	No change from previous inspection.
Ferrous Metal Objects	0	0	No change from previous inspection.
Eccentric Pipeline Casings	0	0	No change from previous inspection.
Dents	13	13	No change from previous inspection.
Girth Weld Anomalies	0	0	No change from previous inspection.
Shell Repairs	0	0	No change from previous inspection.
Patch Repaired Spools	0	0	No change from previous inspection.

More information on pipeline anomalies is given in the anomaly reports presented in Sections 3.2.2 to 3.2.6.

Metal Loss Feature Report

The Metal Loss Feature Report provides detailed inspection sheets for selected metal loss features.

The metal loss features are selected for detailed analysis and reporting according to the selection rules given in the Specification for the Pipeline Inspection Report (Appendix F).

Those metal loss features that are reported on inspection sheets have predicted axial lengths, predicted peak depths and location details to the accuracy described in the Inspection System Performance Specification (Appendix G).

The Rupture Pressure Ratio (RPR) is calculated using the formula given in the "Reporting" section of the contract (Appendix F).

2.1. Summary Tables

This section provides a summary of the metal loss features reported on the inspection sheets.

Tables summarising the inspection sheets are provided in the following sub-sections:

2.1.1. Summary of Inspection Sheets in Distance Order

This table presents a summary of the inspection sheets with the metal loss features sorted in order of their absolute distance from the launch.

2.1.2. Summary of Inspection Sheets in Feature Selection Order

This table presents a summary of the inspection sheets with the metal loss features sorted in order of their selection rule.

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2.1.1 Summary of Inspection Sheets in Distance Order

Insp. Sheet Number	Absolute Distance (feet)	Ext. or Int.	Predicted Dimensions				Pressure Ratio (RPR)	Feature Selection Rule
			Axial (in)	Circ. (in)	Depth % WT			
					Ave.	Peak		
1	1759.068	Ext	0.5	0.9	34	34	MFG	8
2	2228.914	Ext	0.6	0.6	30	30	MFG	8
3	2608.228	Ext	0.7	0.7	33	33	MFG	8
4	5571.040	Ext	5.0	6.0	15	34	MFG	8
5	6041.972	Ext	0.8	1.0	29	29	MFG	8
6	9917.566	Ext	1.0	4.8	28	29	MFG	8
7	11144.669	Ext	2.2	2.0	20	30	MFG	8
8	13595.525	Ext	2.0	1.0	25	32	MFG	8
9	15888.143	Int	0.9	5.1	25	30	MFG	8
10	16237.041	Ext	9.6	4.1	16	34	MFG	8
11	17060.794	Int	2.3	6.6	20	28	MFG	8
12	18269.485	Ext	0.6	1.0	30	30	MFG	8
13	19503.576	Ext	2.5	3.8	25	30	MFG	8
14	20356.745	Ext	12.8	7.3	16	31	MFG	8
15	21280.515	Ext	7.8	5.7	19	35	MFG	8

2.1.2 Summary of Inspection Sheets in Feature Selection Order

Insp. Sheet Number	Absolute Distance (feet)	Ext. or Int.	Predicted Dimensions				Pressure Ratio (RPR)	Feature Selection Rule
			Axial (in)	Circ. (in)	Depth % WT			
					Ave.	Peak		
15	21280.515	Ext	7.8	5.7	19	35	MFG	8
1	1759.068	Ext	0.5	0.9	34	34	MFG	8
4	5571.040	Ext	5.0	6.0	15	34	MFG	8
10	16237.041	Ext	9.6	4.1	16	34	MFG	8
3	2608.228	Ext	0.7	0.7	33	33	MFG	8
8	13595.525	Ext	2.0	1.0	25	32	MFG	8
14	20356.745	Ext	12.8	7.3	16	31	MFG	8
2	2228.914	Ext	0.6	0.6	30	30	MFG	8
7	11144.669	Ext	2.2	2.0	20	30	MFG	8
9	15888.143	Int	0.9	5.1	25	30	MFG	8
12	18269.485	Ext	0.6	1.0	30	30	MFG	8
13	19503.576	Ext	2.5	3.8	25	30	MFG	8
5	6041.972	Ext	0.8	1.0	29	29	MFG	8
6	9917.566	Ext	1.0	4.8	28	29	MFG	8
11	17060.794	Int	2.3	6.6	20	28	MFG	8

2.2. Inspection Sheets

This section provides detailed inspection sheets for selected metal loss features.

The metal loss features are selected for detailed analysis and reporting according to the selection rules specified in the Specification for the Pipeline Inspection Report (Appendix F).

Those metal loss features that are reported on inspection sheets have predicted axial lengths, predicted peak depths and location details to the accuracy described in the Inspection System Performance Specification (Appendix G).

2.2.1. Structure of the Inspection Sheet

Each inspection sheet provides information on the location and predicted dimensions of one metal loss feature.

The inspection sheet consists of three areas:

Feature Description

This section of the inspection sheet provides specific details about the metal loss feature.

Feature Location

This section of the inspection sheet provides information that will enable the metal loss feature to be located for excavation. Wherever possible, the position of the metal loss feature is related to reference points that can easily be identified and located from the surface.

Schematic Location Summary

This provides a schematic diagram of the pipeline within the vicinity of the metal loss feature.

The diagram represents five pipe spools, the spool containing the metal loss feature and two spools either side. The girth weld numbers and spool lengths are also given on the diagram.

2.2.2. Pictorial Representation

Accompanying each inspection sheet are two pictorial representations of the magnetic response derived from the reported metal loss feature.

In both cases the metal loss feature is as viewed from outside the pipe with the upstream end being on the left. The vertical (y) axis is annotated with o'clock orientation as viewed in the

direction of flow (at the time of the inspection). The horizontal (x) axis is annotated with the absolute distance measured from the launch.

The monochrome plot (the Overview Plot) shows the magnetic response in the context of the full circumference of the pipe. In order to assist the Client in identifying the areas of metal loss, it is shaded as if illuminated from the left hand side of the plot.

The colour plot (the Detail Contour Plot) is approximately centred on the area of the pipeline in which the reported metal loss feature is located, and identifies the relative magnitudes of the magnetic responses in this area. The magnitude of change in the magnetic responses is represented by designated colours, with like magnitudes having common colours. Due to the behaviour of this magnetic response, the colour plot will not normally provide a true representation of the physical profile of the reported metal loss feature.

2.2.3. Inspection Sheets 1 to 15

Inspection sheets 1 to 15 are presented on the following pages.

Inspection Sheet Number 1 — 109170_20B

Feature Description

Type:	External Mill/Manufacturing Fault
Orientation:	06:35 (o'clock)
Axial length:	0.5 in
Circumferential width:	0.9 in
Depth - Peak:	34% WT
- Average:	34% WT
Feature Selection Rule:	8
Nominal Pipe wall thickness for spool:	0.812 in
Absolute Distance from Launch:	1759.068 feet

Comments:

This metal loss feature has the appearance of a mill/manufacturing fault.
There is another metal loss feature within this spool.
More information on this feature is given in the Pipeline Listing.

Feature Location

Primary Reference/s:

1. BALL VALVE - MP 1475.74
   (Girth Weld 30 + 1.818ft)

2. BALL VALVE - MP 1479.77
   (Girth Weld 8720 + 1.847ft)

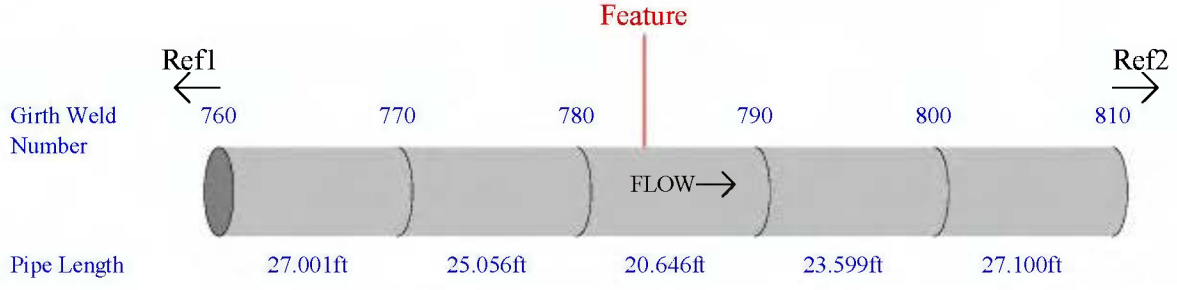
Reference Girth Weld:

The upstream reference girth weld of the feature spool is number 780.
The location of this weld is 1695.397 feet downstream from reference 1 and 20007.149 feet upstream from reference 2.

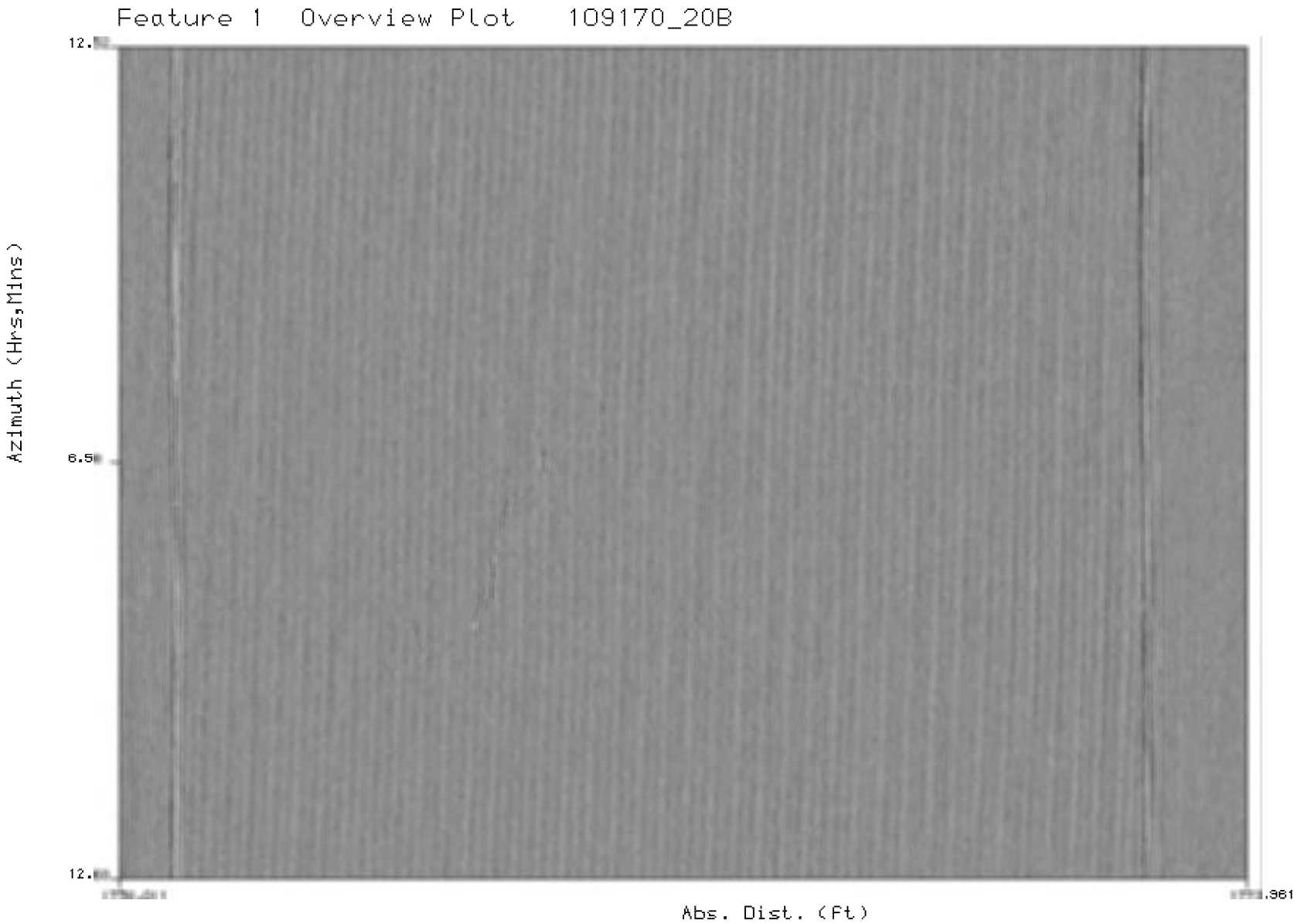
Feature:

The feature is located 7.874 feet downstream from the reference girth weld.

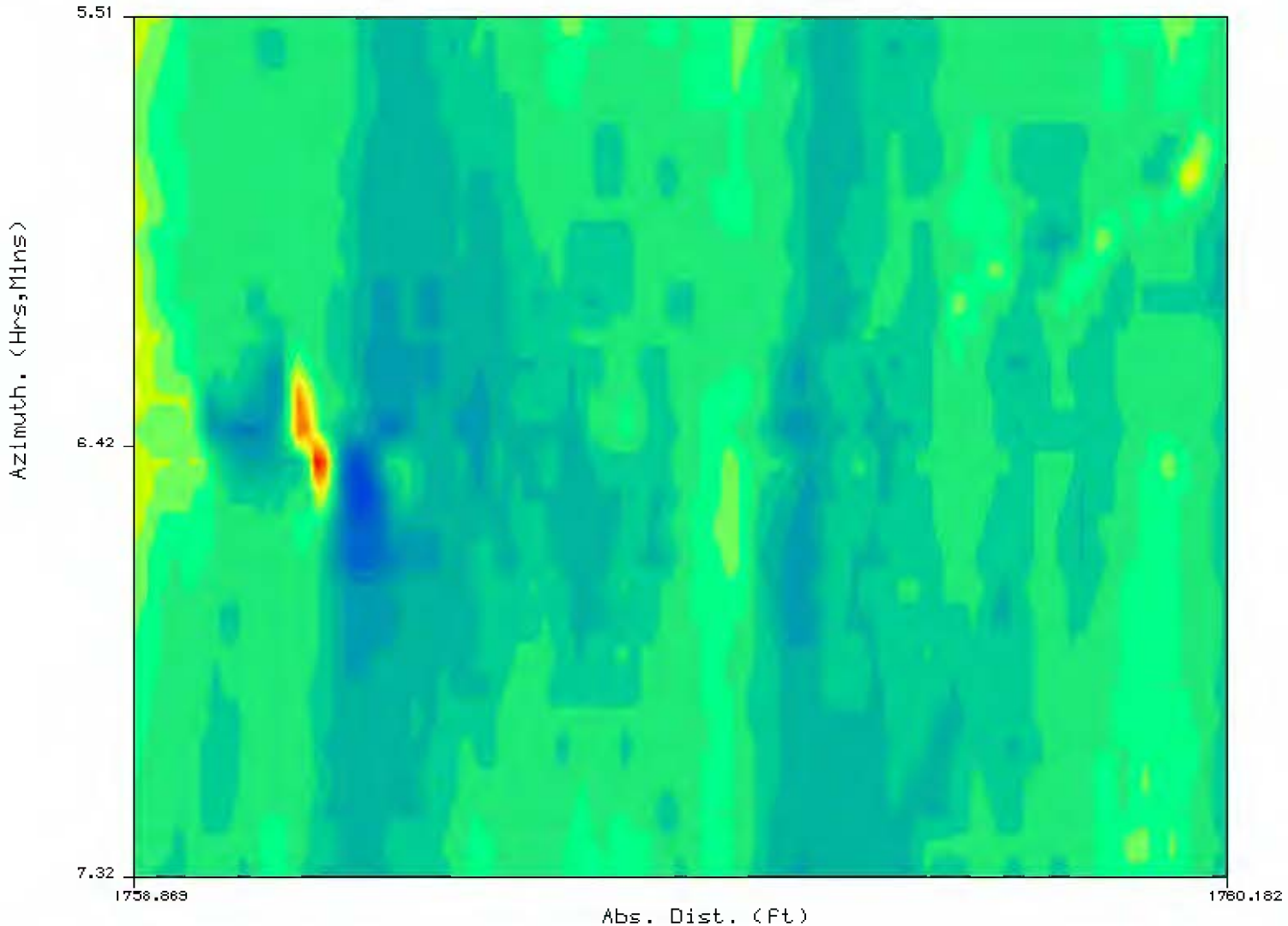
Schematic Location Summary:



← **Straits of Mackinac (East Leg)** →


Feature 1 Overview Plot 109170_20B
Azimuth (Hrs,Mins)
12.
6.5
12.
.361
Abs. Dist. (Ft)

Feature 1 Detail Contour Plot 109170_20B



Inspection Sheet Number 2 — 109170_20B

Feature Description

Type:	External Mill/Manufacturing Fault
Orientation:	06:30 (o'clock)
Axial length:	0.6 in
Circumferential width:	0.6 in
Depth - Peak:	30% WT
- Average:	30% WT
Feature Selection Rule:	8
Nominal Pipe wall thickness for spool:	0.812 in
Absolute Distance from Launch:	2228.914 feet

Comments:

This metal loss feature has the appearance of a mill/manufacturing fault.
There is another metal loss feature within this spool.
More information on this feature is given in the Pipeline Listing.

Feature Location

Primary Reference/s:

1. BALL VALVE - MP 1475.74
   (Girth Weld 30 + 1.818ft)

2. BALL VALVE - MP 1479.77
   (Girth Weld 8720 + 1.847ft)

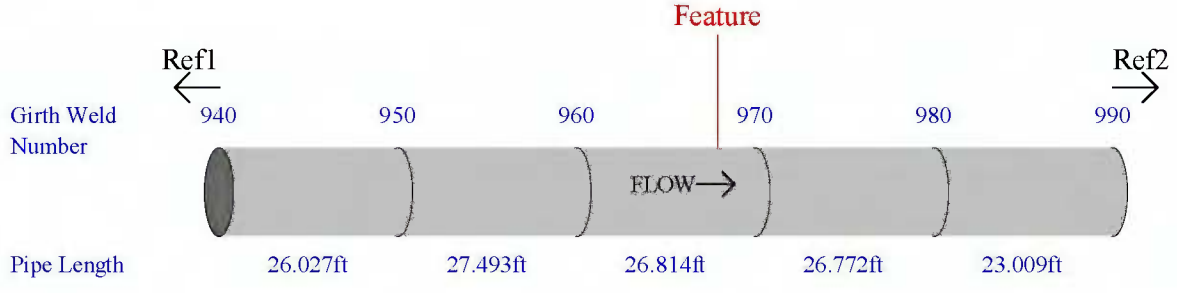
Reference Girth Weld:

The upstream reference girth weld of the feature spool is number 960.
The location of this weld is 2151.880 feet downstream from reference 1 and 19550.666 feet upstream from reference 2.

Feature:

The feature is located 21.237 feet downstream from the reference girth weld.

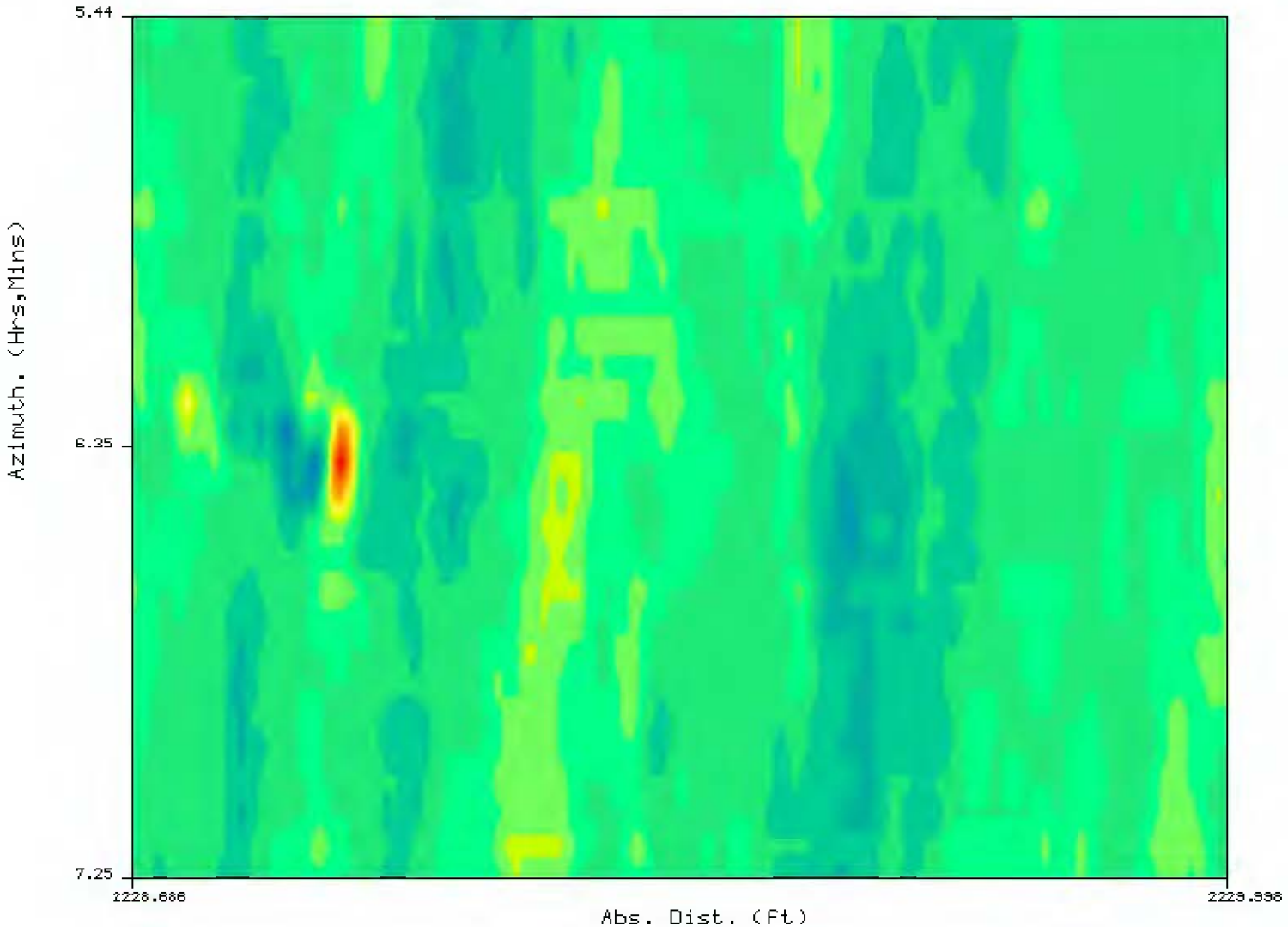
Schematic Location Summary:



← **Straits of Mackinac (East Leg)** →


Feature 2 Overview Plot 109170_20B
Azimuth (Hrs,Mins)
12.5
6.6
1.0
Abs. Dist. (Ft)

Feature 2 Detail Contour Plot 109170_20B



Inspection Sheet Number 3 — 109170_20B

Feature Description

Type:	External Mill/Manufacturing Fault
Orientation:	06:30 (o'clock)
Axial length:	0.7 in
Circumferential width:	0.7 in
Depth - Peak:	33% WT
- Average:	33% WT
Feature Selection Rule:	8
Nominal Pipe wall thickness for spool:	0.812 in
Absolute Distance from Launch:	2608.228 feet

Comments:

This isolated metal loss feature has the appearance of a mill/manufacturing fault.

Feature Location

Primary Reference/s:

1. BALL VALVE - MP 1475.74
   (Girth Weld 30 + 1.818ft)

2. BALL VALVE - MP 1479.77
   (Girth Weld 8720 + 1.847ft)

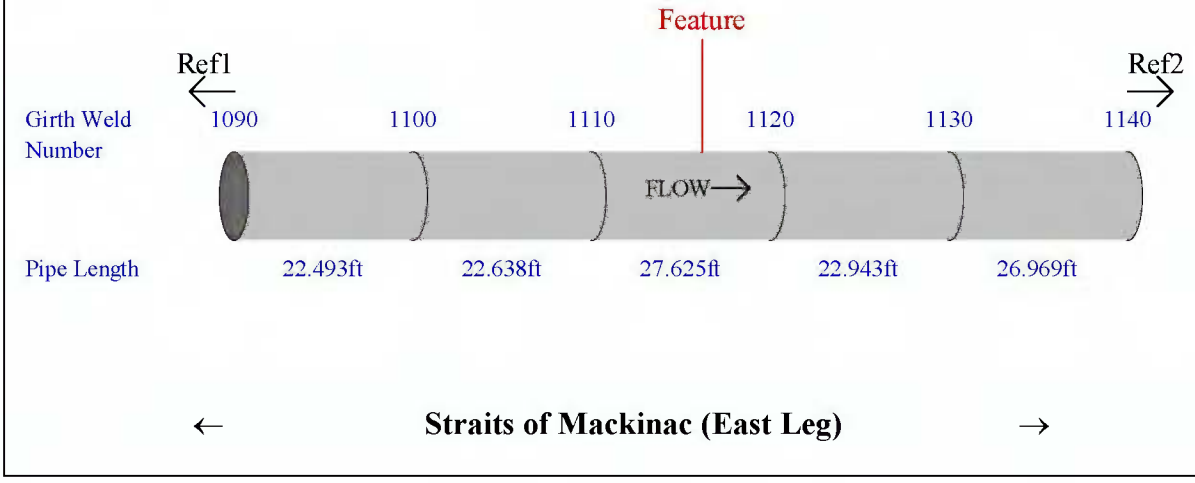
Reference Girth Weld:

The upstream reference girth weld of the feature spool is number 1110.
The location of this weld is 2535.259 feet downstream from reference 1 and 19167.287 feet upstream from reference 2.

Feature:

The feature is located 17.172 feet downstream from the reference girth weld.

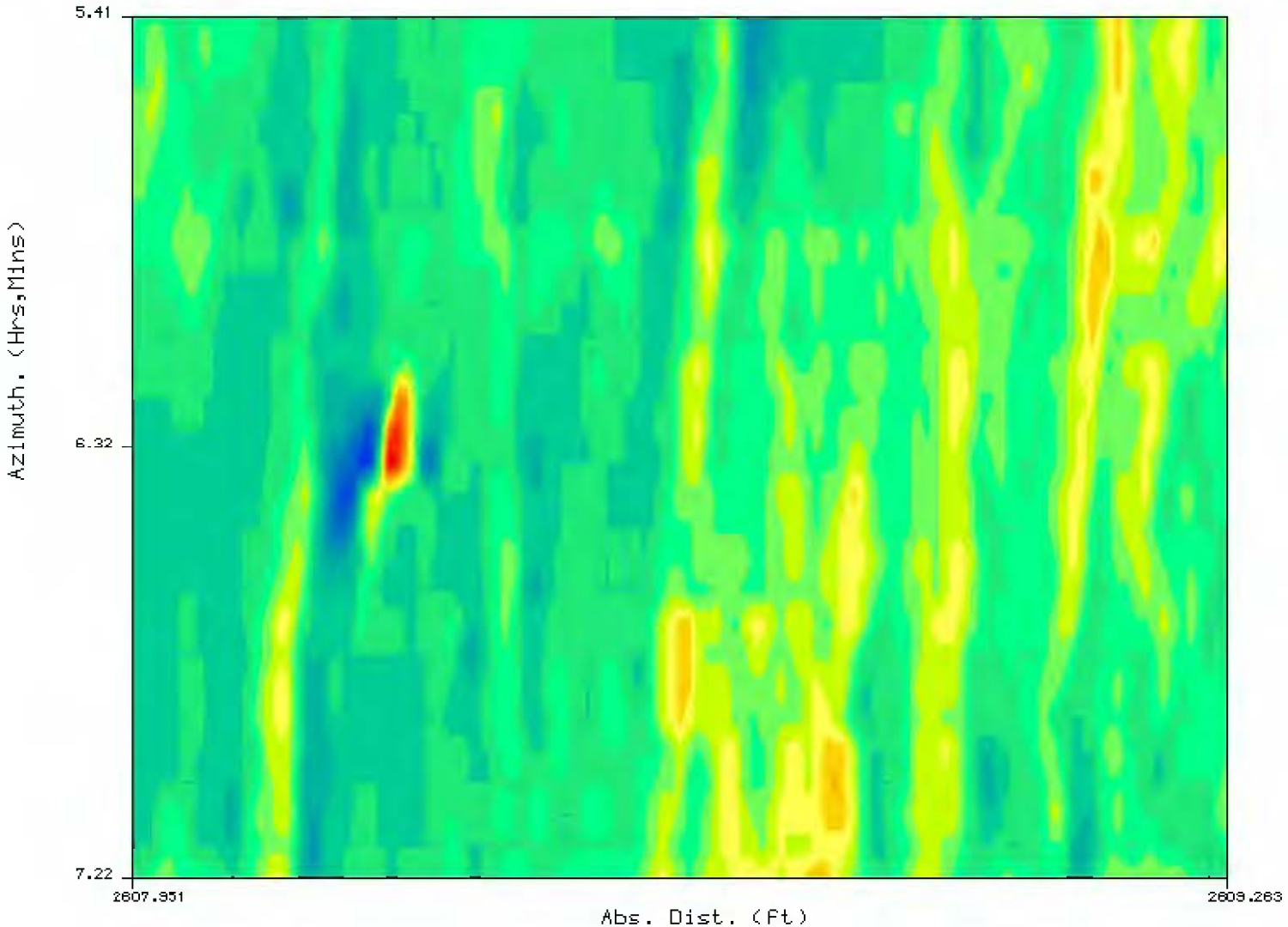
Schematic Location Summary:



← **Straits of Mackinac (East Leg)** →


Feature 3 Overview Plot 109170_20B
Azimuth (Hrs,Mins)
Abs. Dist. (Ft)

Feature 3 Detail Contour Plot 109170_20B



Inspection Sheet Number 4 — 109170_20B

Feature Description

Type:	External Mill/Manufacturing Fault
Orientation:	09:55 (o'clock)
Axial length:	5.0 in
Circumferential width:	6.0 in
Depth - Peak:	34% WT
- Average:	15% WT
Feature Selection Rule:	8
Nominal Pipe wall thickness for spool:	0.812 in
Absolute Distance from Launch:	5571.040 feet

Comments:

This isolated metal loss feature has the appearance of a mill/manufacturing fault.

Feature Location

Primary Reference/s:

1. BALL VALVE - MP 1475.74
   (Girth Weld 30 + 1.818ft)

2. BALL VALVE - MP 1479.77
   (Girth Weld 8720 + 1.847ft)

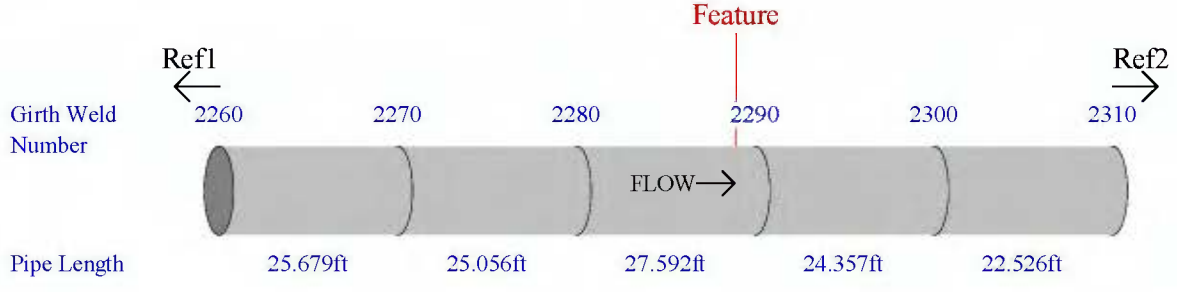
Reference Girth Weld:

The upstream reference girth weld of the feature spool is number 2280.
The location of this weld is 5490.538 feet downstream from reference 1 and 16212.008 feet upstream from reference 2.

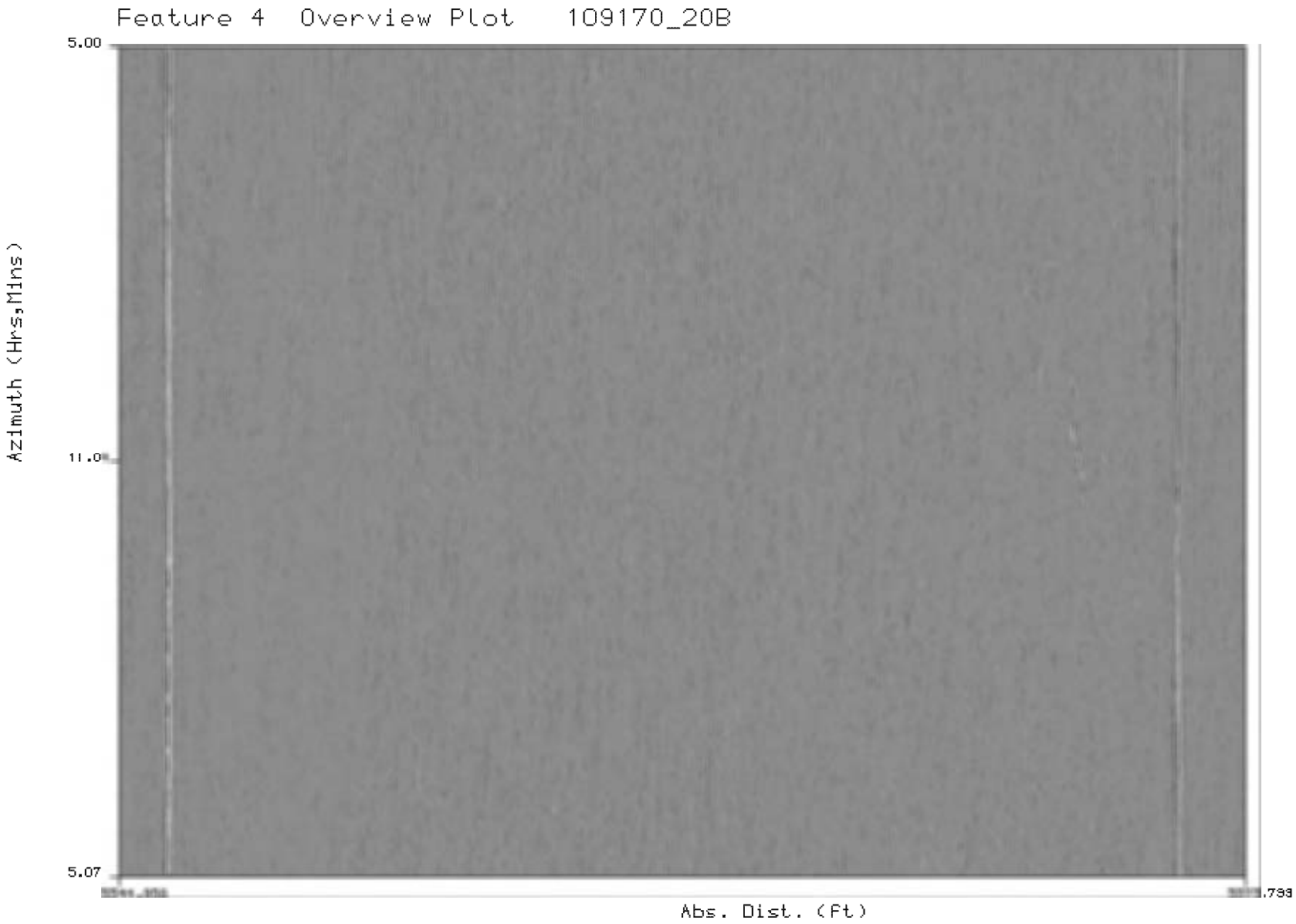
Feature:

The feature is located 24.705 feet downstream from the reference girth weld.

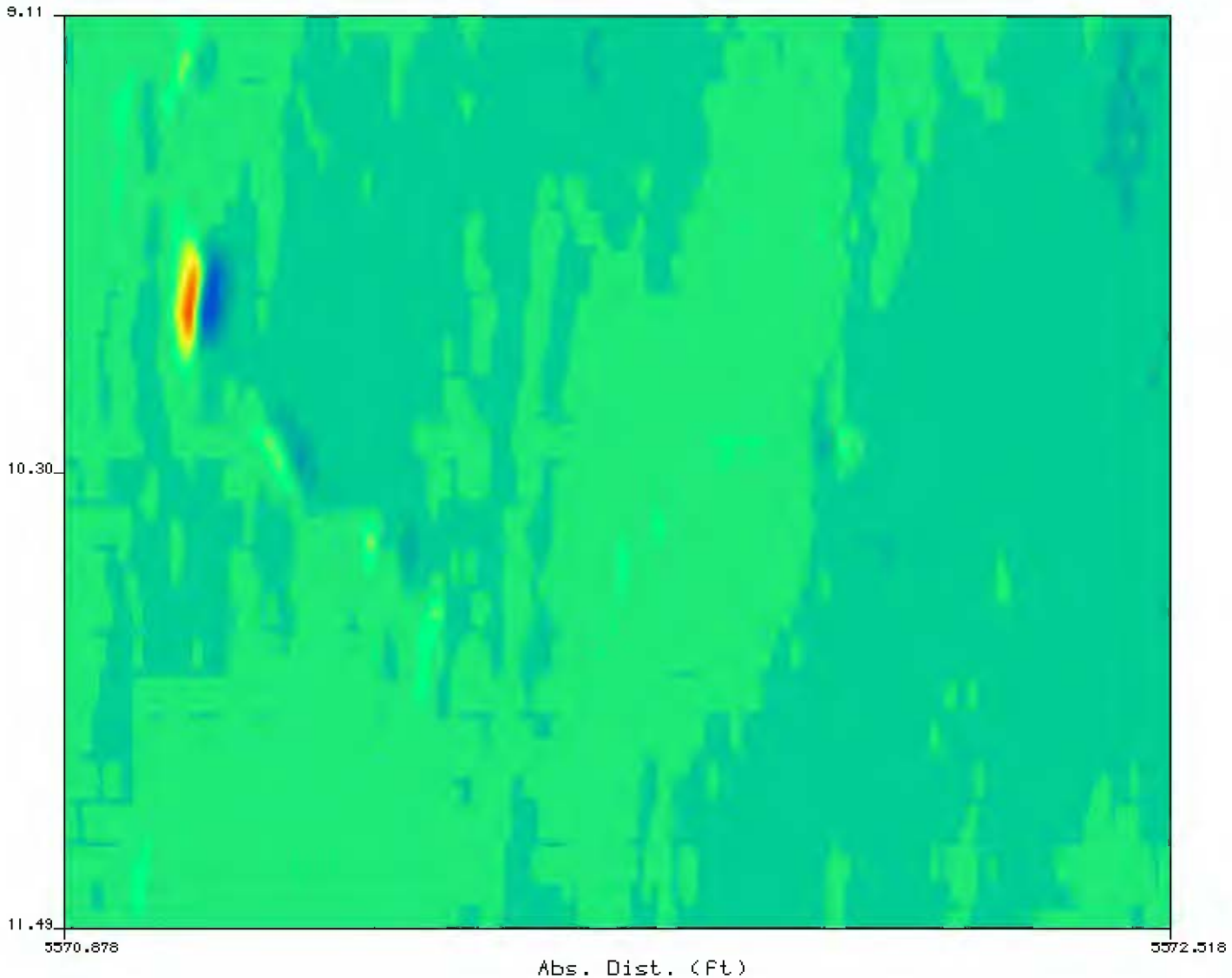
Schematic Location Summary:



← **Straits of Mackinac (East Leg)** →


Feature 4 Overview Plot 109170_20B
5.00
11.0
5.07
Azimuth (Hrs,Mins)
Abs. Dist. (Ft)

Feature 4 Detail Contour Plot 109170_20B



Inspection Sheet Number 5 — 109170_20B

Feature Description

Type:	External Mill/Manufacturing Fault
Orientation:	08:30 (o'clock)
Axial length:	0.8 in
Circumferential width:	1.0 in
Depth - Peak:	29% WT
- Average:	29% WT
Feature Selection Rule:	8
Nominal Pipe wall thickness for spool:	0.812 in
Absolute Distance from Launch:	6041.972 feet

Comments:

This isolated metal loss feature has the appearance of a mill/manufacturing fault.

Feature Location

Primary Reference/s:

1. BALL VALVE - MP 1475.74
   (Girth Weld 30 + 1.818ft)

2. BALL VALVE - MP 1479.77
   (Girth Weld 8720 + 1.847ft)

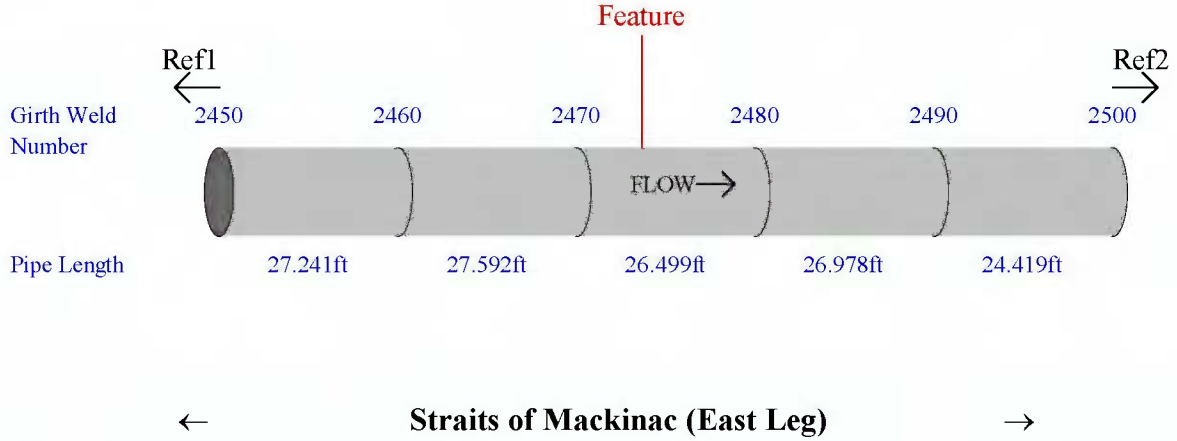
Reference Girth Weld:

The upstream reference girth weld of the feature spool is number 2470.
The location of this weld is 5976.486 feet downstream from reference 1 and 15726.060 feet upstream from reference 2.

Feature:

The feature is located 9.688 feet downstream from the reference girth weld.

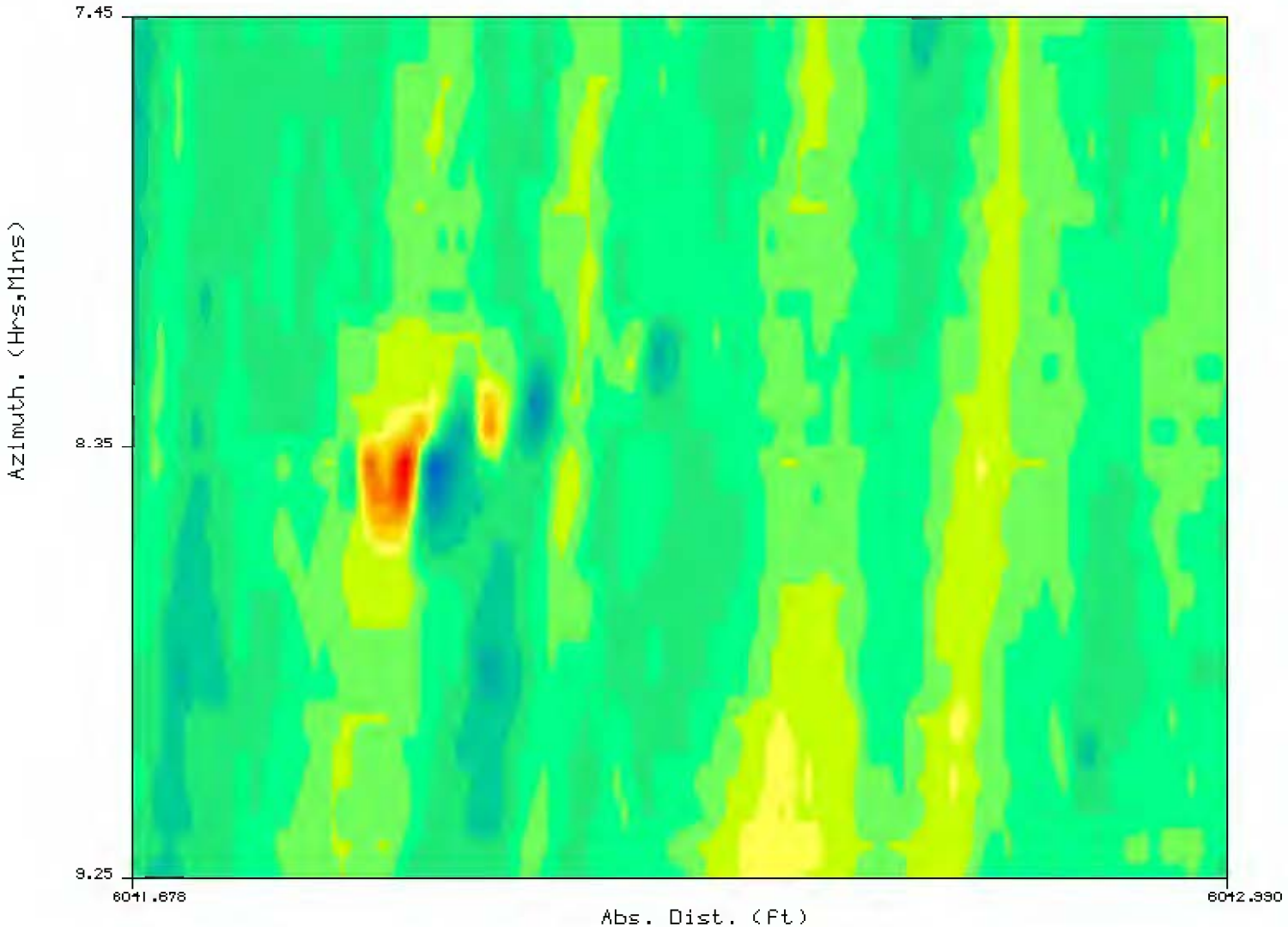
Schematic Location Summary:



← **Straits of Mackinac (East Leg)** →


Feature 5 Overview Plot 109170_20B
2.48
6.52
2.55
Azimuth (Hrs,Mins)
.707
Abs. Dist. (Ft)

Feature 5 Detail Contour Plot 109170_20B



Inspection Sheet Number 6 — 109170_20B

Feature Description

Type:	External Mill/Manufacturing Fault
Orientation:	05:10 (o'clock)
Axial length:	1.0 in
Circumferential width:	4.8 in
Depth - Peak:	29% WT
- Average:	28% WT
Feature Selection Rule:	8
Nominal Pipe wall thickness for spool:	0.812 in
Absolute Distance from Launch:	9917.566 feet

Comments:

This isolated metal loss feature has the appearance of a mill/manufacturing fault.

Feature Location

Primary Reference/s:

1. BALL VALVE - MP 1475.74
   (Girth Weld 30 + 1.818ft)

2. BALL VALVE - MP 1479.77
   (Girth Weld 8720 + 1.847ft)

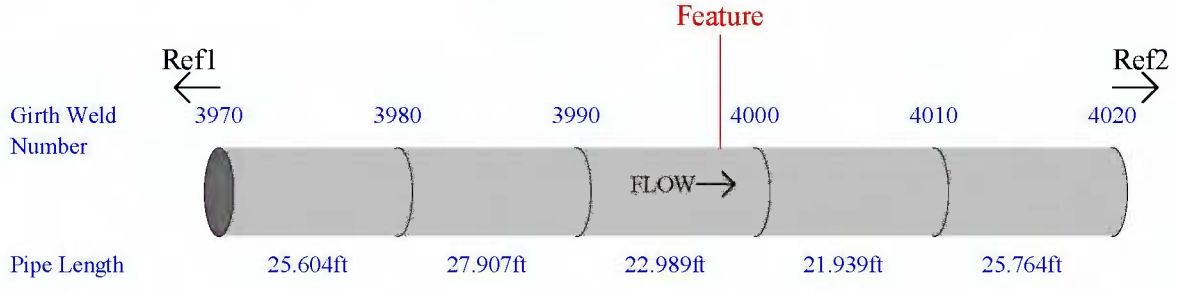
Reference Girth Weld:

The upstream reference girth weld of the feature spool is number 3990.
The location of this weld is 9843.209 feet downstream from reference 1 and 11859.337 feet upstream from reference 2.

Feature:

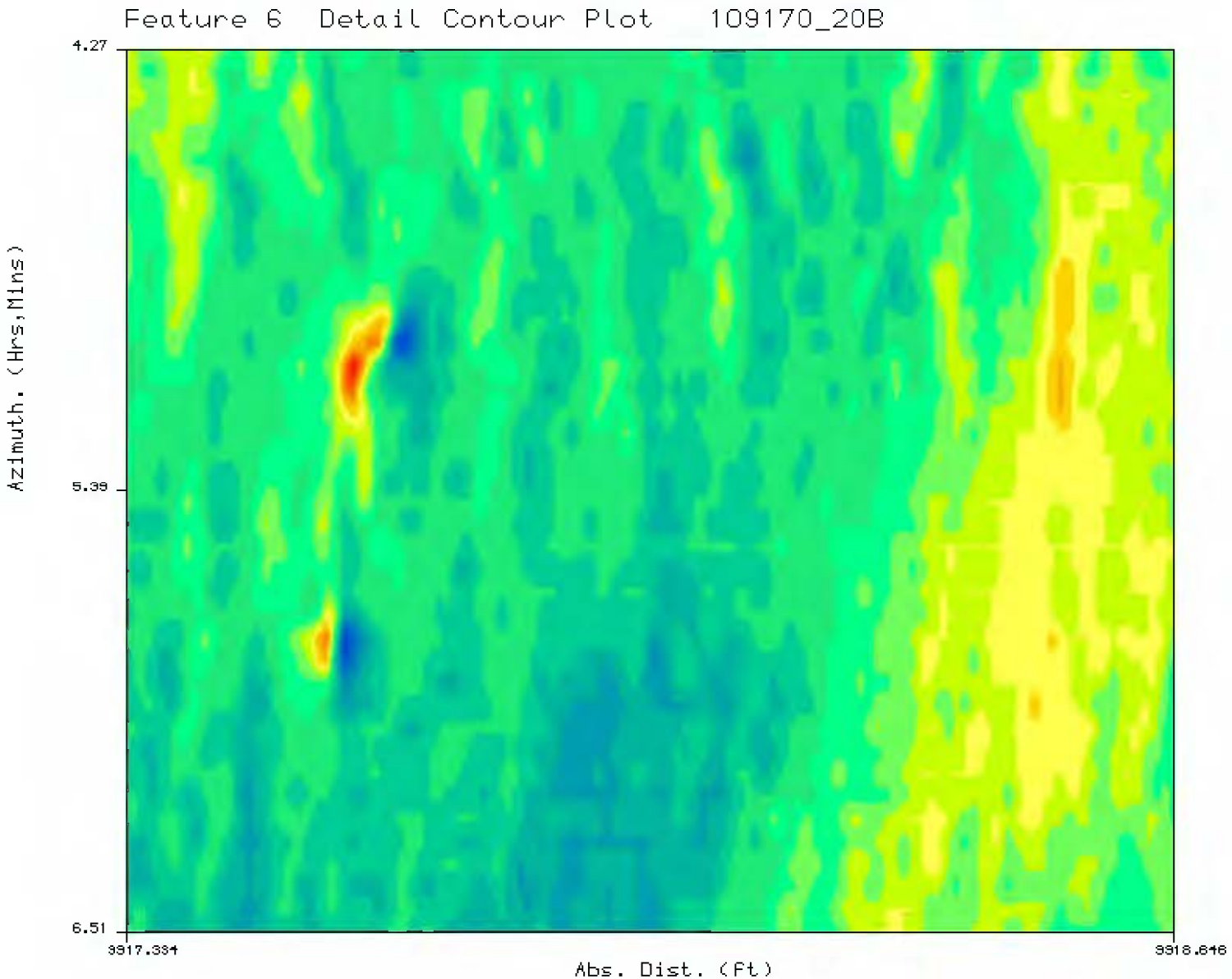
The feature is located 18.560 feet downstream from the reference girth weld.

Schematic Location Summary:



← **Straits of Mackinac (East Leg)** →


Feature 6 Overview Plot 109170_20B
Azimuth (Hrs,Mins)
11.55
5.59
12.02
Abs. Dist. (Ft)


Feature 6 Detail Contour Plot 109170_20B
4.27
5.39
6.51
Azimuth. (Hrs,Mins)
3317.334
3318.646
Abs. Dist. (Ft)

Inspection Sheet Number 7 — 109170_20B

Feature Description

Type:	External Mill/Manufacturing Fault
Orientation:	10:35 (o'clock)
Axial length:	2.2 in
Circumferential width:	2.0 in
Depth - Peak:	30% WT
- Average:	20% WT
Feature Selection Rule:	8
Nominal Pipe wall thickness for spool:	0.812 in
Absolute Distance from Launch:	11144.669 feet

Comments:

This isolated metal loss feature has the appearance of a mill/manufacturing fault.

Feature Location

Primary Reference/s:

1. BALL VALVE - MP 1475.74
   (Girth Weld 30 + 1.818ft)

2. BALL VALVE - MP 1479.77
   (Girth Weld 8720 + 1.847ft)

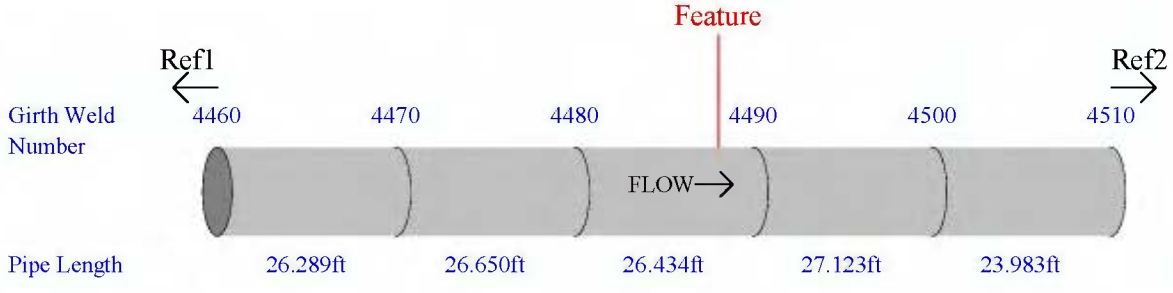
Reference Girth Weld:

The upstream reference girth weld of the feature spool is number 4480.
The location of this weld is 11067.595 feet downstream from reference 1 and 10634.951 feet upstream from reference 2.

Feature:

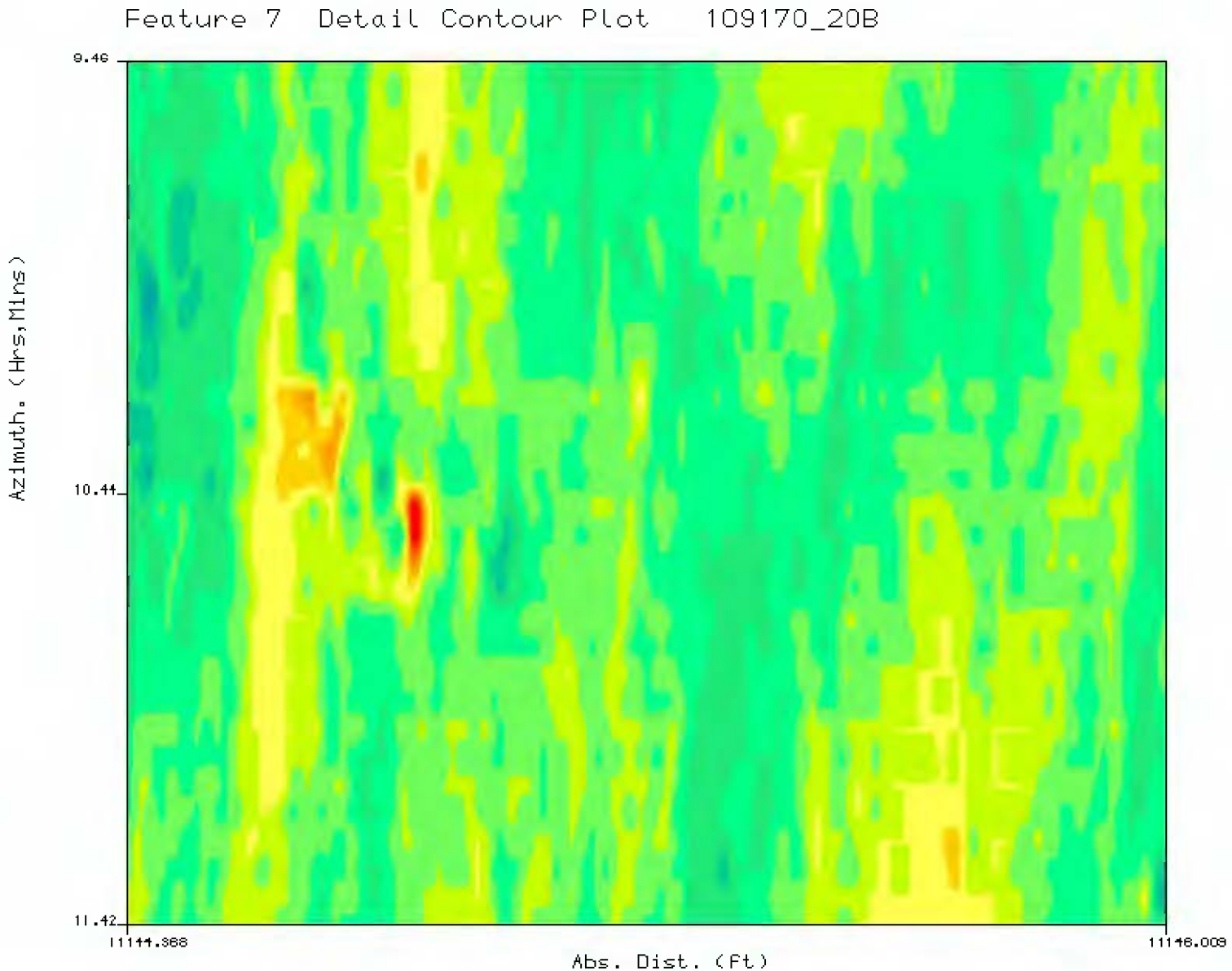
The feature is located 21.276 feet downstream from the reference girth weld.

Schematic Location Summary:



← **Straits of Mackinac (East Leg)** →


Feature 7 Overview Plot 109170_20B
5.00
11.04
5.07
Azimuth (Hrs,Mins)
51.314
Abs. Dist. (Ft)


Feature 7 Detail Contour Plot 109170_20B
9.46
10.44
11.42
Azimuth. (Hrs,Mins)
11144.388
11146.009
Abs. Dist. (Ft)

Inspection Sheet Number 8 — 109170_20B

Feature Description

Type:	External Mill/Manufacturing Fault
Orientation:	04:05 (o'clock)
Axial length:	2.0 in
Circumferential width:	1.0 in
Depth - Peak:	32% WT
- Average:	25% WT
Feature Selection Rule:	8
Nominal Pipe wall thickness for spool:	0.812 in
Absolute Distance from Launch:	13595.525 feet

Comments:

This metal loss feature has the appearance of a mill/manufacturing fault.
There is another metal loss feature within this spool.
More information on this feature is given in the Pipeline Listing.

Feature Location

Primary Reference/s:

1. BALL VALVE - MP 1475.74
   (Girth Weld 30 + 1.818ft)

2. BALL VALVE - MP 1479.77
   (Girth Weld 8720 + 1.847ft)

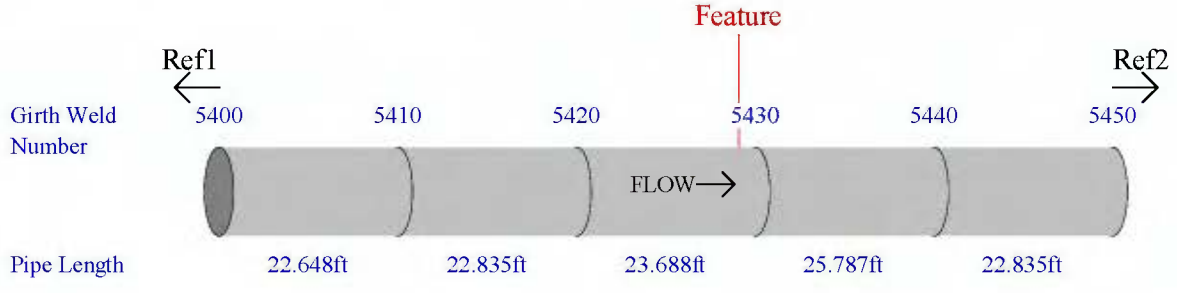
Reference Girth Weld:

The upstream reference girth weld of the feature spool is number 5420.
The location of this weld is 13518.209 feet downstream from reference 1 and 8184.337 feet upstream from reference 2.

Feature:

The feature is located 21.519 feet downstream from the reference girth weld.

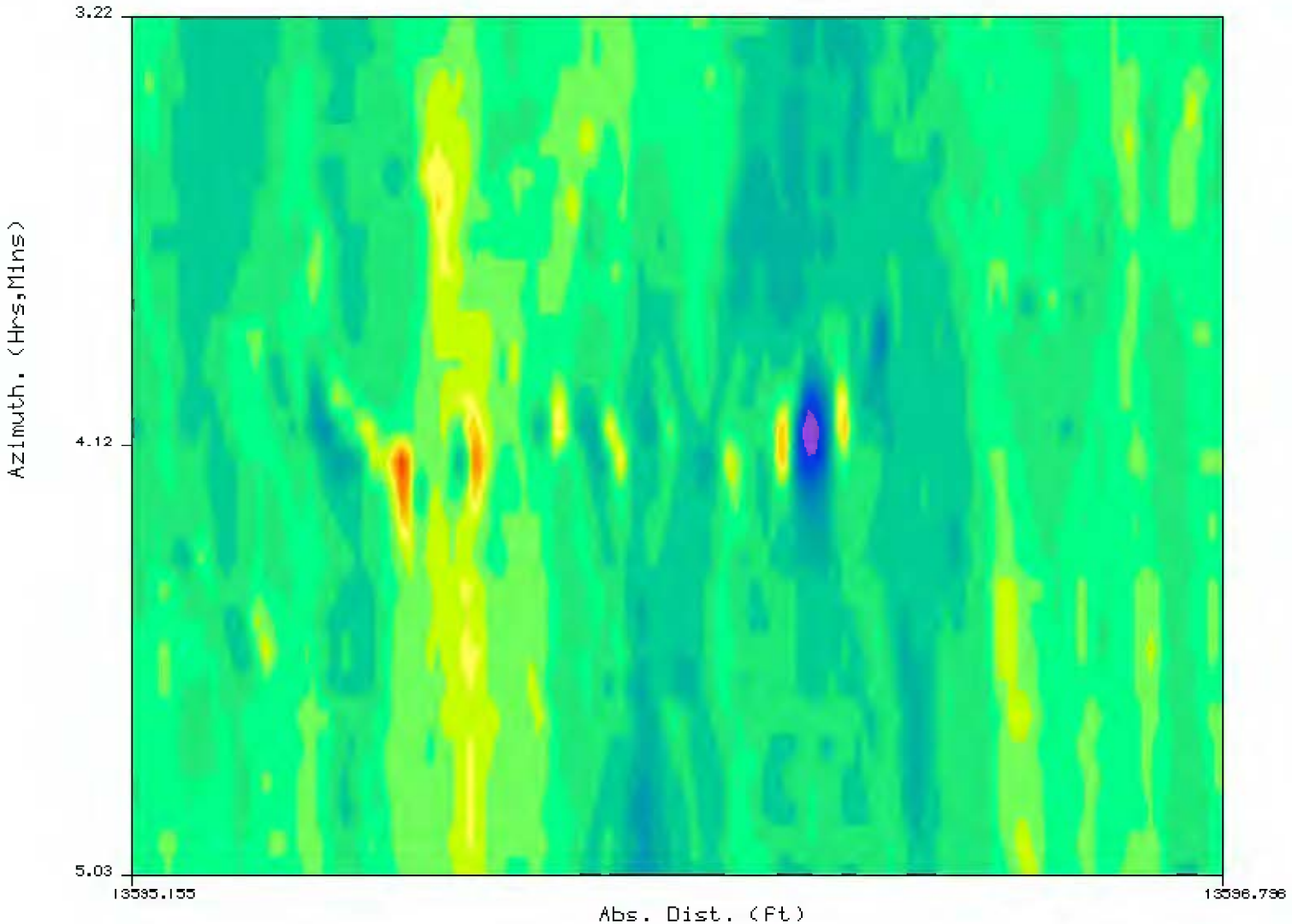
Schematic Location Summary:



← **Straits of Mackinac (East Leg)** →


Feature 8 Overview Plot 109170_20B
Azimuth (Hrs,Mins)
Abs. Dist. (Ft)

Feature 8 Detail Contour Plot 109170_20B



Inspection Sheet Number 9 — 109170_20B

Feature Description

Type:	Internal Mill/Manufacturing Fault
Orientation:	09:35 (o'clock)
Axial length:	0.9 in
Circumferential width:	5.1 in
Depth - Peak:	30% WT
- Average:	25% WT
Feature Selection Rule:	8
Nominal Pipe wall thickness for spool:	0.812 in
Absolute Distance from Launch:	15888.143 feet

Comments:

This isolated metal loss feature has the appearance of a mill/manufacturing fault.

Feature Location

Primary Reference/s:

1. BALL VALVE - MP 1475.74
   (Girth Weld 30 + 1.818ft)

2. BALL VALVE - MP 1479.77
   (Girth Weld 8720 + 1.847ft)

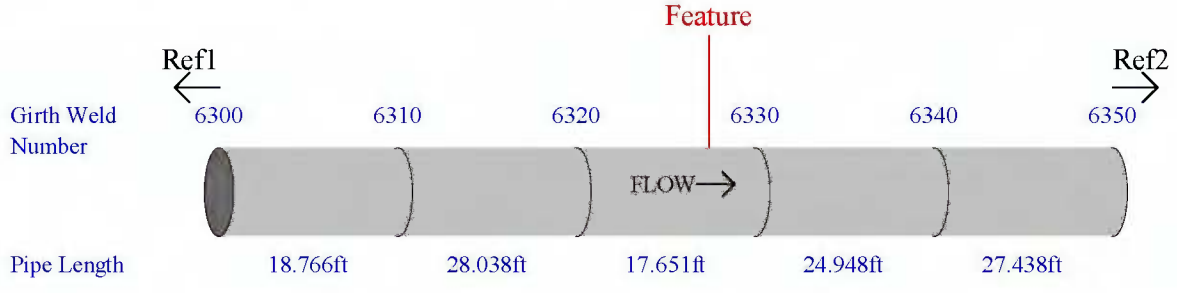
Reference Girth Weld:

The upstream reference girth weld of the feature spool is number 6320.
The location of this weld is 15819.226 feet downstream from reference 1 and 5883.320 feet upstream from reference 2.

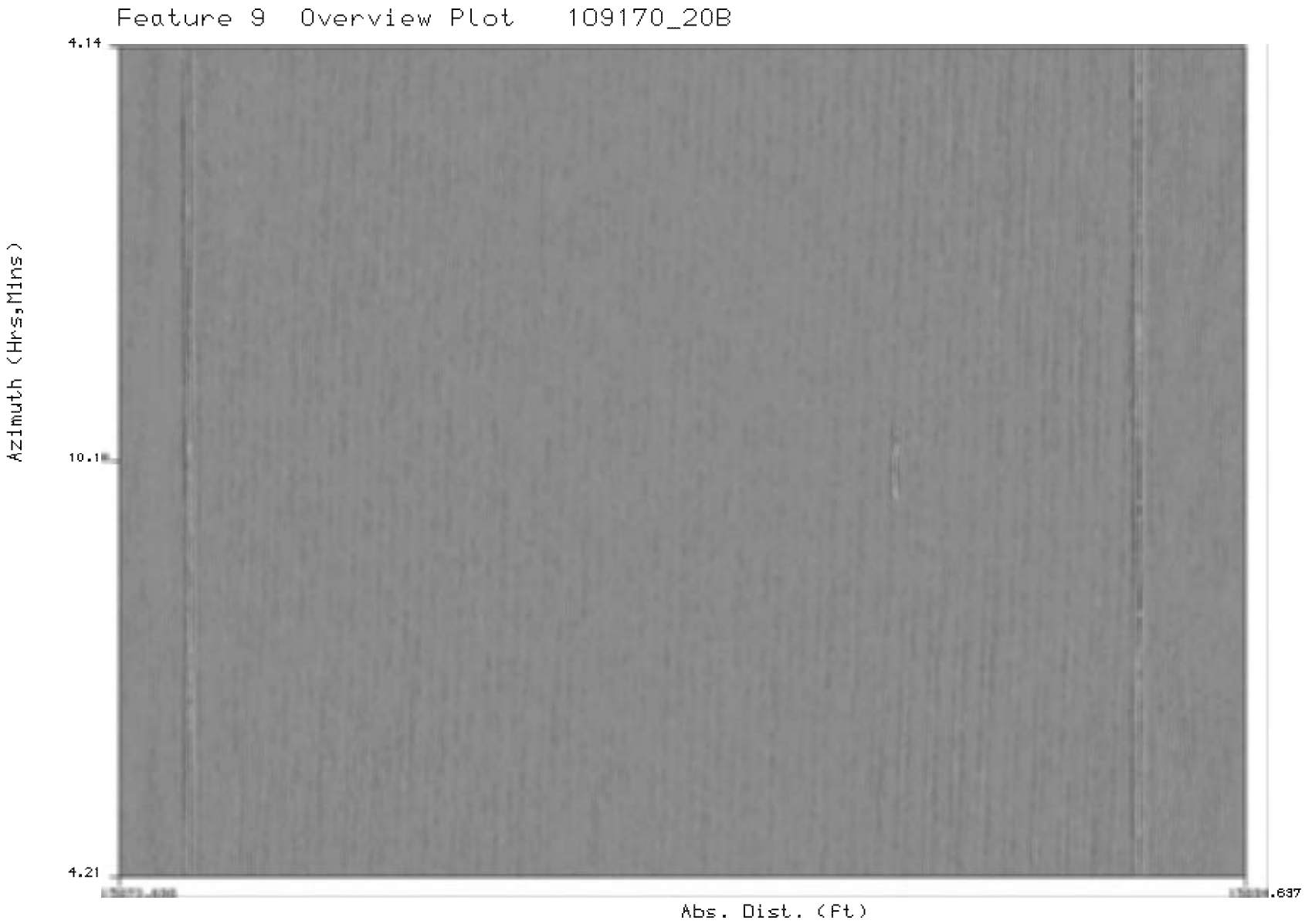
Feature:

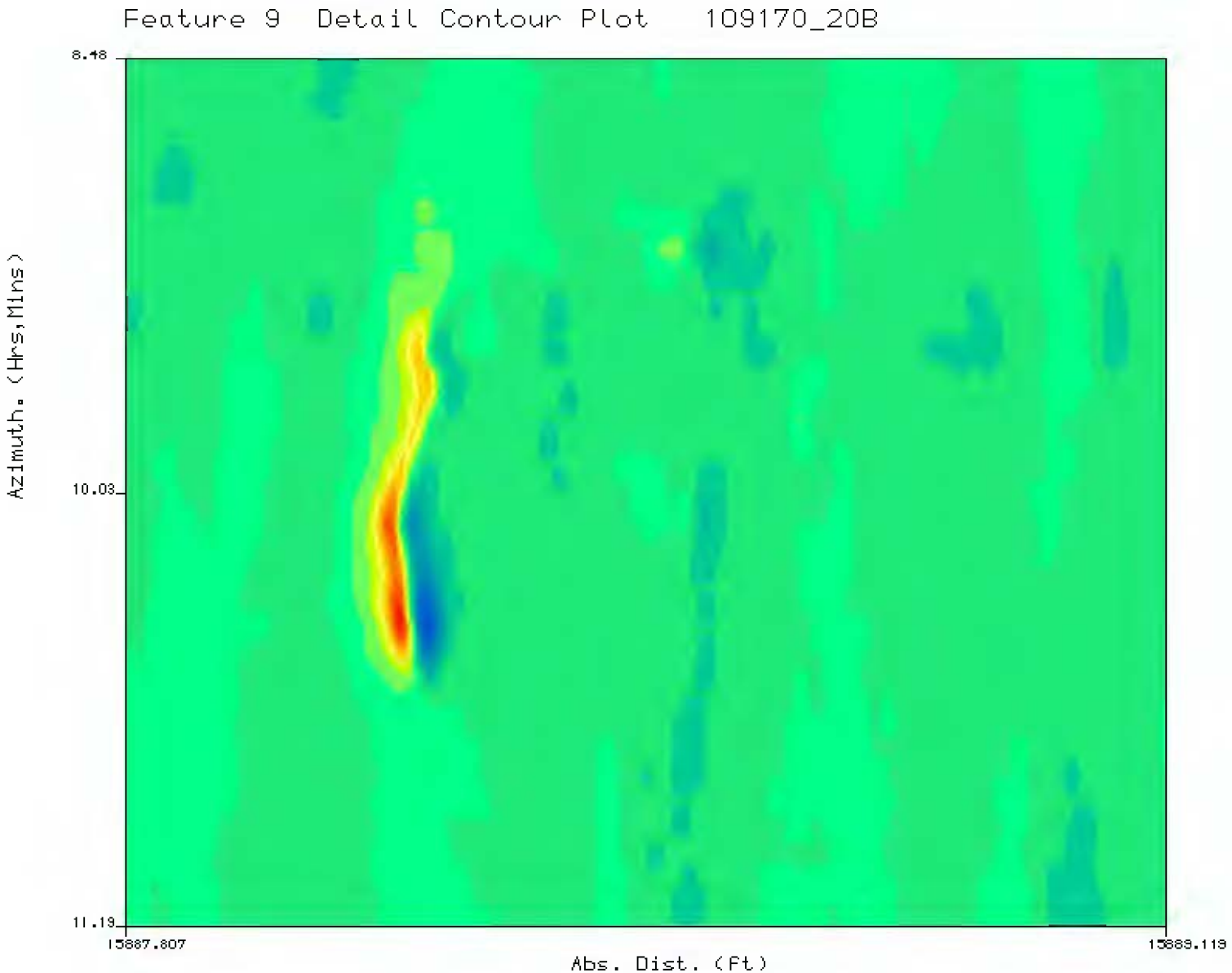
The feature is located 13.120 feet downstream from the reference girth weld.

Schematic Location Summary:



← **Straits of Mackinac (East Leg)** →


Feature 9 Overview Plot 109170_20B
4.14
10.1
4.21
Azimuth (Hrs,Mins)
Abs. Dist. (Ft)


Feature 9 Detail Contour Plot 109170_20B
8.48
10.03
11.19
Azimuth. (Hrs,Mins)
15887.807
15888.119
Abs. Dist. (Ft)

Inspection Sheet Number 10 — 109170_20B

Feature Description

Type:	External Mill/Manufacturing Fault
Orientation:	12:15 (o'clock)
Axial length:	9.6 in
Circumferential width:	4.1 in
Depth - Peak:	34% WT
- Average:	16% WT
Feature Selection Rule:	8
Nominal Pipe wall thickness for spool:	0.812 in
Absolute Distance from Launch:	16237.041 feet

Comments:

This metal loss feature has the appearance of a mill/manufacturing fault.
There is another metal loss feature within this spool.
More information on this feature is given in the Pipeline Listing.

Feature Location

Primary Reference/s:

1. BALL VALVE - MP 1475.74
   (Girth Weld 30 + 1.818ft)

2. BALL VALVE - MP 1479.77
   (Girth Weld 8720 + 1.847ft)

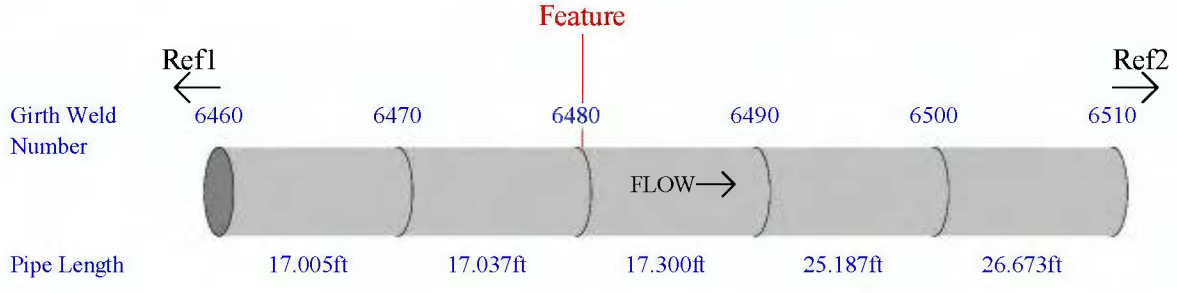
Reference Girth Weld:

The upstream reference girth weld of the feature spool is number 6480.
The location of this weld is 16180.673 feet downstream from reference 1 and 5521.873 feet upstream from reference 2.

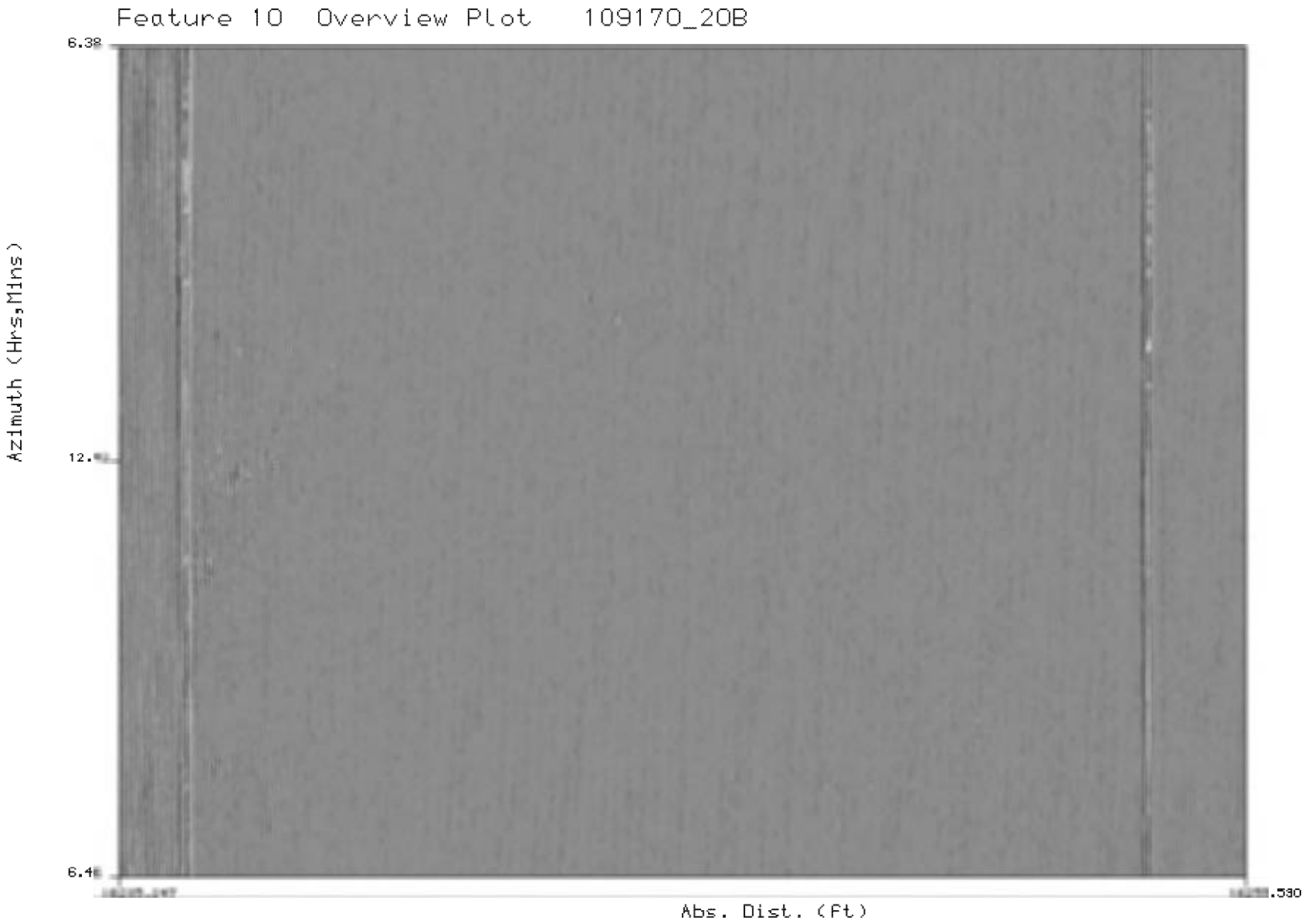
Feature:

The feature is located 0.571 feet downstream from the reference girth weld.

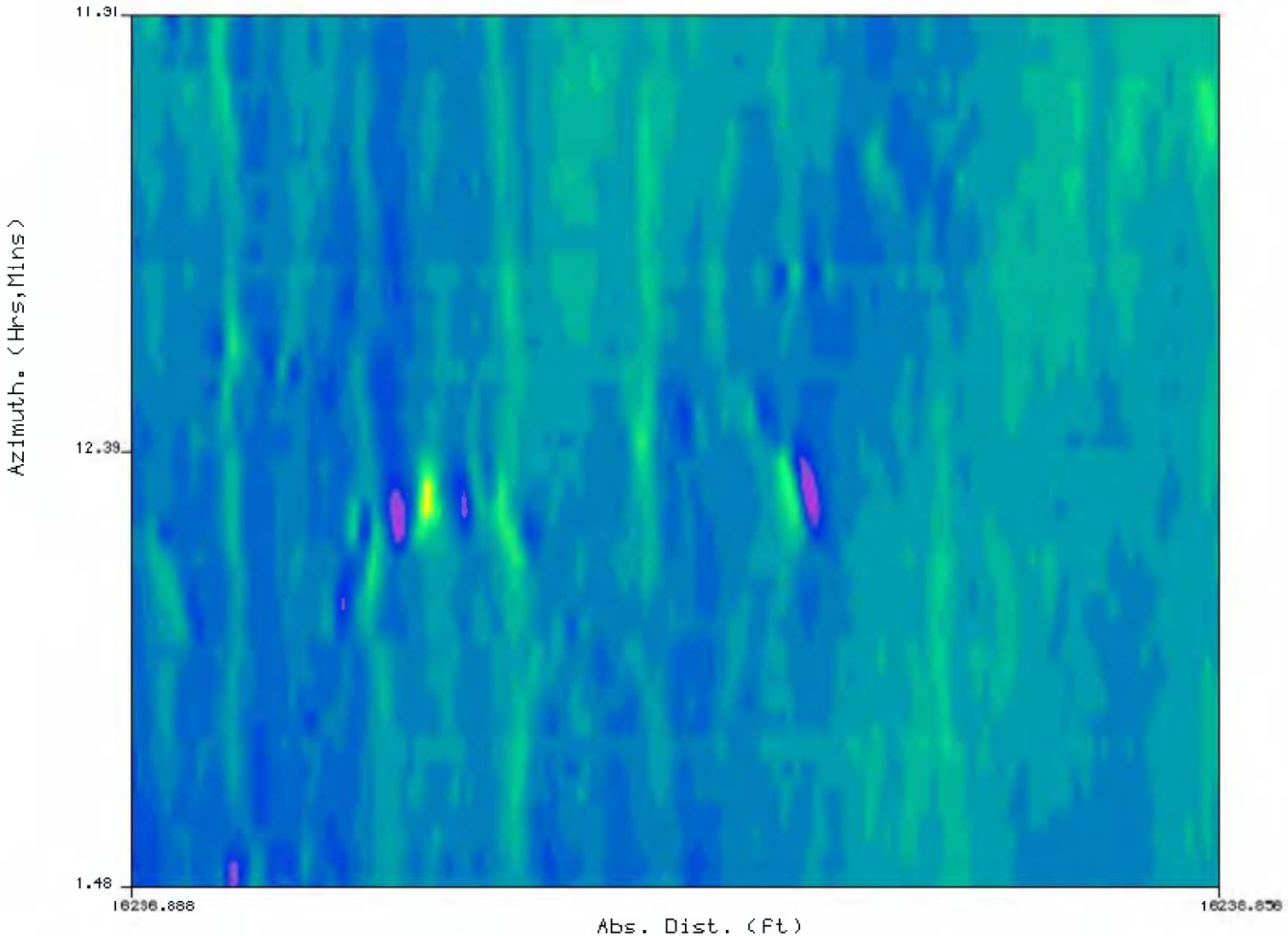
Schematic Location Summary:



← **Straits of Mackinac (East Leg)** →


Feature 10 Overview Plot 109170_20B
6.38
12.
6.46
Azimuth (Hrs,Mins)
.330
Abs. Dist. (Ft)

Feature 10 Detail Contour Plot 109170_20B



Inspection Sheet Number 11 — 109170_20B

Feature Description

Type:	Internal Mill/Manufacturing Fault
Orientation:	05:30 (o'clock)
Axial length:	2.3 in
Circumferential width:	6.6 in
Depth - Peak:	28% WT
- Average:	20% WT
Feature Selection Rule:	8
Nominal Pipe wall thickness for spool:	0.812 in
Absolute Distance from Launch:	17060.794 feet

Comments:

This isolated metal loss feature has the appearance of a mill/manufacturing fault.

Feature Location

Primary Reference/s:

1. BALL VALVE - MP 1475.74
   (Girth Weld 30 + 1.818ft)

2. BALL VALVE - MP 1479.77
   (Girth Weld 8720 + 1.847ft)

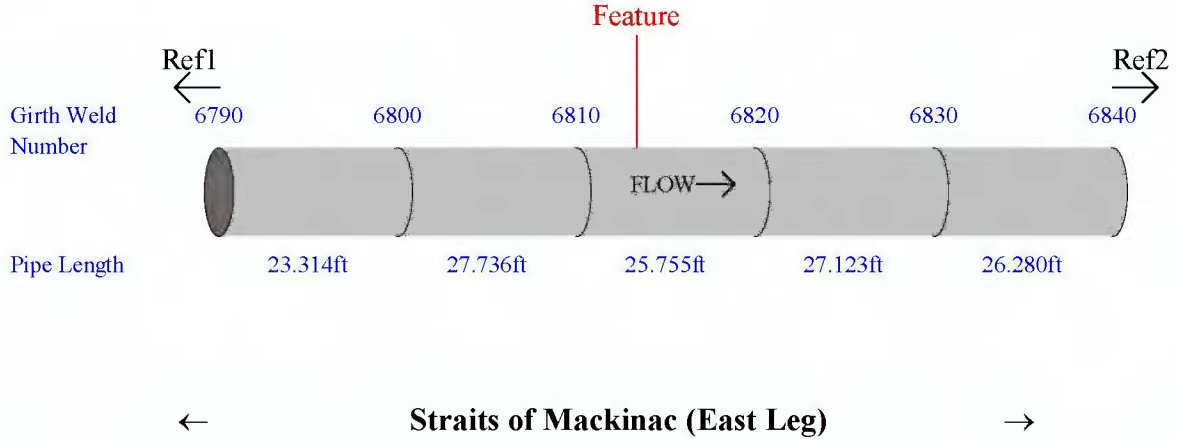
Reference Girth Weld:

The upstream reference girth weld of the feature spool is number 6810.
The location of this weld is 16996.368 feet downstream from reference 1 and 4706.178 feet upstream from reference 2.

Feature:

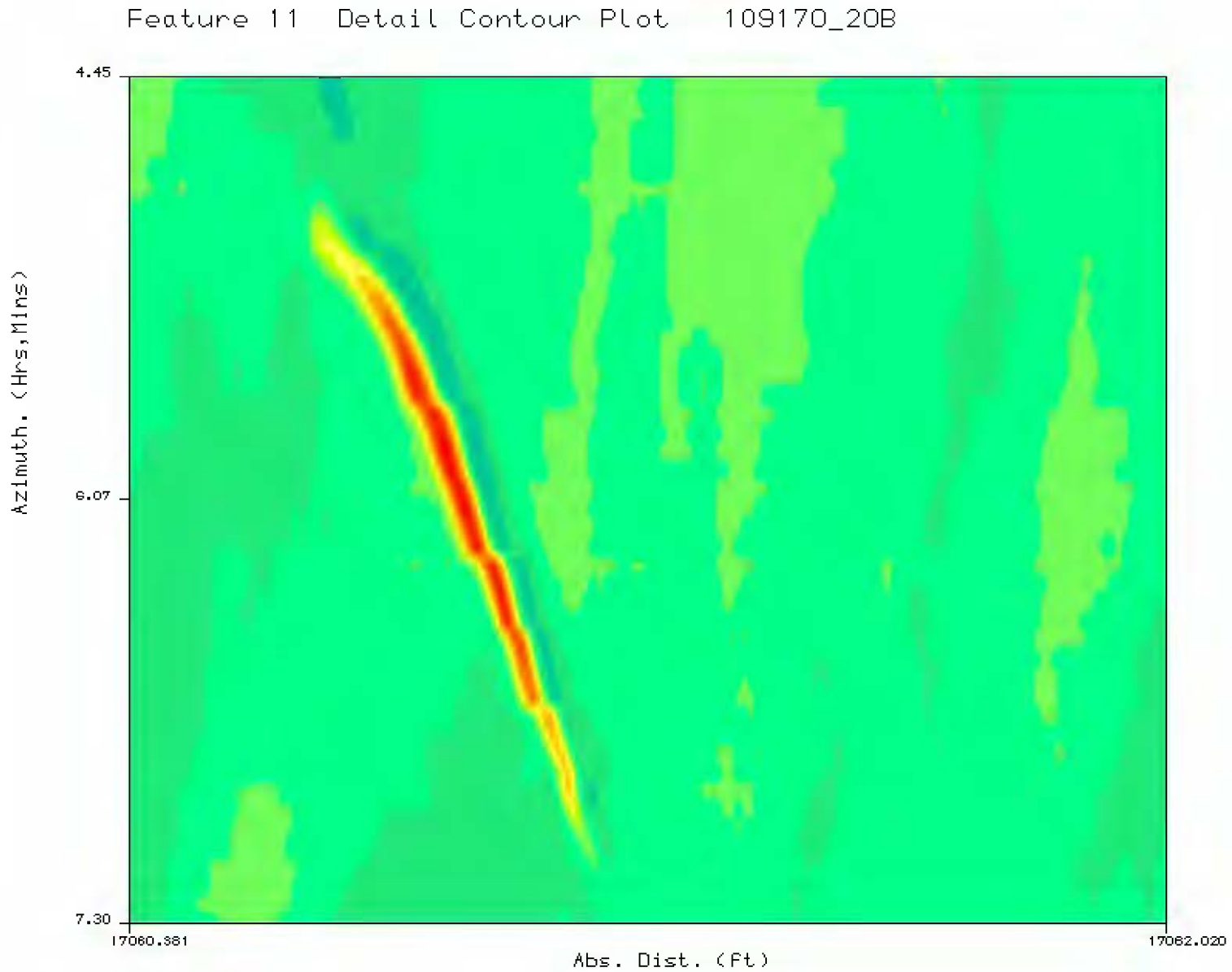
The feature is located 8.629 feet downstream from the reference girth weld.

Schematic Location Summary:



← **Straits of Mackinac (East Leg)** →


Feature 11 Overview Plot 109170_20B
12.1
6.16
12.1
Azimuth (Hrs,Mins)
Abs. Dist. (Ft)


Feature 11 Detail Contour Plot 109170_20B
4.45
6.07
7.30
Azimuth. (Hrs,Mins)
17060.381
17062.020
Abs. Dist. (Ft)

Inspection Sheet Number 12 — 109170_20B

Feature Description

Type:	External Mill/Manufacturing Fault
Orientation:	04:40 (o'clock)
Axial length:	0.6 in
Circumferential width:	1.0 in
Depth - Peak:	30% WT
- Average:	30% WT
Feature Selection Rule:	8
Nominal Pipe wall thickness for spool:	0.812 in
Absolute Distance from Launch:	18269.485 feet

Comments:

This metal loss feature has the appearance of a mill/manufacturing fault.
There is another metal loss feature within this spool.
More information on this feature is given in the Pipeline Listing.

Feature Location

Primary Reference/s:

1. BALL VALVE - MP 1475.74
   (Girth Weld 30 + 1.818ft)

2. BALL VALVE - MP 1479.77
   (Girth Weld 8720 + 1.847ft)

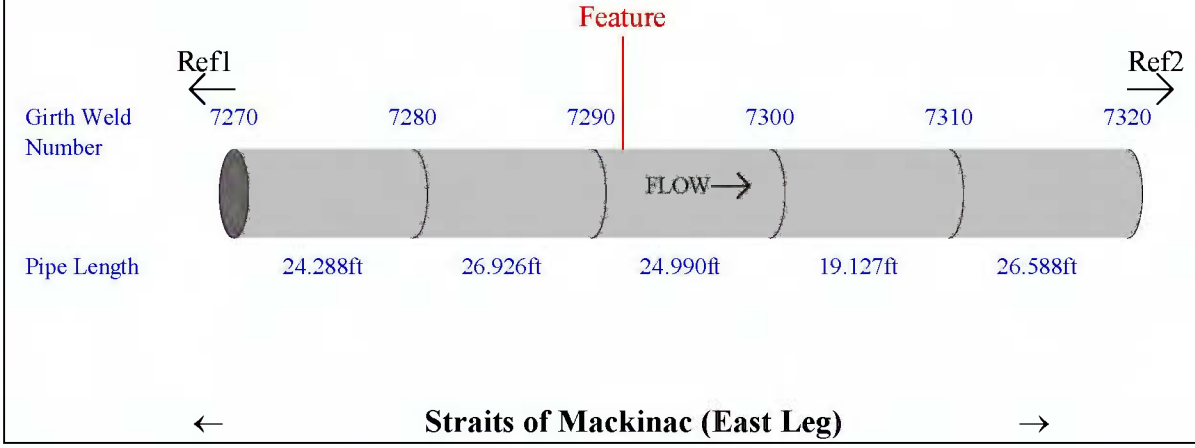
Reference Girth Weld:

The upstream reference girth weld of the feature spool is number 7290.
The location of this weld is 18209.318 feet downstream from reference 1 and 3493.228 feet upstream from reference 2.

Feature:

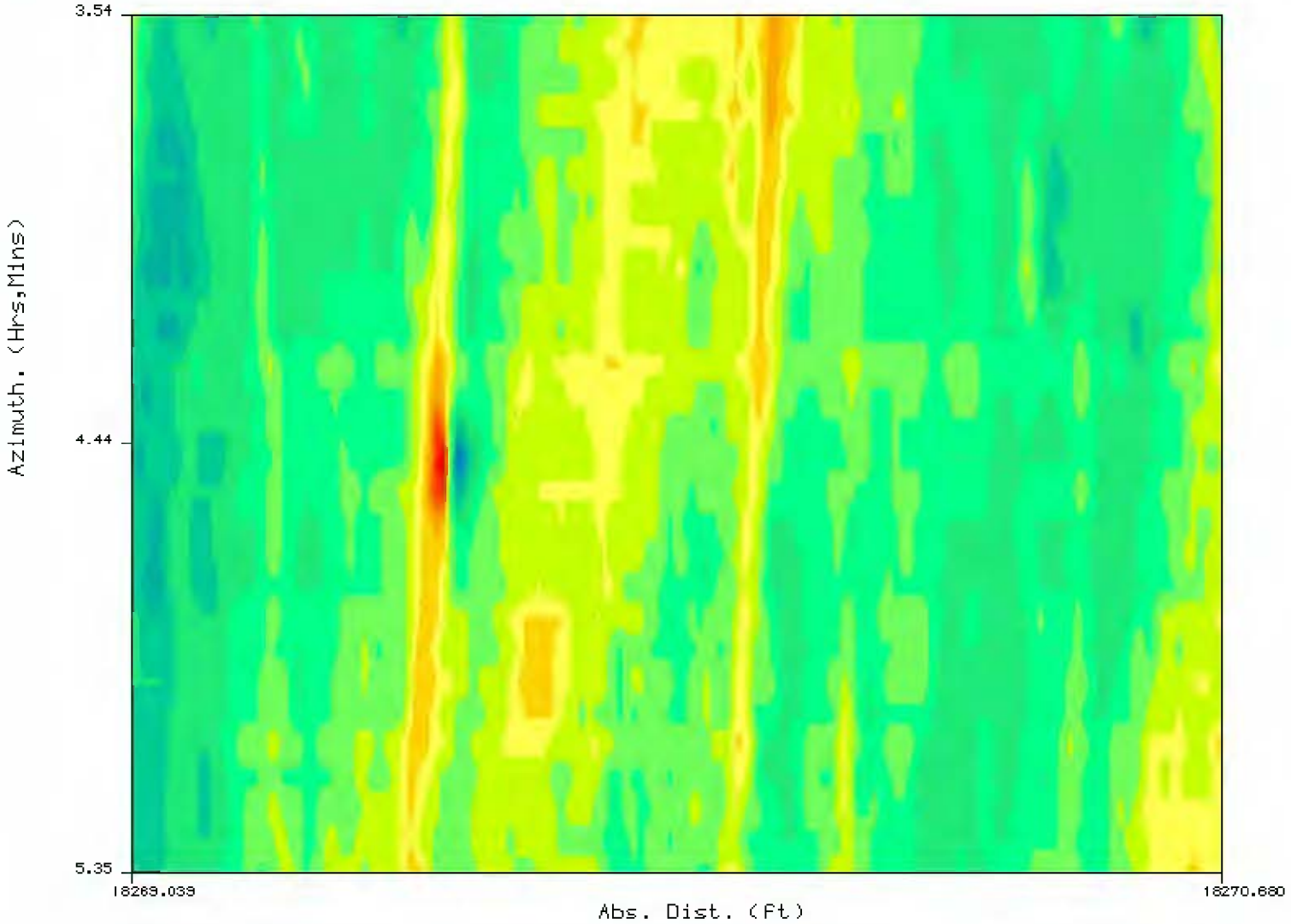
The feature is located 4.370 feet downstream from the reference girth weld.

Schematic Location Summary:




Feature 12 Overview Plot 109170_20B
Azimuth (Hrs,Mins)
Abs. Dist. (Ft)

Feature 12 Detail Contour Plot 109170_20B



Inspection Sheet Number 13 — 109170_20B

Feature Description

Type:	External Mill/Manufacturing Fault
Orientation:	03:15 (o'clock)
Axial length:	2.5 in
Circumferential width:	3.8 in
Depth - Peak:	30% WT
- Average:	25% WT
Feature Selection Rule:	8
Nominal Pipe wall thickness for spool:	0.812 in
Absolute Distance from Launch:	19503.576 feet

Comments:

This metal loss feature has the appearance of a mill/manufacturing fault.
There is another metal loss feature within this spool.
More information on this feature is given in the Pipeline Listing.

Feature Location

Primary Reference/s:

1. BALL VALVE - MP 1475.74
   (Girth Weld 30 + 1.818ft)

2. BALL VALVE - MP 1479.77
   (Girth Weld 8720 + 1.847ft)

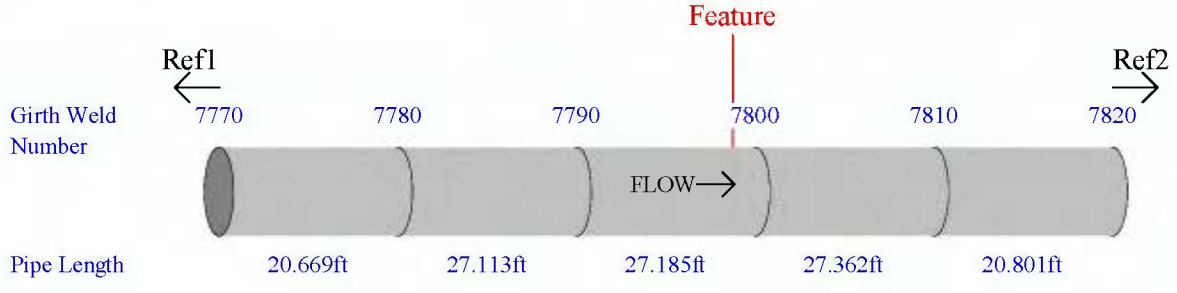
Reference Girth Weld:

The upstream reference girth weld of the feature spool is number 7790.
The location of this weld is 19424.029 feet downstream from reference 1 and 2278.517 feet upstream from reference 2.

Feature:

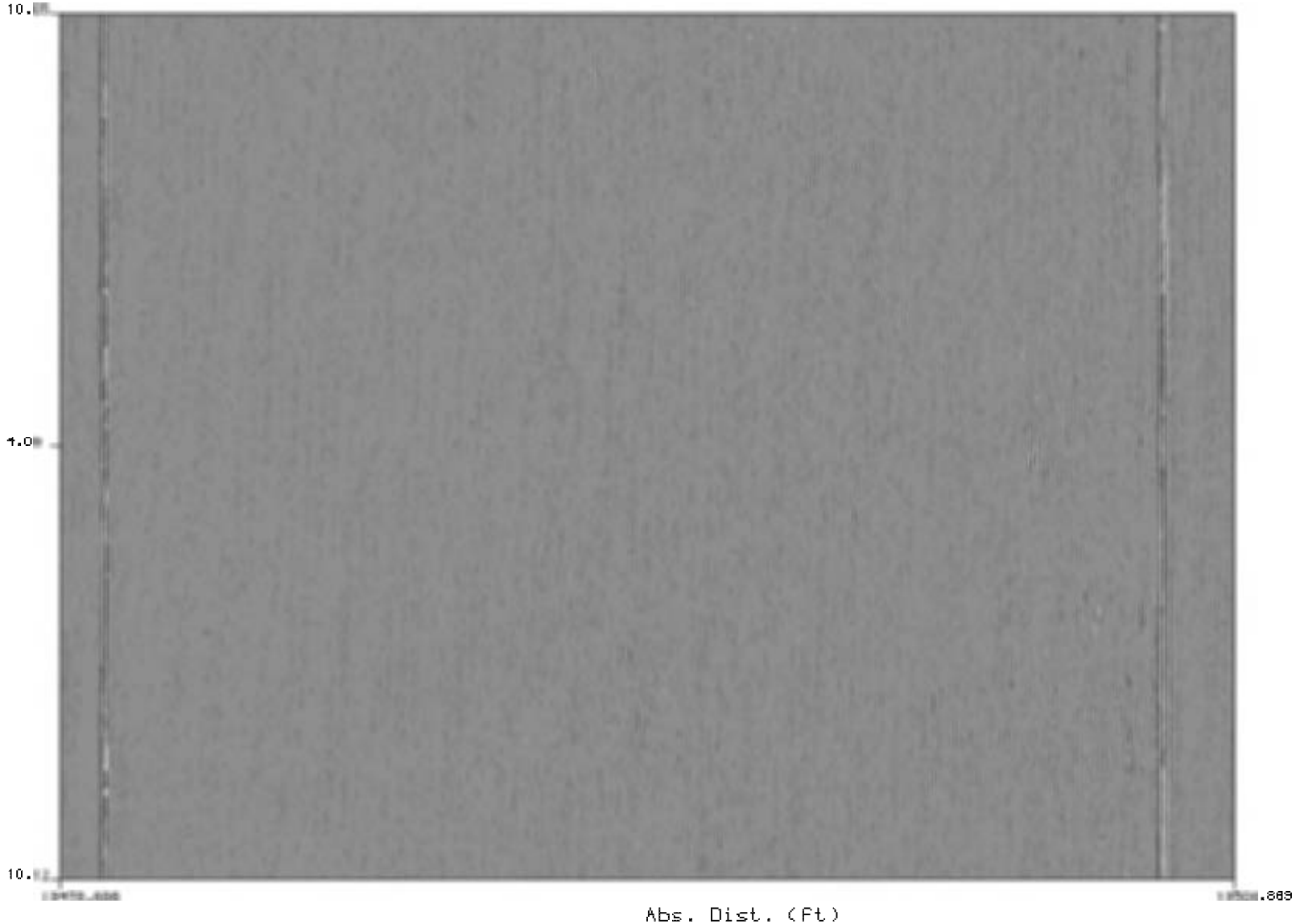
The feature is located 23.750 feet downstream from the reference girth weld.

Schematic Location Summary:

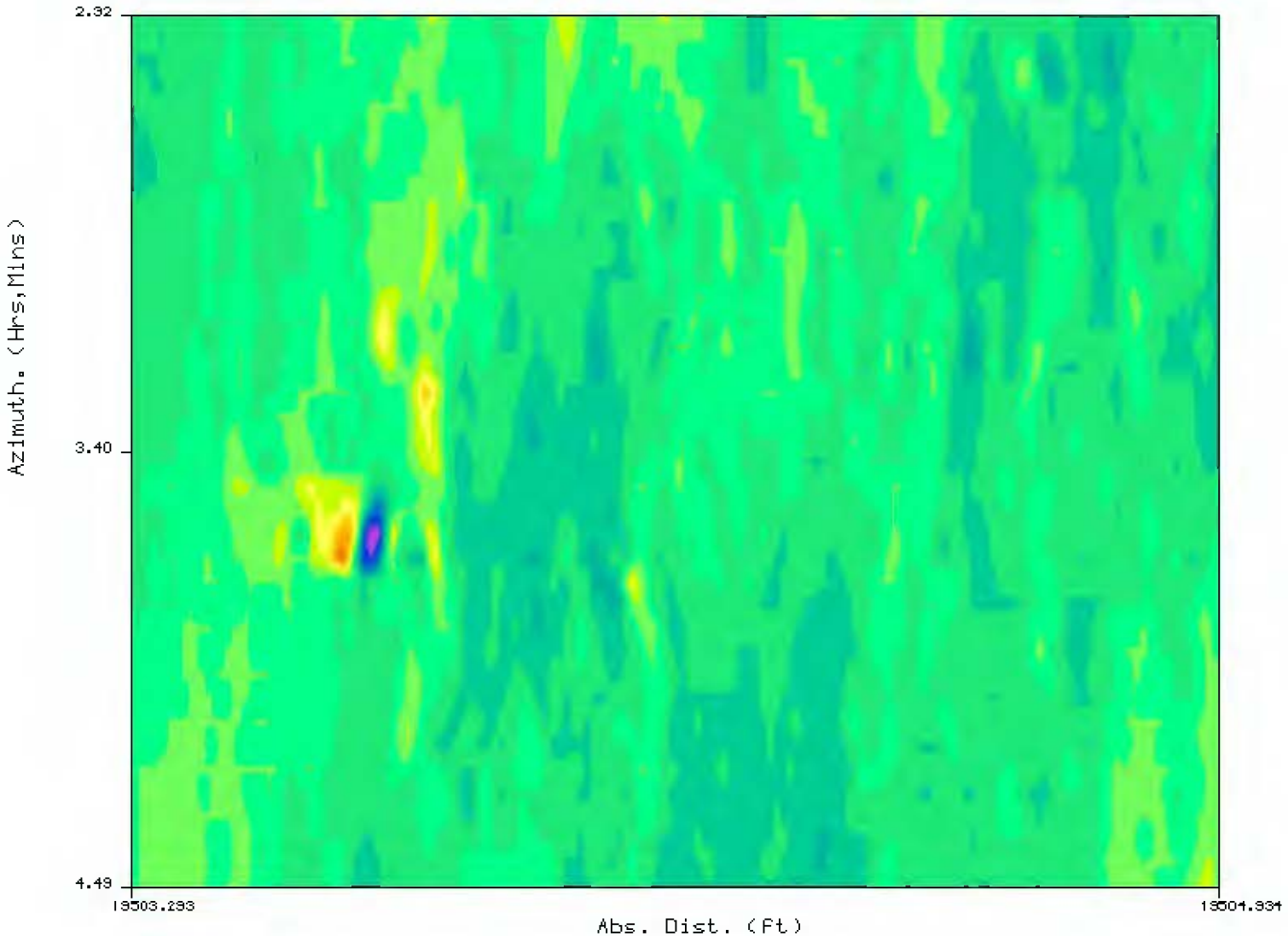


← **Straits of Mackinac (East Leg)** →

Feature 13 Overview Plot 109170_20B



Feature 13 Detail Contour Plot 109170_20B



Inspection Sheet Number 14 — 109170_20B

Feature Description

Type:	External Mill/Manufacturing Fault
Orientation:	10:35 (o'clock)
Axial length:	12.8 in
Circumferential width:	7.3 in
Depth - Peak:	31% WT
- Average:	16% WT
Feature Selection Rule:	8
Nominal Pipe wall thickness for spool:	0.812 in
Absolute Distance from Launch:	20356.745 feet

Comments:

This metal loss feature has the appearance of a mill/manufacturing fault.
There is another metal loss feature within this spool.
More information on this feature is given in the Pipeline Listing.

Feature Location

Primary Reference/s:

1. BALL VALVE - MP 1475.74
   (Girth Weld 30 + 1.818ft)

2. BALL VALVE - MP 1479.77
   (Girth Weld 8720 + 1.847ft)

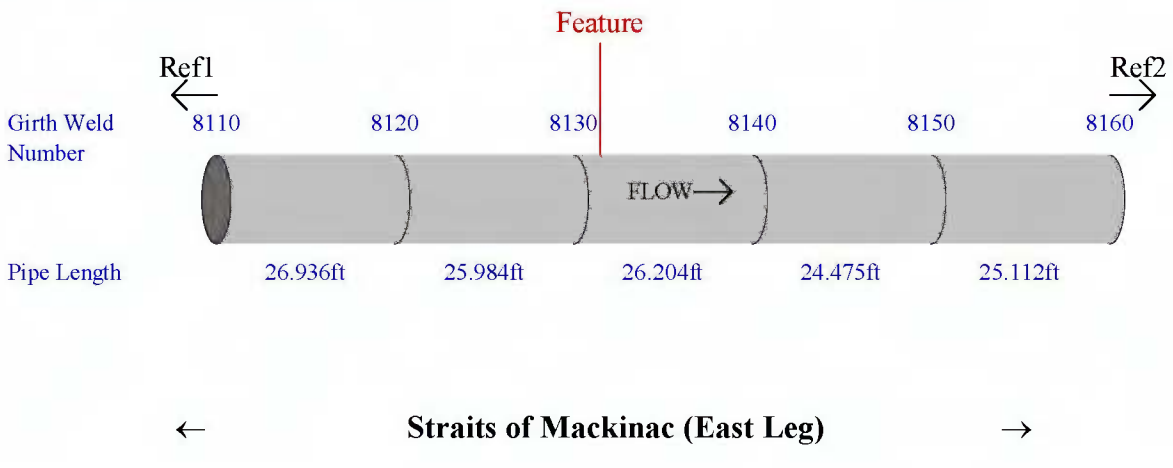
Reference Girth Weld:

The reference girth weld at the Straits of Mackinac (East Leg) (upstream) end of the feature spool is number 8130.
The location of this weld is 20297.156 feet downstream from reference 1 and 1405.390 feet upstream from reference 2.

Feature:

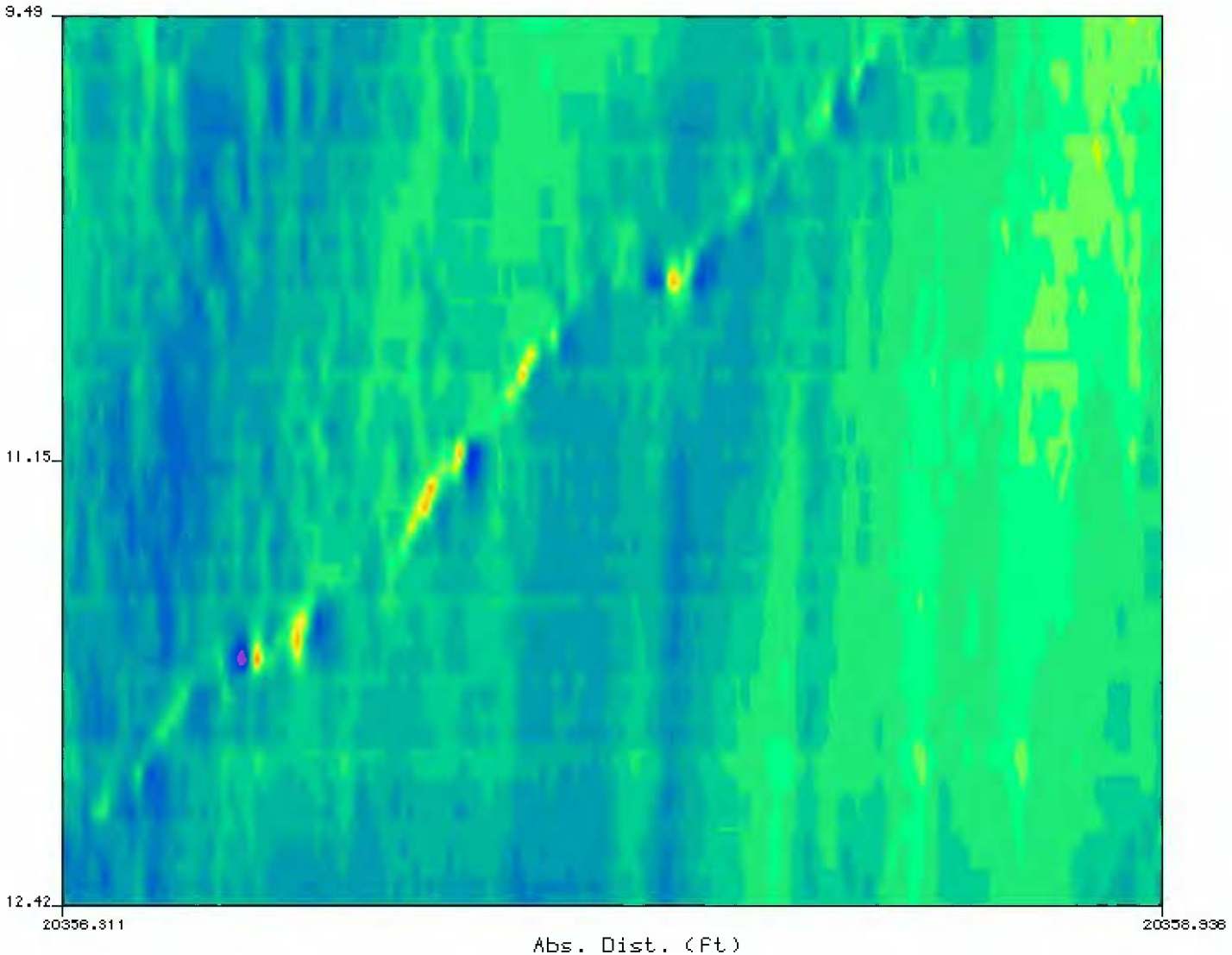
The feature is located 3.793 feet downstream from the reference girth weld.

Schematic Location Summary:




Feature 14 Overview Plot 109170_20B
5.14
11.1
5.22
Azimuth (Hrs,Mins)
1.246
Abs. Dist. (Ft)

Feature 14 Detail Contour Plot 109170_20B



Inspection Sheet Number 15 — 109170_20B

Feature Description

Type:	External Mill/Manufacturing Fault
Orientation:	04:20 (o'clock)
Axial length:	7.8 in
Circumferential width:	5.7 in
Depth - Peak:	35% WT
- Average:	19% WT
Feature Selection Rule:	8
Nominal Pipe wall thickness for spool:	0.812 in
Absolute Distance from Launch:	21280.515 feet

Comments:

This metal loss feature has the appearance of a mill/manufacturing fault.
This is the deepest metal loss feature within the pipeline.
There are other metal loss features within this spool.
More information on these features is given in the Pipeline Listing.

Feature Location

Primary Reference/s:

1. BALL VALVE - MP 1475.74
   (Girth Weld 30 + 1.818ft)

2. BALL VALVE - MP 1479.77
   (Girth Weld 8720 + 1.847ft)

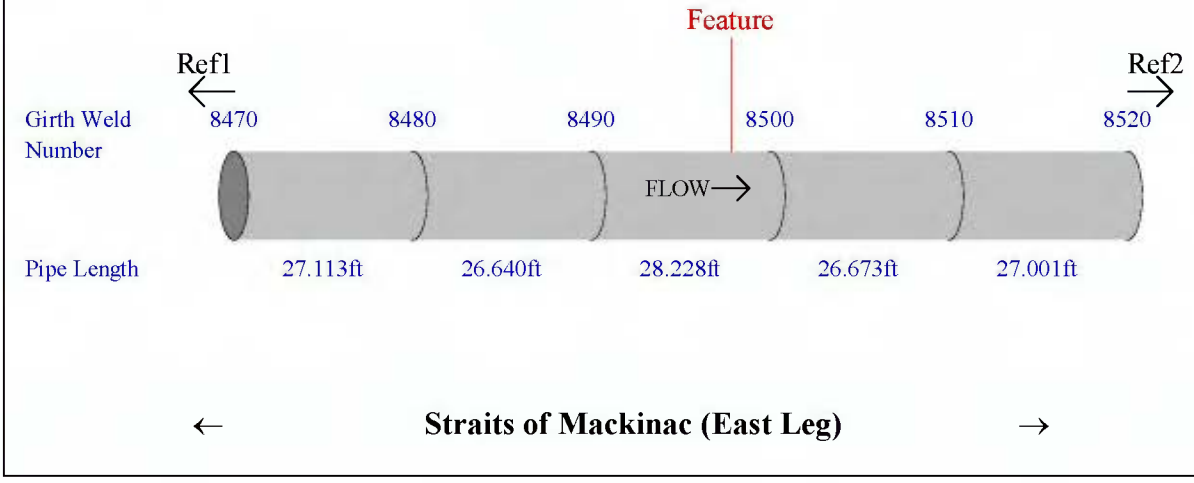
Reference Girth Weld:

The upstream reference girth weld of the feature spool is number 8490.
The location of this weld is 21202.700 feet downstream from reference 1 and 499.846 feet upstream from reference 2.

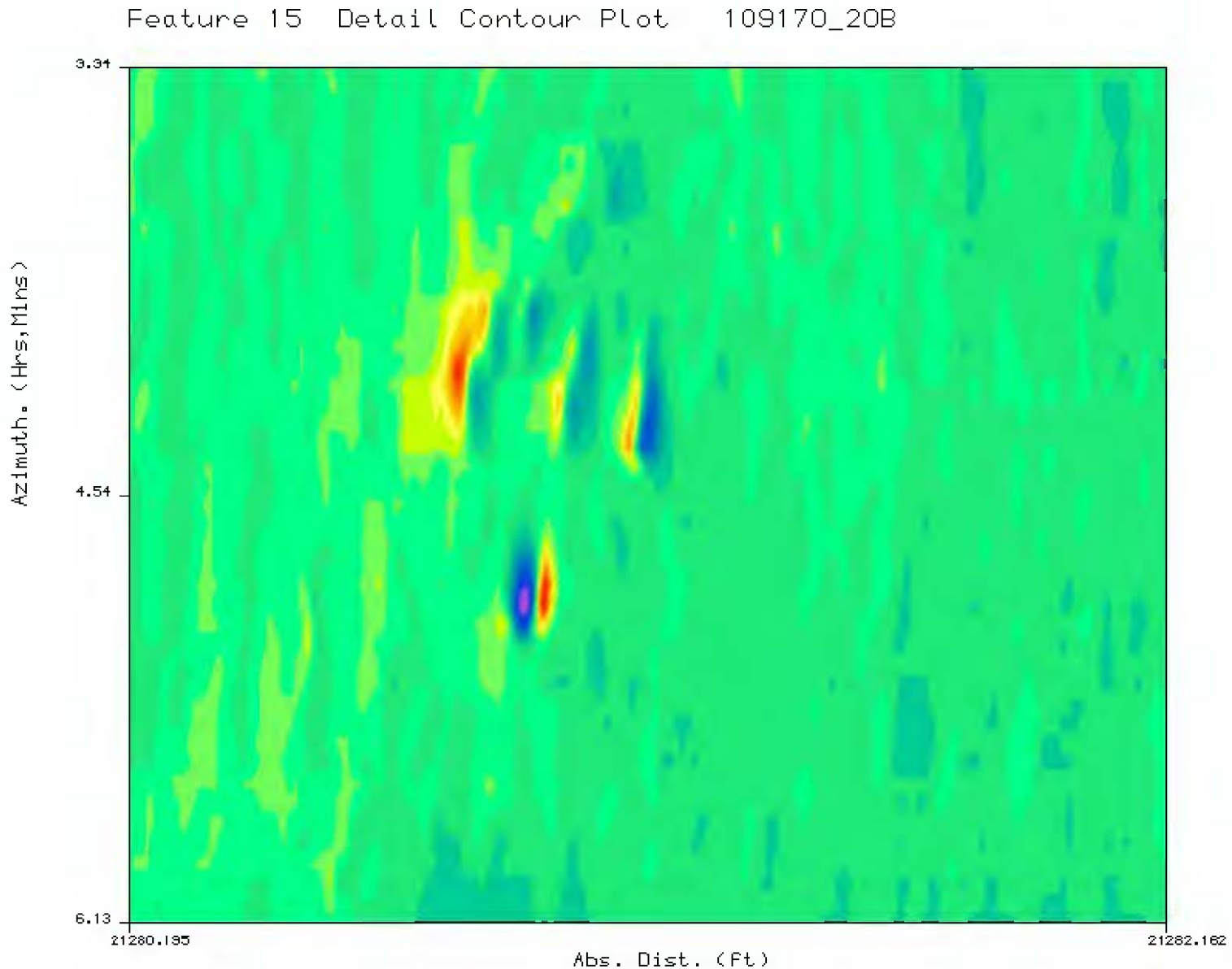
Feature:

The feature is located 22.018 feet downstream from the reference girth weld.

Schematic Location Summary:




Feature 15 Overview Plot 109170_20B
11.1
5.13
11.1
Azimuth (Hrs,Mins)
Abs. Dist. (Ft)


Feature 15 Detail Contour Plot 109170_20B
3.34
4.54
6.13
Azimuth. (Hrs,Mins)
21280.195
21282.162
Abs. Dist. (Ft)

Pressure Based Pipeline Summary Report

The Pressure Based Pipeline Summary Report provides an overview of the pipeline condition.

3.1. Metal Loss Information

This section provides summaries of all the metal loss features detected along the pipeline in the following formats:

- Pressure Sentenced Plot
- Pressure Based Histograms
- Depth Based Histograms
- Orientation Plot
- Severity Table

ENBDNR0000797

3.1.1. Pressure Sentenced Plot

The pressure sentenced plot shows the relative significance of each detected metal loss feature.

Metal loss features that have been identified as manufacturing faults are not included on the pressure sentenced plot.

The significance of each metal loss feature has been assessed using the pressure sentencing formulae as supplied by the client and defined in the Appendix to the Specification for the Pipeline Inspection Report (Appendix F).

These formulae depend on the following five variables;

two measured by the GE Oil & Gas, PII Pipeline Solutions inspection system:

- the predicted peak depth of the metal loss feature, or the area ratio if the metal loss feature consists of two or more metal losses that have been clustered together;
- the predicted axial length of the metal loss feature, or the overall predicted axial length if the metal loss feature consists of two or more metal losses that have been clustered together;

and three specified by the pipeline operator:

- the external pipe radius (r);
- the nominal pipe wall thickness (nwt); and,
- the Specified Minimum Yield Strength (SMYS).

The pressure sentenced plot shows the relative significance of each metal loss feature by plotting the sentenced depth of the metal loss feature against its predicted axial length and by indicating on the graph the appropriate curve that represents an RPR of 1. The curve representing an RPR of 1 will move if any of the values for r, nwt, or SMYS change.

Those metal loss features with RPR values <1 will be plotted above the curve. The lower the value, the higher the significance and the further away from the curve the metal loss feature will be plotted.

The report contains one pressure sentenced plot for each major pipeline segment defined by the pipeline operator. Only those metal loss features within the major segment, and any minor segments within the major segment, are shown on the respective pressure sentenced plot. The RPR unity curve is calculated using the values of r, nwt, and SMYS that have been specified for the major segment by the pipeline operator; these values are also given on each plot.

A pressure sentenced plot will not be provided if the major segment does not contain any metal loss features.

ENBDNR0000798

A list of the major segments and the values of nwt and SMYS that apply within each segment are provided in the nominal wall thickness listing presented in Section 3.2.8. The value for r is assumed to be constant throughout the pipeline.

There are four symbols used on the pressure sentenced plot to represent metal loss features. These are:

+	The metal loss feature is within the major segment. That is the spool containing the metal loss feature has pipeline parameters equal to those used to calculate the RPR unity curve.
⊕	The metal loss feature is reported on an inspection sheet and is within the major segment.
Δ	The metal loss feature is within a minor segment. That is the spool containing the metal loss feature has pipeline parameters different to those used to calculate the RPR unity curve.
⊚	The metal loss feature is reported on an inspection sheet and is within a minor segment.

Each pressure sentenced plot is presented overleaf.

ENBDNR0000799

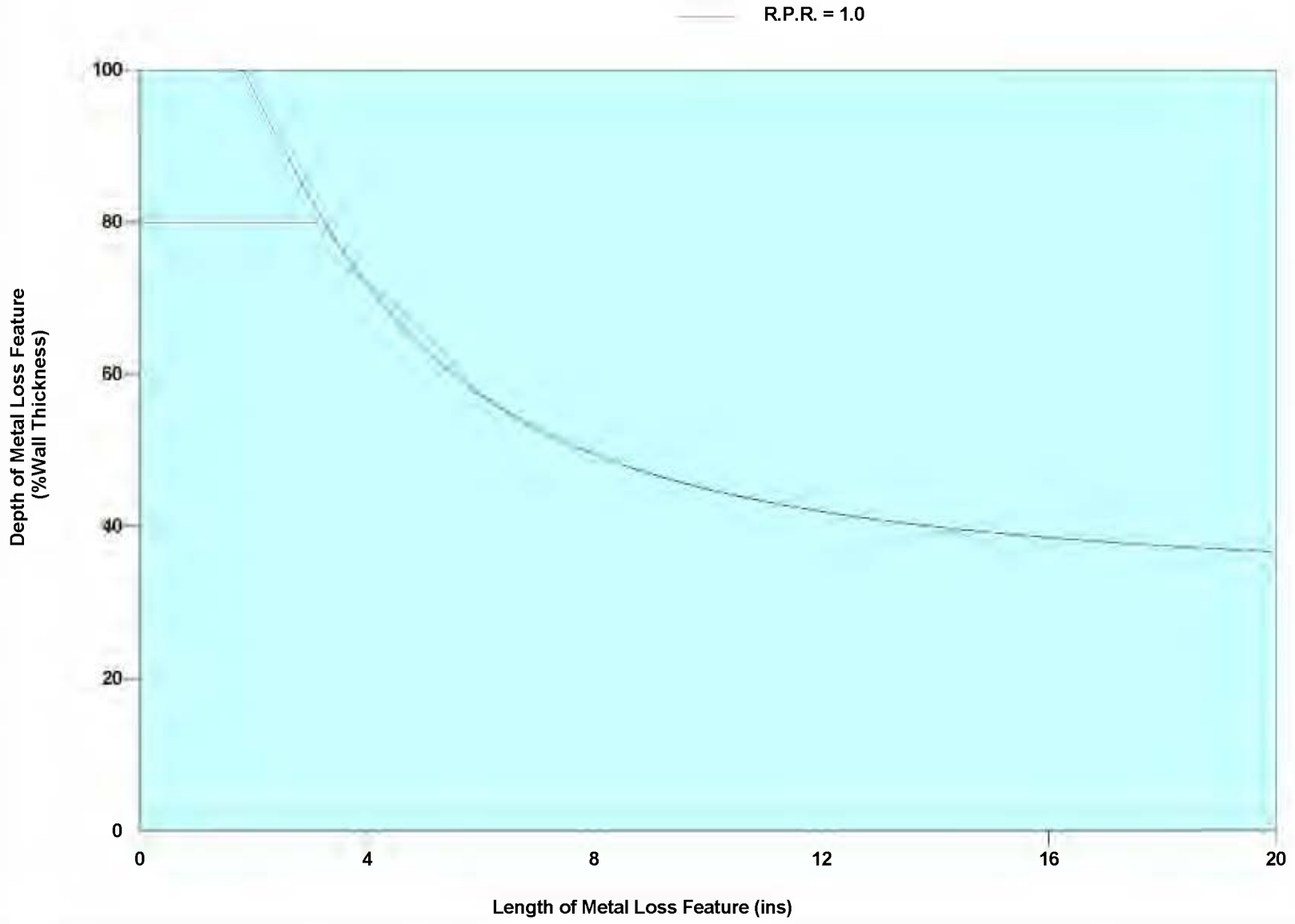
SENTENCED PLOT

Straits of Mackinac (East Leg)

Major Segment 1

External Diameter 20 ins
Wall Thickness 0.812 ins
SMYS 30000.0 PSI

109170_20B
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3.1.2. Pressure Based Histograms

The pressure based histograms show the distribution of the most significant metal loss features along the pipeline.

Metal loss features that have been identified as manufacturing faults are not included in the pressure based histograms.

The significance of each metal loss feature has been assessed using the pressure sentencing formulae supplied by the client and defined in the Appendix to the Specification for the Pipeline Inspection Report (Appendix F).

Each pressure based histogram shows the distribution along the pipeline of those metal loss features with RPR values below a chosen pressure sentenced threshold.

Each bar on the histogram represents the number of occurrences within a 50 ft section of the pipeline.

The pressure sentenced thresholds chosen to highlight the most significant metal loss features are as follows:

- all metal loss features with RPR values <0.850
- all metal loss features with RPR values <1.000
- all metal loss features with RPR values <1.100

Summarising from the histograms:

0 metal loss features with RPR values <0.850

0 metal loss features with RPR values <1.000

0 metal loss features with RPR values <1.100

In addition, a single three-dimensional summary histogram is included which shows the distribution along the pipeline of those metal loss features with RPR values below each of the chosen pressure sentenced thresholds.

The pressure based histograms are presented overleaf.

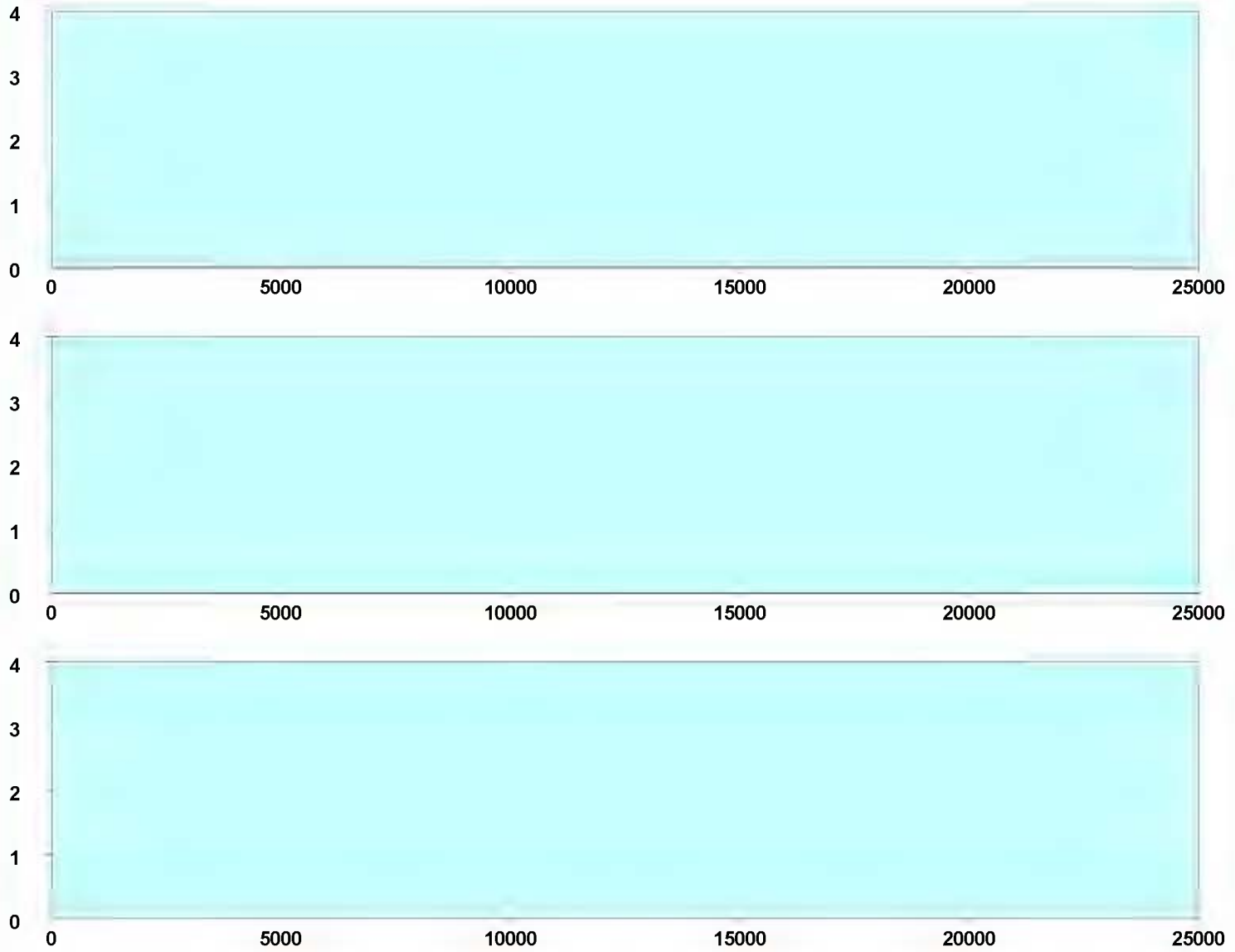
ENBDNR0000801

Number of Metal Loss Features

PRESSURE BASED HISTOGRAM

Straits of Mackinac (East Leg)

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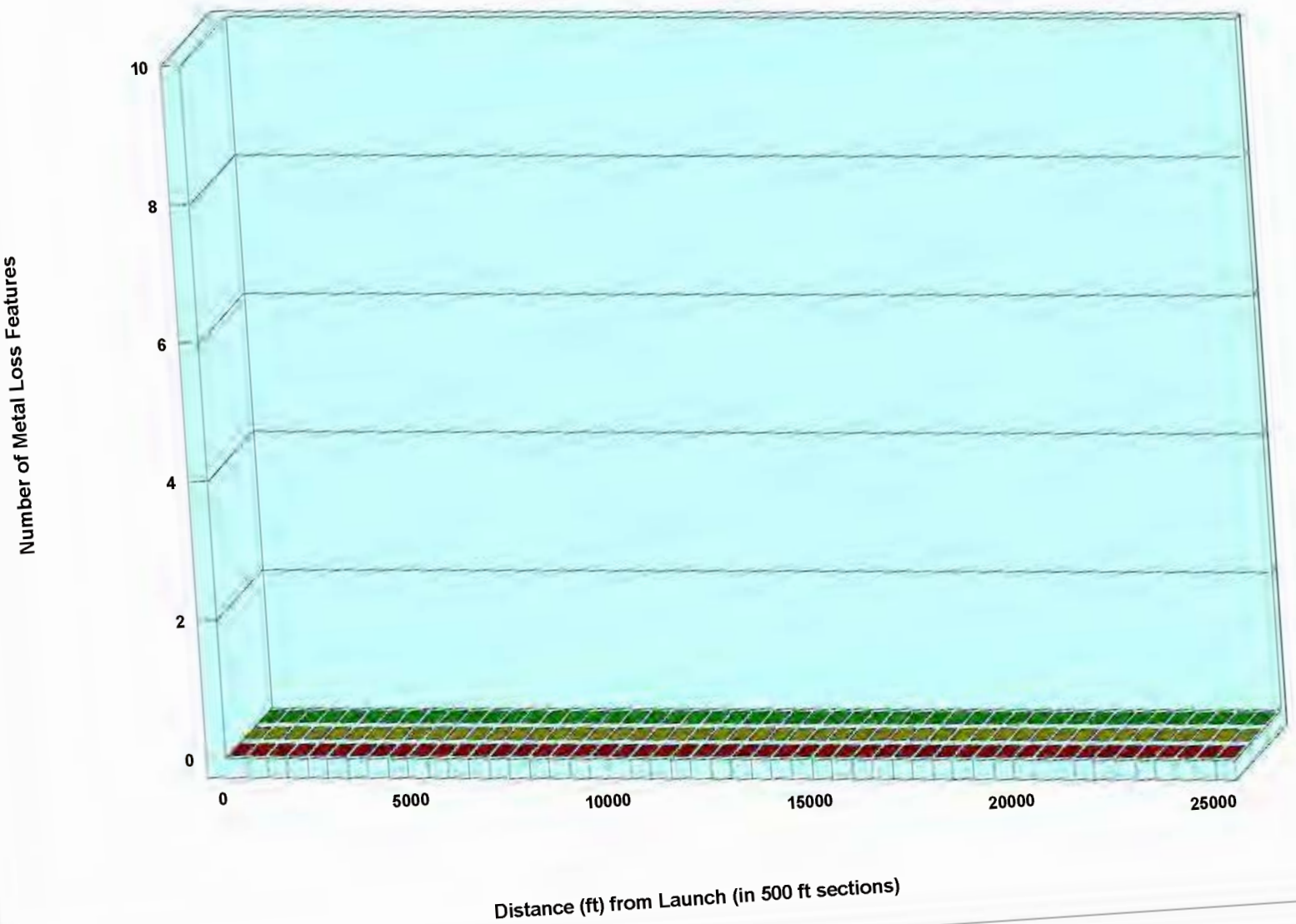


PRESSURE BASED HISTOGRAM

Straits of Mackinac (East Leg) to -

R.P.R. < 1.350
R.P.R. < 1.100
R.P.R. < 1.000

109170_20B
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3.1.3. Depth Based Histograms

The depth based histograms show the distribution of all detected metal loss features along the pipeline.

Twelve histograms are presented in this section:

- three ungraded metal loss histograms
- eight graded metal loss histograms
- one three-dimensional summary histogram

Ungraded Metal Loss Histograms

The total metal loss histogram shows the distribution of all metal loss features along the pipeline. Each bar on the histogram represents the number of occurrences within a 50 ft section of the pipeline.

The area metal loss histogram shows how much of the pipe surface has been affected by metal loss. Each bar on the histogram represents the total surface area of the metal loss within a 50 ft section of the pipeline. This is expressed as a percentage of the surface area of an undamaged pipe section.

The volume metal loss histogram shows how the volume of metal in the pipeline has been affected by metal loss. Each bar on the histogram represents the total volume of the metal loss features within a 50 ft section of the pipeline. This is expressed as a percentage of the volume of metal in an undamaged pipe section.

Graded Metal Loss Histograms

The metal loss features are graded into eight categories, which are derived from combinations of two length and four predicted peak depth categories.

There is one graded metal loss histogram for each category. Each bar on the histogram represents the number of occurrences within a 50 ft section of the pipeline.

Summarising from the histograms, a total of **139** metal loss features have been identified within the pipeline. These have been graded as follows:

108 metal loss features with predicted axial lengths ≤ 3t.
Of these:

17	have a predicted peak depth of ≤ 10%t.
35	have a predicted peak depth of > 10%t and ≤ 20%t.
56	have a predicted peak depth of > 20%t and ≤ 40%t.
0	have a predicted peak depth of > 40%t.

31 metal loss features with a predicted length > 3t.
Of these:

1	have a predicted peak depth of ≤ 10%t.
7	have a predicted peak depth of > 10%t and ≤ 20%t.
23	have a predicted peak depth of > 20%t and ≤ 40%t.
0	have a predicted peak depth of > 40%t.

Three-Dimensional Summary Histogram

The metal loss features are graded into nine depth categories and displayed on a single three-dimensional histogram. Each bar on the summary histogram represents the number of metal loss occurrences within the appropriate depth category for a specific section of the pipeline.

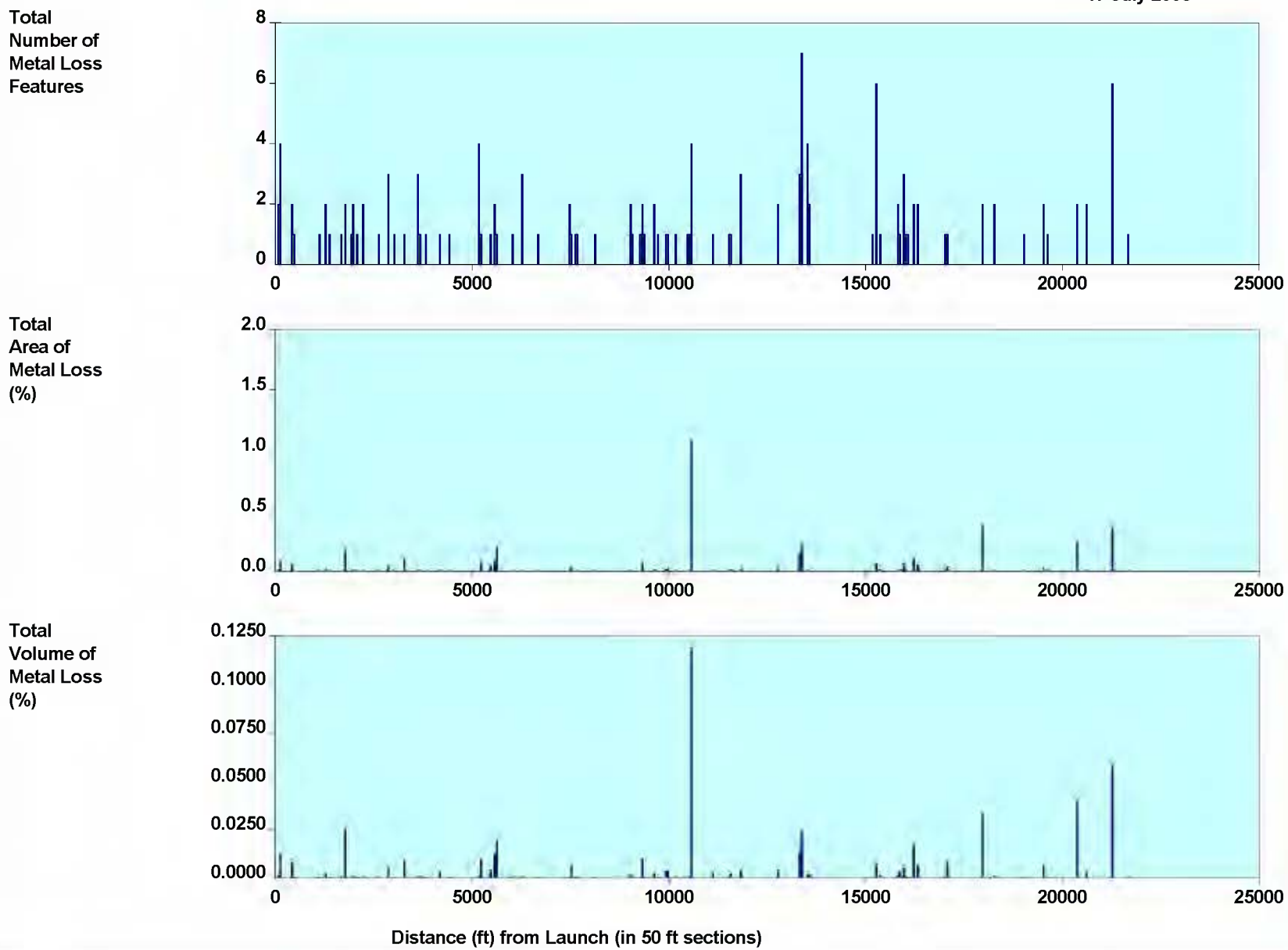
The histograms are presented on four pages overleaf.

ENBDNR0000805

DEPTH BASED HISTOGRAM - ALL METAL LOSS

Straits of Mackinac (East Leg)

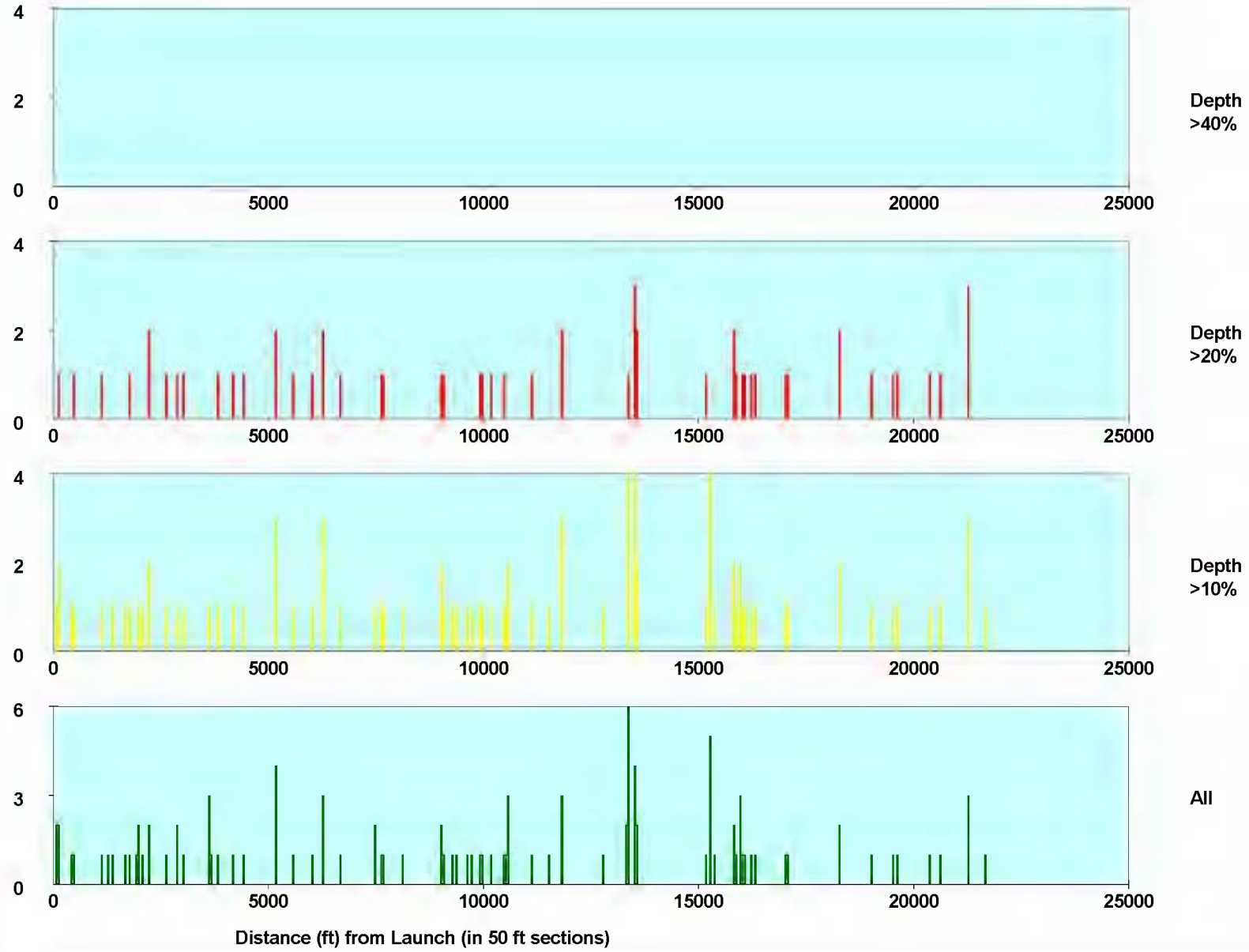
109170_20B
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Number of
Metal Loss
Features

DEPTH BASED HISTOGRAM
Axial Length ≤ 3t
Straits of Mackinac (East Leg)

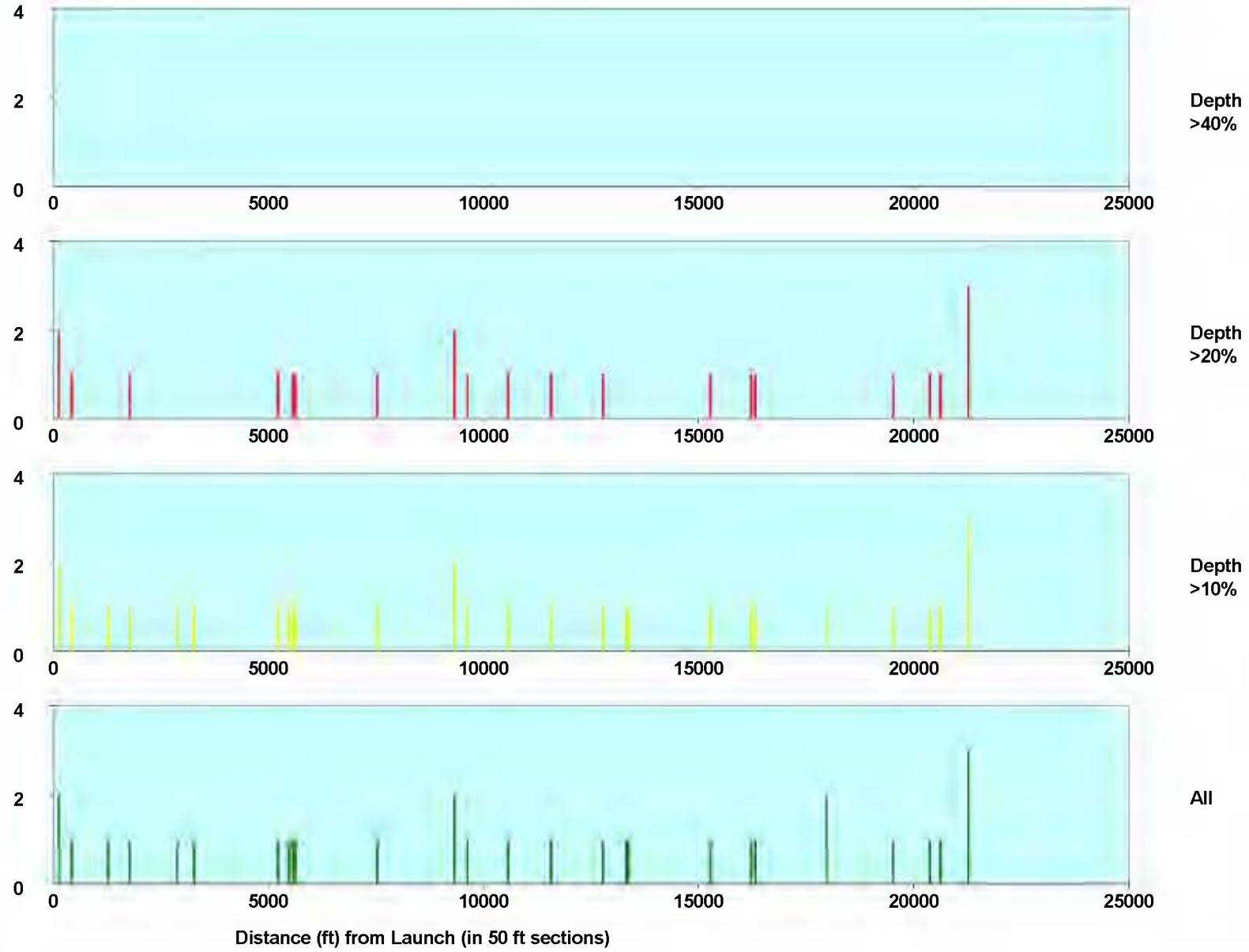
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Number of
Metal Loss
Features

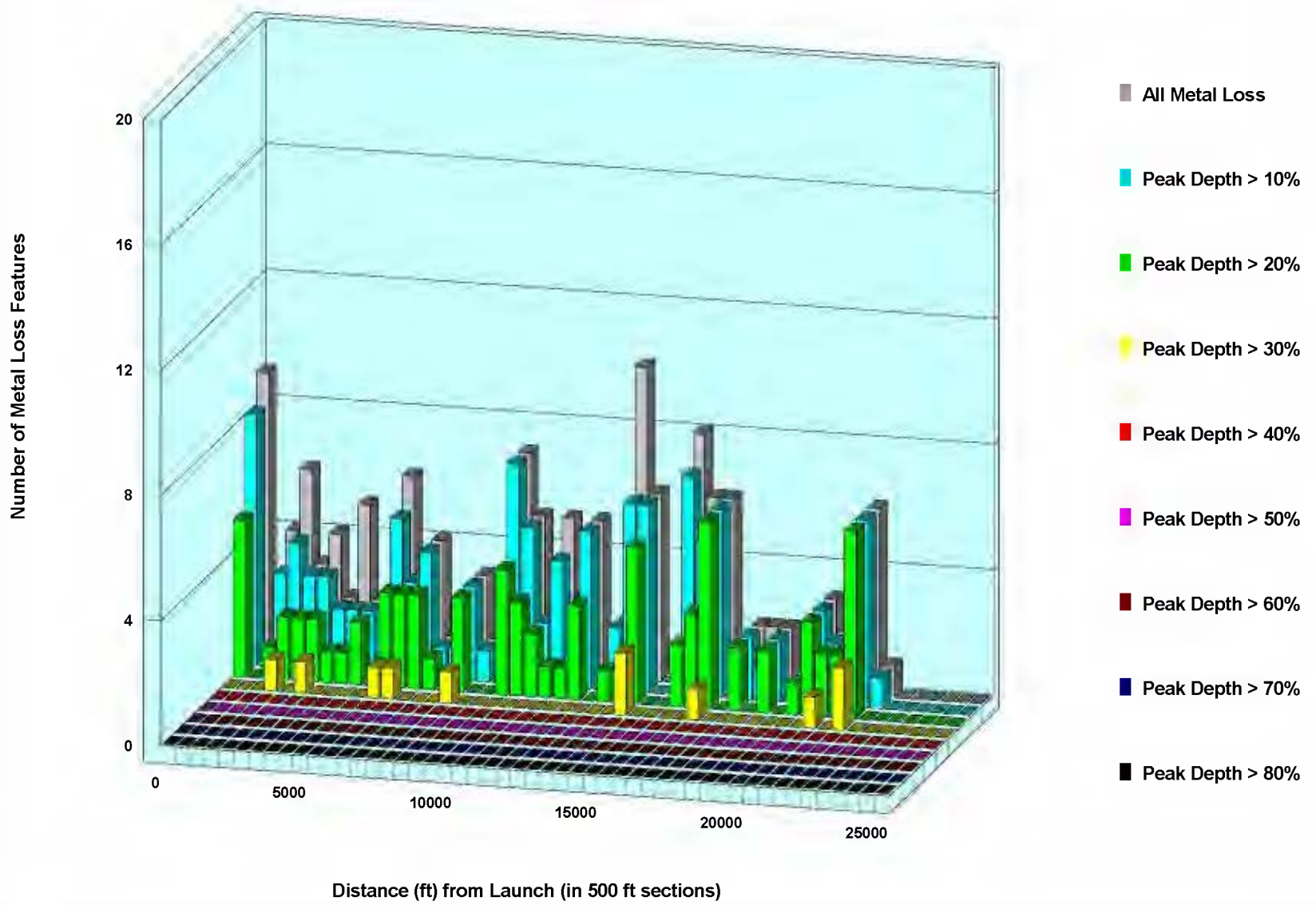
DEPTH BASED HISTOGRAM
Axial Length > 3t
Straits of Mackinac (East Leg)

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DEPTH BASED HISTOGRAM

Straits of Mackinac (East Leg)



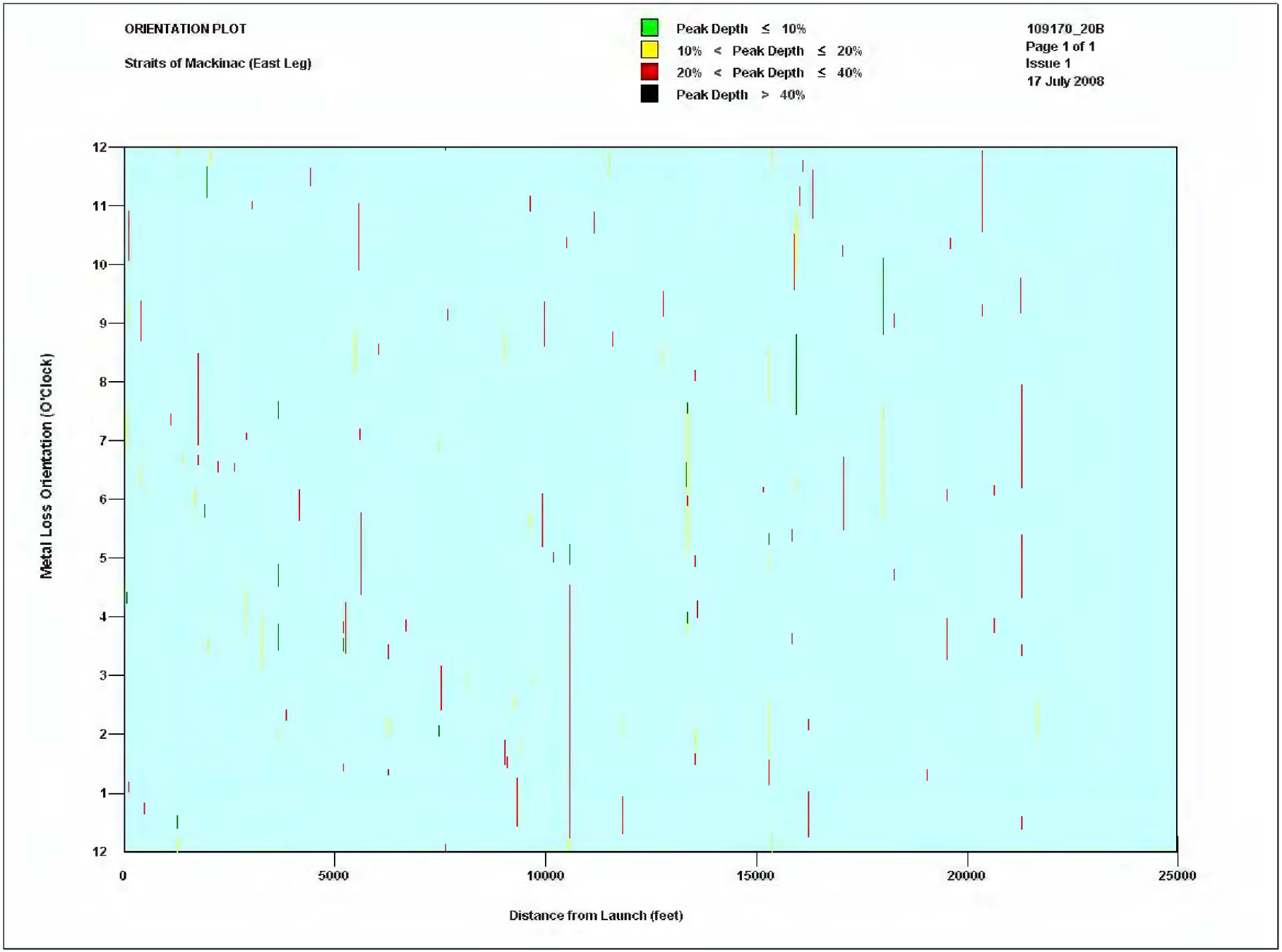
3.1.4. Orientation Plot

The orientation plot shows the location and extent of each metal loss feature around the pipe's circumference.

The absolute distance from the launch is plotted against the orientation of the metal loss. The orientation is based on a 12 hour clock as viewed in the direction of product flow; for example, twelve indicates the top of the pipe and six indicates the bottom.

For each metal loss feature a box is drawn on the plot showing the predicted circumferential and axial extent of the metal loss feature. Due to the scale along the distance axis, each metal loss feature appears as a solid vertical line on the plot.

The orientation plot is presented overleaf.


ORIENTATION PLOT
Straits of Mackinac (East Leg)
Peak Depth ≤ 10%
10% < Peak Depth ≤ 20%
20% < Peak Depth ≤ 40%
Peak Depth > 40%
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Metal Loss Orientation (O'Clock)
12
11
10
9
8
7
6
5
4
3
2
1
12
0
5000
10000
15000
20000
25000
Distance from Launch (feet)

3.1.5. Severity Table

The severity table identifies those pipe spools which contain the most severe metal loss features.

Only the worst metal loss feature in each spool is considered and these are listed in severity order as defined by the selection rules specified in the Specification for the Pipeline Inspection Report contained in the contract (Appendix F).

The severity table lists the twenty-five pipe spools which contain the most severe metal loss features. Metal loss features that have been identified as manufacturing faults are included in the severity table.

The RPR value for undamaged pipe is 1.333.

The severity table is presented overleaf.

Severity Table

Straits of Mackinac (East Leg)

Feature Selection Rule	RPR	Peak Depth (%)	Axial Length (in)	Upstream Girth Weld Number	Absolute Distance (feet)	Orientation (hrs:mins)
8	-	35	7.8	8490	21280.52	04:20
8	-	34	0.5	780	1759.07	06:35
8	-	34	5.0	2280	5571.04	09:55
8	-	34	9.6	6480	16237.04	12:15
8	-	33	0.7	1110	2608.23	06:30
8	-	33	0.3	2140	5197.81	01:25
8	-	32	2.0	5420	13595.53	04:05
8	-	31	0.6	3100	7678.82	09:05
8	-	31	0.5	5400	13539.42	01:30
8	-	31	12.8	8130	20356.75	10:35
8	-	30	0.6	960	2228.91	06:30
8	-	30	0.5	1600	3833.44	02:15
8	-	30	2.2	4480	11144.67	10:35
8	-	30	0.9	6320	15888.14	09:35
8	-	30	0.6	7290	18269.49	04:40
8	-	30	2.5	7790	19503.58	03:15
8	-	29	0.8	2470	6041.97	08:30
8	-	29	0.5	3070	7616.62	11:55
8	-	29	1.0	3990	9917.57	05:10
8	-	29	4.5	6510	16326.03	10:50
8	-	29	0.5	8240	20642.91	06:05
8	-	28	0.4	2550	6263.79	01:20
8	-	28	2.2	4010	9967.73	08:35
8	-	28	4.5	5110	12784.33	09:10
8	-	28	2.3	6810	17060.79	05:30

3.2. Pipeline Information

The Pipeline Information section presents summaries of any pipeline anomalies, repairs, location reference points and changes in the nominal pipe wall thickness along the pipeline. The following summaries are provided:

- Velocity Plot
- Metal Object Report
- Eccentric Casing Report
- Dent Report
- Girth Weld Anomaly Report
- Repair Listing
- Location Reference Point Listing
- Nominal Wall Thickness Listing

3.2.1. Velocity Plot

The velocity plot shows the speed of the inspection vehicle during the inspection run.

The red line on the velocity plot indicates the specified maximum velocity for the inspection vehicle. If the vehicle exceeds the specified maximum velocity then the performance of the inspection vehicle may be degraded.

The inspection vehicle did not exceed the specified maximum velocity during the inspection survey.

The inspection vehicle's average velocity during the inspection run was 9.2 ft/s.

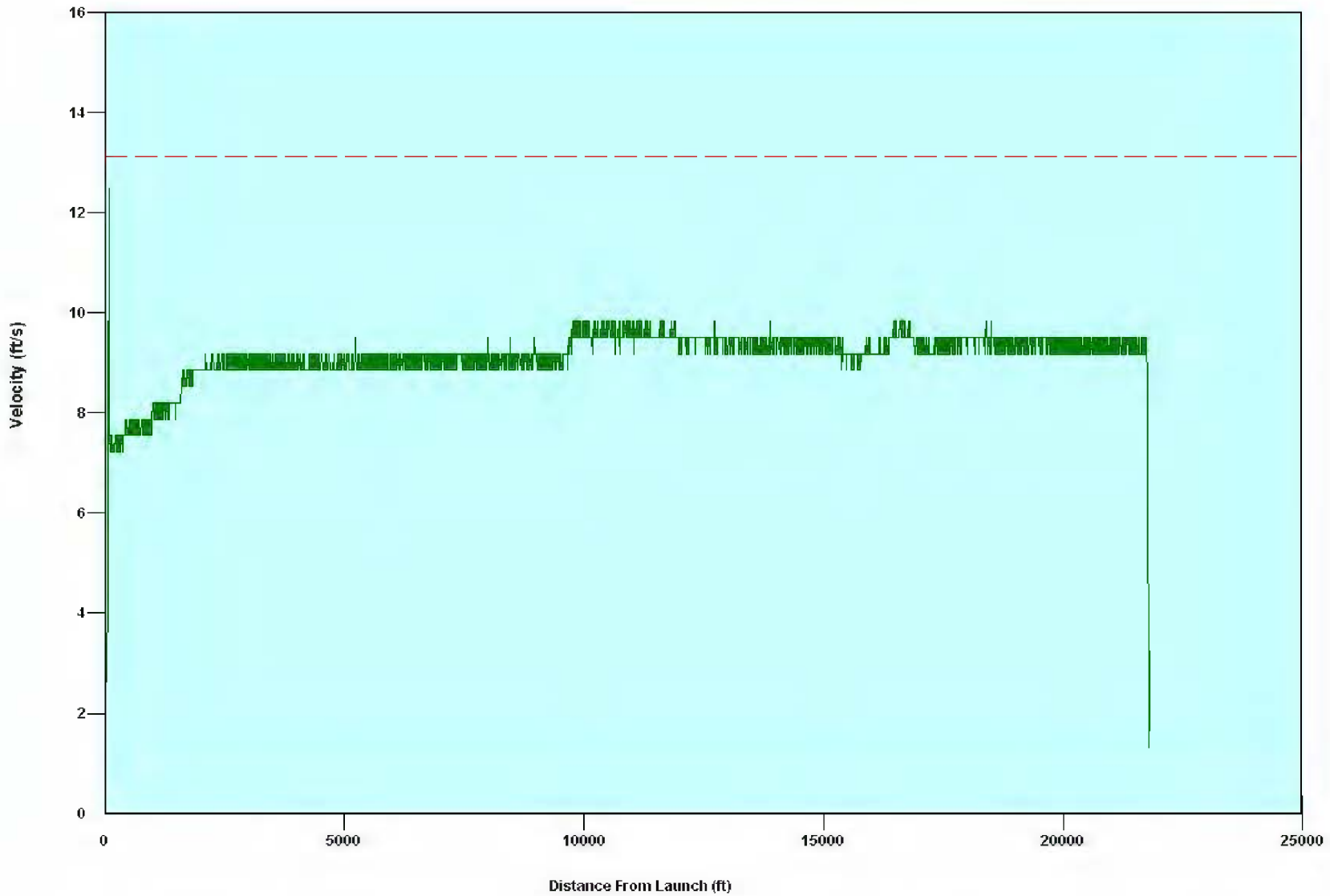
The velocity profile plot is presented overleaf.

VELOCITY PLOT

Straits of Mackinac (East Leg)

Contractual Maximum Velocity

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3.2.2. Metal Object Report

The metal object report provides a list of all ferrous metal objects that have been detected along the pipeline.

Metal objects can be potentially hazardous to the pipeline. They can impair the pipeline's protective coating or the cathodic protection system, and over time they can also dent or damage the pipe itself.

Metal objects are classified as close to or touching the pipeline. Those metal objects classified as touching are considered to have damaged the pipeline's protective coating or impaired the cathodic protection system. Metal objects that are considered to be part of the pipeline build, such as supports but excluding attachments, will only be reported if they are touching the pipeline. Pipeline casings that are touching the pipe will be reported in the eccentric pipeline casing report presented in Section 3.2.3.

No metal objects have been detected during this pipeline inspection.

3.2.3. Eccentric Casing Report

The eccentric casing report provides a list of all casings detected along the pipeline which appear to be eccentric to the pipe and may, therefore, have damaged the pipeline's protective coating or impaired the cathodic protection system.

No eccentric casings have been detected during this pipeline inspection.

3.2.4. Dent Report

The dent report provides a list of all dents that have been detected along the pipeline.

The proximity of dents to metal losses, girth welds and seam welds is indicated in the report. If the orientation of a seam weld is unclear in the data then the dent proximity will be marked '***'.

Dents will affect the integrity of the pipeline and are potentially dangerous. It should be noted that a dent associated with metal loss is potentially more significant than a dent alone.

A Calipper inspection of the pipeline was completed by GE Oil & Gas, PII Pipeline Solutions on the 9th of May 2008. The Calipper survey detected no dents with an Internal Diameter (ID) reduction in excess of 2%OD.

13 dents have been detected during this pipeline inspection.

A table listing the dents is presented overleaf.

Dent Report

Straits of Mackinac (East Leg)

Upstream Girth Weld	Relative Distance (feet)	Absolute Distance (feet)	Associated Metal Loss	Associated Girth Weld	Associated Seam Weld	% ID Reduction	Orientation (hrs:mins)	Upstream Reference	Distance U/S Ref. to Girth Weld (feet)	Downstream Reference	Distance D/S Ref. to Girth Weld (feet)
1400	1.65	3338.60	NO	NO	NO	<2% ID REDUCTION	10:00	BALL VALVE - MP 1475.74	3281.15	BALL VALVE - MP 1479.77	18421.40
2190	2.54	5322.12	NO	NO	NO	<2% ID REDUCTION	03:30	BALL VALVE - MP 1475.74	5263.78	BALL VALVE - MP 1479.77	16438.77
2910	23.81	7203.49	NO	NO	NO	<2% ID REDUCTION	03:30	BALL VALVE - MP 1475.74	7123.89	BALL VALVE - MP 1479.77	14578.66
3040	24.15	7537.05	NO	NO	NO	<2% ID REDUCTION	06:30	BALL VALVE - MP 1475.74	7457.11	BALL VALVE - MP 1479.77	14245.44
3510	24.35	8711.39	NO	NO	NO	<2% ID REDUCTION	08:30	BALL VALVE - MP 1475.74	8631.24	BALL VALVE - MP 1479.77	13071.30
5680	25.25	14273.47	NO	NO	NO	<2% ID REDUCTION	07:30	BALL VALVE - MP 1475.74	14192.42	BALL VALVE - MP 1479.77	7510.13
5720	23.58	14378.10	NO	NO	NO	<2% ID REDUCTION	05:30	BALL VALVE - MP 1475.74	14298.72	BALL VALVE - MP 1479.77	7403.83
5890	21.95	14810.42	NO	NO	NO	<2% ID REDUCTION	04:45	BALL VALVE - MP 1475.74	14732.67	BALL VALVE - MP 1479.77	6969.87
7320	2.37	18338.19	NO	NO	NO	<2% ID REDUCTION	02:00	BALL VALVE - MP 1475.74	18280.02	BALL VALVE - MP 1479.77	3422.53
7350	0.64	18408.94	NO	NO	NO	<2% ID REDUCTION	06:00	BALL VALVE - MP 1475.74	18352.50	BALL VALVE - MP 1479.77	3350.04
7480	3.43	18717.01	NO	NO	NO	<2% ID REDUCTION	02:00	BALL VALVE - MP 1475.74	18657.78	BALL VALVE - MP 1479.77	3044.77
7920	19.61	19840.29	NO	NO	NO	<2% ID REDUCTION	01:15	BALL VALVE - MP 1475.74	19764.88	BALL VALVE - MP 1479.77	1937.66
8180	20.94	20501.53	NO	NO	NO	<2% ID REDUCTION	01:30	BALL VALVE - MP 1475.74	20424.79	BALL VALVE - MP 1479.77	1277.75

3.2.5. Girth Weld Anomaly Report

The girth weld anomaly report provides a list of all significant girth weld anomalies that have been detected along the pipeline.

Incomplete welds and circumferential cracks within the weld are examples of girth weld anomalies.

No girth weld anomalies have been detected during this pipeline inspection.

ENBDNR0000821

3.2.6. Repair Listing

The repair listing provides a list of all fully circumferential repair shells and patch repaired spools that have been detected along the pipeline.

It should be noted that any metal loss detected beneath a repair shell or repair patch will not be included in the inspection analysis.

If a patch repair is detected within the spool then the spool will be reported on this listing as a patch repaired spool. Details of the individual patch repairs within the patch repaired spool will not normally be provided.

The inspection system has detected **no repair shells** and **no patch repaired spools** during this pipeline inspection.

3.2.7. Location Reference Point Listing

This is a list of the line markers (timer boxes), magnets, mainline valves, offtakes and anodes, as appropriate, that have been detected by the inspection system and that can be used to locate features along the pipeline.

Line markers were not used on the inspection survey.

A table listing the location reference points along the pipeline is presented overleaf.

Location Reference Point Listing

Straits of Mackinac (East Leg)

Upstream Girth Weld	Relative Distance (feet)	Absolute Distance (feet)	Comment	Identification
30	1.82	55.80	BALL VALVE	MP 1475.74
8720	1.85	21758.34	BALL VALVE	MP 1479.77

3.2.8. Nominal Wall Thickness Listing

The nominal wall thickness listing provides a list of the locations along the pipeline where a change in the nominal pipe wall thickness, or other parameter of the pipeline, has been detected by the inspection system. This listing identifies the major and minor pipeline segments used during the analysis of the inspection data.

A pipeline segment is a section of the pipeline where the nominal wall thickness (nwt) and the SMYS are constant.

Pipeline segments can be categorised as either major or minor segments.

A major segment is a pipeline segment that has been defined by the pipeline operator in the table provided in the Company Defined Operating Parameters section of the contract. In this table the pipeline operator specifies the locations of the start and end of the segment and the values of nwt and SMYS that apply within it.

A minor segment is a pipeline segment identified by the inspection system. The minor segment is a section within the major segment where the nominal wall thickness is distinctly different from that detected for the major segment.

In the absence of information from the pipeline operator, the SMYS value for the minor segment will be assumed to be the same as that specified for the major segment in which it is located.

The nominal wall thickness within the minor segment will be estimated from readings obtained from the inspection survey. The estimated nominal wall thickness will be either a wall thickness stated by the pipeline operator as being present in the pipeline, or the nearest American Petroleum Institute (API) nominal wall thickness.

The values of nwt and SMYS specified for each segment are used to calculate the RPR value of each metal loss feature detected within the segment.

A table listing the pipeline segments is presented overleaf.

Nominal Wall Thickness Listing

Straits of Mackinac (East Leg)

Upstream Girth Weld	Absolute Distance (feet)	Length of Segment (feet)	NWT (in)	Segment Number	SMYS (PSI)
10	23.78	21794.31	0.812	1	30000

3.3. Pipeline Listing

The pipeline listing presents the sequence of girth welds, metal loss features, metal objects, eccentric pipeline casings, dents, girth weld anomalies and repairs detected along the pipeline. Location reference points and changes in the nominal pipe wall thickness are also included in the pipeline listing.

The listing also contains all other pipeline tally information.

There are four types of entry in the pipeline listing. These are:

Girth Welds

Each girth weld entry consists of:

- a girth weld number;
- the relative distance along the pipeline to the girth weld from the previous (upstream) girth weld; and,
- the absolute distance from the start of the pipeline.

Metal Loss Features

Each entry for a metal loss feature consists of:

- the relative distance along the pipeline to the upstream edge of the metal loss feature from the previous (upstream) girth weld;
- the absolute distance along the pipeline to the upstream edge of the metal loss feature;
- ML to denote that the entry refers to a metal loss feature;
- EXT or INT to denote whether the metal loss feature is on the external or internal surface of the pipe. It should be noted that mid-wall metal loss features would be classified as external;
- the predicted peak depth of the metal loss feature;
- the predicted axial length of the metal loss feature;
- the predicted circumferential width of the metal loss feature;
- the local wall thickness;
- the orientation of the metal loss feature, as viewed in the direction of flow;
- the calculated RPR value for the metal loss feature;
- the calculated LAPA Pressure value for the metal loss feature;

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- the calculated RPR LAPA value for the metal loss feature;
- a unique Cluster Identifier for the metal loss feature; and,
- those metal loss features which have undergone detailed processing and analysis are indicated by a *. This includes all features reported on inspection sheets.

Please be aware that the RPR values in the Pipeline Listing are allocated to individual features. In the case of future corrosion, increasing depth of individual corrosion features is not the only consideration. Individual features in close proximity may link together through low level corrosion leading to lower net RPR values.

Identified Manufacturing Faults

The entry for an identified manufacturing fault is the same as that for a metal loss feature with the following differences:

- MFG (in place of ML) to denote that the entry refers to an identified manufacturing fault; and,
- there is no calculated RPR value for an identified manufacturing fault.

Pipeline Anomalies and Fittings

Other entries in the pipeline listing relate to pipeline fittings and pipeline anomalies. These entries consist of:

- the relative distance along the pipeline to the fitting or anomaly from the previous (upstream) girth weld;
- the absolute distance along the pipeline to the fitting or anomaly; and,
- a comment describing the fitting or anomaly.

It should be noted that where the orientation of a pipeline fitting has not been specified then the fitting is centred on the 12-00 position.

The pipeline listing is presented overleaf.

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Pipeline Listing

Straits of Mackinac (East Leg)

Upstream Girth Weld	Relative Distance (feet)	Absolute Distance (feet)	Comment	Peak Depth (% wt)	Length (in)	Width (in)	Local Wall Thickness (in)	RPR	Orientation (hrs:mins)	LAPA Pressure (PSI)	LAPA RPR	Cluster Identifier
10	0.00	23.78										
10	0.00	23.78	SEAMLESS START									
20	8.76	32.54										
20	10.63	43.17	25 DEG BEND-COLD UNDER									
20	20.40	52.93	INT MFG	9%	0.51	1.06	0.812		04:15			1
20	20.88	53.41	INT MFG	18%	1.61	2.36	0.812		06:55			2
30	21.45	53.98										
30	0.00	53.98	STRAITS OF MACKINAC (EAST LEG)									
30	1.82	55.80	BALL VALVE - MP 1475.74									
60	3.58	57.56										
70	2.92	60.48										
70	1.30	61.78	16 IN OFFTAKE-FORGED						09:00			
80	2.56	63.04										
80	5.01	68.05	1.0 IN OFFTAKE-WELDOLET						09:00			
80	8.77	71.81	2 IN OFFTAKE-WELDOLET						12:00			
90	17.53	80.57										
95	1.63	82.20										
95	0.57	82.77	JOINT-INSULATED									
105	1.14	83.33										
110	1.42	84.75										
110	25.68	110.44	EXT MFG	27%	4.92	4.45	0.812		10:05			3
110	26.72	111.47	EXT MFG	18%	0.55	1.46	0.812		09:05			4
110	27.01	111.77	EXT MFG	23%	0.79	1.02	0.812		01:00			5
110	27.21	111.96	EXT MFG	24%	2.76	2.95	0.812		10:10			6
120	28.01	112.76										
130	28.01	140.77										
140	20.19	160.96										
150	24.90	185.86										
160	26.47	212.33										
170	20.07	232.39										
180	26.38	258.77										
190	17.29	276.06										
200	26.01	302.07										
210	27.89	329.95										
220	26.91	356.87										
230	26.90	383.77										
230	20.20	403.97	EXT MFG	24%	5.24	3.66	0.812		08:40			7
240	21.62	405.39										
240	0.73	406.12	*INT MFG	16%	1.42	1.73	0.812		06:15			8
250	6.28	411.67										
260	26.60	438.26										

Pipeline Listing

Straits of Mackinac (East Leg)

Upstream Girth Weld	Relative Distance (feet)	Absolute Distance (feet)	Comment	Peak Depth (% wt)	Length (in)	Width (in)	Local Wall Thickness (in)	RPR	Orientation (hrs:mins)	LAPA Pressure (PSI)	LAPA RPR	Cluster Identifier
270	26.21	464.48										
270	3.23	467.71	EXT MFG	24%	0.47	1.02	0.812		12:40			9
280	26.07	490.55										
290	27.60	518.16										
300	28.03	546.18										
310	20.90	567.08										
320	28.26	595.34										
330	26.75	622.09										
340	21.87	643.96										
340	14.82	658.78	20 DEG BEND-COLD RIGHT									
350	27.75	671.71										
360	19.12	690.82										
370	8.36	699.18										
380	15.48	714.66										
390	26.04	740.69										
400	25.86	766.56										
410	27.32	793.88										
420	25.49	819.37										
430	27.40	846.76										
440	27.53	874.29										
450	27.92	902.21										
460	26.18	928.39										
470	25.94	954.33										
480	25.61	979.94										
490	25.96	1005.91										
500	26.24	1032.14										
510	23.05	1055.19										
520	25.67	1080.86										
530	23.47	1104.33										
530	3.82	1108.15	EXT MFG	26%	0.47	1.02	0.812		07:15			10
540	28.19	1132.52										
550	26.89	1159.42										
560	21.00	1180.41										
570	23.75	1204.17										
580	25.82	1229.99										
590	27.77	1257.75										
590	0.65	1258.40	INT MFG	7%	0.79	1.30	0.812		12:25			11
590	1.24	1258.99	INT MFG	15%	3.58	1.77	0.812		11:55			12
600	23.54	1281.30										
610	26.22	1307.52										
620	27.56	1335.08										

Pipeline Listing

Straits of Mackinac (East Leg)

Upstream Girth Weld	Relative Distance (feet)	Absolute Distance (feet)	Comment	Peak Depth (% wt)	Length (in)	Width (in)	Local Wall Thickness (in)	RPR	Orientation (hrs:mins)	LAPA Pressure (PSI)	LAPA RPR	Cluster Identifier
630	26.24	1361.32										
640	27.48	1388.80										
640	0.20	1389.00	*INT MFG	19%	0.67	0.71	0.812		06:35			13
650	25.80	1414.60										
660	27.95	1442.55										
670	27.19	1469.74										
680	20.70	1490.44										
690	26.91	1517.36										
700	22.35	1539.71										
710	27.75	1567.45										
720	24.02	1591.47										
730	27.13	1618.60										
740	27.92	1646.52										
740	23.54	1670.07	EXT MFG	17%	1.34	1.50	0.812		05:50			14
750	26.40	1672.92										
760	26.21	1699.14										
770	27.00	1726.14										
780	25.06	1751.19										
780	6.75	1757.94	EXT MFG	27%	7.80	8.23	0.812		06:55			15
780	7.87	1759.07	*EXT MFG	34%	0.47	0.87	0.812		06:35			16
790	20.65	1771.84										
800	23.60	1795.44										
810	27.10	1822.54										
820	25.73	1848.27										
830	27.84	1876.11										
840	25.16	1901.27										
840	0.33	1901.59	INT MFG	9%	0.63	1.30	0.812		05:40			17
850	26.38	1927.64										
850	25.41	1953.05	INT MFG	7%	0.79	2.84	0.812		11:10			18
860	25.61	1953.26										
860	23.94	1977.20	INT MFG	16%	1.30	0.98	0.812		03:25			19
870	24.78	1978.04										
880	26.53	2004.57										
890	23.88	2028.45										
900	26.63	2055.08										
900	0.14	2055.22	INT MFG	15%	0.79	1.02	0.812		11:45			20
910	23.58	2078.65										
920	28.22	2106.87										
930	20.80	2127.67										
940	26.49	2154.16										
950	26.03	2180.18										

Pipeline Listing

Straits of Mackinac (East Leg)

Upstream Girth Weld	Relative Distance (feet)	Absolute Distance (feet)	Comment	Peak Depth (% wt)	Length (in)	Width (in)	Local Wall Thickness (in)	RPR	Orientation (hrs:mins)	LAPA Pressure (PSI)	LAPA RPR	Cluster Identifier
960	27.49	2207.68										
960	20.19	2227.87	EXT MFG	25%	0.47	1.02	0.812		06:30			21
960	21.24	2228.91	*EXT MFG	30%	0.59	0.63	0.812		06:30			22
970	26.81	2234.49										
980	26.77	2261.26										
990	23.01	2284.27										
1000	27.32	2311.59										
1010	27.56	2339.15										
1020	25.86	2365.02										
1030	20.19	2385.20										
1040	24.54	2409.74										
1050	26.76	2436.51										
1060	27.52	2464.02										
1070	27.66	2491.68										
1080	26.52	2518.20										
1090	27.72	2545.92										
1100	22.49	2568.42										
1110	22.64	2591.05										
1110	17.17	2608.23	*EXT MFG	33%	0.71	0.75	0.812		06:30			23
1120	27.63	2618.68										
1130	22.94	2641.62										
1140	26.97	2668.59										
1150	27.44	2696.03										
1160	27.39	2723.42										
1170	19.94	2743.35										
1180	26.12	2769.47										
1190	26.42	2795.89										
1200	25.67	2821.56										
1210	27.42	2848.97										
1210	24.06	2873.03	INT MFG	17%	4.17	3.94	0.812		03:45			24
1210	25.33	2874.30	INT MFG	10%	0.71	0.75	0.812		03:50			25
1220	26.02	2874.99										
1220	22.26	2897.25	INT MFG	23%	0.71	0.71	0.812		07:00			26
1230	22.80	2897.79										
1240	26.20	2923.99										
1250	26.76	2950.76										
1260	26.80	2977.56										
1270	27.15	3004.71										
1280	27.06	3031.76										
1280	6.44	3038.20	INT MFG	23%	0.63	0.71	0.812		10:55			27
1290	28.07	3059.83										

Pipeline Listing

Straits of Mackinac (East Leg)

Upstream Girth Weld	Relative Distance (feet)	Absolute Distance (feet)	Comment	Peak Depth (% wt)	Length (in)	Width (in)	Local Wall Thickness (in)	RPR	Orientation (hrs:mins)	LAPA Pressure (PSI)	LAPA RPR	Cluster Identifier
1300	21.75	3081.59										
1310	27.10	3108.68										
1320	26.30	3134.98										
1330	26.98	3161.97										
1340	26.86	3188.82										
1350	21.99	3210.82										
1360	27.21	3238.03										
1370	22.64	3260.66										
1380	25.57	3286.23										
1380	6.01	3292.24	EXT MFG	15%	7.95	4.84	0.812		03:05			28
1390	23.12	3309.35										
1400	27.59	3336.94										
1400	1.65	3338.60	DENT <2% ID REDUCTION						10:00			
1410	25.76	3362.70										
1420	24.80	3387.50										
1430	25.10	3412.60										
1440	19.51	3432.11										
1450	24.25	3456.36										
1460	27.49	3483.85										
1470	27.11	3510.96										
1480	26.85	3537.81										
1490	27.36	3565.17										
1500	17.43	3582.60										
1510	26.86	3609.46										
1520	24.75	3634.21										
1520	12.06	3646.27	INT MFG	5%	0.63	1.54	0.812		07:25			29
1520	12.21	3646.41	INT MFG	6%	0.75	2.09	0.812		04:30			30
1520	12.75	3646.96	INT MFG	12%	0.59	0.91	0.812		01:55			31
1520	18.50	3652.71	INT MFG	8%	0.95	2.48	0.812		03:25			32
1530	24.50	3658.70										
1540	22.33	3681.04										
1550	24.48	3705.51										
1560	24.03	3729.54										
1570	27.25	3756.79										
1580	22.06	3778.85										
1590	24.08	3802.93										
1600	26.50	3829.43										
1600	4.01	3833.44	*EXT MFG	30%	0.47	1.02	0.812		02:15			33
1610	26.30	3855.73										
1620	22.05	3877.78										
1630	26.30	3904.08										

Pipeline Listing

Straits of Mackinac (East Leg)

Upstream Girth Weld	Relative Distance (feet)	Absolute Distance (feet)	Comment	Peak Depth (% wt)	Length (in)	Width (in)	Local Wall Thickness (in)	RPR	Orientation (hrs:mins)	LAPA Pressure (PSI)	LAPA RPR	Cluster Identifier
1640	26.77	3930.85										
1650	19.47	3950.32										
1660	26.18	3976.50										
1670	26.50	4003.00										
1680	25.39	4028.39										
1690	26.27	4054.66										
1700	26.57	4081.22										
1710	27.32	4108.54										
1720	24.44	4132.98										
1730	17.89	4150.88										
1730	17.40	4168.27	EXT MFG	27%	1.42	2.87	0.812		05:40			34
1740	17.65	4168.52										
1750	27.45	4195.97										
1760	25.84	4221.82										
1770	22.67	4244.49										
1780	27.58	4272.07										
1790	22.71	4294.78										
1800	26.61	4321.39										
1810	23.82	4345.21										
1820	23.53	4368.74										
1830	27.55	4396.29										
1840	25.44	4421.73										
1840	1.33	4423.06	*EXT MFG	25%	0.35	1.65	0.812		11:20			35
1850	27.23	4448.96										
1860	26.26	4475.22										
1870	27.03	4502.25										
1880	26.57	4528.82										
1890	22.91	4551.73										
1900	23.20	4574.93										
1910	25.78	4600.70										
1920	27.19	4627.89										
1930	26.35	4654.23										
1940	27.23	4681.46										
1950	27.01	4708.47										
1960	25.98	4734.46										
1970	27.09	4761.55										
1980	26.95	4788.49										
1990	27.35	4815.85										
2000	27.02	4842.87										
2010	24.50	4867.37										
2020	22.77	4890.14										

Pipeline Listing

Straits of Mackinac (East Leg)

Upstream Girth Weld	Relative Distance (feet)	Absolute Distance (feet)	Comment	Peak Depth (% wt)	Length (in)	Width (in)	Local Wall Thickness (in)	RPR	Orientation (hrs:mins)	LAPA Pressure (PSI)	LAPA RPR	Cluster Identifier
2030	26.15	4916.28										
2040	26.51	4942.79										
2050	27.62	4970.41										
2060	21.46	4991.86										
2070	27.01	5018.88										
2080	27.80	5046.68										
2090	27.41	5074.08										
2100	27.54	5101.62										
2110	25.63	5127.25										
2120	22.94	5150.20										
2130	20.83	5171.03										
2140	24.96	5195.99										
2140	0.25	5196.23	INT MFG	9%	0.63	1.22	0.812		03:25			36
2140	0.37	5196.36	*INT MFG	14%	0.47	0.55	0.812		01:15			37
2140	1.26	5197.25	EXT MFG	26%	0.47	1.02	0.812		03:45			38
2140	1.82	5197.81	*INT MFG	33%	0.28	0.71	0.812		01:25			39
2150	28.01	5223.99										
2150	14.77	5238.76	EXT MFG	26%	5.87	4.61	0.812		03:25			40
2160	17.82	5241.81										
2170	28.34	5270.14										
2180	25.68	5295.82										
2190	23.75	5319.58										
2190	2.54	5322.12	DENT <2% ID REDUCTION						03:30			
2200	26.04	5345.61										
2210	20.18	5365.79										
2220	27.57	5393.36										
2230	27.36	5420.73										
2240	22.62	5443.34										
2250	27.70	5471.04										
2250	1.85	5472.89	INT MFG	12%	4.53	3.54	0.812		08:10			41
2260	24.56	5495.60										
2270	25.68	5521.28										
2280	25.06	5546.34										
2280	24.71	5571.04	*EXT MFG	34%	5.00	5.98	0.812		09:55			42
2290	27.59	5573.93										
2290	23.34	5597.27	EXT MFG	27%	0.47	1.06	0.812		07:00			43
2300	24.36	5598.28										
2300	21.14	5619.42	INT MFG	21%	10.00	7.44	0.812		04:20			44
2310	22.53	5620.81										
2320	24.31	5645.13										
2330	24.89	5670.01										

Straits of Mackinac (East Leg)

Upstream Girth Weld	Relative Distance (feet)	Absolute Distance (feet)	Comment	Peak Depth (% wt)	Length (in)	Width (in)	Local Wall Thickness (in)	RPR	Orientation (hrs:mins)	LAPA Pressure (PSI)	LAPA RPR	Cluster Identifier
2340	24.98	5694.99										
2350	24.87	5719.86										
2360	25.07	5744.93										
2370	25.93	5770.86										
2380	27.58	5798.44										
2390	22.74	5821.17										
2400	24.39	5845.56										
2410	26.36	5871.92										
2420	27.45	5899.37										
2430	26.73	5926.09										
2440	26.88	5952.98										
2450	24.48	5977.45										
2460	27.24	6004.69										
2470	27.59	6032.28										
2470	9.69	6041.97	*EXT MFG	29%	0.79	1.02	0.812		08:30			45
2480	26.50	6058.78										
2490	26.98	6085.76										
2500	24.42	6110.18										
2510	25.73	6135.92										
2520	26.62	6162.53										
2530	24.42	6186.95										
2540	25.96	6212.92										
2550	24.08	6237.00										
2550	26.79	6263.79	*EXT MFG	28%	0.35	0.63	0.812		01:20			46
2560	27.02	6264.02										
2560	0.55	6264.57	EXT MFG	21%	0.47	1.30	0.812		03:20			47
2560	0.56	6264.58	EXT MFG	17%	0.47	1.50	0.812		02:00			48
2570	24.04	6288.06										
2580	26.59	6314.64										
2590	27.01	6341.66										
2600	25.15	6366.81										
2610	27.69	6394.50										
2620	27.31	6421.81										
2630	25.11	6446.92										
2640	23.13	6470.05										
2650	26.04	6496.09										
2660	26.22	6522.31										
2670	27.43	6549.74										
2680	24.76	6574.50										
2690	25.18	6599.68										
2700	27.52	6627.20										

Pipeline Listing

Straits of Mackinac (East Leg)

Upstream Girth Weld	Relative Distance (feet)	Absolute Distance (feet)	Comment	Peak Depth (% wt)	Length (in)	Width (in)	Local Wall Thickness (in)	RPR	Orientation (hrs:mins)	LAPA Pressure (PSI)	LAPA RPR	Cluster Identifier
2710	26.95	6654.14										
2720	27.84	6681.99										
2720	1.14	6683.13	INT MFG	22%	0.39	1.06	0.812		03:45			49
2730	25.46	6707.45										
2740	25.26	6732.71										
2750	24.41	6757.12										
2760	27.48	6784.60										
2770	27.63	6812.23										
2780	27.49	6839.72										
2790	26.42	6866.14										
2800	27.33	6893.47										
2810	27.19	6920.66										
2820	26.31	6946.97										
2830	26.39	6973.36										
2840	26.67	7000.03										
2850	25.60	7025.64										
2860	25.57	7051.20										
2870	24.09	7075.30										
2880	26.74	7102.03										
2890	27.30	7129.33										
2900	25.98	7155.32										
2910	24.37	7179.68										
2910	23.81	7203.49	DENT <2% ID REDUCTION						03:30			
2920	25.32	7205.00										
2930	23.03	7228.03										
2940	25.24	7253.27										
2950	22.74	7276.01										
2960	25.89	7301.89										
2970	27.99	7329.88										
2980	26.43	7356.31										
2990	26.81	7383.13										
3000	25.98	7409.11										
3010	25.03	7434.14										
3020	25.71	7459.85										
3020	3.86	7463.71	INT MFG	11%	0.55	0.71	0.812		06:50			50
3020	4.80	7464.65	INT MFG	8%	0.39	1.06	0.812		02:00			51
3030	27.22	7487.07										
3040	25.83	7512.90										
3040	20.04	7532.94	EXT MFG	25%	3.50	4.06	0.812		02:25			52
3040	24.15	7537.05	DENT <2% ID REDUCTION						06:30			
3050	26.21	7539.12										

Pipeline Listing

Straits of Mackinac (East Leg)

Upstream Girth Weld	Relative Distance (feet)	Absolute Distance (feet)	Comment	Peak Depth (% wt)	Length (in)	Width (in)	Local Wall Thickness (in)	RPR	Orientation (hrs:mins)	LAPA Pressure (PSI)	LAPA RPR	Cluster Identifier
3060	27.66	7566.78										
3070	26.16	7592.94										
3070	23.69	7616.62	*EXT MFG	29%	0.47	1.02	0.812		11:55			53
3080	26.74	7619.68										
3090	26.94	7646.61										
3100	27.29	7673.89										
3100	4.93	7678.82	*EXT MFG	31%	0.63	1.02	0.812		09:05			54
3110	26.06	7699.96										
3120	26.67	7726.63										
3130	18.42	7745.05										
3140	16.72	7761.77										
3150	26.54	7788.31										
3160	20.17	7808.48										
3170	25.84	7834.32										
3180	28.62	7862.94										
3190	26.80	7889.73										
3200	17.80	7907.53										
3210	25.90	7933.42										
3220	26.08	7959.51										
3230	26.43	7985.94										
3240	21.48	8007.42										
3250	26.25	8033.66										
3260	23.00	8056.66										
3270	18.05	8074.72										
3280	27.66	8102.37										
3280	25.92	8128.29	INT MFG	17%	0.59	0.71	0.812		02:50			55
3290	26.94	8129.31										
3300	26.71	8156.02										
3310	26.58	8182.59										
3320	23.92	8206.51										
3330	24.47	8230.97										
3340	25.70	8256.67										
3350	27.00	8283.67										
3360	18.58	8302.25										
3370	27.15	8329.41										
3380	23.79	8353.19										
3390	19.46	8372.65										
3400	27.45	8400.10										
3410	27.31	8427.41										
3420	27.92	8455.33										
3430	26.44	8481.77										

Pipeline Listing

Straits of Mackinac (East Leg)

Upstream Girth Weld	Relative Distance (feet)	Absolute Distance (feet)	Comment	Peak Depth (% wt)	Length (in)	Width (in)	Local Wall Thickness (in)	RPR	Orientation (hrs:mins)	LAPA Pressure (PSI)	LAPA RPR	Cluster Identifier
3440	23.40	8505.17										
3450	25.33	8530.50										
3460	27.23	8557.73										
3470	26.36	8584.09										
3480	20.32	8604.41										
3490	27.29	8631.69										
3500	27.70	8659.39										
3510	27.65	8687.04										
3510	24.35	8711.39	DENT <2% ID REDUCTION						08:30			
3520	27.23	8714.27										
3530	24.85	8739.12										
3540	24.28	8763.40										
3550	21.73	8785.13										
3560	19.66	8804.79										
3570	27.02	8831.81										
3580	27.68	8859.49										
3590	27.24	8886.74										
3600	28.03	8914.76										
3610	24.99	8939.75										
3620	27.22	8966.97										
3630	24.34	8991.32										
3640	24.13	9015.44										
3640	20.90	9036.34	EXT MFG	26%	0.47	2.28	0.812		01:30			56
3640	22.81	9038.25	EXT MFG	14%	1.26	2.13	0.812		08:25			57
3650	23.77	9039.22										
3660	26.50	9065.72										
3670	25.31	9091.02										
3670	0.54	9091.57	EXT MFG	27%	0.87	1.02	0.812		01:25			58
3680	21.79	9112.81										
3690	27.65	9140.45										
3700	27.23	9167.68										
3710	26.25	9193.93										
3720	27.09	9221.02										
3730	27.04	9248.06										
3730	5.29	9253.36	INT MFG	17%	0.28	0.71	0.812		02:30			59
3740	26.41	9274.48										
3750	27.16	9301.63										
3750	7.56	9309.18	*EXT MFG	24%	5.67	2.40	0.812		12:50			60
3750	8.50	9310.14	*EXT MFG	24%	6.06	2.44	0.812		12:25			61
3760	20.40	9322.02										
3770	28.27	9350.30										

Pipeline Listing

Straits of Mackinac (East Leg)

Upstream Girth Weld	Relative Distance (feet)	Absolute Distance (feet)	Comment	Peak Depth (% wt)	Length (in)	Width (in)	Local Wall Thickness (in)	RPR	Orientation (hrs:mins)	LAPA Pressure (PSI)	LAPA RPR	Cluster Identifier
3780	26.52	9376.81										
3780	1.76	9378.57	INT MFG	18%	0.71	0.79	0.812		01:40			62
3790	25.89	9402.70										
3800	19.03	9421.73										
3810	27.43	9449.16										
3820	20.19	9469.35										
3830	26.26	9495.60										
3840	24.74	9520.34										
3850	23.23	9543.57										
3860	28.24	9571.81										
3870	27.66	9599.47										
3880	26.70	9626.16										
3880	1.45	9627.61	EXT MFG	20%	0.83	1.42	0.812		05:30			63
3880	8.02	9634.18	INT MFG	21%	3.15	1.34	0.812		10:55			64
3890	21.25	9647.41										
3900	25.26	9672.67										
3910	27.91	9700.58										
3910	4.62	9705.19	*EXT MFG	20%	0.51	0.71	0.812		02:55			65
3920	23.72	9724.30										
3930	19.33	9743.64										
3940	23.36	9767.00										
3950	27.22	9794.22										
3960	24.79	9819.01										
3970	26.49	9845.50										
3980	25.60	9871.10										
3990	27.91	9899.01										
3990	18.56	9917.57	*EXT MFG	29%	0.98	4.76	0.812		05:10			66
4000	22.99	9921.99										
4010	21.94	9943.93										
4010	23.80	9967.73	*EXT MFG	28%	2.21	3.98	0.812		08:35			67
4020	25.76	9969.70										
4030	22.88	9992.58										
4040	27.34	10019.92										
4050	27.29	10047.20										
4060	26.18	10073.38										
4070	24.54	10097.92										
4080	22.39	10120.31										
4090	28.30	10148.61										
4100	27.35	10175.97										
4100	12.21	10188.17	*EXT MFG	23%	1.18	0.95	0.812		04:55			68
4110	28.65	10204.62										

Pipeline Listing

Straits of Mackinac (East Leg)

Upstream Girth Weld	Relative Distance (feet)	Absolute Distance (feet)	Comment	Peak Depth (% wt)	Length (in)	Width (in)	Local Wall Thickness (in)	RPR	Orientation (hrs:mins)	LAPA Pressure (PSI)	LAPA RPR	Cluster Identifier
4120	25.05	10229.67										
4130	17.20	10246.87										
4140	25.88	10272.75										
4150	26.67	10299.42										
4160	26.72	10326.14										
4170	27.48	10353.62										
4180	26.08	10379.70										
4190	26.59	10406.29										
4200	25.49	10431.78										
4210	27.01	10458.79										
4220	23.86	10482.65										
4220	14.31	10496.97	EXT MFG	26%	0.87	1.02	0.812		10:15			69
4220	22.80	10505.45	INT MFG	17%	0.98	1.22	0.812		12:00			70
4230	24.11	10506.77										
4240	26.80	10533.56										
4250	26.80	10560.36										
4250	7.01	10567.37	INT MFG	22%	17.99	22.60	0.812		12:15			71
4250	12.12	10572.47	INT MFG	18%	0.28	0.71	0.812		03:50			72
4250	12.57	10572.92	INT MFG	16%	0.67	1.34	0.812		12:30			73
4250	12.74	10573.09	INT MFG	4%	0.63	1.85	0.812		04:55			74
4260	26.06	10586.42										
4270	26.07	10612.49										
4280	24.88	10637.37										
4290	25.20	10662.57										
4300	26.01	10688.57										
4310	26.98	10715.55										
4320	27.26	10742.82										
4330	18.49	10761.31										
4340	18.36	10779.67										
4350	27.63	10807.29										
4360	26.08	10833.38										
4370	22.31	10855.69										
4380	25.57	10881.26										
4390	22.47	10903.73										
4400	27.84	10931.56										
4410	16.91	10948.47										
4420	16.57	10965.04										
4430	26.62	10991.66										
4440	26.40	11018.05										
4450	25.65	11043.70										
4460	26.75	11070.45										

Straits of Mackinac (East Leg)

Upstream Girth Weld	Relative Distance (feet)	Absolute Distance (feet)	Comment	Peak Depth (% wt)	Length (in)	Width (in)	Local Wall Thickness (in)	RPR	Orientation (hrs:mins)	LAPA Pressure (PSI)	LAPA RPR	Cluster Identifier
4470	26.29	11096.74										
4480	26.65	11123.39										
4480	21.28	11144.67	*EXT MFG	30%	2.21	1.97	0.812		10:35			75
4490	26.43	11149.83										
4500	27.12	11176.95										
4510	23.98	11200.93										
4520	25.12	11226.05										
4530	27.21	11253.26										
4540	28.44	11281.69										
4550	24.55	11306.24										
4560	26.51	11332.75										
4570	26.88	11359.64										
4580	26.98	11386.61										
4590	22.73	11409.34										
4600	26.78	11436.12										
4610	21.52	11457.64										
4620	26.67	11484.32										
4620	25.31	11509.62	INT MFG	14%	0.51	2.24	0.812		11:30			76
4630	27.11	11511.43										
4640	27.10	11538.53										
4650	20.43	11558.96										
4660	26.95	11585.90										
4660	0.77	11586.68	EXT MFG	26%	4.09	1.34	0.812		08:35			77
4670	27.82	11613.72										
4680	26.98	11640.71										
4690	27.71	11668.42										
4700	26.28	11694.70										
4710	27.27	11721.97										
4720	28.11	11750.08										
4730	26.31	11776.39										
4740	27.14	11803.53										
4740	23.46	11826.99	EXT MFG	24%	1.02	1.02	0.812		12:30			78
4740	24.32	11827.85	EXT MFG	23%	2.05	3.31	0.812		12:20			79
4740	24.88	11828.42	*EXT MFG	14%	0.47	1.02	0.812		02:00			80
4750	27.26	11830.80										
4760	19.40	11850.20										
4770	21.95	11872.15										
4780	25.79	11897.93										
4790	27.67	11925.60										
4800	25.11	11950.71										
4810	24.61	11975.32										

Straits of Mackinac (East Leg)

Upstream Girth Weld	Relative Distance (feet)	Absolute Distance (feet)	Comment	Peak Depth (% wt)	Length (in)	Width (in)	Local Wall Thickness (in)	RPR	Orientation (hrs:mins)	LAPA Pressure (PSI)	LAPA RPR	Cluster Identifier
4820	27.91	12003.23										
4830	26.06	12029.29										
4840	25.01	12054.30										
4850	21.01	12075.31										
4860	26.83	12102.13										
4870	26.59	12128.72										
4880	19.72	12148.44										
4890	26.64	12175.08										
4900	26.18	12201.26										
4910	28.47	12229.72										
4920	27.62	12257.34										
4930	26.75	12284.09										
4940	27.31	12311.39										
4950	28.24	12339.63										
4960	27.19	12366.82										
4970	27.70	12394.52										
4980	27.47	12422.00										
4990	25.00	12446.99										
5000	24.92	12471.91										
5010	26.00	12497.90										
5020	26.71	12524.61										
5030	22.10	12546.71										
5040	26.93	12573.63										
5050	27.69	12601.32										
5060	26.34	12627.66										
5070	27.39	12655.04										
5080	27.83	12682.87										
5090	27.34	12710.21										
5100	23.31	12733.52										
5110	27.36	12760.88										
5110	22.87	12783.76	EXT MFG	14%	0.87	1.89	0.812		08:15			81
5110	23.45	12784.33	*EXT MFG	28%	4.49	2.24	0.812		09:10			82
5120	26.26	12787.14										
5130	24.46	12811.59										
5140	26.86	12838.45										
5150	24.08	12862.53										
5160	25.63	12888.17										
5170	27.11	12915.28										
5180	26.41	12941.69										
5190	27.35	12969.04										
5200	25.30	12994.33										

Straits of Mackinac (East Leg)

Upstream Girth Weld	Relative Distance (feet)	Absolute Distance (feet)	Comment	Peak Depth (% wt)	Length (in)	Width (in)	Local Wall Thickness (in)	RPR	Orientation (hrs:mins)	LAPA Pressure (PSI)	LAPA RPR	Cluster Identifier
5210	27.24	13021.58										
5220	26.96	13048.54										
5230	25.92	13074.45										
5240	27.63	13102.08										
5250	25.58	13127.66										
5260	26.98	13154.64										
5270	27.02	13181.66										
5280	26.30	13207.96										
5290	27.35	13235.31										
5300	26.88	13262.20										
5310	26.67	13288.87										
5320	26.52	13315.39										
5330	26.58	13341.96										
5330	5.04	13347.01	INT MFG	9%	0.79	2.17	0.812		06:15			83
5330	6.53	13348.49	INT MFG	6%	0.67	1.54	0.812		07:20			84
5330	7.54	13349.50	INT MFG	16%	6.22	8.03	0.812		05:40			85
5330	8.22	13350.18	*INT MFG	19%	0.63	1.02	0.812		03:40			86
5330	8.52	13350.48	INT MFG	19%	7.60	10.43	0.812		05:10			87
5330	10.10	13352.06	INT MFG	9%	0.39	0.91	0.812		05:55			88
5330	12.98	13354.94	*INT MFG	21%	0.75	0.95	0.812		05:55			89
5330	13.40	13355.36	INT MFG	19%	1.26	2.76	0.812		06:55			90
5330	13.95	13355.92	INT MFG	19%	0.51	0.71	0.812		06:40			91
5330	14.58	13356.54	INT MFG	6%	0.51	1.61	0.812		03:50			92
5340	27.61	13369.58										
5350	26.16	13395.74										
5360	27.43	13423.16										
5370	25.03	13448.20										
5380	26.29	13474.49										
5390	27.42	13501.90										
5400	26.62	13528.52										
5400	9.26	13537.79	EXT MFG	15%	0.79	1.73	0.812		01:45			93
5400	10.90	13539.42	*EXT MFG	31%	0.47	1.02	0.812		01:30			94
5400	10.95	13539.47	EXT MFG	25%	0.51	1.02	0.812		08:00			95
5400	12.54	13541.06	EXT MFG	24%	0.47	1.02	0.812		04:50			96
5410	22.65	13551.17										
5420	22.84	13574.01										
5420	21.52	13595.53	*EXT MFG	32%	2.01	1.02	0.812		04:05			97
5420	22.20	13596.21	*EXT MFG	26%	0.47	1.02	0.812		04:00			98
5430	23.69	13597.69										
5440	25.79	13623.48										
5450	22.84	13646.32										

Straits of Mackinac (East Leg)

Upstream Girth Weld	Relative Distance (feet)	Absolute Distance (feet)	Comment	Peak Depth (% wt)	Length (in)	Width (in)	Local Wall Thickness (in)	RPR	Orientation (hrs:mins)	LAPA Pressure (PSI)	LAPA RPR	Cluster Identifier
5460	28.27	13674.58										
5470	24.84	13699.42										
5480	26.49	13725.91										
5490	27.73	13753.64										
5500	27.66	13781.30										
5510	26.53	13807.83										
5520	27.72	13835.55										
5530	26.37	13861.92										
5540	26.26	13888.18										
5550	26.90	13915.08										
5560	27.33	13942.41										
5570	26.54	13968.95										
5580	24.86	13993.81										
5590	26.51	14020.32										
5600	25.49	14045.81										
5610	26.01	14071.82										
5620	25.36	14097.18										
5630	25.36	14122.54										
5640	27.25	14149.79										
5650	25.99	14175.79										
5660	26.97	14202.76										
5670	22.23	14224.99										
5680	23.23	14248.22										
5680	25.25	14273.47	DENT <2% ID REDUCTION						07:30			
5690	26.49	14274.71										
5700	26.97	14301.67										
5710	27.36	14329.04										
5720	25.48	14354.52										
5720	23.58	14378.10	DENT <2% ID REDUCTION						05:30			
5730	25.80	14380.32										
5740	23.36	14403.68										
5750	27.26	14430.94										
5760	26.45	14457.39										
5770	27.55	14484.94										
5780	25.26	14510.20										
5790	28.19	14538.40										
5800	25.62	14564.02										
5810	27.78	14591.80										
5820	26.80	14618.60										
5830	27.56	14646.16										
5840	19.40	14665.56										

Pipeline Listing

Straits of Mackinac (East Leg)

Upstream Girth Weld	Relative Distance (feet)	Absolute Distance (feet)	Comment	Peak Depth (% wt)	Length (in)	Width (in)	Local Wall Thickness (in)	RPR	Orientation (hrs:mins)	LAPA Pressure (PSI)	LAPA RPR	Cluster Identifier
5850	26.65	14692.22										
5860	27.08	14719.29										
5870	24.80	14744.09										
5880	20.89	14764.98										
5890	23.49	14788.47										
5890	21.95	14810.42	DENT <2% ID REDUCTION						04:45			
5900	25.80	14814.27										
5910	26.76	14841.03										
5920	28.23	14869.26										
5930	22.17	14891.43										
5940	26.35	14917.77										
5950	24.96	14942.73										
5960	27.01	14969.74										
5970	27.81	14997.55										
5980	27.84	15025.38										
5990	25.02	15050.40										
6000	26.97	15077.38										
6010	26.84	15104.21										
6020	24.96	15129.17										
6030	26.41	15155.58										
6030	5.70	15161.28	EXT MFG	21%	0.51	0.47	0.812		06:05			99
6040	28.15	15183.73										
6050	26.99	15210.72										
6060	24.76	15235.48										
6070	25.04	15260.52										
6080	25.72	15286.24										
6080	1.20	15287.45	INT MFG	14%	0.75	0.91	0.812		02:25			100
6080	4.17	15290.41	INT MFG	22%	3.15	2.21	0.812		01:10			101
6080	6.54	15292.78	INT MFG	8%	0.67	0.98	0.812		05:15			102
6080	7.52	15293.76	INT MFG	11%	0.59	1.06	0.812		04:50			103
6080	8.04	15294.28	INT MFG	11%	1.81	4.37	0.812		01:40			104
6080	8.67	15294.92	INT MFG	15%	1.65	4.88	0.812		07:40			105
6090	26.12	15312.36										
6100	26.29	15338.65										
6110	27.49	15366.14										
6110	0.42	15366.56	INT MFG	11%	1.50	3.39	0.812		11:40			106
6120	27.91	15394.05										
6130	25.80	15419.85										
6140	26.27	15446.12										
6150	15.71	15461.82										
6160	27.36	15489.18										

Pipeline Listing

Straits of Mackinac (East Leg)

Upstream Girth Weld	Relative Distance (feet)	Absolute Distance (feet)	Comment	Peak Depth (% wt)	Length (in)	Width (in)	Local Wall Thickness (in)	RPR	Orientation (hrs:mins)	LAPA Pressure (PSI)	LAPA RPR	Cluster Identifier
6170	26.86	15516.04										
6180	24.73	15540.77										
6190	26.04	15566.81										
6200	25.58	15592.39										
6210	27.03	15619.42										
6220	25.94	15645.36										
6230	20.54	15665.90										
6240	25.11	15691.01										
6250	26.88	15717.89										
6260	27.92	15745.81										
6270	17.80	15763.62										
6280	17.49	15781.10										
6290	21.11	15802.21										
6300	26.01	15828.22										
6300	1.55	15829.76	EXT MFG	24%	0.63	1.02	0.812		03:30			107
6310	18.77	15846.98										
6310	0.14	15847.12	EXT MFG	26%	1.14	1.14	0.812		05:15			108
6320	28.04	15875.02										
6320	13.12	15888.14	*INT MFG	30%	0.91	5.08	0.812		09:35			109
6330	17.65	15892.67										
6340	24.95	15917.62										
6350	27.44	15945.06										
6350	7.09	15952.15	INT MFG	15%	0.35	0.75	0.812		06:15			110
6350	8.27	15953.33	INT MFG	16%	1.46	5.08	0.812		09:55			111
6350	9.69	15954.74	INT MFG	9%	2.40	7.17	0.812		07:25			112
6360	26.57	15971.62										
6370	17.75	15989.37										
6370	17.87	16007.24	EXT MFG	23%	0.67	1.77	0.812		11:00			113
6380	25.10	16014.47										
6390	26.20	16040.67										
6400	25.51	16066.18										
6410	26.02	16092.20										
6410	0.55	16092.76	EXT MFG	24%	0.59	1.02	0.812		11:35			114
6420	27.42	16119.62										
6430	17.90	16137.52										
6440	25.66	16163.18										
6450	16.88	16180.06										
6460	22.37	16202.43										
6470	17.01	16219.43										
6480	17.04	16236.47										
6480	0.37	16236.85	*EXT MFG	26%	0.47	1.06	0.812		02:05			115

Pipeline Listing

Straits of Mackinac (East Leg)

Upstream Girth Weld	Relative Distance (feet)	Absolute Distance (feet)	Comment	Peak Depth (% wt)	Length (in)	Width (in)	Local Wall Thickness (in)	RPR	Orientation (hrs:mins)	LAPA Pressure (PSI)	LAPA RPR	Cluster Identifier
6480	0.57	16237.04	*EXT MFG	34%	9.61	4.13	0.812		12:15			116
6490	17.30	16253.77										
6500	25.19	16278.96										
6510	26.67	16305.63										
6510	13.40	16319.03	EXT MFG	23%	0.47	0.63	0.812		10:45			117
6510	20.39	16326.03	*EXT MFG	29%	4.49	4.29	0.812		10:50			118
6520	27.13	16332.77										
6530	25.69	16358.45										
6540	27.18	16385.63										
6550	26.98	16412.61										
6560	26.32	16438.93										
6570	23.35	16462.28										
6580	17.54	16479.82										
6590	28.11	16507.93										
6600	18.89	16526.81										
6610	27.22	16554.04										
6620	18.40	16572.43										
6630	18.11	16590.54										
6640	18.49	16609.03										
6650	25.25	16634.29										
6660	26.24	16660.52										
6670	26.80	16687.32										
6680	27.05	16714.37										
6690	27.77	16742.14										
6700	26.97	16769.11										
6710	27.97	16797.08										
6720	25.66	16822.74										
6730	27.03	16849.77										
6740	27.22	16876.99										
6750	23.35	16900.34										
6760	25.46	16925.80										
6770	26.95	16952.75										
6780	20.44	16973.19										
6790	27.93	17001.12										
6800	23.31	17024.43										
6800	18.09	17042.52	EXT MFG	27%	0.55	1.02	0.812		10:10			119
6810	27.74	17052.17										
6810	8.63	17060.79	*INT MFG	28%	2.32	6.58	0.812		05:30			120
6820	25.76	17077.92										
6830	27.12	17105.04										
6840	26.28	17131.32										

Pipeline Listing

Straits of Mackinac (East Leg)

Upstream Girth Weld	Relative Distance (feet)	Absolute Distance (feet)	Comment	Peak Depth (% wt)	Length (in)	Width (in)	Local Wall Thickness (in)	RPR	Orientation (hrs:mins)	LAPA Pressure (PSI)	LAPA RPR	Cluster Identifier
6850	24.42	17155.74										
6860	24.98	17180.72										
6870	25.99	17206.72										
6880	26.42	17233.14										
6890	27.11	17260.25										
6900	27.63	17287.87										
6910	27.31	17315.18										
6920	27.42	17342.60										
6930	23.83	17366.42										
6940	27.04	17393.46										
6950	24.25	17417.71										
6960	27.26	17444.97										
6970	27.71	17472.68										
6980	26.98	17499.66										
6990	24.85	17524.51										
7000	26.20	17550.71										
7010	25.69	17576.40										
7020	27.60	17603.99										
7030	27.17	17631.16										
7040	28.08	17659.24										
7050	26.58	17685.82										
7060	26.51	17712.32										
7070	23.91	17736.23										
7080	22.31	17758.54										
7090	26.53	17785.07										
7100	18.89	17803.96										
7110	25.11	17829.07										
7120	16.84	17845.91										
7130	27.93	17873.84										
7140	27.83	17901.67										
7150	18.30	17919.97										
7160	18.45	17938.42										
7170	19.88	17958.30										
7180	21.90	17980.20										
7180	11.04	17991.24	INT MFG	5%	11.93	6.85	0.812		08:50			121
7180	11.48	17991.68	INT MFG	14%	6.22	9.84	0.812		05:45			122
7190	27.30	18007.50										
7200	24.51	18032.01										
7210	25.28	18057.28										
7220	27.20	18084.48										
7230	27.01	18111.49										

Straits of Mackinac (East Leg)

Upstream Girth Weld	Relative Distance (feet)	Absolute Distance (feet)	Comment	Peak Depth (% wt)	Length (in)	Width (in)	Local Wall Thickness (in)	RPR	Orientation (hrs:mins)	LAPA Pressure (PSI)	LAPA RPR	Cluster Identifier
7240	24.71	18136.20										
7250	24.66	18160.86										
7260	26.20	18187.06										
7270	26.84	18213.90										
7280	24.29	18238.19										
7290	26.93	18265.12										
7290	4.37	18269.49	*EXT MFG	30%	0.63	1.02	0.812		04:40			123
7290	5.15	18270.26	EXT MFG	22%	0.87	1.34	0.812		08:55			124
7300	24.99	18290.10										
7310	19.13	18309.23										
7320	26.59	18335.82										
7320	2.37	18338.19	DENT <2% ID REDUCTION						02:00			
7330	26.78	18362.60										
7340	27.16	18389.75										
7350	18.55	18408.30										
7350	0.64	18408.94	DENT <2% ID REDUCTION						06:00			
7360	26.31	18434.61										
7370	16.24	18450.85										
7380	27.71	18478.56										
7390	18.36	18496.93										
7400	26.39	18523.32										
7410	26.84	18550.15										
7420	17.55	18567.71										
7430	16.64	18584.35										
7440	27.30	18611.65										
7450	23.80	18635.45										
7460	24.53	18659.97										
7470	27.12	18687.10										
7480	26.48	18713.57										
7480	3.43	18717.01	DENT <2% ID REDUCTION						02:00			
7490	26.35	18739.92										
7500	16.19	18756.10										
7510	28.18	18784.29										
7520	27.28	18811.57										
7530	21.91	18833.48										
7540	26.98	18860.46										
7550	19.12	18879.57										
7560	20.64	18900.21										
7570	17.27	18917.48										
7580	25.72	18943.20										
7590	27.30	18970.50										

Pipeline Listing

Straits of Mackinac (East Leg)

Upstream Girth Weld	Relative Distance (feet)	Absolute Distance (feet)	Comment	Peak Depth (% wt)	Length (in)	Width (in)	Local Wall Thickness (in)	RPR	Orientation (hrs:mins)	LAPA Pressure (PSI)	LAPA RPR	Cluster Identifier
7600	27.67	18998.16										
7610	19.46	19017.62										
7610	19.95	19037.57	EXT MFG	25%	0.47	1.02	0.812		01:15			125
7620	27.76	19045.37										
7630	25.89	19071.26										
7640	23.98	19095.24										
7650	23.98	19119.23										
7660	26.74	19145.97										
7670	25.49	19171.46										
7680	26.71	19198.16										
7690	27.34	19225.51										
7700	25.12	19250.62										
7710	25.59	19276.21										
7720	25.46	19301.67										
7730	24.62	19326.29										
7740	25.75	19352.03										
7750	26.21	19378.25										
7760	27.41	19405.65										
7770	26.39	19432.04										
7780	20.67	19452.71										
7790	27.11	19479.82										
7790	23.75	19503.58	*EXT MFG	30%	2.52	3.82	0.812		03:15			126
7790	25.44	19505.26	EXT MFG	23%	0.47	1.02	0.812		06:00			127
7800	27.19	19507.01										
7810	27.36	19534.37										
7820	20.80	19555.17										
7830	26.73	19581.90										
7830	23.09	19604.99	EXT MFG	26%	0.47	1.02	0.812		10:15			128
7840	27.97	19609.88										
7850	26.23	19636.10										
7860	26.54	19662.64										
7870	26.01	19688.65										
7880	27.85	19716.50										
7890	26.55	19743.05										
7900	26.54	19769.60										
7910	23.45	19793.05										
7920	27.64	19820.68										
7920	19.61	19840.29	DENT <2% ID REDUCTION						01:15			
7930	28.19	19848.88										
7940	24.11	19872.99										
7950	21.70	19894.69										

Pipeline Listing

Straits of Mackinac (East Leg)

Upstream Girth Weld	Relative Distance (feet)	Absolute Distance (feet)	Comment	Peak Depth (% wt)	Length (in)	Width (in)	Local Wall Thickness (in)	RPR	Orientation (hrs:mins)	LAPA Pressure (PSI)	LAPA RPR	Cluster Identifier
7960	28.58	19923.26										
7970	26.98	19950.24										
7980	25.13	19975.37										
7990	28.47	20003.84										
8000	27.54	20031.38										
8010	28.15	20059.52										
8020	21.22	20080.75										
8030	26.64	20107.38										
8040	23.52	20130.91										
8050	28.48	20159.38										
8060	26.89	20186.28										
8070	28.01	20214.28										
8080	13.62	20227.90										
8090	20.20	20248.10										
8100	26.99	20275.09										
8110	24.94	20300.03										
8120	26.94	20326.97										
8130	25.98	20352.95										
8130	3.79	20356.75	*EXT MFG	31%	12.76	7.28	0.812		10:35			129
8130	5.78	20358.73	EXT MFG	29%	0.47	1.02	0.812		09:10			130
8140	26.20	20379.16										
8150	24.48	20403.63										
8160	25.11	20428.74										
8170	27.38	20456.13										
8180	24.47	20480.59										
8180	20.94	20501.53	DENT <2% ID REDUCTION						01:30			
8190	24.55	20505.14										
8200	25.23	20530.37										
8210	24.58	20554.94										
8220	17.52	20572.46										
8230	25.77	20598.24										
8240	25.50	20623.74										
8240	18.78	20642.52	*EXT MFG	25%	2.84	1.34	0.812		03:45			131
8240	19.16	20642.91	EXT MFG	29%	0.47	1.02	0.812		06:05			132
8250	27.52	20651.26										
8260	24.53	20675.79										
8270	27.45	20703.24										
8280	24.26	20727.49										
8290	26.92	20754.41										
8300	26.41	20780.82										
8310	27.23	20808.05										

Straits of Mackinac (East Leg)

Upstream Girth Weld	Relative Distance (feet)	Absolute Distance (feet)	Comment	Peak Depth (% wt)	Length (in)	Width (in)	Local Wall Thickness (in)	RPR	Orientation (hrs:mins)	LAPA Pressure (PSI)	LAPA RPR	Cluster Identifier
8320	20.93	20828.98										
8330	28.04	20857.02										
8340	24.67	20881.69										
8350	8.65	20890.34										
8350	8.89	20899.24	10 DEG BEND-COLD UNDER									
8360	25.80	20916.14										
8370	25.47	20941.61										
8380	27.36	20968.97										
8380	14.75	20983.73	5 DEG BEND-COLD OVER									
8390	24.99	20993.96										
8400	25.50	21019.47										
8410	26.32	21045.79										
8420	25.31	21071.10										
8430	27.32	21098.42										
8440	25.84	21124.26										
8450	25.83	21150.09										
8460	27.48	21177.57										
8470	27.18	21204.75										
8480	27.11	21231.86										
8490	26.64	21258.50										
8490	12.64	21271.14	20 DEG BEND-COLD RIGHT									
8490	16.21	21274.71	EXT MFG	26%	2.72	3.23	0.812		09:10			133
8490	17.43	21275.92	*EXT MFG	32%	8.86	9.17	0.812		06:10			134
8490	22.02	21280.52	*EXT MFG	35%	7.80	5.71	0.812		04:20			135
8490	22.10	21280.59	EXT MFG	29%	0.67	1.46	0.812		06:20			136
8490	22.86	21281.36	*EXT MFG	30%	0.47	1.02	0.812		03:20			137
8500	28.23	21286.73										
8500	3.52	21290.25	EXT MFG	25%	0.75	1.18	0.812		12:25			138
8500	11.12	21297.84	15 DEG BEND-COLD RIGHT									
8510	26.67	21313.40										
8510	12.84	21326.24	25 DEG BEND-COLD RIGHT									
8520	27.00	21340.40										
8520	10.01	21350.40	20 DEG BEND-COLD RIGHT									
8530	27.02	21367.42										
8540	23.50	21390.92										
8550	19.75	21410.67										
8560	18.88	21429.55										
8570	26.41	21455.96										
8580	26.88	21482.84										
8590	27.14	21509.99										
8600	25.99	21535.98										

Pipeline Listing

Straits of Mackinac (East Leg)

Upstream Girth Weld	Relative Distance (feet)	Absolute Distance (feet)	Comment	Peak Depth (% wt)	Length (in)	Width (in)	Local Wall Thickness (in)	RPR	Orientation (hrs:mins)	LAPA Pressure (PSI)	LAPA RPR	Cluster Identifier
8610	25.71	21561.69										
8620	24.85	21586.54										
8630	23.75	21610.29										
8640	28.34	21638.63										
8650	27.82	21666.45										
8650	24.34	21690.78	INT MFG	15%	0.47	3.27	0.812		01:55			139
8660	26.36	21692.81										
8670	27.08	21719.88										
8675	1.56	21721.44										
8675	0.60	21722.03	JOINT-INSULATED									
8685	1.23	21722.67										
8690	1.32	21723.99										
8700	26.94	21750.93										
8700	1.47	21752.40	16 IN OFFTAKE-FORGED						09:00			
8710	2.48	21753.41										
8720	3.08	21756.50										
8720	0.00	21756.50	STRAITS OF MACKINAC (EAST LEG)									
8720	1.85	21758.34	BALL VALVE - MP 1479.77									
8750	3.62	21760.12										
8750	7.68	21767.79	10 DEG BEND-COLD UNDER									
8760	22.71	21782.83										
8770	10.07	21792.90										
8770	2.13	21795.04	1.0 IN OFFTAKE-WELDOLET						12:00			
8770	10.25	21803.15	10 DEG BEND-COLD OVER									
8780	25.19	21818.09										

Glossary of Terms

Absolute Distance	The distance from the start of the pipeline to the upstream edge of the metal loss feature.
Axial Length	The predicted axial length of the metal loss feature.
Relative Distance	The distance between the upstream girth weld and the feature under consideration.
ERF	The calculated Estimated Repair Factor value of the metal loss feature.
Ext or Int	Denotes whether the metal loss feature is on the external or internal surface of the pipe. It should be noted that mid-wall metal loss features would be classified as external.
Feature Selection Rule	The number of the selection rule under which the metal loss feature was chosen. The selection rules are specified in the Specification for a Pipeline Inspection Report (Appendix F)
FPR	The calculated Failure Pressure Ratio value of the metal loss feature.
Girth Weld Number	The number of the girth weld at which the pipeline segment begins, as used in the pipeline listing.
Identification	The identification number of the line marker, magnet or anode.
Inspection Sheet Number	The number of the inspection sheet which is summarised by each line in the Summary tables.
Major Segment	A pipeline segment that has been defined by the pipeline operator in the table provided in the Company Defined Operating Parameters section of the contract. In this table the pipeline operator specifies the locations of the start and end of the segment and the values of nwt and SMYS that apply within it.
MAOP	The maximum allowable operating pressure for the pipeline segment, as specified by the pipeline operator.
Minor Segment	A pipeline segment identified by the inspection system. The minor segment is a section within the major segment where the nominal wall thickness is distinctly different from that detected for the major segment.
Nominal Wall Thickness	The pipe wall thickness of the spool containing the metal loss feature.
Orientation	The location of the metal loss feature around the circumference of the pipe, as viewed in the direction of flow.

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Peak Depth	The predicted peak depth of the metal loss feature, expressed as a percentage of nominal wall thickness.
Pi	The internal design pressure for the pipeline segment, as specified by the pipeline operator.
Predicted Dimensions	The predicted dimensions of a metal loss feature are: **Axial length:** The dimension along the pipe and parallel to the pipe axis; **Circumferential width:** The dimension around the pipe and perpendicular to the pipe axis; **Peak depth:** The depth of the metal loss feature expressed as a percentage of nominal wall thickness.
Pressure Ratio	The Estimated Repair Factor (ERF), Failure Pressure Ratio (FPR) or Rupture Pressure Ratio (RPR) calculated for the metal loss feature. This value was calculated using the formulae defined in the Specification for a Pipeline Inspection Report contained in the contract; a copy of which is given in Appendix F.
Primary Reference	A pipeline fitting or marker from which the metal loss feature can be easily located. More than one reference point may be provided on an inspection sheet.
Reference Girth Weld	The girth weld located at the upstream end of the spool containing the metal loss feature.
RPR	The calculated Rupture Pressure Ratio value of the metal loss feature.
Segment Number	Denotes whether the segment is a major or minor segment. A number (n) indicates that the segment is part of the nth major segment defined by the pipeline operator. A number (n/m) indicates that the segment is the mth minor segment within the nth major segment.
Selection Rule	The selection rule under which the most severe metal loss feature within the pipe spool is rated.
Strip Map Number	The drawing number, where available, of the pipeline strip map on which the metal loss feature is located.
Type	Denotes whether the metal loss feature is on the internal or external surface of the pipe. It should be noted that mid-wall metal loss features would be classified as external.
Upstream Girth Weld Number	The girth weld number of the girth weld located at the upstream end of the pipe spool.

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Appendix A. Locating Metal Loss Features And Pipeline Anomalies

Locating metal loss features or pipeline anomalies is a difficult task, which can cost the pipeline operator valuable time and resources. Therefore, it is important that appropriate techniques are used at each stage in locating these features.

This appendix gives guidelines for locating pipeline features efficiently and effectively.

A1. Reference Points

Wherever possible, the position of metal loss features and pipeline anomalies is related to reference points that can be easily identified and located from the surface.

Reference points are either pipeline fittings, such as mainline valves, offtakes, anodes or side bends, or artificial reference points, such as magnets or line markers; these will have been placed on or near the pipeline at the time of the inspection.

At least one reference point is provided for each metal loss feature reported on the inspection sheets. If the reference point is more than 1600 feet from the metal loss feature then a second reference point will usually be provided.

Two reference points are provided for each pipeline anomaly. These reference points are extracted automatically from the pipeline listing and are limited to mainline valves and line markers.

A2. Location of Features

The location of the feature can be carried out in two stages; locating the spool that contains the metal loss feature or pipeline anomaly; then locating the feature within that spool.

To locate the spool containing the feature, the distance from the reference point to the girth weld at the upstream end of the spool is provided.

To locate the feature within the spool, the distance from the upstream girth weld to the feature and the location of the feature around the circumference of the pipe, as viewed in the direction of flow, are provided. Girth weld anomalies will be located within the upstream girth weld.

These distances are given to an accuracy of ±1%. It is recommended that electronic distance measuring equipment (EDM) is used to measure out these distances accurately.

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A3. Identification of Features

Metal objects should be easily identified. Metal loss, dents and girth weld anomalies will require an area of the protective wrap to be removed.

A minimum area of approximately 2 ft along the pipe axis by 45° of the circumference, centred on the reported feature position, should be cleaned back to bare metal.

Once this has been done, any external metal loss, dents or the girth weld that contains an anomaly should be easily identified. The position of internal metal loss should be marked on the outside of the pipe in preparation for further examination.

Shallow dents can usually be identified by running one's hand along the pipe surface, or by placing a straight edge along the pipe.

NOTE: Features that are wholly contained within the pipe wall, such as voids, slag inclusions, or non-magnetic alloys, may have been classified as external metal loss, however these anomalies are quite rare.

A4. Contacting GE Oil & Gas, PII Pipeline Solutions

GE Oil & Gas, PII Pipeline Solutions aims to provide its clients with a quality service. If you cannot locate a metal loss feature from the information provided on the inspection sheet or if the metal loss is very different from the description given on the inspection sheet, then please do not hesitate to contact the project manager at GE Oil & Gas, PII Pipeline Solutions.

GE Oil & Gas, PII Pipeline Solutions Telephone Numbers:

Telephone:	+1-403-262-7447	(CANADA)
Facsimile:	+1-403-237-9693	(CANADA)
Address:	GE Oil & Gas, PII Pipeline Solutions 1003, 11th Street. S.W. Calgary, Alberta T2R 1G2 CANADA	

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Appendix B. Guidance Notes for Recording Excavation of Metal Loss Features

Contents

B1. Introduction

B2. Preparing pipe surface for inspection and recording

B2.1 Surface Preparation

B3. External metal loss area mapping

B3.1 Rubbing and Photographic Methods

B4. External metal loss depth recording

B5. Wall thickness and remaining ligament thickness recording

B6. Locating and quantifying internal metal loss in gas pipelines using x-radiography

B6.1 Introduction
B6.2 Technique for Quantifying Internal Metal Loss

Illustrations

Figure 1 Example of rubbing

Figure 2 Typical micrometer and bridging bar arrangement

Figure 3 Typical arrangement for X-ray technique

Figure 4 Procedure for inspecting and recording reported metal loss features - simplified flow diagram

Figure 5 Example of completed Pipeline Damage Record form

Blank 7097A for Client use

ENBDNR0000859

B1. Introduction

To help maintain and improve the defect sizing accuracy from these high resolution inspection systems it is extremely valuable to have feedback from defect excavations.

Reliable and accurate information from site investigations can be used to monitor actual defect dimensions against the dimensions reported from the inspection survey. This site data can then be used to improve defect sizing methods which brings benefit to all users of the inspection service.

We would ask pipeline operators wherever possible to feed any available comparison data from excavations back to us to help improve our service even more. For guidance, the most useful format for this data is as shown in the sample Damage Record Form in figure 5. This shows feature dimensions and location information.

We would like to express our appreciation to those who have provided this data in the past.

B2. Preparing Pipe Surface For Inspection And Recording

B2.1 Surface Preparation

To achieve satisfactory recording and measurement of the feature it is essential that the specified area of pipe surface is cleaned back to bare bright metal.

There are a number of methods for removing pipe wrap primer including:

(a) Solvent cleaning.

(b) Chemical cleaning.

(c) Wire brushing.

(d) Grit blasting.

For certain types of corrosion product it is possible to produce a finish resembling bright metal when cleaned using a wire brush. In this instance grit blasting is the preferred method in order to remove all the corrosion product.

B3. External Metal Loss Area Mapping

B3.1 Rubbing and Photographic Methods

The preferred method of mapping is by taking a simple rubbing. This is achieved by placing a sheet of paper over the feature, holding the paper firmly in place with, for example, small magnets and rubbing the long edge of a wax crayon over the surface of the paper. The edges of the feature will be delineated and if required, can be highlighted by careful manipulation of the crayon.

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The following parameters should be annotated on the paper:

(a) Feature identity (e.g. PII Report Number and Feature Number).

(b) Direction of flow.

(c) Orientation of the feature.

(d) Distance of the feature from the nearest girth weld.

Refer to Figure 1 for an example of a mapped area using the rubbing technique.

The rubbing technique has a definite advantage over photographic recording methods in that it is possible to record all subsequent measurements directly on the rubbing in the appropriate location e.g. each individual pit depth in multiple pitting. Refer to Figure 1 for the example.

Photographic recording can be used but unless a 'polaroid' type film is used it can be a lengthy process before a result is obtained.

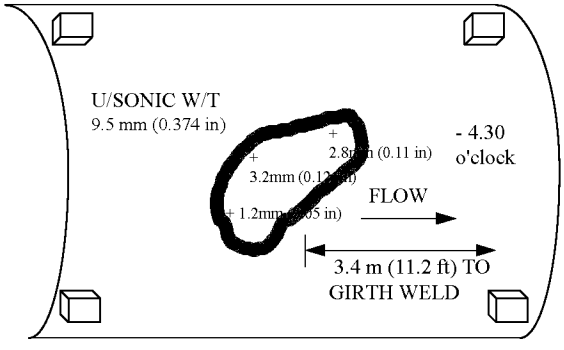


Figure 1: Example of Rubbing

B4. External Metal Loss Depth Recording

The most effective method for recording external metal loss depth is by using a depth micrometer in conjunction with a large bridging bar. Refer to Figure 2 for a typical arrangement.

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It is recommended that the micrometer anvil be ground to a taper with a tip diameter of approximately 0.04 inches. This will enable entry into the small diameter pitting and concave surfaces found at the bottom of most metal loss features.

A pit gauge is not recommended because of its potential inaccuracy of up to 0.08 inches. A depth micrometer has a resolution of better than 0.002 inches.

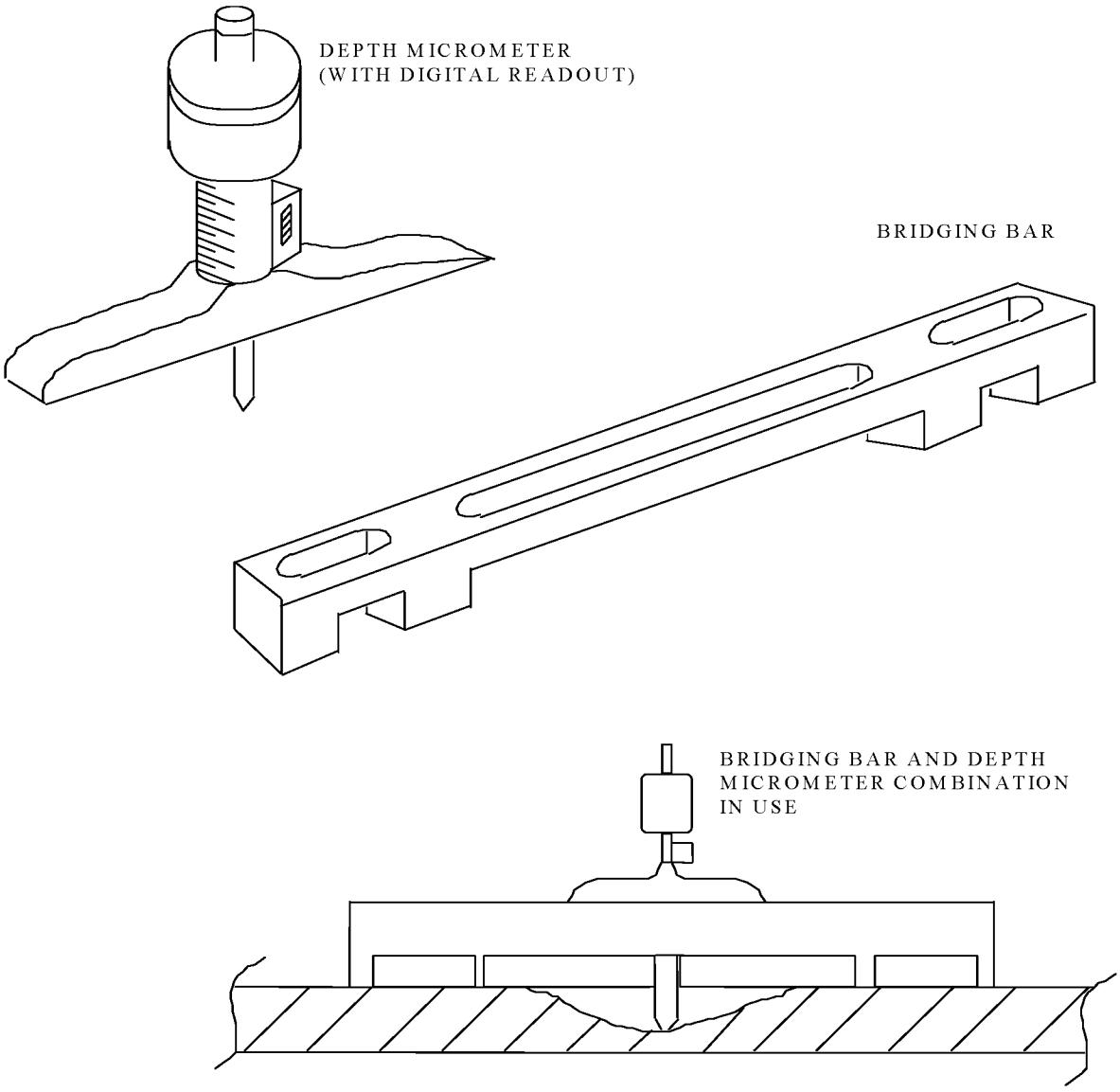


Figure 2: Typical Micrometer and Bridging Bar Arrangement

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B5. Wall Thickness And Remaining Ligament Thickness Recording

Pipe wall thicknesses and remaining ligament thicknesses of internal damage can be measured to an accuracy of ±0.002 inches using standard ultrasonic wall thicknesses meters and suitable couplant.

Extreme care should be exercised when attempting to measure remaining ligament thicknesses directly within an area of external damage because there is extra couplant under the transducer when mounted on concave surfaces which results in an overestimated reading.

Decisions on assessing the significance of the damage are primarily based on the remaining ligament thickness. It is therefore important to obtain a reliable reading. This is best accomplished by obtaining the minimum ultrasonic thickness reading immediately surrounding the damage and subtracting the mechanical depth measurement.

B6. Locating And Quantifying Internal Metal Loss In Gas Pipelines Using X-Radiography

B6.1 Introduction

Locating a small area of internal metal loss is occasionally difficult using manual ultrasonic techniques. In these instances it is usually preferable to obtain an X-ray of the suspect area to locate the feature. Although time consuming the X-ray technique does have the advantage of providing a permanent record of the feature, and obtaining full inspection coverage.

Gamma radiography is not recommended since this technique is relatively insensitive to metal loss. Depending on wall thickness and the diameter of the pipe a sensitivity of approximately 10% of wall thickness can be achieved using gamma-ray techniques whereas X-ray techniques can achieve a sensitivity of better than 2% of wall thickness.

B6.2 Technique for Quantifying Internal Metal Loss

The following procedure for quantifying metal loss using X-radiograph has been devised and proved successful by GE Oil & Gas, PII Pipeline Solutions. Refer to Figure 3.

(1) Locate area of metal loss using ultrasonic or Double Wall Single Image (DWSI) X-ray techniques.

(2) Place plate of known thickness over the metal loss area or deepest part of the metal loss. The plate thickness must be equal to or greater than the damage through-wall thickness.

(3) Place an ultrasonic step wedge on the pipe surface the adjacent to the metal loss but on sound pipe.

(4) Carry out DWSI X-radiography aiming for a density of approximately 3 on the parent plate.

(5) Using a densitometer on the radiograph compare the density of the darkest part in the metal loss plus plate with that on the step wedge and note the step thickness.

(6) Subtract the step thickness from the plate thickness to give the through-wall depth of the metal loss.

NOTE: It has been shown that slag or air are equally transparent to X-ray when using the energies applied to steel pipelines where the density is equal to that of the metal loss.

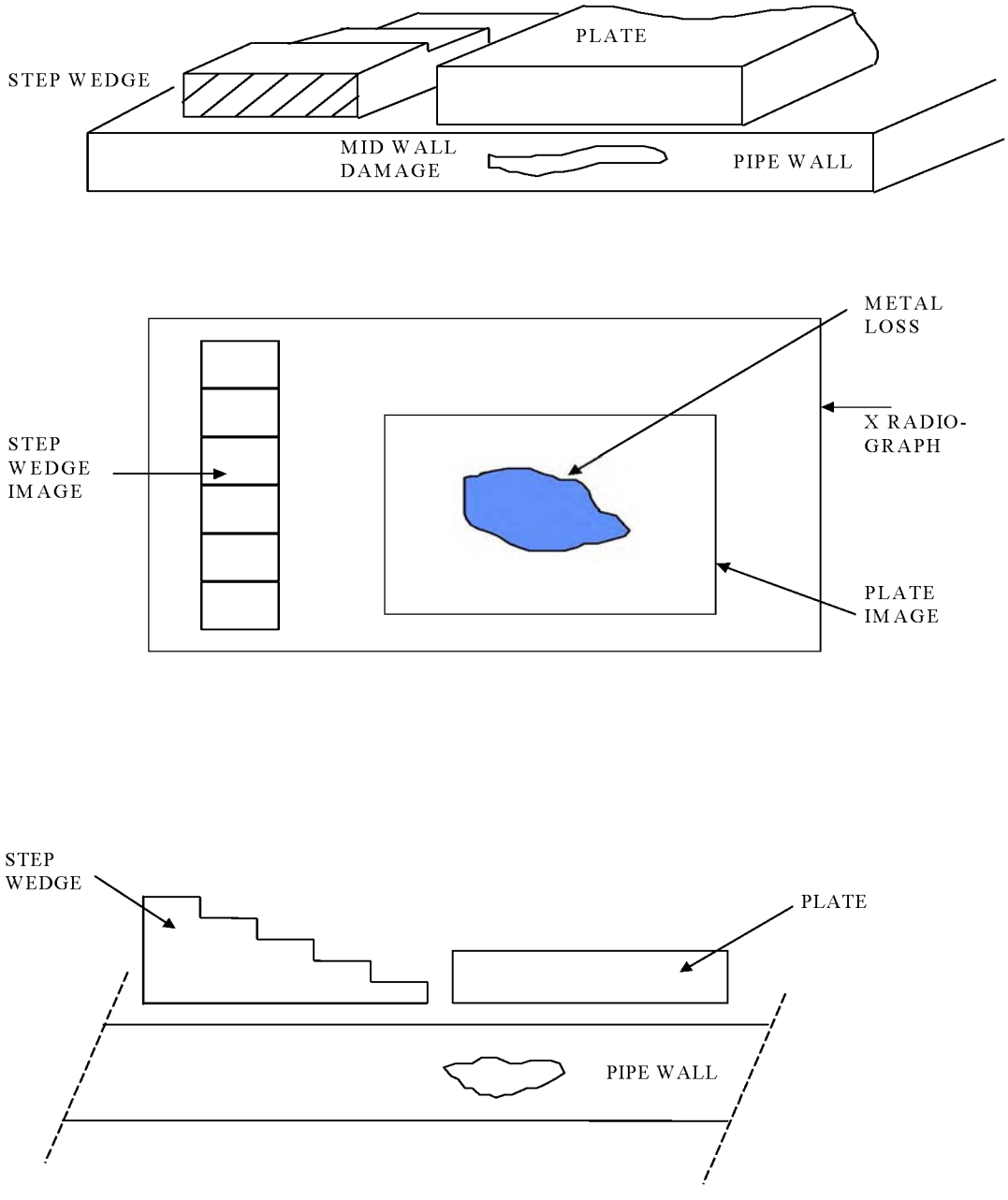


Figure 3: Typical Arrangement for X-ray Technique

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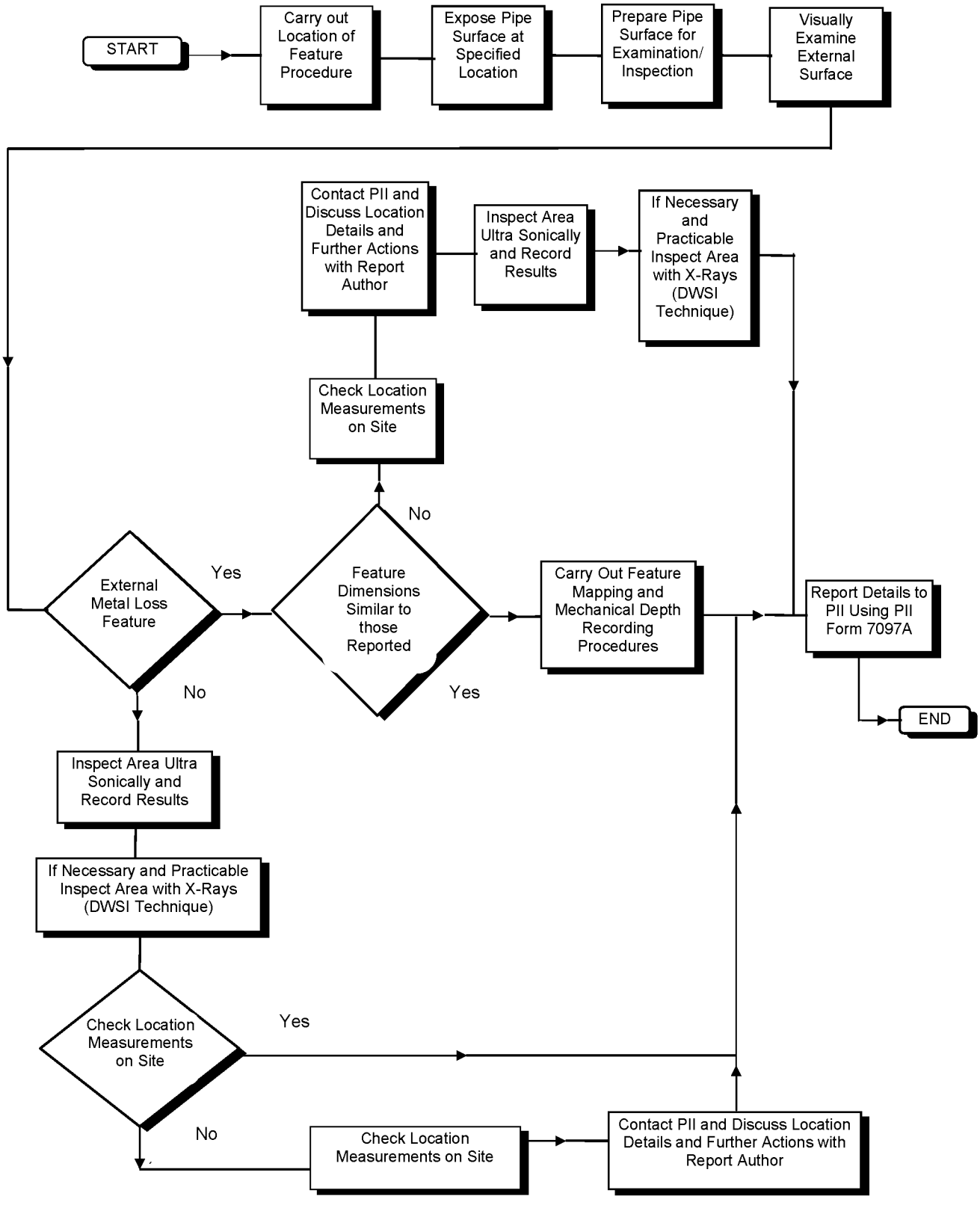


Figure 4: Procedure for Inspecting and Recording Reported Metal Loss Features - Simplified Flow Diagram

ENBDNR0000867

PIPELINE DAMAGE RECORD **7097A**
Oct 18/93

1. LOCATION OF DAMAGE

PIPELINE START: .....Somewhere Launch..... END: .....Somewhere Receive.....

FEATURE IDENTITY (PII) - REPORT NUMBER: ..SR 192..... INSP SHEET NO: ....3.....

FEATURE TYPE: General Corrosion ☒ Isolated Pit ☐ Gouge ☐ Manufacturing (Mill) ☐

Other: .....

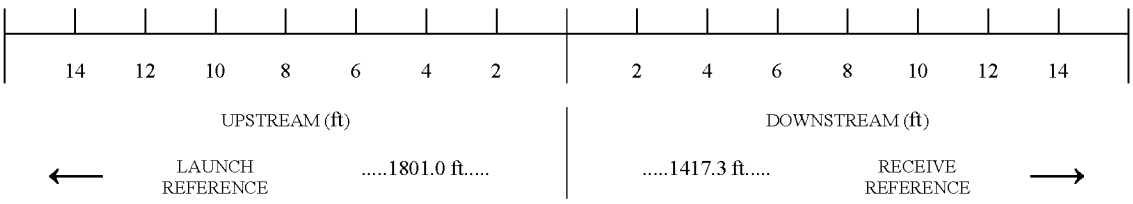
MEASURED WALL THICKNESS: .....0.361in.....

2. FEATURE DIMENSIONS

PII FEATURE NO.	EXACT POSITION UPSTREAM OR DOWNSTREAM OF REF. GIRTH WELD (ft)	ORIENTATION (o'clock)	AXIAL LENGTH (in)	CIRC'L WIDTH (in)	DEPTH	
					AVERAGE in% WT	PEAK in% WT
3/1	4.25 ft down	4.45	2.6	3.2		0.13
3/2	5.10 ft down	4.45	4.1	5.0		0.15
3/3	7.5 ft down	2.45	0.8	0.9		0.28

3. PLAN DIAGRAM OF SPOOL

CLOCK POSITION		REF GIRTH WELD
6	BOTTOM	.....
7	.....	.....
8	.....	.....
9	.....	.....
10	.....	.....
11	.....	.....
12	TOP	.....
1	.....	.....
2	.....	.....3/3.....
3	.....	.....+.....
4	.....	.....3/1.....3/2.....
5	.....	.....+.....+.....
6	BOTTOM	.....



NOTE: FOR COMPLEX FEATURES PLEASE ATTACH A 'RUBBING' OR SKETCH WITH DIMENSIONS AND DEPTHS IDENTIFIED.

RUBBING ATTACHED ☐ SKETCH ATTACHED ☐

DATA OF SITE INSPECTION: ..... SIGNATURE: .....

Figure 5: Example of completed Pipeline Damage Record Form (7097A)

ENBDNR0000868

PIPELINE DAMAGE RECORD

7097A
Oct 18/93

1. LOCATION OF DAMAGE

PIPELINE START: ..... END: .....

FEATURE IDENTITY (PII) - REPORT NUMBER: ..... INSP SHEET NO: .....

FEATURE TYPE: General Corrosion ☐ Isolated Pit ☐ Gauge ☐ Manufacturing (Mill) ☐

Other: .....

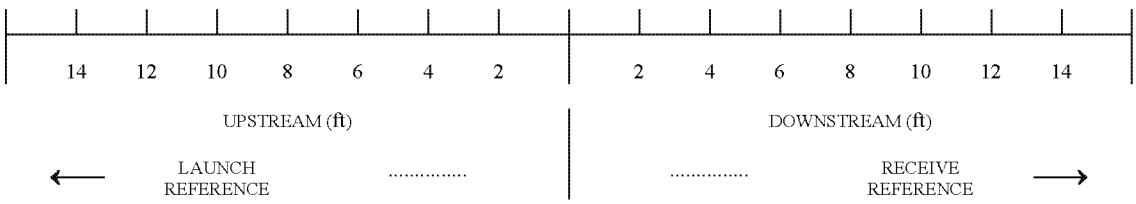
MEASURED WALL THICKNESS: .....

2. FEATURE DIMENSIONS

PII FEATURE NO.	EXACT POSITION UPSTREAM OR DOWNSTREAM OF REF. GIRTH WELD (ft)	ORIENTATION (o'clock)	AXIAL LENGTH (in)	CIRC'L WIDTH (in)	DEPTH	
					AVERAGE in% WT	PEAK in% WT

3. PLAN DIAGRAM OF SPOOL

CLOCK POSITION	REF GIRTH WELD
6 BOTTOM	.....
7	.....
8	.....
9	.....
10	.....
11	.....
12 TOP	.....
1	.....
2	.....
3	.....
4	.....
5	.....
6 BOTTOM	.....



NOTE: FOR COMPLEX FEATURES PLEASE ATTACH A 'RUBBING' OR SKETCH WITH DIMENSIONS AND DEPTHS IDENTIFIED.

RUBBING ATTACHED ☐ SKETCH ATTACHED ☐

DATA OF SITE INSPECTION: ..... SIGNATURE: .....

Appendix C. Operational Details

Contract Number	109170_20B
Operator	Enbridge Energy Limited Partnership
Launch Site	Straits of Mackinac (East Leg)
Inspection Run	
Date of Operation	May 09 2008
Duration of Run	0 hours 40 minutes
Data Recorded	0.000 miles to 4.133 miles
Inspection Modules	MTV: 1290 IV1: 975 BV: 1292 BATT: 124 REC: 2/006
Processor Pack	036

Appendix D. Pipeline Details

Contract Number	109170_20B
Date of Pipeline Commission	1950
Pipeline Outside Diameter	20 inches nominal
Product	Crude Oil
Pipeline Length (Client Data)	4.133 miles
Pipeline Length (PII Data)	4.133 miles
API Grade	A
Predominant Pipe Type	Seamless
Previous PII Inspection	March 2003 (101211_20H).

The nominal wall thickness listing, presented in Section 3.2.8, provides a list of the major and minor pipeline segments.

The listing identifies the locations of the start and end of each segment and the values of the nominal wall thickness (nwt) and the SMYS that apply within it.

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Appendix E. Additional Services

As a complement to the inspection service GE Oil & Gas, PII Pipeline Solutions can offer the following:

- Assessment

  This involves an Integrity Assessment which relates the severity of any defects reported by the inspection to the required future operating conditions of the pipeline. At GE Oil & Gas, PII Pipeline Solutions we have a dedicated team of engineers who have:

  - successfully conducted over 60 commercial consultancies for major oil and gas companies world-wide;
  - pioneered new integrity assessment methods now accepted by Regulatory Authorities (which have been included in pipeline codes); and
  - initiated and conducted extensive pipeline research.

- Repair

  Specialist repair services can be provided based on proven technologies established to support British Gas' 11000 miles pipeline transmission system. The repair team have extensive experience of operating a pipeline repair service, including work for many clients in Europe and the Middle East.

ENBDNR0000872

Appendix F. Pipeline Inspection Report Specification

The contents of the pipeline inspection report and the selection rules for selecting individual metal loss features for detailed analysis and reporting are specified in the Specification for the Pipeline Inspection Report, a copy of which is provided overleaf.

ENBDNR0000873

SCHEDULE 5 (Enbridge Version)

PIPELINE INSPECTION REPORT

MAGNESCAN™

For the Pipeline the subject of this Contract the Pipeline Inspection Report shall comprise:

1. **Preliminary Assessment Report**

2. **Metal Loss Feature Report**

    2.1 Inspection Sheets
    2.2 Colour Plots of data
    For a number of the worst metal loss features; manually analyzed and selected against pre-defined selection rules.

3. **Pipeline Summary Report**

(a) Metal Loss Information

3.1 Sentenced Plots
3.2 Pressure Based Histograms
3.3 Depth Based Histograms
3.4 Orientation Plot
3.5 Severity Table

(b) Pipeline Information

3.6 Velocity Plot
3.7 Metal Object Report
3.8 Eccentric Casing Report
3.9 Dent Report
3.10 Girth Weld Anomaly Report
3.11 Repair Listing
3.12 Location Reference Points Listing
3.13 Nominal Wall Thickness Listing

(c) Summary

3.14 Pipeline Listing

4. **PipeImage™ Inspection Data Software**

In addition to detailing the Report, this Schedule also contains:

APPENDIX 1 – Definition of Terms

APPENDIX 2 – Interaction Rules

APPENDIX 3 – Software Licensing

1. Preliminary Assessment Report

At the Company's request, a Preliminary Assessment Report will not be provided. Instead, during the course of data analysis, the Contractor will notify the Company of any feature assessed to be greater than 80% on an as discovered basis.

The Contractor will ensure that accurate feature location information is supplied when informing the Company of any feature of concern.

2. Metal Loss Feature Report

The Contractor will provide for each Component Line, a Metal Loss Feature Report comprising up to a maximum of fifteen (15) Inspection Sheets describing the severity, type, size and location of individual Metal Loss Features, all in accordance with those parameters set out in the Inspection Performance Specification.

If due to high levels of metal loss in the Pipeline the Company requires Inspection Sheets in excess of said maximum the Company may select additional Metal Loss Features and the Contractor shall report on such Metal Loss Features at additional charge.

2.1 Inspection Sheets

(a) Inspection Sheets will be prepared employing detailed examination and analysis techniques, for those sentenced metal loss features (or identified Manufacturing Faults) selected for detailed reporting using the Selection Rules listed below. The information contained within a typical Inspection Sheet is as follows:

(i) **Metal Loss Feature Description**

1. Internal/external characterization
2. Orientation of Metal Loss Feature viewed in the direction of the flow
3. Axial length, circumferential width, peak and where appropriate, average depth of the Metal Loss Feature, to the accuracy specified in the Inspection Performance Specification
4. Indication of Pressure Sentenced Ratio
5. Selection Rule Number
6. Nominal wall thickness of the pipe spool as advised by the Company
7. Distance from start of the Component Line to the Metal Loss Feature (absolute distance)
8. Comment of the general nature of the Metal Loss Feature and the existence of any nearby metal loss

(ii) **Metal Loss Feature Location**

1. Relevant strip map number, if available
2. Definition of at least one primary reference point on the Component Line which can be used to locate the Metal Loss Feature
3. Definition of the reference girth weld as the nearest upstream girth weld to the Metal Loss Feature
4. Distance between the reference girth weld and the primary reference points to the accuracy specified in the Inspection Performance Specification
5. Distance between the Metal Loss Feature and the reference girth weld (relative distance) to the accuracy specified in the Inspection Performance Specification
6. Length of the spool containing the Metal Loss Feature, the length of the two adjacent spools both upstream and downstream from the Metal Loss Feature spool and if visible, the orientation of the seam welds in each of the spools

(b) Selection Rules, for detailed reporting of Metal Loss Features on Inspection Sheets, will be selected according to the following:

Rule 1 - The 3 (three) most significant Metal Loss Features with Pressure Sentenced Ratio less than 1.0
Rule 2 - Metal Loss Features with peak depth greater than 80% wall penetration (0.8t)
Rule 3 - Metal Loss Features with a Pressure Sentenced Ratio less than 0.8
Rule 4 - Metal Loss Features with a Pressure Sentenced Ratio between 0.8 and 1.0
Rule 5 - Metal Loss Features with a Pressure Sentenced Ratio less than 1.1 (providing always that such Metal Loss Features are above the Inspection reporting parameters set out in the Inspection Performance Specification)
Rule 6 - Metal Loss Features with a peak depth greater than 60% wall penetration (0.6t)
Rule 7 - Metal Loss Features with a peak depth greater than 40% wall penetration (0.4t)
Rule 8 - Metal Loss Features with a peak depth greater than 20% wall penetration (0.2t)
Rule 9 - Metal Loss Features with a peak depth greater than 10% wall penetration (0.1t) and whose length is greater than 3 times the wall thickness

Some of the Metal Loss Features reported may fall below the Inspection Performance Specification and therefore the Inspection Performance Specification may not apply to the sizing of such Metal Loss Features.

(c) Initially reporting of Metal Loss Features will be limited to not more than 1 (one) per pipe spool. If due to low numbers of corroded pipe spools, the specified maximum number of Metal Loss Features to be separately reported upon has not been achieved for each Component Line then the one Metal Loss Feature per pipe per spool rule will be relaxed. The Selection Rules will then be reactivated such that so far as is possible, the balance of the Metal Loss Features up to the maximum specified are selected for inclusion on Individual Inspection Sheets.

(d) If due to low levels of detected metal loss within the Pipeline, the maximum number of Metal Loss Features to be separately reported upon for each Component Line has not been achieved subsequent to the reporting of Rule 9 Features, then those Manufacturing Faults identified in the Pipeline Listing shall be selected for reporting. This shall be on a one per pipe spool basis. The Inspection Performance Specification may not apply to the sizing of such Manufacturing Faults.

(e) In the event that subsequent to (b), (c) and (d) above, the maximum number of Inspection Sheets to be provided for each Component Line has not been achieved, the Contractor shall have no obligation to report further save that where no Metal Loss Features or Manufacturing Faults are selected under the Selection Rules, the Contractor shall select one (1) low level metal loss instance for reporting. The Inspection Performance Specification may not apply to the sizing of such low level metal losses.

2.2 Colour Plots

Accompanying each Inspection Sheet are two pictorial representations of the magnetic response derived from the Metal Loss Feature.

In both cases the pictorial representations of Metal Loss Feature are as viewed from outside the pipe with the upstream end being on the left. The vertical (y) axis is annotated with o'clock orientation as viewed in the direction of flow (at the time of the inspection). The horizontal (x) axis is annotated with the absolute distance measured from the launch.

The Overview Plot (monochrome) shows the magnetic response of the full circumference of the pipe for a length of approximately one spool to give the context of the Metal Loss Feature reported on the Inspection Sheet. To assist the Company in identifying the areas of metal loss it is shaded as if illuminated from the left side of the plot.

The Detailed Contour Plot (colour) is approximately centered on the Metal Loss and identifies the relative magnitudes of the magnetic responses in this area. The magnitude of the magnetic responses is represented by designated colours, with common magnitudes having common colours. Due to the behaviour of this magnetic response, the plot will not normally, provide a true representation of the physical profile of the Metal Loss Feature. The aspect ratio and zoom will be chosen to produce an appropriate image with the Metal Loss Feature being displayed to a higher magnification than in the Overview Plot.

3. Pipeline Summary Report

The Pipeline Summary Report provides an overview of the detected metal loss and other pipeline anomalies within each Component Line. Metal Loss Features, which during the process of selection have undergone detailed processing and analysis will be highlighted on the Pipeline Listing and the sizing accuracy specified in the Inspection Performance Specification will apply to all such Metal Loss Features (excluding identified Manufacturing Faults).

Otherwise than aforesaid, the processes used to size the Metal Loss Features in the Pipeline Summary Report do not include the detailed examination and analysis

employed when reporting Metal Loss Features on Inspection Sheets and hence, the sizing accuracy contained in the Inspection Performance Specification does not apply to the Pipeline Summary Report.

The Pipeline Summary Report shall comprise the following:

(A) Metal Loss Information:

3.1 Sentenced Plots
3.2 Pressure Based Histograms
3.3 Depth Based Histograms
3.4 Orientation Plot
3.5 Severity Table

(B) Pipeline Information:

3.6 Velocity Plot
3.7 Metal Object Report
3.8 Eccentric Casing Report
3.9 Dent Report
3.10 Girth Weld Anomaly Report
3.11 Repair Listing
3.12 Location Reference Points Listing
3.13 Nominal Wall Thickness Listing

(C) Summary

3.14 Pipeline Listing

3.1 Sentenced Plots

A Sentenced Plot will be produced for each Major Segment of each Component Line (as detailed by the Company). This will show sentenced depth versus length for all detected Metal Loss Features (excluding identified Manufacturing Faults) and includes the curve for a Pressure Sentenced Ratio of unity also defined in the Appendix. Metal Loss Features detected in Minor Segments identified within the Major Segment of any Component Line will be represented separately on the Sentenced Plot.

3.2 Pressure Based Histograms

A histogram will be provided indicating the number of occurrences of Pressure Sentenced Metal Loss Features (excluding identified Manufacturing Faults) per unit distance against absolute distance along each Component Line. Such Pressure Sentenced Metal Loss Features will be graded into bands according to severity. Additionally, a three-dimensional histogram will be provided showing the metal loss distribution for each of the pre-selected graded bands along each Component Line

3.3 Depth Based Histograms

The Depth Based Histograms show the number of occurrences of detected Metal Loss Features and identified Manufacturing Faults against absolute distance along each Component Line, presented in the following formats:

(i) All detected Metal Loss Features against absolute distance along each Component Line.

(ii) Total area of metal loss expressed as a percentage of surface area of Component Line against absolute distance.

(iii) Total volume of metal loss expressed as a percentage of pipe wall volume, against absolute distance.

(iv) Short Metal Loss Features i.e. Metal Loss Features with axial length < 3t graded into bands according to peak depth.

(v) Long Metal Loss Features i.e. Metal Loss Features with axial length > 3t graded into bands according to peak depth.

(vi) The distribution of detected metal loss graded into bands according to peak depth. This will be provided on a three dimensional histogram.

3.4 Orientation Plot

This plot shows all the instances of Metal Loss Features and identified Manufacturing Faults detected over the total length of each Component Line and indicates the orientation of the metal loss viewed in the direction of flow, against the absolute distance along the Component Line. The Orientation Plot is colour coded to show the depth grading of the Metal Loss Feature as reported in the Depth Based Histogram. Internal/external distribution can be viewed on the Orientation Plot contained in PipeImage™ Inspection Data Software.

3.5 Severity Table

The Severity Table comprises a list of pipe spools indicating the Pressure Sentenced Ratio, peak depth and axial length of the most severe Metal Loss Feature (excluding identified Manufacturing Faults) within each spool. These Metal Loss Features are selected in accordance with the Selection Rules detailed in Paragraph 2.1.(b) and listed in descending order of severity.

The Severity Table includes all pipe spools containing a Metal Loss Feature with Pressure Sentenced Ratio less than or equal to unity.

In the event that there are less than 25 (twenty five) pipe spools containing a Metal Loss Feature with Pressure Sentenced Ratio equal to or less than unity, the balance up to 25 shall be made up of the most severe of the remaining pipe spools.

The Severity Table shall contain the following:

(a) Pressure Sentenced Ratio of the Metal Loss Feature calculated in accordance with the Appendix

(b) Peak Depth and axial length of the Metal Loss Feature

(c) Weld number of nearest upstream girth weld

(d) Distance from the start of the Component Line (absolute distance)

(e) Orientation of the Metal Loss Feature viewed in the direction of the flow

3.6 Velocity Plot

This plot indicates the Inspection Vehicle velocity against absolute distance along the Component Line

3.7 Metal Object Report

The following information will be provided for all ferrous metal objects detected in proximity to a Component Line:

(a) Number of nearest upstream girth weld from the metal object

(b) Distance of metal object from the nearest upstream girth weld (relative distance) to the accuracy set out in the Inspection Performance Specification

(c) Distance of metal object from the start of the Component Line (absolute distance)

(d) Proximity classification (i.e. close or touching). Those metal objects classified as 'touching' may in the Contractor's opinion, have interfered with the coating or cathodic protection of the Component Line

(e) Orientation of detected metal object viewed in the direction of the flow

(f) Identification of nearest upstream location reference point

(g) Distance of upstream location reference point from nearest upstream girth weld to the accuracy set out in the Inspection Performance Specification

(h) Identification of nearest downstream location reference point

(i) Distance of downstream location reference point from nearest upstream girth weld to the accuracy set out in the Inspection Performance Specification

3.8 Eccentric Casing Report

Where a casing is considered by the Contractor to be so eccentric as to affect the carrier protective coating or the cathodic protection system the following information will be provided:

(a) Number of nearest upstream girth weld from the start of the casing

(b) Distance from nearest upstream girth weld to upstream end of casing (relative distance) to the accuracy set out in the Inspection Performance Specification

(c) Distance from the start of the Component Line to the upstream end of the casing (absolute distance)

(d) Category of position (i.e. start, end or intermediate)

- upstream end
- downstream end
- ends of unconnected spools making up the casing, if appropriate

(e) Comment as to whether the point of minimum separation of the casing so affected is 'close' or 'touching'

(f) Comment as to whether corrosion has been detected within the casing

(g) Length of casing (relative distance from start of casing)

(h) Comment on the identity of the casing and a statement as to whether the affected casing is associated with a road/railway crossing.

(i) Orientation of the point of minimum separation between the casing and the carrier pipe

3.9 Dent Report

All dents detected by the Inspection System will be reported upon in the following format:

(a) Number of nearest upstream girth weld from dent

(b) Distance of dent from nearest upstream girth weld (relative distance) to the accuracy set out in the Inspection Performance Specification

(c) Distance of dent from the start of the Component Line (absolute distance)

(d) Indication of presence of associated metal loss

(e) Indication of presence of associated girth weld

(f) Indication of presence of associated seam weld

(g) Orientation of dent viewed in the direction of the flow

(h) Identification of nearest upstream location reference point

(i) Distance of upstream location reference point from nearest upstream girth weld to the accuracy set out in the Inspection Performance Specification

(j) Identification of nearest downstream location reference point

(k) Distance of downstream location reference point from nearest upstream girth weld to the accuracy specified in the Inspection Performance Specification

3.10 Girth weld Anomaly Report

The following information shall be provided for all girth weld anomalies detected by the Inspection System:

(a) The number of the girth weld in which the anomaly occurs

(b) Distance of girth weld from the start of the Component Line (absolute distance)

(c) Indication of the type of girth weld anomaly (e.g. crack, incomplete weld, dressing repairs etc.

(d) Estimated circumferential extent of the girth weld anomaly

(e) Orientation of detected girth weld anomaly viewed in the direction of the flow

(f) Identification of nearest upstream location reference point

(g) Distance of upstream location reference point from the nearest upstream girth weld to the accuracy specified in the Inspection Performance Specification

(h) Identification of nearest downstream location reference point

(i) Distance of downstream location reference point from nearest upstream girth weld to the accuracy specified in the Inspection Performance Specification

3.11 Repair Listing

The following information shall be provided for all repair shells (i.e. full circumferential, snug fitting, welded or epoxy filled, or repair clamps) or spools containing repair patches detected by the Inspection System:-

(a) Number of nearest upstream girth weld from the start of the repair shell or the spool containing the repair patch(es)

(b) Distance from nearest upstream girth weld to upstream end of repair shell (relative distance) to the accuracy specified in the Inspection Performance Specification

(c) Distance from the start of the Component Line to the upstream end of the repair shell or the spool containing the repair patch(es) (absolute distance)

(d) Comment as to whether the repair is a shell or a patch-repair spool

(e) Length of repair shell

NB: Metal loss detected under repair shells and repair patches shall not be included in the reports, which comprise the Pipeline Summary Report.

3.12 Location Reference Point Listing

To assist in the location of features the Contractor shall detail the location of reference points such as timer boxes, magnets and/or anodes, valves and major offtakes (i.e. offtakes >50% of Component Line nominal bore), and shall provide the following information:

(a) Number of nearest upstream girth weld from reference point

(b) Distance of reference point from nearest upstream girth weld (relative distance)

(c) Distance of reference point from the start of the Component Line (absolute distance)

(d) Indication of the presence of a reference point

(e) Magnet/timerbox/anode identification number

(f) Mile Post value for location points as supplied by the Company

Additionally, the Contractor shall provide a separate listing containing the reference point identification number from the above listing against which a description of the above ground geographical location of each such reference point shall be provided, when available.

3.13 Nominal Wall Thickness Listing

All pipe spool nominal wall thickness changes detected by the Inspection System will be reported in the following format:

(a) The number of the girth weld at which the change in the pipe spool nominal wall thickness occurs

(b) Distance of the girth weld from the start of the Component Line (absolute distance)

(c) Distance from the girth weld to the next identified pipe spool nominal wall thickness change (length)

(d) Nominal wall thickness of the spools downstream from the girth weld

(e) Segment Number which also gives an indication as to whether the spools are in Major or Minor Segments

(f) SMYS value as supplied by the Company

3.14 Pipeline Listing

The Pipeline Listing will provide a comprehensive overview of all detected features along the length of the pipeline, including girth welds, fittings, metal loss features, identified manufacturing faults, metal objects, casings, dents, girth weld anomalies, repair shells, location reference points, and nominal wall thickness changes. This will include the following information:

(a) Girth weld number

(b) Distance from the nearest upstream girth weld (relative distance) to the current listing item (provided such information can be reliably identified)

(c) Distance from the start of the Component Line to the current listing item (absolute distance)

(d) Description of the current listing item

(e) Peak depth of Metal Loss Feature or Manufacturing Fault

(f) Axial length of Metal Loss Feature or Manufacturing Fault

(g) Pressure sentenced ratio of the Metal Loss Feature calculated in accordance with the Appendix

(h) Orientation of detected Metal Loss Feature, Manufacturing Fault, metal object, dent, girth weld anomaly or major offtake viewed in the direction of the flow. For welds this will show orientation of seam weld (when visible) or start and end orientation of spiral weld on the downstream spool.

4. PipeImage™ Inspection Data Software

4.1 The PipeImage™ Inspection Data Software will be supplied on CD-ROM and will include all the information contained within the Pipeline Inspection Report.

4.2 PipeImage™ Inspection Data Software provides the following user features:

(i) Data Display
- Menu driven command interface in Windows environment
- Icon driven pipeline data navigation and report generation
- Graphical Mainview report window
- Graphical display of inspection data in multiple formats including "Grey Scale"
- Pipeline overview window
- Pipeline zoom and pan
- Graphical representation of feature boxes and clusters
- User defined annotation of areas of features and other interest

(ii) Pipeline Listing
- User defined reports
- Pipeline feature search and go to
- Data filtering and sorting
- Interactive listings and graphical reports

(iii) Reporting
- Sentenced Plots
- Re-sentencing with variable pipeline and pressure parameters
- Pressure and Depth Based Histogram
- Metal Loss Plot
- Velocity Plot
- Inspection/Dig sheet generation
- Report Browser Utility

(iv) Utilities
- PipeImage™ Inspection Data Software -set up program
- Data export tool
- Online Help
- Suitable for installation on a network

4.3 The Contractor hereby grants to the Company the perpetual right to use the PipeImage™ Inspection Data Software save that all patent, copyright and other intellectual property rights embodied in the PipeImage™ Inspection Data Software shall remain vested in the Contractor. The Company hereby agrees that it shall not cause or permit the reverse engineering, disassembly or de-compilation of the PipeImage™ Inspection Data Software and shall keep confidential information relating to the processes and/or programs employed in the aforementioned software

SCHEDULE 5 (Enbridge Version)

APPENDIX 1

MAGNESCAN™ - PIPELINE INSPECTION REPORT

1. Definition of Terms

1.1 Metal Loss Feature

The term Metal Loss Feature is used to describe an occurrence of metal loss detected by the Inspection System. Where an occurrence of metal loss has been recognized to be "distinct", a box will be drawn around the Metal Loss Feature, which will be used to describe the boundary of the metal loss by its axial length and circumferential width. For isolated Metal Loss Features "distinct" means that the metal loss levels surrounding the box are below the reporting levels set out in the Inspection Performance Specification. For more complex areas of metal loss where pitting occurs within an area of general metal loss "distinct" shall mean that the metal loss level surrounding the box is significantly lower than that of the box.

Within areas of Pipeline where general corrosion has been detected, background metal loss below the reporting threshold of the Inspection System is commonly found to surround the boxed Metal Loss Feature. To ensure that the Company is made aware of all Metal Loss Features, which could pose a threat to the integrity of the Pipeline, the Contractor adopts a conservative approach to such areas of general corrosion by the application of signal clustering rules. Where the Contractor considers two or more boxed Metal Loss Features in close proximity may reasonably be joined by background metal loss, these will be combined and classified as a "cluster". The dimensions of the resulting cluster will be described by the peak depth, axial length and circumferential width.

1.2 Manufacturing Fault

A Manufacturing Fault is an occurrence of metal loss detected by the Inspection System, which has been assessed as having been caused during the manufacture of the line pipe/Component Line prior to commissioning/hydrostatic testing. It will be either,

(a) a single isolated box, or
(b) a cluster

The profile and surface texture of some Manufacturing Faults may make it difficult during analysis of the inspection data, to distinguish between a Manufacturing Fault and metal loss caused for example by corrosion. However, such faults should have been subject to the hydrostatic test during commissioning of the Pipeline and therefore should pose no threat to the integrity of the Pipeline.

1.3 Interaction Rules

The Interaction Rules are intended to represent the physical interaction between areas of metal loss (boxes). The Interaction Rules to be used in the compilation of the Pipeline Inspection Report are as follows;

Feature boxes, regardless of reported depth, will "interact" if they are separated by no more than 6 wall-thicknesses (6t) both axially and circumferentially. Each set of interacting boxes will be "clustered".

1.4 Pressure Sentenced Ratio

The Pressure Sentenced Ratio expresses the severity of the Metal Loss Feature. This is calculated below as RPR085. The more severe the Metal Loss Feature, the lower the Pressure Sentenced Ratio.

$S =$ Hoop stress level at failure

$$A = \frac{L^2}{Dt}$$

If the value of A is greater than 50

$$M_{085} = 3.3 + 0.032A$$

If the value of A is less than or equal to 50

$$M_{085} = \sqrt{1 + 0.6275A - 0.003375A^2}$$

$$T = \frac{1 - \frac{0.85d_{\%}}{100}}{1 - \frac{0.85d_{\%}}{100M_{085}}}$$

$$S = F_{stress}T$$

$$\text{RPR085} = \frac{S}{SMYS}$$

d	=	Sentenced Depth = Peak depth of the cluster.
t	=	Nominal wall thickness of pipe for each Component Line Major segment as defined in Paragraph 1.5 (page 4 of 4).
L	=	Axial length of the Cluster. Note the individual metal loss boxes will have been clustered according to the specified Interaction Rules of Appendix 2.
D	=	Nominal outside diameter of the pipe.

1.5 Company Defined Operating Parameters

Pressure Sentenced calculations may be varied for each identifiable segment of a Component Line to suit different operating parameters as required. The Company shall define such Major Segments and the appropriate operating parameters in the table below prior to Contract signature or as soon as possible thereafter.

In the event that the operating parameters have not been so defined by the Company, the Contractor shall perform Pressure Sentenced calculations using the following default parameters:

(a) The design pressure and MAOP will be assumed to be the same pressure and the same pressure will apply to all Major Segments. This provides for a conservative evaluation of any Metal Loss Feature in relation to Pipeline safety.

(b) The wall thickness in Major and Minor Segments (t and t' respectively) will be derived from the inspection data and where appropriate cross checked against previous inspection data or other data provided by the Company.

Component Line

Major Segment	START	FINISH	P_i kpa/psi	t mm/ins	SMYS Kpa/psi	MAOP kpa/psi	Minor Segment t' mm/ins
1	Launch to						
2							
3							
4							
5		Receive to					

P_i = Internal Design Pressure
t = Nominal Wall Thickness of Pipe (Major Segment)
MAOP = Maximum Allowable Operating Pressure or Company chosen Operating Pressure
SMYS = Specified Minimum Yield Stress
t' = Nominal Wall Thickness of Pipe within a Minor Segment where it is known to vary from t (e.g. road, river crossings etc.)

Those Major Segments of the Component Line listed by the Company above will be subdivided into Minor Segments in the event that the Contractor identifies areas of the Major Segment containing line pipe with Nominal Wall Thickness which varies significantly to that stated by the Company (e.g. road or river crossings, repair sections etc.).

For Minor Segments, the Contractor shall use either the appropriate Minor Segment wall thickness (t') supplied in the table above or the appropriate API wall thickness that is most consistent with the inspection data.

In the absence of any other information from the Company (strip maps, pipe listings etc.), the Contractor shall assume the Major Segment pressure parameters (P_i, MAOP) for the Minor Segments.

Pressure Sentenced Calculations shall be produced for each Metal Loss Feature in such Minor Segments on this basis.

This additional information relating to the wall thickness in Minor Segments shall be provided in the Nominal Wall Thickness Listing. Detailed sentenced plot data for Minor segments will be presented in the PipeImage™ Inspection Data Software report only.

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APPENDIX 2

MAGNESCAN™ - PIPELINE INSPECTION REPORT

Interaction Rules

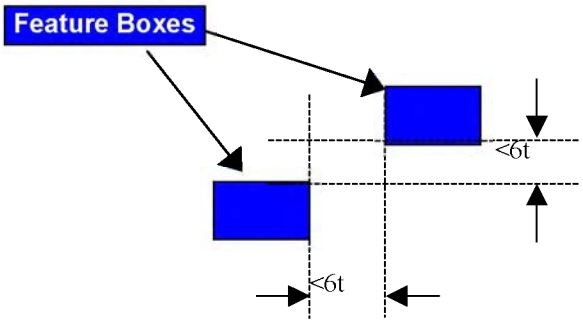
The Interaction Rules are intended to represent the physical interaction between areas of metal loss (boxes). The Interaction Rules to be used in the compilation of the Pipeline Inspection Report are as follows:

(i) Feature boxes will "interact" if their axial separation and their circumferential separation are both no more than 6 wall-thicknesses (6t).

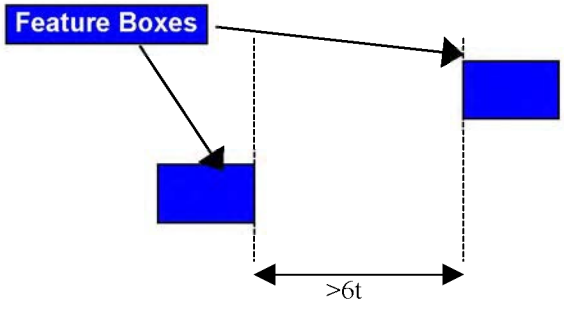
(ii) A set of interacting boxes will form a "cluster"

An example is as follows:

Example of Feature Boxes that Interact



Example of Feature Boxes that Do Not Interact



Feature Boxes must be within 6 Wall Thicknesses (6t) in both directions.

A cluster of pits situated across a girth weld shall be considered to be continuous (i.e. girth welds do not prevent interaction).

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APPENDIX 3

MAGNESCAN™ - PIPELINE INSPECTION REPORT

General Terms and Conditions for Software Licensing

PII Limited, a company incorporated under the laws of England and Wales and having its registered office at Atley Way, North Nelson Industrial Estate, Cramlington, Northumberland, NE23 1WW, England, grants the Company a royalty free, non-exclusive, non-transferable license to use this copy of the program and accompanying documentation according to the following terms:

LICENCE

You may:

- install the program on only one computer;
- make one (1) copy of the program in machine readable form solely for backup purposes, provided that you reproduce all proprietary notices on the copy; and
- physically transfer the program from one computer to another, provided that the program is used on only one computer at a time.

You must not:

- use the program on more than one computer or workstation at a time in a network or multi-user system;
- modify, translate, reverse engineer, decompile, disassemble, create derivative works based on, or copy (except for the backup copy) the program or the accompanying documentation;
- lease, transfer or grant any rights in the program or accompanying documentation in any form to any person without the prior written consent of PII Limited; or
- remove any proprietary notices, labels or marks on the program and accompanying documentation.

This license is not a sale. Title and copyrights to the program, accompanying documentation and any copy made by you remain with PII Limited. Unauthorized copying of the program or the accompanying documentation, or failure to comply with the above restrictions, will result in automatic termination of this license and will make available to PII Limited other legal remedies.

LIMITED WARRANTY AND DISCLAIMER

PII Limited warrants that, for a period of ninety (90) days from the date of delivery to you as evidenced by a copy of your receipt, the diskettes on which the program is provided for normal use will be free from defects in materials and workmanship and the program under normal use will perform without significant errors that make it unusable. PII Limited's entire liability and your exclusive remedy under this warranty (which is subject to your returning the program to PII Limited with a copy of your receipt) will be, at PII Limited's option, to attempt to correct or help you around errors with efforts which PII Limited believes suitable to the problem, to replace the program or diskettes with functionally equivalent software or diskettes, as applicable, or to refund the purchase price and terminate this Agreement.

Except for the above express limited warranties, PII Limited gives no warranties or guarantees, express or implied, of whatsoever nature and specifically disclaims any implied warranty of merchantability or fitness for a particular purpose. PII Limited does not warrant that the operation of the program will be uninterrupted or error free.

LIMITATION OF LIABILITY

In no event will PII Limited be liable for any damages, including loss of data, lost profits, cost of cover or other special, incidental, consequential or indirect damages arising from the use of the program or accompanying documentation howsoever caused. This limitation will apply even if PII Limited has been advised of the possibility of such damage.

The above conditions shall be interpreted in accordance with the laws of England and Wales.

USE OF THE SOFTWARE ACCOMPANYING THIS DOCUMENT SHALL MEAN AUTOMATIC ACCEPTANCE OF THE FOREGOING CONDITIONS.

Appendix G Inspection System Performance Specification

The pipeline inspection system employed by GE Oil & Gas, PII Pipeline Solutions has been designed to carry out a genuine high resolution pipeline inspection.

The performance capabilities of the inspection system are defined in the Inspection System Performance Specification, a copy of which is provided overleaf:

SCHEDULE 5

THE INSPECTION PERFORMANCE SPECIFICATION

1. Introduction

The Contractor's Inspection Vehicles have been specifically designed to ensure high resolution inspection of the full circumferential extent of the Pipeline and the detection of metal loss occurrences therein.

Inspection data obtained during the Inspection Vehicle run(s) in the Pipeline is subjected to a two stage processing and analysis procedure.

During Stage 1, preliminary processing and analysis is performed using the Contractor's automatic data analysis facilities. All Metal Loss Features detected by the Inspection System irrespective of depth or surface dimension are automatically sized and are reported together with Pipeline Anomalies and Pipeline Fittings, in the Pipeline Summary Report detailed in Schedule 5. The analysis systems employed during this stage are specifically designed such that all Metal Loss Features which may be of concern to the integrity of the Pipeline are highlighted and are selected for more detailed processing and analysis, subject to the maximum number of Features specified in Schedule 5.

During Stage 2, the most significant Metal Loss Features identified in Stage 1 are selected using the priority rules detailed in Schedule 5, for more detailed processing and analysis and reported on Individual Inspection Sheets. Those Metal Loss Features that have undergone such detailed processing and analysis shall be sized to the accuracy detailed in section 4 below.

The Contractor's Inspection Vehicles together with the aforementioned data processing and analysis comprise the Contractor's Inspection System.

2. Detection Capability

The capability of the Contractor's Inspection System, which applies irrespective of the type of pipeline construction (i.e. seamless, seamwelded, spiral etc.), is such that the following types of feature present in the pipeline can be detected:

(a) Metal loss

(i) associated with corrosion, including
- such metal loss in the vicinity of girth welds
- such metal loss associated with dents
- such metal loss situated beneath casings

(ii) associated with gouging

All such metal loss of depth and surface dimension greater than the minimum required for accurate sizing as detailed in Table 1 shall be detected. Metal loss below such depth and surface dimension can be detected. However, the probability of detection is reduced as the depth and surface dimension of the feature is reduced.

(b) Metal loss situated beneath repair clamps

(c) Metal loss associated with manufacturing faults

(d) Welds - girth, seam and spiral

(e) Girth weld anomalies including circumferential cracks within girth welds

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(f) Dents

(g) Manufacturing/mill type defects

(h) Construction damage

(i) Changes in nominal pipe wall thickness

(j) Pipeline fixtures and fittings including:
- (i) Tees
- (ii) Offtakes
- (iii) Valves
- (iv) Bends
- (v) Anodes
- (vi) Buckle Arrestors
- (vii) External Supports
- (viii) Ground Anchors
- (ix) Repair Shells
- (x) CP Connections - ferro-magnetic type

(k) Ferrous metal objects in close proximity to the pipeline considered likely to affect the carrier protective coating or cathodic protection system.

(l) Casings, including eccentric casings where the degree of eccentricity is considered likely to affect the carrier protective coating or cathodic protection system.

(m) Reference marker magnets

3. Location Accuracy

3.1 All those features detailed in section 2 detected by the Inspection System shall be located to the accuracy detailed in Table 1.

4. Sizing Accuracy

4.1 Those Metal Loss Features as detailed in section 2.(a) detected by the Inspection System and which have been selected for reporting on Individual Inspection Sheets shall subject to section 4.2, be sized to the accuracy detailed in Table 1 attached hereto.

4.2 It should be noted that the sizing accuracy is dependent upon several factors such as pipeline cleanliness, pipe construction methods, product flow conditions etc. These factors have been taken into account by the Contractor when designing the Inspection System. However it has been found impractical to compensate fully for the extremes which have been noticed in practice and as a result the accuracy with which Metal Loss Features can be detected and sized can vary from point to point along a pipeline. The Contractor's experience of operating on-line Inspection Systems show that the sizing accuracy detailed in Table 1 is attained for greater than 80% of Metal Loss Features reported.

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TABLE 1 DETECTION, SIZING AND LOCATION ACCURACY (10/20)

	METAL LOSS CATEGORY		
	PITTING <(3t X 3t)*	**GENERAL >(3t x 3t)***	**GOUGING**
Minimum Depth for Accurate Sizing	If surface dimension is > 0.275" x 0.275" or 0.4t x 0.4t (whichever greater): 0.2t	0.1t	If width > 0.5t or 0.275" (whichever greater): 0.2t If width > 3t: 0.lt
Sizing Accuracy (Depth)	±0.1t	±0.1t	±0.1t
Sizing Accuracy (Length)	±0.4"	±0.8"	±0.8"
Sizing Accuracy (Width)	±0.8"	±0.8"	±0.8"
Location Accuracy (Axial)	±8" between the feature and the reference girth weld and ±1% of stated distance between reference girth weld and identified location reference		
Location Accuracy (Circumferential)	±7.5 degrees which for ease of reference is stated to the nearest half hour clock position		

t = nominal wall thickness

* Metal loss is characterized by the minimum rectangle of dimensions, circumferential width (W) and axial length (L) that contains the surface area of pipe affected by metal loss.

Pipeline Anomalies (i.e. Dents, Weld Anomalies, Eccentric Casings, and Metal Objects) and Pipeline Fittings (i.e. Valves, Offtakes, etc.) shall also be located to the accuracy stated above.

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