

Corrosion ILI Program Summary Document

Line 5 ENO-EMA BH GEMINIMFL 2018

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1.0 Purpose

This document will provide a summary of all aspects associated with the corrosion management program. Contents of this summary may include but it is not limited to:

- Summary of priority notification features
- Summary of the results of Lakehead system integrity remediation process

It is important to consider that this document is a working file that tracks learnings and/or status of the corrosion program. Therefore, all changes to the selection process should be included in the corresponding sections and a clear summary of the learnings and resultant actions should be documented within this document.

All sections that are not applicable to the ILI program should be deleted.

2.0 Scope

This record applies to the ILI reports indicated on the front page of this document. This document will reference Pipeline Integrity (PI) procedures and work instructions as part of the Fitness for Service (FfS) process defined further in Integrated Management System IMS-09.

3.0 Basic Inspection Remarks

Table 1 Previous Inspections

Year Month	ILI Corrosion Tool	ILI Vendor
2018 March	MFL	GE
2017 April	GEMINIMFL	BH
2013 August	MFL	GE
2008 May	MFL	GE
2003 March	MFL	PII
1998 September	Metal Loss	PII

Hazard specific susceptibility ranking for the line is:

External corrosion	Low
Internal Corrosion	Low

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Axial slotting corrosion	Low

4.0 Priority Notification for Imperative Condition

Were there any features reported meeting imperative condition?

☐ Yes
☒ No

If Yes, summarize actions taken for the priority notification(s).

Were there any features not reported as imperative condition that meet the imperative condition criteria?

☐ Yes
☒ No

If Yes, summarize additional actions taken to ensure a successful program.

Were the imperative condition confirmed by NDE?

☐ Yes
☐ No

Summarizes the ILI and field findings

5.0 Inspection Report Review (PI-36) and Remarks

Prepared by: Mengshan Yu Date: 6/25/2018

Approved by: Samuel Cheng Date: 7/10/2018

Complete review based on PI-36 Data Quality Review In-Line Inspection.

Please be noticed that no external/internal corrosion features were reported by 2018 BH GEMINIMFL

Step 1.0 Was the data degraded?

☐ Yes
☒ No

If Yes, explain the cause and affected region of the data degradation. And follow PI-36 to document additional actions taken to ensure a successful program.

Pre-launch inspections of the GEMINI™ tool were performed. After passing all of the Baker Hughes pre-run inspection procedures, the tool was launched at 13:16 EDT on April 17, 2018 from North Straits station, Michigan and tool entered the receiver trap at 15:13 EDT on April 17, 2018 at the Mackinaw, Michigan. Tool was extracted from the receiver approximately 16:00 EDT on April 17, 2018. The GEMINI™ tool was received relatively clean with 1 damaged caliper sensor arm.

Field analysis indicated that a 100% of MFL and 98.24% of caliper data were collected for the run. 1 caliper sensor arm was damaged during the run but it did not affect the size of the geometry anomalies. All other systems including the odometers and inertial system functioned normally for the entire run.

Step 2.0 Do features align with expectations?

☒ Yes

☐ No

Use Appendix A of PI-36 as guidance.

1) No Matched features

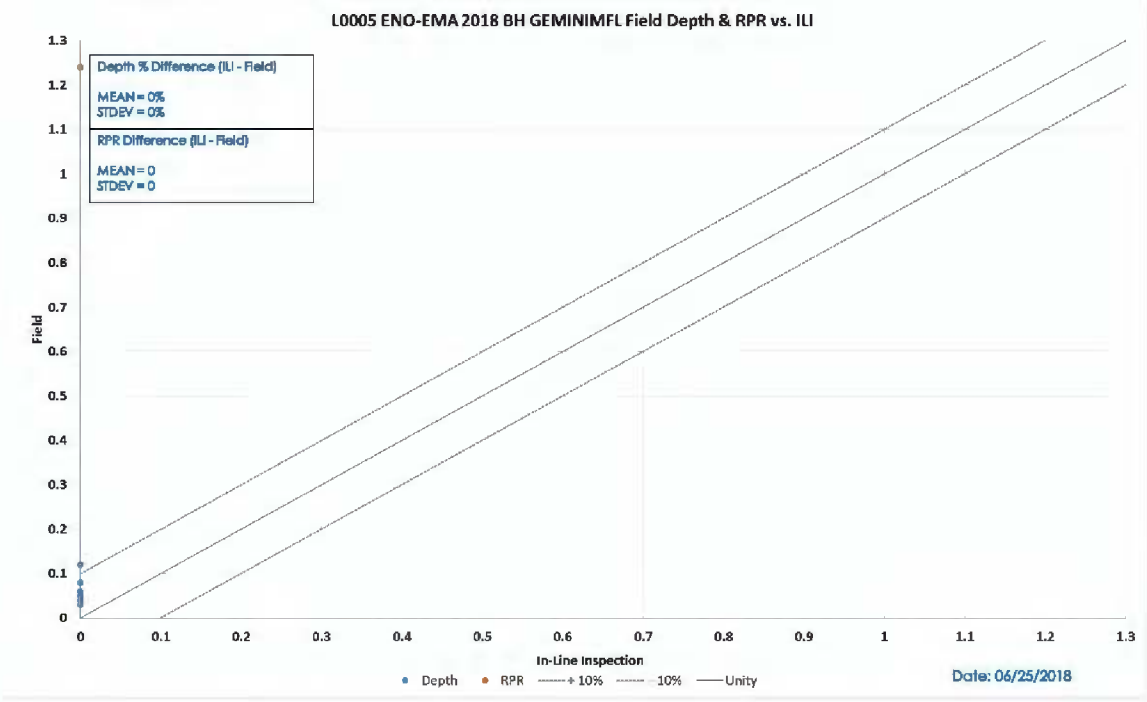
2017 BH GEMINIMFL did not report any corrosion features.

Table 2 No matched features cases in PI-36

Current ILI	Previous ILI(2017, GEMINIMFL)	Description	# of features	Comments
2018 BH GEMINIMFL	>=40%	No Match	**0**	**N/A**
2018 BH GEMINIMFL	1.0<RPR <1.05	No Match	**0**	**N/A**

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2) Preliminary Unity Plot



Probability of Sizing Analysis								
	Pitting	Extended Corrosion	Axial Slotting	Circumferential Slotting	Pinhole	Circumferential Grooving	Axial Grooving	Overall POS
Number of True Positive Features Above Threshold	-	-	-	-	-	-	-	-
POS (%)	-	-	-	-	-	-	-	-

Probability of Detection Analysis								
	Pitting	Extended Corrosion	Axial Slotting	Circumferential Slotting	Pinhole	Circumferential Grooving	Axial Grooving	Overall POD
Number of Features Above Threshold	-	-	-	-	-	-	-	-
POD (%)	-	-	-	-	-	-	-	-

Overall Validation										CEPA Check				
ILI Certainty	Confidence Level	z_α	z_α^2	X	n	$\hat{n}$	$\hat{p}$	$\hat{p}_{upper}$	Result	Avg Combined Tolerance	Std Dev of Error	Result	Mean of Error	General Result
80%	95%	1.645	2.706	0	-1	1706	79.3%	100.0%	ACCEPTABLE	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!

RPR		
Std Dev of Error	Mean of Error	General Result
#DIV/0!	#DIV/0!	N/A

Normal Distribution Check (Depth)			Normal Distribution Check (RPR)		
Skewness	Kurtosis	Result	Skewness	Kurtosis	Result
#DIV/0!	#DIV/0!	N/A	#DIV/0!	#DIV/0!	N/A

Refresh Validation Analysis

3) Near miss and safety and resource (defined in WI-13) outliers of Preliminary Unity Plot

There are no major outlier report.

Table 3 Summary of significant outliers of Preliminary Unity plot

GW	ILI		Field		Brief Explanation
	Depth	RPR	Depth	RPR	

4) Is Orientation plot as expected?

☒ Yes

☐ No

Please be noticed that no external/internal corrosion features reported by 2018 BH GEMINIMFL.

If No, explain how it is not as expected

5) Unexpected feature type?

☐ Yes

☒ No

The 2018 BH GEMINIMFL reported 0 external corrosion features and 0 internal corrosion features, while 2017 BH GEMINI MFL did not report any corrosion features.

6) Change in density (+/- 20%) of features >=40%?

☐ Yes

☒ No

The 2018 BH MFL did not report any features with a depth >= 40%, and the 2017 BH GEMINI MFL did not report any features >= 40%.

For features with a depth >= 10%: the 2018 BH GEMINI MFL reported 3 external and 28 internal manufacturing defects (< 27% NWT), while the 2017 BH GEMINI MFL reported 0 external and 8 internal manufacturing defects. There is an increase in the number of reported internal manufacturing defects, however, all reported features are < 27% NWT. The 2017 GEMINI MFL was run at a tool velocity (> 2 m/s) which resulted in reduced feature detection and sizing specifications; thus it did not report many minor features. The 2018 GEMINI MFL was run at a lower velocity (~ 1 m/s) and thus had improved feature detection and sizing. The tables below show the change in specification.

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2. VECTRA/GEMINI Sizing Specification (0.812" at 1 m/s)

	General	Pitting	Axial Grooving	Circ. Grooving	Pinhole	Axial Slotting	Circ. Slotting
Minimum dimensions for sizing accuracy[1]	W>3A L>3A	W>A L>A	W>A L>2A	W>2A L>A	W>0.7A L>0.7A	W>0.7A L>A	W>A L>0.7A
Depth at POD=90%	0.05t	0.08t	0.10t	0.08t	0.20t	0.20t	0.10t
Depth sizing accuracy at 80% certainty	± 0.10t	± 0.10t	± 0.10t	± 0.10t	± 0.20t	± 0.20t	± 0.20t
Width sizing accuracy at 80% certainty	± 0.4-in. ± 10 mm	± 0.4-in. ± 10 mm	± 0.4-in. ± 10 mm	± 0.4-in. ± 10 mm	± 0.4-in. ± 10 mm	± 0.4-in. ± 10 mm	± 0.4-in. ± 10 mm
Length sizing accuracy at 80% certainty	± 0.4-in. ± 10 mm	± 0.4-in. ± 10 mm	± 0.4-in. ± 10 mm	± 0.4-in. ± 10 mm	± 0.4-in. ± 10 mm	± 0.4-in. ± 10 mm	± 0.4-in. ± 10 mm

3. VECTRA/GEMINI Sizing Specification (0.812" at 2 m/s)

	General	Pitting	Axial Grooving	Circ. Grooving	Pinhole	Axial Slotting	Circ. Slotting
Minimum dimensions for sizing accuracy[1]	W>3A L>3A	W>A L>A	W>A L>2A	W>2A L>A	W>0.7A L>0.7A	W>0.7A L>A	W>A L>0.7A
Depth at POD=90%	0.10t	0.10t	0.30t	0.12t	0.30t	0.30t	0.15t
Depth sizing accuracy at 80% certainty	± 0.13t	± 0.13t	± 0.10t	± 0.10t	± 0.25t	± 0.20t	± 0.20t
Width sizing accuracy at 80% certainty	± 0.5-in. ± 13 mm	± 0.5-in. ± 13 mm	± 0.5-in. ± 13 mm	± 0.5-in. ± 13 mm	± 0.5-in. ± 13 mm	± 0.6-in. ± 16 mm	± 0.6-in. ± 16 mm
Length sizing accuracy at 80% certainty	± 0.5-in. ± 13 mm	± 0.5-in. ± 13 mm	± 0.5-in. ± 13 mm	± 0.5-in. ± 13 mm	± 0.5-in. ± 13 mm	± 0.5-in. ± 13 mm	± 0.5-in. ± 13 mm

In addition, seamless pipe presents conditions which, due to the manufacturing process, vary from location to location. As such, ILI anomaly detection and sizing specifications may be impacted by the level of noise observed in each section of seamless pipe. In high noise sections, the detection and sizing specification may increase up to an additional ±10% WT.

	All Features		> 10% NWT Depth	
East Straits	2017 GEMINI	2018 GEMINI	2017 GEMINI	2018 GEMINI
External	0	3	0	3
Internal	41	168	8	28

7) At least 60% of the features are >= 20% deeper or >= 20% shallower than previously reported?

☐ Yes

☒ No

8) Is severity, density or unexpected feature type driving investigative dig program and expedite excavation deadlines?

☐ Yes

☒ No

End of PI-36

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6.0 Consent Decree Excavation Criteria

Prepared by: Mengshan Yu Date: 6/25/2018

Approved by: Samuel Cheng Date: 7/10/2018

Table 4 Consent Decree Corrosion Feature Excavation Selection

Criteria	Unmitigated features are selected for excavation (Y/N/NA)
Any corrosion feature with a depth >80% of the wall thickness of the joint where the feature is located	NA
Any corrosion feature with a Predicted Burst Pressure < the established MOP	NA
Any corrosion feature with a Predicted Burst Pressure < 1.39 MOP	NA
Any corrosion feature with a depth>50% wall thickness but < 80% WT	NA
For Line 3 outside an HCA, any corrosion feature with a depth >65% wall thickness but <80% WT	NA
Any corrosion feature with a remaining life < 5 years (Not applicable to Line 3)	NA
Any corrosion feature with a remaining life < 2 times the planned re-inspection interval	NA

Explain if "N" is selected for any criterion

Table 5 Remaining Unmitigated Features **(Updated on 7/10/2018)**

There are no corrosion features reported in this inspection. The deepest manufacturing defect reported is 27% NWT.

Remaining Unmitigated Features	
The worst depth (%)	N/A
The lowest Safety Factor	N/A
The shortest remaining life (years)	N/A

7.0 Consent Decree Threat Integration Excavation Selection

Prepared by: Mengshan Yu Date: 6/25/2018

Approved by: Samuel Cheng Date: 7/10/2018

Table 6 Consent Decree Threat Integration Excavation Selection

Criteria	Unmitigated features are selected for excavation (Y/N/NA)
Any dent located in the top of the pipeline that has any indication of metal loss, cracking, or a stress riser	NA
Any dent located in bottom of the pipe that has any indication of metal loss, cracking, or stress riser	NA
Any case in which a crack feature intersects or interacts with a corrosion feature and the Predicted Burst Pressure of such interacting or intersecting features determined using the CorLAS ™ model is less than 1.25 MOP	NA
Any intersecting or interacting crack/corrosion feature with a remaining life < 5 years	NA

Any intersecting or interacting crack/corrosion feature with a remaining life < 2X planned re-inspection	NA

Explain if "N" is selected for any criterion

From Pipeline Listing

ML+Crack

No interactions between metal loss and crack were reported.

ML+deformation

No interactions between metal loss and deformation were reported.

From Feature Match in Threat Integration

ML+Crack

No interactions between metal loss and crack were reported.

ML+deformation

No interactions between metal loss and crack were reported.

8.0 Summary of Consent Decree Excavation Selection

Table 7 Summary of Consent Decree Excavation Selection

Criteria	Number of Features Issued

9.0 Updates based on Statistical Analysis of field data

Prepared by: Date:

Approved by: Date:

Are additional digs required based on statistical analysis of field data

☐ Yes

☐ No

If Yes, update Table 4 (Remaining Unmitigated Features) and Table 6 (CMFL Remaining Unmitigated axial slotting and seam weld anomaly A/B Features (if applicable)

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