

Corrosion ILI Program Summary Document

Line 5 West Straights 2018 BH Gemini MFL

Effective Date: Jul 6 , 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
1998 Sept	MFL	PII
2003 June	MFL	PII
2008 May	MFL	GE
2013 Aug	MFL	GE
2017 Apr	Gemini MFL	BH
2018 Mar	MFL	GE
2018 Apr	Gemini MFL	BH

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Hazard specific susceptibility ranking for the line is:

External corrosion	Low
Internal Corrosion	Low
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

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5.0 Inspection Report Review (PI-36) and Remarks

Prepared by: Braiden Redman Date: June 22, 2018

Approved by: Samuel Cheng Date: 7/11/2018

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

Step 1.0 Was the data degraded?

☐ Yes

☒ No

1.1 Inspection Summary

1.1.1 Operational Details

Baker Hughes Pipeline Inspection has mobilized equipment and a qualified crew to perform in-line inspections of the following system:

BHI Job Number	2008-357
Pipeline Operator	Enbridge Energy, Limited Partnership
Segment Name	NPS20 Line5 North Straits West - Mackinaw
Launch Site	North Straits, Michigan
Receive Site	Mackinaw, Michigan
Pipeline Nominal Diameter	20"
Product	Oil
Predominant Pipeline Grade(API)	X30/X52X60X65
Predominant Weld Type	Seamless
Section Length	4.15 miles
Date of GEMINI™ Inspection	April 18, 2018
Duration of GEMINI™ Inspection	1 hour and 54 minutes
Field Project Manager	Dale Simpson

Table 1. Operational Details

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 08:23 EDT on April 18, 2018 from North Straits station, Michigan and tool entered the receiver trap at 10:17 EDT on April 18, 2018 at the Mackinaw, Michigan. Tool was extracted from the receiver approximately 11:00 EDT on April 18, 2018. The GEMINI™ tool was received relatively clean with 1 damaged odometer.

Field analysis indicated that a 100% of MFL and 100% of caliper data were collected for the run. 1 odometer was damaged during the run. All other systems including the odometers and inertial system functioned normally for the entire run.

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Step 2.0 Do features align with expectations?

☒ Yes

☐ No

Considering features with depths > 10% NWT, there are 25 internal and 6 external manufacturing defects reported in the 2018 GEMINI MFL and 8 internal manufacturing defects in the 2017 GEMINI MFL. This is an increase in both internal and external manufacturing defects when compared to the 2017 run. As stated in the final report, the sizing of manufacturing defects is subject to inaccuracy and variability due to the sizing algorithm being tailored for metal loss features. In addition, 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

The 2013 GE MFL reported 81 internal manufacturing defects and 194 external manufacturing defects. This is an increase in both internal and external features between the 2018 GEMINI MFL and 2013 MFL inspections. A portion of this discrepancy can be attributed to differences in tool technology. BHGE is currently looking further into this issue.

Use Appendix A of PI-36 as guidance.

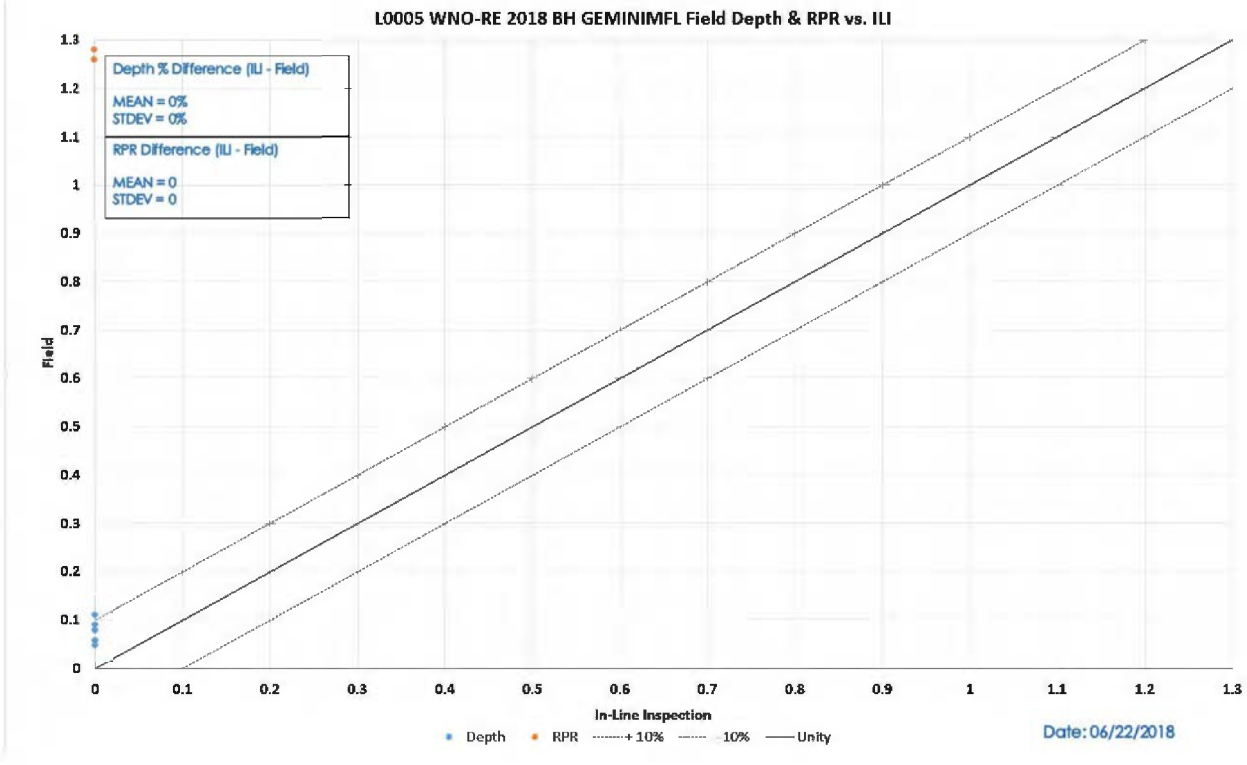
1) No Matched features

Table 2 No matched features cases in PI-36

Current ILI	2017 GE MFL	Description	# of features	Comments
2018 BH Gemini MFL	>=40%	No Match	0	No Features
2018 BH Gemini MFL	1.0<RPR <1.05	No Match	0	No Features

2) Preliminary Unity Plot

No external metal loss ILI indications were reported in the run. Internal NDE features and grinds were trended.



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

No outliers generated.

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

Orientation plot has no data to display. No features are indicated to be metal loss in either 2018 BH Gemini or 2017 GE MFL tool runs.

5) Unexpected feature type?

☐ Yes

☒ No

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

☒ Yes

☐ No

The most severe manufacturing defect reported in the 2018 GEMINI MFL is 38% NWT. When comparing to the 2013 GE MFL there is one manufacturing defect feature with a depth of 41% NWT. This feature is reported in the 2018 GEMINI MFL with a depth of 12% NWT. The 2017 GEMINI MFL reported this feature with a depth of 27% NWT. Considering the 2018 MFL reported this feature at 41% NWT, no action is required at this time.

Using >= 10% NWT instead as a change in density threshold:

Tool Run	Ext. Features >=10% Depth	Int. Features >=10% Depth
2018 BH Gemini MFL	6	25

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2017 GE MFL	0	8
2013 GE MFL	194	84

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

☐ Yes

☒ No

No features changed by more than 20% depth. Greatest magnitude of change is 15% depth.

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: Braiden Redman Date: June 22, 2018

Approved by: Samuel Cheng Date: 7/11/2018

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

No corrosion features reported by the 2018 GEMINI MFL; only manufacturing defects were reported. No features meet criteria.

Table 5 Remaining Unmitigated Features **(Updated on 7/6/2018)**

There are no corrosion features reported in this inspection. The deepest manufacturing defect reported is 38% NWT.

Remaining Unmitigated Features	
The worst depth (%)	N/A

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The lowest Safety Factor	N/A
The shortest remaining life (years)	N/A

7.0 Consent Decree Threat Integration Excavation Selection

Prepared by: Braiden Redman Date: June 22, 2018

Approved by: Samuel Cheng Date: 7/11/2018

Two sources were used to check threat integration interaction. Pipeline listing and Threat Integration CD file. No interactions were found in the pipeline listing or the threat integration file.

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

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)