

Corrosion ILI Program Summary Document

Line 5 ENO-EMA BHGE MFL3 2019

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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.

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 April	GEMINIMFL	BH
2018 March	MFL3	GE
2017 April	GEMINIMFL	BH
2013 August	MFL	GE
2008 May	MFL	GE
2003 March	MFL	PII
1998 September	Metal Loss	PII

4.0 Priority Notification for Imperative Condition

Were there any features reported meeting Priority Notification criteria?

☐ Yes

☒ No

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

☐ Yes

☒ No

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Was the imperative condition confirmed by NDE?

☐ Yes

☒ No

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5.0 Inspection Report Review (PI-36) and Remarks

Prepared by: Michael Nguyen Date: 7/4/2019

Approved by: Samuel Cheng Date: 7/10/2019

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

Step 1.0 Was the data degraded? ☒ Yes ☐ No

1.3. Inspection Quality

Inspection data was obtained for the full length (4.1 miles) of the pipeline.

The primary sensors for metal loss detection CH 170 was non-responsive from launch and CHs 1, 2, 31, 84, 93 and 9 were under responding throughout the inspection. For the non-adjacent sensors, we can meet full contractual detection and sizing specifications.

For the 2 adjacent under-responding sensors (CHs 1 and 2), we can offer the following revised HR specifications. Please refer to the table below for further details.

Seamwelded Pipe

Faulty Sensor Type	Sensor No.	Start Distance (ft)	End Distance (ft)	Affected Distance	Circumferential Impact	Min diameter for sizing/ detection	Detection (90%POD)		Sizing Specification (80% Confidence Level)		
							General Corrosion / Circum. Groove	Pitting / Axial Groove	Pitting / General Corrosion	Axial Groove	Circumferential Groove
Main T1	7-Jan	0	21753	21753	1.2%	0.55 in	12%	15%	+7/-17%	-22/+7%	7/+22%

Seamless Pipe

Faulty Channel	No.	Start Distance (ft)	End Distance (ft)	Affected Distance	Circumferential Impact	Min diameter for sizing/ detection	Detection (90%POD)		Sizing Specification (80% Confidence Level)		
							General Corrosion / Circum. Groove	Pitting / Axial Groove	Pitting / General Corrosion	Axial Groove	Circumferential Groove
Main T1	7-Jan	0	21753	21753	1.2%	0.55 in	15%	20%	+7/-17%	-22/+7%	7/+22%

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

For non-adjacent sensors that were under responding, the vendor stated they met full contractual detection and sizing. Below are the remaining under responding and non-responsive sensors:

Channel	Orientation Start (deg)	Orientation End (deg)
1	354	356
2	356	358
170	332	334

Corrosion tools 2018 Gemini BH, 2018 MFL3 GE, 2017 Gemini BH, and 2013 MFL GE did not have metal loss feature calls at the orientation ranges above.

The velocity of the tool exceeded the specified maximum velocity in one section of the pipe. The speed excursion covered a total distance of 3.4 ft. the affected joint is detailed in the table below.

ABSOLUTE DISTANCE (ft)		GIRTH WELD		DISTANCE OF SPEED EXCURSION (ft)
FROM	TO	FROM	TO	
35.6	39	71	71	3.4

There were no features previously observed on the affected area.

Tool Run	Comments
2018 MFL3 GE	No metal loss or manufacturing features on GW 71.
2018 GEMINI BH	No metal loss or manufacturing features on GW 71.
2017 GEMINI BH	No metal loss or manufacturing features on GW 71.

Step 2.0 Do features align with expectations?

☒ Yes

☐ No

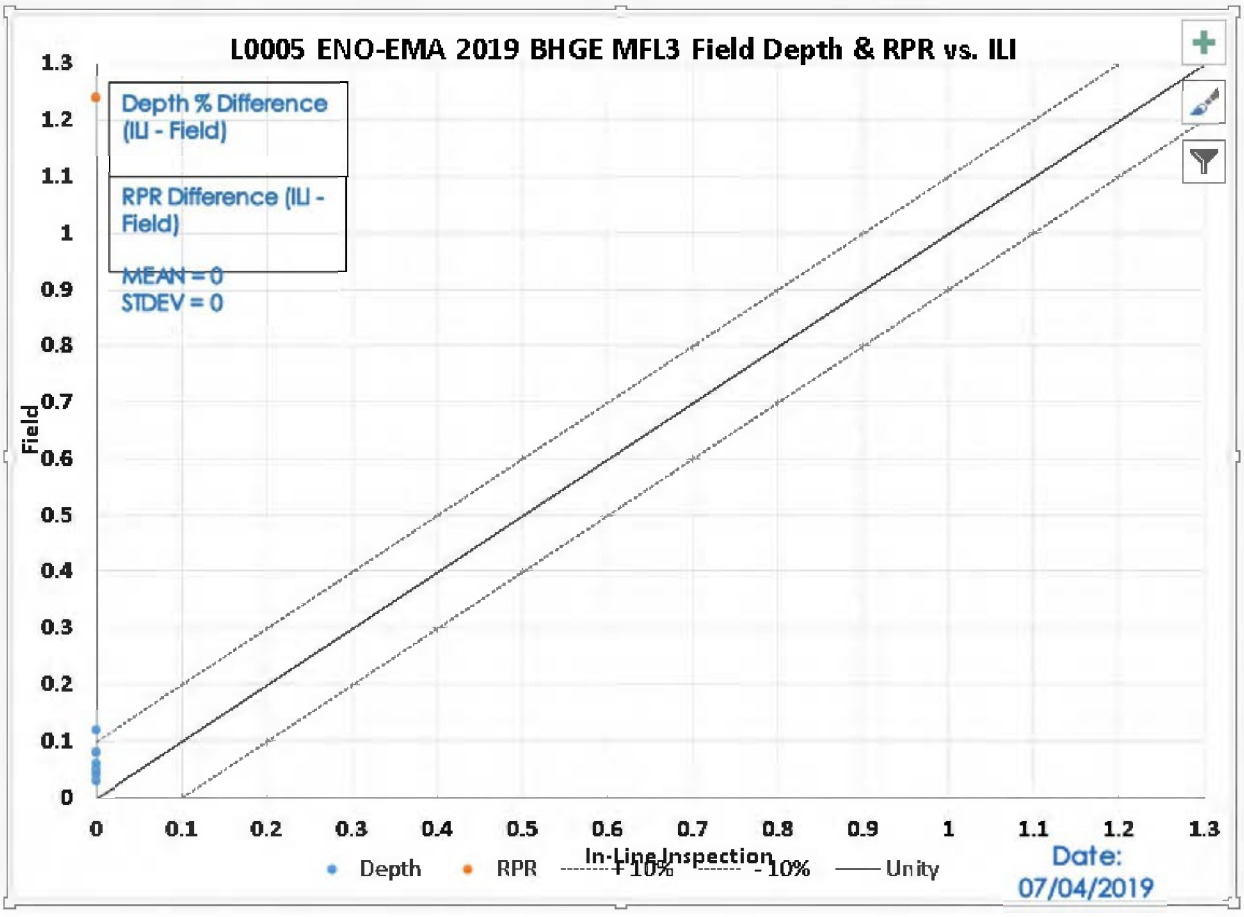
1) No Matched features

No feature

Table 2 No matched features cases in PI-36

Current ILI	Previous ILI(2018, GE MFL3)	Description	# of features	Comments
2019 BHGE MFL3	>=40%	No Match	0	N/A
2019 BHGE MFL3	1.0<RPR <1.05	No Match	0	N/A

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 (%)	-	-	-	-	-	-	-	-

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

Table 3 Summary of significant outliers of Preliminary Unity plot

GW	ILI		Field		Brief Explanation
	Depth	RPR	Depth	RPR	

No near-miss or safety outliers were identified in the Preliminary Unity Plot.

4) Is Orientation plot as expected? ☒ Yes ☐ No

5) Unexpected feature type? ☐ Yes ☒ No

	2019 BHGE MFL3	2018 GE MFL3	Percentage Change
Internal Corrosion Features	12	12	
External Corrosion Features	0	0	
Int and Ext Corrosion Features	0	0	
Internal Corrosion/Total	100.00%	100.00%	0.00%

	2019 BHGE MFL3	2018 GE MFL3	% Count Change
Manufacturing Defects	150	149	0.7%

No external corrosion features were called by 2019 BHGE MFL3 or 2018 GE MFL3 tools. There is 0% change in the amount of internal corrosion features. There is a 0.7% change in the number of manufacturing defects detected.

6) Change in density (+/- 20%) of features >=40%? ☐ Yes ☒ No

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Tool Run	Metal Loss 0%-10%	All Feature Types 0%-10%
2018 GE MFL3	10	10
2019 BHGE MFL3	10	10
Density Change %	0.0%	0.0%

Tool Run	Metal Loss 10%-20%	All Feature Types 10%-20%
2018 GE MFL3	1	1
2019 BHGE MFL3	1	1
Density Change %	0.0%	0.0%

Tool Run	Metal Loss 20%-30%	All Feature Types 20%-30%
2018 GE MFL3	1	1
2019 BHGE MFL3	1	1
Density Change %	0.0%	0.0%

Tool Run	Metal Loss 30%-40%	All Feature Types 30%-40%
2018 GE MFL3	0	0
2019 BHGE MFL3	0	0
Density Change %	#DIV/0!	#DIV/0!

Tool Run	Metal Loss >= 40%	All Feature Types >= 40%
2018 GE MFL3	0	0
2019 BHGE MFL3	0	0
Density Change %	#DIV/0!	#DIV/0!

No features were meeting >= 40% depth on both tools, so there is no density change to observe.

7) Do more than 60% of the features have ILI reported depth >= 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: Michael Nguyen Date: 7/5/2019

Approved by: Samuel Cheng Date: 7/10/2019

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	N/A
Any corrosion feature with a Predicted Burst Pressure < the established MOP	N/A
Any corrosion feature with a Predicted Burst Pressure < 1.39 MOP	N/A
Any corrosion feature with a depth>50% wall thickness but < 80% WT	N/A
For Line 3 outside an HCA, any corrosion feature with a depth >65% wall thickness but <80% WT	N/A
Any corrosion feature with a remaining life < 5 years (Not applicable to Line 3)	N/A
Any corrosion feature with a remaining life < 2 times the planned re-inspection interval	N/A

No reported features meet Consent Decree excavation criteria.

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Table 5 Remaining Unmitigated Features **(Updated on 7/10/2019)**

Remaining Unmitigated Features	
The worst depth (%)	25% NWT
The lowest Safety Factor	4.82
The shortest remaining life (years)	67 years

7.0 Consent Decree Threat Integration Excavation Selection

Prepared by: Michael Nguyen Date: 7/5/2019

Approved by: Samuel Cheng Date: 7/10/2019

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	N/A
Any dent located in bottom of the pipe that has any indication of metal loss, cracking, or stress riser	N/A
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	N/A
Any intersecting or interacting crack/corrosion feature with a remaining life < 5 years	N/A
Any intersecting or interacting crack/corrosion feature with a remaining life < 2X planned re-inspection	N/A

No reported features meet Consent Decree threat integration excavation criteria.

From PI Listing

No Interaction between metal loss and crack features reported.

No interaction between metal loss and deformation features reported.

From Feature match – Threat Integration

No Interaction between metal loss and crack features reported

No interaction between metal loss and deformation features 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: Samuel Cheng Date: 7/10/2019

Approved by: Date:

Are additional digs required based on statistical analysis of field data

☐ Yes

☒ No

Based on the Preliminary Unity Plot, no bias was identified and no further action is required.

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