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Final Report: Coating Repairs Work Plan

Line 5 Dual Pipelines

Enbridge Energy, Limited Partnership

Submitted: October 12, 2018

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Objective

This Final Report is submitted in accordance with Condition No. 2 of the US Environmental Protection Agency's (EPA) September 14, 2017 approval of Enbridge's Coating Repairs Work Plan for the Line 5 Dual Pipelines, Version 3 (CRWP). This Final Report summarizes the activities that were conducted by Enbridge under the EPA-approved CRWP, and also identifies and justifies minor deviations from the procedures in the CRWP.

Introduction

On June 13, 2017, EPA approved Enbridge's May 18, 2017 Biota Investigation Work Plan (BIWP). The BIWP sets forth detailed steps under which Enbridge was to complete biota sampling at specific locations along the Line 5 Dual Pipelines' crossing of the Straits of Mackinac (Straits). The BIWP, as supplemented, specifically identified Areas of Interest[1] (AOIs) along the Dual Pipelines that would be investigated by divers, as well as additional inspection sites.

On August 14, 2017, crews were mobilized to inspect the pipeline coating on Line 5 using work barges, divers, and support teams. At the completion of inspections in December 2017, a total of 23 coating inspection locations, including 18 AOIs and 5 additional sites were examined by divers.

As listed in Table 1, bare metal was identified by divers at the following three coating inspection locations: EAS-1, EAS-3 and EAS-4. The bare metal identified by divers at these locations totaled approximately 2.58 sq. ft. in exposed area. Notably, the identified bare metal at locations EAS-3 and EAS-4 was found to comprise 99.6% of the total bare metal identified at all coating inspection locations. Locations EAS-3 and EAS-4 were added to the list of coating inspections locations in August 2017 after the BIWP had been submitted to, and approved by, the EPA. The locations were added because the exposed bare metal at these two locations resulted from contact with an abandoned communication cable during the execution of the 2017 BIWP.

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[1] An Area of Interest is a part of the pipeline where, based on visual inspection, (i) the normal (local) Biota is unexpectedly absent or (ii) there is evidence of possible coating damage (e.g., Dislodged Coating and/or potential Holiday).

In addition, calcareous deposits[2] were observed at six of the BIWP locations, as shown in Table 1. All six calcareous deposits were removed (as summarized in Table 1) to confirm the condition of the pipe beneath them, and to gather samples to study the deposit chemistry. Removal of the six calcareous deposits at EAOI-1, EAOI-5, EAOI-7, EAS-1, EAS-2, and WAS-1 resulted in the exposure of bare pipe underlying the calcareous deposits.

Enbridge committed to inspecting the pipeline surface and completing coating repairs at these bare metal locations (i.e., at EAS-1, EAS-3 and EAS-4, and at five additional locations where the removal of calcareous deposits resulted in the visibility of bare metal). Enbridge submitted the CRWP to EPA on September 13, 2017. EPA initially approved the CRWP with conditions on September 14, 2017. EPA subsequently modified the conditions on September 20, 2017, to read as follows:

> On September 14, 2017, EPA approved the Work Plan with three conditions. EPA now revises the conditions upon which it approves the Work Plan as follows:
>
> 1. EPA is not approving the use of Modified Method 2 (described on page 4 of the Work Plan) at this time because Enbridge has not yet demonstrated the effectiveness of that Method. Enbridge may not use Modified Method 2 unless EPA provides prior written approval;
>
> 2. within 30 days of Enbridge's completion of the activities required by the Work Plan, Enbridge shall submit to EPA a Final Report, summarizing its activities and identifying and justifying any deviations from the procedures in the Work Plan; and
>
> 3. Enbridge shall implement the Work Plan in accordance with all federal, state, and local regulations and laws, including any permitting requirements.

Diver Training and Certification

In order to support the successful implementation of the coating repairs, the divers that completed the repairs were Operator Qualified (OQ). The divers completed the OQ training

[2] A layer consisting of calcium carbonate and other salts deposited on the surface. When the surface is cathodically polarized by cathodic protection, this layer is the result of the increased pH adjacent to the protected surface. This layer functions as a barrier against the corrosive environment, leading to a decrease in cathodic protection current demand and more persistent chemical polarization of the pipe surface. A calcareous coating is also known as a calcareous deposit.

on September 12, 2017. The results of that OQ training were uploaded to ISNetworld (i.e. Global work compliance safety registry) to verify compliance. A list of the OQ-covered tasks is provided in Appendix F of the CRWP. OQ training was not required in 2018 because the returning divers were all trained in 2017 and the divers' qualifications remain valid for three years, until 2020.

To supplement the OQ certification process, Enbridge had the coating manufacturer provide the divers with specific training for the materials and coating applications that were used for the Line 5 underwater coating repairs. Upon successful completion of the manufacturer's training, the divers were issued a certificate of completion.

The manufacturer's training consisted of verbal technical training and introduction to the products, their components, and the basic installation procedure. The manufacturer also utilized audio visual presentations of various installations, wet out procedures, and technical aspects of the uses of the products. This instruction was followed by a "hands on" application of the filler, the composite, the stricture banding, and the pre-cast sleeve.

The marine contractor performed and completed a simulated wet trial of a repair on September 20, 2017. That wet trial was conducted close to a dock near the Straits to test the coating repair procedure specified in the CRWP prior to completing the underwater coating repairs on the Dual Pipelines.

Scope of the Repairs

All coating repairs were completed using Method 1 as outlined in the CRWP. In total, 8 locations were identified as having bare metal as-found at the time of inspection or created by the removal of the calcareous deposits (see Table 1). All bare-metal locations were repaired in 2017, except for EAS-4. For EAS-4 site, Enbridge required permits from the Michigan Department of Environmental Quality (MDEQ) and the U.S. Army Corps of Engineers (USACE) to authorize Enbridge's removal of lake bed soil from around the bottom of the pipe prior to recoating and repair. The MDEQ permit was received on December 8, 2017 and the USACE permit was received on January 5, 2018. Excavation at EAS-4 began on July 16th, 2018. The excavation was completed on August 7, 2018 due to prioritization of the marine contractor to complete the Dual Pipelines dent repairs and operational procedure reviews to increase safety. The coating repair at EAS-4 was started on August 8, 2018 and inspected for

cure on September 13, 2018 following a number of weather delay days and barge maintenance activities.

Deviations to the Coating Repairs Procedure

There were a total of three deviations from the procedures specified in the CRWP.

The first two deviation requests were submitted by the execution team to Pipeline Integrity (PI) Coating Specialist on October 17, 2017, and approved by the PI Coating Specialist on October 23, 2017, to revise Sections 3.2.3 and 4.3.6 of the coating repair procedure in Appendix E of the CRWP. The revisions were specifically requested with respect to the coating repair at the location of EAS-3 because: (i) the pipe support anchor at that location impeded the ability to coat-over at least 6 inches of existing adjacent coating from the edge of the repair area; and (ii) the pipe support anchor at that location impeded the application of the Stricture Banding™ as called for in the approved CRWP. Revision to Sections 3.2.3 and 4.3.6 were deemed to be appropriate when compared to the alternative of removing the pipe support anchor at that location, which would have resulted in a span in excess of the distance allowed under the existing easement. The language of Section 3.2.3 of the coating repair at EAS-3 was therefore revised to read, "roughening shall extend at least 6 inches from the upstream and downstream edge of the repair area *if possible* and around the entire circumference of the pipe." Similarly, Section 4.3.6 was revised to read as follows: the "Stricture Banding™ shall extend at least 4 inches upstream and downstream of the repair if possible. Where it is not possible to extend 4 inches from the repair area, the Stricture Banding™ shall completely cover the composite wrap and extend as far as possible." All deviations were supported by the product manufacturer. Enbridge provided the Management of Change (MOC) for the deviations to Sections 3.2.3 and 4.3.6 to EPA on October 27, 2017.

The third deviation request was submitted by the marine contractor to the Enbridge project manager to deviate from the CRWP requirement that the "Manufacturer will be on the barge overseeing the work related to the surface preparation, application and confirming/verifying of the repair." This request was made specifically with respect to the coating repair at EAS-4. In 2017, the divers were trained and qualified by the Manufacturer and have field experience using the coating repair. Accordingly, for EAS-4, the requirement for the Manufacturer to have an on-site representative was deemed by Enbridge to no longer be required due to the competency, training, and experience of the divers. On June 6, 2018, the ITP and the PI

Coating Specialist were consulted about the proposed deviation and did not object. A coating inspector was charged with overseeing the work related to the surface preparation, application, and confirming/verifying the repair at EAS-4.

Tables

Table 1: Diver Inspection Results at BIWP Locations

Location	Area of Bare Steel As-Found (sq. ft.)	Area of Bare Steel Created by Calcareous Deposit Removal (sq. ft.)
EAOI-1	-	0.03
EAOI-5	-	0.01
EAOI-7	-	6.18
EAS-1	0.01	0.88
EAS-2	-	0.14
EAS-3	0.93	-
EAS-4	1.64	-
WAS-1	-	0.40
Totals	2.58	7.64

Coating repair forms for the inspection locations identified in Table 1 are provided in Appendix A.

Appendix A: Coating Repair Forms

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Coating Repair Form for L5 Straits of Mackinac

General Information			
Date:	10/06/2017 10/09/2017 10/10/2017 10/22/2017	Diver:	10/06 – Mike Rosette, Andrew Alber 10/09 – McKenzie Tompkins, Joe Rieman, Mike Rosette, Andrew Alber 10/10 – Joe Rieman, Mike Rosette, Andrew Alber 10/22 – Andrew Alber
AFE / W.O.#:	BPI-1264792-17	Company Inspector:	Neil Pittman
Segment:	EAS-1	Water Depth (ft):	76
Longitude:	-84.76762989	Latitude:	45. 79912833

Material Information			
BIO- DUR™ 563 SW Epoxy Base – Black	17T-391 17T-582 17T-586	Expiration Date:	7/04/2019 9/19/2019 9/20/2019
BIO – DUR ™ 563SW Curing Agent – White	17T-534 17T-583 17T-587	Expiration Date:	9/05/2019 9/19/2019 9/20/2019
X100 – UW Epoxy Base – Blue	17T-580 17T-570 17T-598	Expiration Date:	9/20/2019 9/12/2019 9/25/2019
BIO-SEAL ™ X-100 Curing Agent – Clear	17T-581 17T-571 17T-597	Expiration Date:	9/20/2019 9/12/2019 9/25/2019

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Coating Repair Form for L5 Straits of Mackinac

Temperature (°F):	61, 56, 57, 56, 61	Wall Thickness Measurements (mil):	1	808, 814, 824, 824, 824, 824,822
			1b	UT cannot read on weld.
			1c/d	842, 842, 850, 838, 818, 788, 798, 790, 788, 788, 786, 782, 776, 764, 770, 772, 774, 780, 790, 780, 780, 792, 808, 798, 808, 820, 834
			1e	838, 830, 822, 816
			1f	812, 814, 812, 814, 816
Location of the Coating Repair:		Top, Side, and Bottom of Pipe	Coating Repair Method:	Full Circumferential Composite Wrap Repair

Quaity Assurance During Application

☑	The steel surface was cleaned using scarpers, hydroblasting cleaning, wet abrasive blasting, or pneumatic power wire wheel brush. (3.1)
☑	Feathering removed the sharp edge at the transition from the parent coating. The parent coating was roughened (abraded) using a cup disk brush to remove the loosely adherent biota, coating and provide a surface for overcoating (3.2).
☑	Immediately prior to coating application, the Diver removed any flash rust and/or accumulated debris (silt, clay, etc.) using a wire brush or other method approved by the Manufacturer (4.1).
☑	The diver applied sufficient BIO-DUR epoxy filler so that the bare steel is completely covered and the repair area is flush with the adjacent parent coating (4.2.2 and 4.2.3).
☑	Full Circumferential Composite Wrap Repair (4.3) or Composite Patch Repair (4.4) applied in accordance with the coating procedure.
☑	Blue Stricture Banding© or alternative protective wraps/encasements allowed by the coating Manufacturer applied over the composite wrap or patch repair.

After Cure of Coating Repair

Date:	10/22/2017	Cure Time (days):	12
Temperature (°F):	56	Hardness Quaity Check (4.5.2)	Pass
Total thickness measurements of the Coating Repair (mil):		250+, 250+, 250+, 250+, 250+	

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Coating Repair Form for L5 Straits of Mackinac

Comments/Issues/Discussion

- No external corrosion reported by diver.
- Additional bare metal exposed during surface preparation. No external corrosion reported by diver at these areas. After surface preparation, anchor profile was (1) 3.2 mils, (1b) 4.5 mils, (1c/d/e) 2.6, 2.5, 2.6, 2.5, and 3.5 mils, and (1f) 3.5 mils.
- Time from mixing filler to application did not exceed 16 minutes.

Contractor Signature	Company Inspector Signature

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Coating Repair Form for L5 Straits of Mackinac

Surface of pipe after surface preparation.



Date:	9/10/2017	Frame (HH:MM:SS)	12:11:43

Surface of the pipe after filler application.



Date:	9/10/2017	Frame (HH:MM:SS)	12:58:42

Surface of the pipe after composite wrap.



Date:	10/10/2017	Frame (HH:MM:SS)	14:26:08

Surface of the pipe after Stricture Banding.



Date:	10/10/2017	Frame (HH:MM:SS)	14:26:47

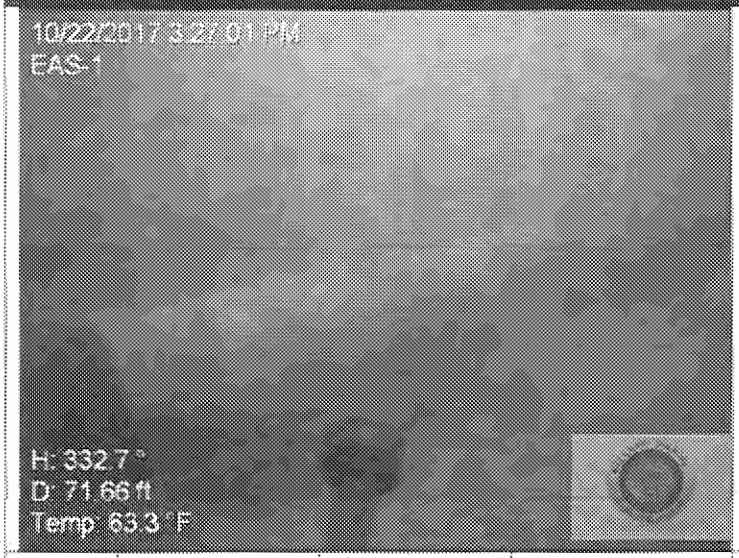
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Coating Repair Form for L5 Straits of Mackinac

Surface of the pipe after cure and removal of Stricture banding.	[Additional Photograph Caption]



Date:	10/22/2017	Frame (HH:MM:SS)	15:27:01	Date:	DD/MM/YY	Frame (HH:MM:SS)	

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Coating Repair Form for L5 Straits of Mackinac

General Information

Date:	09/21/2017	Diver:	Mackenzie Thopkins Mike Rosette
AFE / W.O.#:	BPI-1264792-17	Company Inspector:	Neil Pittman
Segment:	EAS-2	Water Depth (ft):	74
Longitude:	-84.76797867	Latitude:	45.7982423

Material Information

BIO- DUR™ 563 SW Epoxy Base – Black	17T-391	Expiration Date:	07/04/19
BIO – DUR ™ 563SW Curing Agent – White	17T-534	Expiration Date:	09/05/19
X100 – UW Epoxy Base – Blue	17T-535	Expiration Date:	09/05/19
BIO-SEAL ™ X-100 Curing Agent – Clear	17T-537	Expiration Date:	09/05/19

Temperature (°F):	55	Wall Thickness Measurements (mil):	848, 848, 854, 852, 850
Location of the Coating Repair:	Top of Pipe	Coating Repair Method:	Full Circumferential Composite Wrap Repair

Quality Assurance During Application

☑	The steel surface was cleaned using scarpers, hydroblasting cleaning, wet abrasive blasting, or pneumatic power wire wheel brush. (3.1)
☑	Feathering removed the sharp edge at the transition from the parent coating. The parent coating was roughened (abraded) using a cup disk brush to remove the loosely adherent biota, coating and provide a surface for overcoating (3.2).
☑	Immediately prior to coating application, the Diver removed any flash rust and/or accumulated debris (silt, clay, etc.) using a wire brush or other method approved by the Manufacturer (4.1).
☑	The diver applied sufficient BIO-DUR epoxy filler so that the bare steel is completely covered and the repair area is flush with the adjacent parent coating (4.2.2 and 4.2.3).
☑	Full Circumferential Composite Wrap Repair (4.3) or Composite Patch Repair (4.4) applied in accordance with the coating procedure.
☑	Blue Stricture Banding® or alternative protective wraps/encasements allowed by the coating Manufacturer applied over the composite wrap or patch repair.

After Cure of Coating Repair

Date:	10/6/2017	Cure Time (days): 15	Craig Palmer
Temperature (°F):	62	Hardness Quality Check (4.5.2)	Pass
Total thickness measurements of the Coating Repair (mil):		250+, 250+, 250+, 250+	

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Coating Repair Form for L5 Straits of Mackinac

Comments/Issues/Discussion

- No external corrosion reported by diver.
- Additional bare metal exposed during surface preparation. No external corrosion reported by Diver at these areas.
- After surface preparation, anchor profile was 3.4 mils.

Contractor Signature	Company Inspector Signature

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Coating Repair Form for L5 Straits of Mackinac

Surface of pipe after surface preparation.



Date:	09/21/2017	Frame (HH:MM:SS)	15:53:26

Surface of the pipe after filler application.



Date:	09/21/2017	Frame (HH:MM:SS)	16:19:04

Surface of the pipe after composite wrap.



Date:	09/21/2017	Frame (HH:MM:SS)	18:08:24

Surface of the pipe after Stricture Banding.



Date:	09/21/2017	Frame (HH:MM:SS)	18:16:16

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Coating Repair Form for L5 Straits of Mackinac

Surface of the pipe after cure and removal of Stricture banding.	[Additional Photograph Caption]



Date:	10/06/2017	Frame (HH:MM:SS)	16:02:08	Date:	DD/MM/YY	Frame (HH:MM:SS)	

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Coating Repair Form for L5 Straits of Mackinac

General Information

Date:	10/01/2017 10/29/2017 12/15/2017	**Diver:**	10/01 - Joe Rieman 10/29 – Mike Rosette, Andrew Alber 12/15 – Joe Rieman
AFE / W.O.#:	BPI-1264792-17	**Company Inspector:**	Neil Pittman/ Brandon Price
Segment:	EAS-3	**Water Depth (ft):**	133
Longitude:	-84.76103226	**Latitude:**	45.81648309

Material Information

BIO- DUR™ 563 SW Epoxy Base – Black	17T-582	**Expiration Date:**	9/19/19
BIO – DUR ™ 563SW Curing Agent – White	17T-583	**Expiration Date:**	9/19/19
X100 – UW Epoxy Base – Blue	17T-580 17T-570	**Expiration Date:**	9/20/19 9/12/19
BIO-SEAL ™ X-100 Curing Agent – Clear	17T-581 17T-571	**Expiration Date:**	9/20/19 9/12/19

Temperature (°F):	55	**Wall Thickness Measurements (mil):**	1	806, 802, 804, 800, 800, 802, 808, 810, 806, 806, 804
			1a	810, 810, 812, 810, 808, 808
Location of the Coating Repair:	Top of Pipe and side of pipe		**Coating Repair Method:**	Full Circumferential Composite Wrap Repair

Quaity Assurance During Application

☑	The steel surface was cleaned using scrapers, hydroblasting cleaning, wet abrasive blasting, or pneumatic power wire wheel brush. (3.1)
☑	Feathering removed the sharp edge at the transition from the parent coating. The parent coating was roughened (abraded) using a cup disk brush to remove the loosely adherent biota, coating and provide a surface for overcoating (3.2).
☑	Immediately prior to coating application, the Diver removed any flash rust and/or accumulated debris (silt, clay, etc.) using a wire brush or other method approved by the Manufacturer (4.1).
☑	The diver applied sufficient BIO-DUR epoxy filler so that the bare steel is completely covered and the repair area is flush with the adjacent parent coating (4.2.2 and 4.2.3).
☑	Full Circumferential Composite Wrap Repair (4.3) or Composite Patch Repair (4.4) applied in accordance with the coating procedure.
☑	Blue Stricture Banding® or alternative protective wraps/encasements allowed by the coating Manufacturer applied over the composite wrap or patch repair.

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Coating Repair Form for L5 Straits of Mackinac

After Cure of Coating Repair			
Date:	112/15/2017	**Cure Time (days)**	54
Temperature (°F):	38	**Hardness Quality Check (4.5.2)**	PASS
Total thickness measurements of the Coating Repair (mil):	240, 250+, 250+, 225		

Comments/Issues/Discussion

- No external corrosion reported by diver.
- Additional bare metal exposed during surface preparation. No external corrosion reported by diver at these areas.
- After surface preparation, anchor profile was (1) - 4.3 and 3.7, and (1a) - 3.3 mils.
- Filler was applied within 15 minutes of mixing.

Contractor Signature	Brandon Price **Company Inspector Signature**

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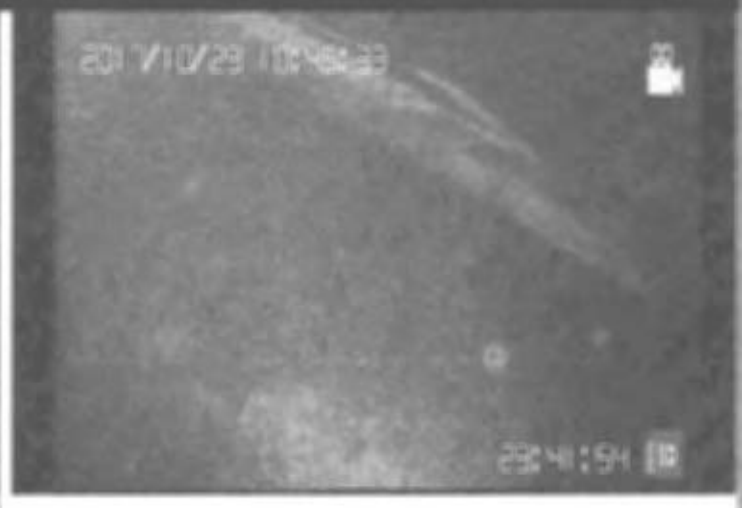
Coating Repair Form for L5 Straits of Mackinac

Surface of pipe after surface preparation.



Date:	10/29/2017	Frame (HH:MM:SS)	10:26:50

Surface of the pipe after filler application.



Date:	10/29/2017	Frame (HH:MM:SS)	10:45:33

Surface of the pipe after composite wrap.



Date:	10/29/2017	Frame (HH:MM:SS)	12:28:32

Surface of the pipe after Stricture Banding.

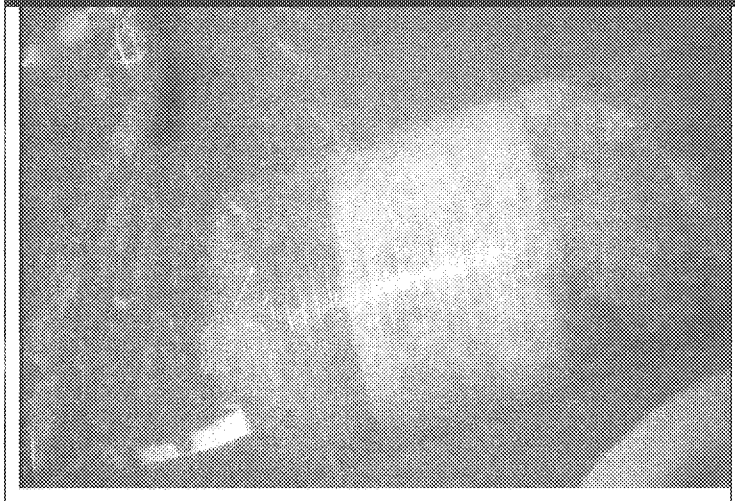


Date:	10/29/2017	Frame (HH:MM:SS)	12:34:35

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Surface of the pipe after cure and removal of Stricture banding.	[Additional Photograph Caption]
	

Date:	12/15/2017	Frame (HH:MM:SS)	09:58:00	Date:	DD/MM/YY	Frame (HH:MM:SS)	

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Coating Repair Form for L5 Straits of Mackinac

General Information

Date:	11/12/2017 11/13/2017 12/02/2017	Diver:	11/12 – Joe Reiman, Andrew Alber, ChadCantrell, 11/13 – Brad Jonas 12/02 – Shawn Binsfield
AFE / W.O.#:	20011702	Company Inspector:	Brandon Price/Neil Pittman
Segment:	EAOI-1	Water Depth (ft):	196
Longitude:	-84.758548	Latitude:	45.822884

Material Information

BIO- DUR™ 563 SW Epoxy Base – Black	17T-715	Expiration Date:	11/06/2019
BIO – DUR ™ 5635W Curing Agent – White	17T-717	Expiration Date:	11/06/2019
X100 – UW Epoxy Base – Blue	17T-598 17T-596	Expiration Date:	9/25/2019 9/25/2019
BIO-SEAL ™ X-100 Curing Agent – Clear	17t-581	Expiration Date:	9/20/2019

Temperature (°F):	46, 46, 44,48	Wall Thickness Measurements (mil):	816, 818, 814, 814, 812
Location of the Coating Repair:	Top of Pipe	Coating Repair Method:	Full Circumferential Composite Wrap Repair

Quaity Assurance During Application

☑	The steel surface was cleaned using scarpers, hydroblasting cleaning, wet abrasive blasting, or pneumatic power wire wheel brush. (3.1)
☑	Feathering removed the sharp edge at the transition from the parent coating. The parent coating was roughened (abraded) using a cup disk brush to remove the loosely adherent biota, coating and provide a surface for overcoating (3.2).
☑	Immediately prior to coating application, the Diver removed any flash rust and/or accumulated debris (silt, clay, etc.) using a wire brush or other method approved by the Manufacturer (4.1).
☑	The diver applied sufficient BIO-DUR epoxy filler so that the bare steel is completely covered and the repair area is flush with the adjacent parent coating (4.2.2 and 4.2.3).
☑	Full Circumferential Composite Wrap Repair (4.3) or Composite Patch Repair (4.4) applied in accordance with the coating procedure.
☑	Blue Stricture Banding® or alternative protective wraps/encasements allowed by the coating Manufacturer applied over the composite wrap or patch repair.

After Cure of Coating Repair

Date:	12/02/2017	Cure Time (days)	19
Temperature (°F):	41	Hardness Quaility Check (4.5.2)	Pass
Total thickness measurements of the Coating Repair (mil):	250+, 250+, 250+		

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Coating Repair Form for L5 Straits of Mackinac

- No external corrosion reported by diver.
- Additional bare metal exposed during surface preparation. No external corrosion reported by diver at these areas.
- After surface preparation, anchor profile was 3.5 mils and 3.2 mils.
- Epoxy filler transferred to diver within 6 minutes after initial mixing.

	Brandon Price
Contractor Signature	Company Inspector Signature

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Coating Repair Form for L5 Straits of Mackinac

Surface of pipe after surface preparation.



Date:	11/12/2017	Frame (HH:MM:SS)	11:04:55

Surface of the pipe after filler application.



Date:	11/12/2017	Frame (HH:MM:SS)	11:22:52

Surface of the pipe after composite wrap.



Date:	11/13/2017	Frame (HH:MM:SS)	12:31:25

Surface of the pipe after Stricture Banding.



Date:	12/02/2017	Frame (HH:MM:SS)	11:24:09

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Coating Repair Form for L5 Straits of Mackinac

Surface of the pipe after cure and removal of Stricture banding.	[Additional Photograph Caption]
	

Date:	12/02/2017	Frame (13:20:55)	11:44:31	Date:	DD/MM/YY	Frame (HH:MM:SS)

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Coating Repair Form for L5 Straits of Mackinac

General Information

Date:	10/01/2017	Diver:	Chad Palmer Mackenzie Thopkins
AFE / W.O.#:	BPI-1264792-17	Company Inspector:	Neil Pittman
Segment:	EAOI-5	Water Depth (ft):	103
Longitude:	-84.76510434	Latitude:	45.80581380

Material Information

BIO- DUR™ 563 SW Epoxy Base – Black	17T-391	Expiration Date:	07/04/19
BIO – DUR ™ 563SW Curing Agent – White	17T-534	Expiration Date:	09/05/19
X100 – UW Epoxy Base – Blue	17T-580	Expiration Date:	09/20/19
BIO-SEAL ™ X-100 Curing Agent – Clear	17T-581 17T-571	Expiration Date:	09/20/19 09/12/19

Temperature (°F):	54	Wall Thickness Measurements (mil):	766, 762, 762, 766, 754, 764
Location of the Coating Repair:	Top of Pipe	Coating Repair Method:	Full Circumferential Composite Wrap Repair

Quaity Assurance During Application

☑	The steel surface was cleaned using scarpers, hydroblasting cleaning, wet abrasive blasting, or pneumatic power wire wheel brush. (3.1)
☑	Feathering removed the sharp edge at the transition from the parent coating. The parent coating was roughened (abraded) using a cup disk brush to remove the loosely adherent biota, coating and provide a surface for overcoating (3.2).
☑	Immediately prior to coating application, the Diver removed any flash rust and/or accumulated debris (silt, clay, etc.) using a wire brush or other method approved by the Manufacturer (4.1).
☑	The diver applied sufficient BIO-DUR epoxy filler so that the bare steel is completely covered and the repair area is flush with the adjacent parent coating (4.2.2 and 4.2.3).
☑	Full Circumferential Composite Wrap Repair (4.3) or Composite Patch Repair (4.4) applied in accordance with the coating procedure.
☑	Blue Stricture Banding® or alternative protective wraps/encasements allowed by the coating Manufacturer applied over the composite wrap or patch repair.

After Cure of Coating Repair

Date:	10/28/2017	Cure Time (days):	27
Temperature (°F):	54	Hardness Quaity Check (4.5.2)	PASS
Total thickness measurements of the Coating Repair (mil):	250+, 250+, 250+		

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Coating Repair Form for L5 Straits of Mackinac

Comments/Issues/Discussion

- No external corrosion reported by diver.
- Additional bare metal exposed during surface preparation. No external corrosion reported by diver at these areas.
- After surface preparation, two anchor profile were measured at 2.9 and 3.3 mils.
- Epoxy filler transferred to diver within 14 minutes after initial mixing.

Contractor Signature	Company Inspector Signature

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Coating Repair Form for L5 Straits of Mackinac

Surface of pipe after surface preparation.



Date:	10/01/2017	Frame (HH:MM:SS)	15:15:20

Surface of the pipe after filler application.



Date:	10/01/2017	Frame (HH:MM:SS)	16:02:17

Surface of the pipe after composite wrap.



Date:	10/01/2017	Frame (HH:MM:SS)	16:23:10

Surface of the pipe after Stricture Banding.



Date:	10/01/2017	Frame (HH:MM:SS)	16:38:43

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Coating Repair Form for L5 Straits of Mackinac

Surface of the pipe after cure and removal of Stricture banding.	[Additional Photograph Caption]



Date:	10/28/2017	Frame	11:58:43	Date:	DD/MM/YY	Frame (HH:MM:SS)	

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Coating Repair Form for L5 Straits of Mackinac

General Information

Date:	10/01/2017 10/12/2017 10/13/2017 10/14/2017 10/16/2017 10/20/2017 10/21/2017 10/22/2017 10/23/2017 11/01/2017	Diver:	10/01 - Shawn Binsfield 10/12 – Shawn Binsfield, Craig Palmer, Joe Rieman, Jesse Tabor 10/13 – Daylon Hutton, Mike Rosette 10/14 – Andrew Alber, Shawn Binsfield, Craig Palmer, Joe Rieman, Jesse Tabor 10/16 – Mike Rosette, Shawn Binsfield, Craig Palmer 10/20 – McKenzie Tompkins, Joe Rieman, Jesse Tabor 10/21 Mike Rosette, Shawn Binsfield, Craig Palmer,Mckenzie Tompkins 10/22 Joe Reiman, Jessie Tabor, Mike Rosette,Andrew Alber 10/23 Shawn Binsfield, Mackenzie Tompson 11/01 Daylin Hutton, Mackenzie Tompson
AFE / W.O.#:	BPI-1264792-17	Company Inspector:	Neil Pittman, Brandon Price
Segment:	EAOI-7	Water Depth (ft):	81
Longitude:	-84.76583464	Latitude:	45.80393026

Material Information

BIO- DUR™ 563 SW Epoxy Base – Black	17T-582 17T-586	Expiration Date:	09/19/2019 09/20/2019
BIO – DUR ™ 563SW Curing Agent – White	17T-583 17T-587	Expiration Date:	09/19/2019 09/20/2019
X100 – UW Epoxy Base – Blue	17T-580	Expiration Date:	09/20/2019
BIO-SEAL ™ X-100 Curing Agent – Clear	17T-571	Expiration Date:	09/12/19

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Coating Repair Form for L5 Straits of Mackinac

Temperature (°F):	54, 56, 55, 55, 59, 55, 55, 56, 56, 59, 56, 56, 58, 56, 58, 56, 53, 56, 56, 53	Wall Thickness Measurements (mil):	1	824, 824, 822, 812, 802, 828, 812, 822
			1a	790, 792, 794, 784, 788, 788, 792, 792
			1b	810, 806, 790, 776, 804, 794, 776, 776
			1c/d/e	832, 826, 822, 806, 794, 796, 794, 786, 774, 776, 800, 792, 778, 818, 804, 812, 824, 828, 836, 836, 840, 840, 840, 830, 826, 820
			1f	814, 816, 824, 826, 822, 798, 788, 798, 808
			1g	840, 836, 836, 838, 838
			1h	818, 818, 820, 820, 822
			1i	830, 812, 794, 814, 834, 826, 798, 786, 786
			1j	826, 830, 834, 840, 834, 834, 846, 840
			1k	779, 778, 772, 774, 774, 782, 778, 810, 808, 810
			1l	786, 804, 794, 800, 810, 806, 808, 798
			1m	768, 768, 774, 784, 780, 806, 802
			1n	784, 784, 802, 802, 816, 814, 834, 838
			1o	802, 802, 818, 834, 830, 838, 844, 836
Location of the Coating Repair:	Top, Side, and Bottom of Pipe		Coating Repair Method:	Full Circumferential Composite Wrap Repair

Quaity Assurance During Application

☑	The steel surface was cleaned using scarpers, hydroblasting cleaning, wet abrasive blasting, or pneumatic power wire wheel brush. (3.1)
☑	Feathering removed the sharp edge at the transition from the parent coating. The parent coating was roughened (abraded) using a cup disk brush to remove the loosely adherent biota, coating and provide a surface for overcoating (3.2).
☑	Immediately prior to coating application, the Diver removed any flash rust and/or accumulated debris (silt, clay, etc.) using a wire brush or other method approved by the Manufacturer (4.1).
☑	The diver applied sufficient BIO-DUR epoxy filler so that the bare steel is completely covered and the repair area is flush with the adjacent parent coating (4.2.2 and 4.2.3).
☑	Full Circumferential Composite Wrap Repair (4.3) or Composite Patch Repair (4.4) applied in accordance with the coating procedure.
☑	Blue Stricture Banding® or alternative protective wraps/encasements allowed by the coating Manufacturer applied over the composite wrap or patch repair.

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Coating Repair Form for L5 Straits of Mackinac

After Cure of Coating Repair			
Date:	11/01/2017	Cure Time (days)	9
Temperature (°F):	53	Hardness Quaiity Check (4.5.2)	PASS
Total thickness measurements of the Coating Repair (mil):		245, 250+, 250+, 250+, 250+, 250+, 250+, 250+, 250+, 250+,	

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Coating Repair Form for L5 Straits of Mackinac

Comments/Issues/Discussion

- No external corrosion reported by diver.
- Additional bare metal exposed during surface preparation. No external corrosion reported by diver at these areas.
- After surface preparation, anchor profile at 1, 1a, …, 1o were 4.0, 3.9, 3.0, 3.4, 3.3, 3.7, 3.6, 3.8, 2.7, 3.7, 3.3, 4.0, 4.0, 2.8, 3.4, 4.0, 4.1 mils, respectively.
- Filler was applied within 16 minutes of mixing.

Contractor Signature	Brandon Price Company Inspector Signature

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Coating Repair Form for L5 Straits of Mackinac

Surface of pipe after surface preparation.



Date:	10/21/2017	Frame (HH:MM:SS)	13:38:24

Surface of the pipe after filler application.



Date:	10/21/2017	Frame (HH:MM:SS)	11:33:38

Surface of the pipe after composite wrap.



Date:	11/01/2017	Frame (HH:MM:SS)	10:03:35

Surface of the pipe after Stricture Banding.



Date:	10/23/2017	Frame (HH:MM:SS)	14:04:09

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Coating Repair Form for L5 Straits of Mackinac

Surface of the pipe after cure and removal of Stricture banding.	[Additional Photograph Caption]
	

Date:	11/01/2017	Frame (HH:MM:SS)	10:03:35	Date:	DD/MM/YY	Frame (HH:MM:SS)	

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Coating Repair Form for L5 Straits of Mackinac

General Information

Date:	09/22/2017 09/23/2017 09/24/2017 09/25/2017 09/26/2017 09/30/2017 11/1/2017	Diver:	9/22 - Joe Rieman, Chad Cantrell, George Palmer 9/23 – Shawn Binsfield, Craig Palmer, McKenzine Thompkins, Mike Rosette 9/24 – Troy Basket, Andrew Alber, Joe Rieman 9/25 – Chad Cantrell, Shawn Binsfield, George Palmer, McKenzie Thompkins 9/26 – Mike Rosette, Andrew Alber 9/30 – Craig Palmer, McKenzie Thompkins, Mike Rosette 11/01 – Mackenzie Tompkins
AFE / W.O.#:	BPI-1264792-17	Company Inspector:	Neil Pittman
Segment:	WAS-1	Water Depth (ft):	201
Longitude:	-84.7657657	Latitude:	45.81739681

Material Information

BIO- DUR™ 563 SW Epoxy Base – Black	17T-391	Expiration Date:	07/04/19
BIO – DUR ™ 563SW Curing Agent – White	17T-534	Expiration Date:	09/05/19
X100 – UW Epoxy Base – Blue	17T-535 17T-570	Expiration Date:	09/05/19 09/05/19
BIO-SEAL ™ X-100 Curing Agent – Clear	17T-537 17T-571	Expiration Date:	09/05/19 09/05/19

Temperature (°F):	42, 40, 42, 40, 46, 41, 40, 41, 40, 44, 49, 49, 41, 45, 49, 50	Wall Thickness Measurements (mil):	1	No bare steel at area
			1b	860, 860, 860, 862, 862
			2	830, 820, 830, 818, 820, 826, 822, 836
			3	820, 834, 832, 822, 824
			4	848, 836, 828, 840, 826
			4b	832, 832, 834, 832, 834
Location of the Coating Repair:	Top to side		Coating Repair Method:	Full Circumferential Composite Wrap Repair

Quaity Assurance During Application

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Coating Repair Form for L5 Straits of Mackinac

☑	The steel surface was cleaned using scarpers, hydroblasting cleaning, wet abrasive blasting, or pneumatic power wire wheel brush. (3.1)
☑	Feathering removed the sharp edge at the transition from the parent coating. The parent coating was roughened (abraded) using a cup disk brush to remove the loosely adherent biota, coating and provide a surface for overcoating (3.2).
☑	Immediately prior to coating application, the Diver removed any flash rust and/or accumulated debris (silt, clay, etc.) using a wire brush or other method approved by the Manufacturer (4.1).
☑	The diver applied sufficient BIO-DUR epoxy filler so that the bare steel is completely covered and the repair area is flush with the adjacent parent coating (4.2.2 and 4.2.3).
☑	Full Circumferential Composite Wrap Repair (4.3) or Composite Patch Repair (4.4) applied in accordance with the coating procedure.
☑	Blue Stricture Banding® or alternative protective wraps/encasements allowed by the coating Manufacturer applied over the composite wrap or patch repair.

After Cure of Coating Repair			
Date:	11/01/2017	Cure Time (days)	32
Temperature (°F):	50	Hardness Quality Check (4.5.2)	PASS
Total thickness measurements of the Coating Repair (mil):		250+, 250+, 250+, 250+, 250+, 250+, 250+, 250+, 250+, 250+	

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Coating Repair Form for L5 Straits of Mackinac

Comments/Issues/Discussion

- No external corrosion reported by diver.
- Additional bare metal exposed during surface preparation. No external corrosion reported by diver at these areas.
- After surface preparation, anchor profile was (1) 4.0, (1b) 2.7, (2) 3.3, (3) 3.9 and 3.0, (4) 3.3, and (4b) 3.3 mils.
- Epoxy filler transferred to diver within 16 minutes after initial mixing.

	Brandon Price
Contractor Signature	Company Inspector Signature

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Coating Repair Form for L5 Straits of Mackinac

Surface of pipe after surface preparation.



Date:	9/23/2017	Frame (HH:MM:SS)	11:53:43

Surface of the pipe after filler application.



Date:	9/23/2017	Frame (HH:MM:SS)	14:33:06

Surface of the pipe after composite wrap.



Date:	9/23/2017	Frame (HH:MM:SS)	16:56:12

Surface of the pipe after Stricture Banding.



Date:	9/23/2017	Frame (HH:MM:SS)	17:03:06

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Coating Repair Form for L5 Straits of Mackinac

Surface of the pipe after cure and removal of Stricture banding.	[Additional Photograph Caption]
	

Date:	11/01/2017	Frame (HH:MM:SS)	12:10:31	Date:	DD/MM/YY	Frame (HH:MM:SS)	

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