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2018 Screw Anchor Work Plan
Line 5 Dual Pipelines

United States v. Enbridge Energy et al Case 1:16 –cv-914

(submitted May 17, 2018)

Consent Decree	VII. Injunctive Measures, E. Measures To Prevent Spills In The Straits Of Mackinac, Paragraph 68., Screw Anchor Installation		
Version	1.0	Version date	May 17, 2018

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Introduction

Paragraph 68 of the Consent Decree entered in Case 1:16-cv-00914 (ECF No. 14, 05/23/17) establishes requirements for the installation of screw anchors on the Dual Pipelines that cross the Straits of Mackinac. The deadlines set forth in ¶ 68 were modified by the parties as set forth in ECF No. 15 (filed 06/01/17). Under the modified deadlines, the date for installation of required screw anchors is now October 1, 2018.

Per Paragraph 68.c. of the current Consent Decree, Enbridge is required to submit a final report to the EPA within 60 days of completion of the Screw Anchor Work Plan ("SA Work Plan"). In this regard, Enbridge shall document the work completed including any deviations from the SA Work Plan.

This SA Work Plan shall be provided to and reviewed with all contractors and sub-contractors engaged to complete any portion of the scope of work listed herein.

Objective

The objective of the SA Work Plan is to ensure that all the screw anchors as required by the CD modification are installed safely and in accordance with the Enbridge's screw anchor installation procedures and in compliance with applicable federal, state, and local regulations, by October 1, 2018, including provisions of the 1953 Easement executed by the State of Michigan.

This scope of work will not commence until approvals (to the extent required) have been obtained from relevant State and Federal agencies including the US Coast Guard, the US EPA, the US Army Corps of Engineers, the Michigan DNR, and the Michigan DEQ.

Background

Current requirements for the installation of anchors are set forth in ¶ 68 of the Consent Decree ("Span Management Program"). Timetables for installation of required anchors were adjusted to require installation of required screw anchors by October 1, 2018, in ECF No. 15 (filed with the Court on 06/01/17).

The purpose of the anchoring scope of work is to install anchors in locations to prevent growth of pipe spans beyond the Easement limit of 75 ft before the next scheduled visual inspection of the Dual Lines.

Screw Anchor Scope Of Work And Schedule

The scope of work includes the installation of 70 screw anchors on both pipelines within the Straits of Mackinac. As of May 16, 2018, Enbridge has obtained permits from the State of Michigan to commence installation of 22 anchors. Enbridge has applied for and is currently waiting for approval of permits from the State of Michigan and the U.S. Army Corps of Engineers for the additional 48 anchors. The specific locations of the anchors to be installed in 2018 will be provided to both the marine contractor as well as the Independent Third Party (ITP) prior to commencement of work. Enbridge and the ITP have exchanged a table reflecting GPS coordinates that correspond to chainage values.

Enbridge plans to start anchor installation on May 21st and to complete the installation of all Screw Anchors by October 1, 2018, assuming all required permitting is received in time. Enbridge requires permits for the additional 48 anchors by July

15th to complete installation of all anchors by October 1st. To the extent that the start of installation is delayed beyond May 21, Enbridge intends to start installation as soon as possible after May 21.

Ballard Marine will be the primary contractor performing the screw anchor installations, coating inspections and any required coating repairs.

The Project Manager (PM) is accountable for the overall work plan. Any proposed deviation to this Work Plan shall be brought to the PM for resolution. The PM will consult with the key stakeholders that include but are not limited to Enbridge Pipeline Integrity. Enbridge Pipeline Compliance and the ITP. Any deviations required as a result of its execution will require their acceptance. Prior to approving a deviation to the SA Work Plan, the PM will consult with the ITP.

Screw Anchor Procedures

The following procedures are attached to, and form part of this SA Work Plan. All procedures will be executed by Ballard Marine.

Appendix A – Summary of "Screw Anchor Installation Procedure," Ballard Marine Construction

NOTE: Appendix A currently references 22 Screw Anchors. For the purposes of ths SA Work Plan, however, Appendix A will apply to all screw anchors installed pursuant to Paragraph 68 of the Consent Decree.

Appendix B- Enbridge "Line 5 Coating Inspection During Screw Anchor Installation" Work Instruction - procedures to inspect for damage to the coating of the Dual Pipelines caused by the Screw Anchor installation upon completion of any installation. Diver will inspect the coating in the area where the biota was cleared for saddle installation to identify any areas of (i) bare metal or (ii) coating damage caused by screw anchor installation. Anchor saddles will not be installed directly over a deposit unless repaired using an approved coating repair procedure.

Appendix - C – Enbridge "Application of Underwater Repair Coatings for Line 5 Straits" - procedures to repair (a) damage to coating caused by Screw Anchor installation as well as (b) any other damage that has resulted in an area of bare metal on one of the Dual Pipelines that is discovered during the SA inspection.

Diver Training and Qualification

In order to support the successful implementation of the screw anchor installation, the divers will be Operator Qualified (OQ) for the work to be completed. To meet 49 CFR 195.559 requirements for Operator Qualifications, any contractor that is performing an OQ task is required to complete training modules and hands-on training to demonstrate they are qualified. This training process is designed to deliver the basic skills required for each task. After completion of the OQ training, the results will be uploaded to ISNET to verify compliance. To supplement the OQ certification process, Enbridge will also have a representative of the appropriate coating manufacturer (for example BIO-DUR, Stricture Banding, Belzona) perform specific training for divers concerning the materials and coating applications that will be used for any underwater coating repairs.

Screw Anchor Work Plan Deviations

Enbridge has established the following deviation procedures for the SA Work Plan to ensure the appropriate approvals are received.

SCREW ANCHOR LOCATION DEVIATIONS

If Enbridge determines that it is impracticable to complete installation of any screw anchor at the location specified, Enbridge may modify the location after consulting with the ITP. The decision that a location is impracticable to complete the installation will be made by the Project Manager in consultation with the ITP, third party marine contractor, and the Enbridge's Pipeline Integrity department. The alternative location will be selected to ensure that the spans do not exceed 75 feet. Any deviation needs to be documented on the attached Screw Anchor Installation Inspection - L5 Straits of Mackinac Compliance Verification Checklist, attached in Appendix "D". In addition, Enbridge shall provide the following information regarding the deviation in the next Semi-Annual Report required under ¶ 143 of the Consent Decree: (i) a discussion of the basis for the determination that it was impracticable to complete the Screw Anchor installation at the location specified for such Screw Anchor, and (ii) the specific location where the such Screw Anchor was installed.

COATING REPAIRS

The deviation procedure outlined in the latest version of Enbridge's "Application of Underwater Repair Coatings For Line 5 Straits" is assigned to the Enbridge Pipeline Integrity's technical subject matter expert (SME) to sign-off on any deviations as they relate to the Coatings Repair procedure. The Pipeline Integrity SME is Enbridge's Coatings Specialist and they will be responsible for evaluating all deviations requested on the coating repair procedure to ensure such deviations are supported by the Manufacturer. This information or decisions made will be communicated to the Project Manager. If coating repairs are required, the Coating Inspector will be on the barge overseeing the work related to the surface preparation, application and confirming/verifying of the repair.

Monitoring of Screw Anchor Locations and Compliance Verification

Enbridge understands that its pipeline system, particularly the section through the Straits of Mackinac, is both an important part of the region's energy infrastructure and a point of concern for many people. Enbridge continuously monitors, maintains and modernizes Line 5 to ensure its continued safe operation.

As part of the biennial scope of work, Enbridge completes a sonar based survey utilizing an Autonomous Underwater Vehicle (AUV). In addition, Enbridge's marine contractor utilizes a remotely operated vehicle (ROV) with an Ultra Short Baseline (USBL) sonar positioning system that provides GPS coordinates of the remotely operated vehicle. This system allows the marine contractor to verify the GPS coordinates of both existing anchors as well as a new anchor installation location. The ITP will be given access to verify the anchor installation location in real-time through reviewing the GPS position of the ROV at the time of installation as well as the GPS position of any reference anchors. The compliance verification will be documented on the Screw Anchor Installation Inspection - L5 Straits of Mackinac Compliance Verification Checklist in Appendix "D".

Reporting

Per Paragraph 68.e. of the current Consent Decree, Enbridge is required to submit a final report to the EPA within 60 days of completion of the SA Work Plan. If anchor installation work is completed by October 1, 2018, as currently planned, this final report will be submitted on or before November 30, 2018. Enbridge will notify the ITP/EPA by July 15th 2018, regarding the current status of planned installations and if delays in execution put the October 1st deadline at risk as of that time. As noted above, as of May 16, 2018, Enbridge has applied for but not yet received permits from the State of Michigan and the U.S. Army Corps of Engineers that are required before installation can begin.

Report to include:

- Summary of activities
- SA checklist reports (all 70 screw anchors) including how ITP has verified the location as required by the exhibit (GPS locations)
- Any deviations from this Work Plan

The following Appendices are enclosed as part of this report:

- Appendix A: Ballard Screw Anchor Installation Procedure Summary
- Appendix B: Enbridge Work Instruction for Coating Inspection
- Appendix C: Enbridge Coating Repair Application Procedure
- Appendix D: Screw Anchor Installation Inspection - L5 Straits of Mackinac Compliance Verification Checklist

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Appendix A:
Ballard Screw Anchor Installation Procedure Summary

SCREW ANCHOR INSTALLATION PROCEDURE

Ballard Marine Construction

Introduction

By letter dated September 13, 2017 the Michigan Department of Environmental Quality ("MDEQ") requested Enbridge Pipelines (Lakehead), LLC ("Enbridge") to provide additional information in further support of its permit application for the twenty-two (22) Line 5 Enbridge Straits Anchors. MDEQ requested details on prior anchor installations and differences in current procedures that "will protect and maintain the integrity of the pipeline, including the pipeline coating during anchor installation."

Enbridge has contracted Ballard Marine Construction ("BMC") to install the anchors on the Straits of Mackinac lakebed. BMC is a marine infrastructure and utility contractor with over forty years of experience. BMC's record of safety and success on over 10,000 individual projects have allowed it to grow to global reputation as an industry leader for clients in the pipeline, nuclear, hydroelectric, salvage, submarine cable and public infrastructure industries. BMC's procedures for performing its work for this Project in a safe and effective manner protecting environment, public trust, and riparian interest are set forth herein. BMC reserves the right to modify the procedures detailed herein to react to unfavorable or differing site conditions, variations on equipment available, or due to alternative methods that prove at least as safe and more efficient.

1. Promoting and maintaining a safe working environment is paramount.

BMC places the protection and preservation of life above all responsibilities – both on behalf of those performing the work and the public who may be using or enjoying the waterway. As such, BMC has carefully crafted policies and procedures designed to protect the lives affected by BMC's work.

BMC will only work in conditions suitable for safe and effective marine construction. BMC will employ an offshore manager that will make final determinations as to whether the conditions are suitable for construction. No work will begin without an adequate forecast of suitable weather for the time required to complete the work activities scheduled. BMC's work will not proceed in unfavorable conditions such as wave heights greater than 5 feet, sustained winds in excess of 25 M.P.H. (less for winds with a westerly component), surface visibility less than 1 mile, or lightening strikes within 10 miles. An occurrence of any hazardous event will cause BMC to immediately secure its work-space, cease operations, and return to shore.

BMC's work will be operated from vessels suitable for the construction activities. All vessels will be USCG Certification of Documentation, ABS Classed for Service in the Great Lakes, USCG Uninspected towing Vessel Safety Inspection with inspection and maintenance records maintained for not less than the prior year. All personnel charged with operating and maintaining the vessels will have a minimum of 1 year of fleeting and deck work experience on the Great Lakes. All vessel operators will have and maintain the appropriate USCG licenses with a radar operations endorsement and an FCC license for marine radio communications.

BMC's work will proceed off of vessels at underwater depths of 60 to 240 feet requiring the utmost care in protecting the personnel performing or observing the work. BMC will supply a deep air and mixed gas diving spread, including two decompression chambers, diver hot water units, a class-2 dive bell, bell LARS with 2 man-rated winches, and other critical features for the effective and safe performance of work. Before each dive, BMC's qualified personnel will define the breathing gas needed for each diver performing the scheduled work.

From the time BMC leaves shore to the time it returns, it will continue to engage safety protocols ensuring the life safety of its crew and the public. BMC will continue to monitor weather forecast and review the fleeting operations with its crew. Once the vessels are in place to perform work, BMC will continue to adhere to proper safety protocols.

BMC will deploy the requisite number of divers to perform its work as determined by the actual conditions encountered for each screw anchor support assembly. BMC will perform pre-dive checks on the dive bell and its equipment, including the backup recovery winch. Before deploying the dive bell, the primary and secondary decompression chambers will be prepared, along with the control gas distribution and hot water distribution systems.

Once the dive bell is deployed a safe but effective distance from an anchor assembly (at least 10-feet above assembly elevation), BMC will continually monitor the dive bell location to ensure each diver can safely access its tools, equipment, and personal protective equipment. While divers are engaged, BMC will continue to monitor weather from the vessels and ensure the dive bell movements are not more than 15-feet in any direction from its target spot of deployment.

After each dive, BMC will recover each diver through its primary (and, if necessary, secondary) decompression chambers constantly monitoring for decompression illness. A detailed neurological and physical exam will be conducted. The vessels will be returned and secured to shore. Maintaining a safe work environment is paramount to BMC's success.

2. Protection of environmental and riparian interests

The protection of the environment and riparian interest is of the utmost importance to BMC, and therefore, BMC will employ carefully considered procedures and protocols to further that interest. Before leaving shore, BMC will review the planned operations with the entire fleeting crew. BMC's weather monitors help ensure the ambient conditions do not impair the work or cause an environmental impact.

The fleeting vessels will be carefully moved to the location of the assembly being constructed and secured using an adequate number of moor anchors. BMC will deploy a small inspection class remotely operated vehicle (ROV) to video inspect the lake bottom conditions in real time, measure and confirm span heights, and monitor the diver and installation tool movements. The ROV will use a three-dimensional positioning system to confirm the location of each assembly. BMC's team will observe the entire work site with the ROV, and maintain video recording during all installation procedures.

To ensure BMC's equipment functions properly and does not adversely impact the pipeline, the installation tools and assemblies will be function tested before deployment. The installation tools will be slowly and deliberately moved into place. The tools, when not in use, will be maintained at least 50-feet from the pipeline (and opposite from the position of the diving bell). After installation of an assembly is complete, a detailed video inspection of the assembly as-installed and the surrounding coating (20-feet on either side) will be conducted. A hard-line measurement of the constructed assembly and previous assemblies (or pipeline features) will be documented. Survey logs will be maintained.

3. Protection of commercial and recreational interests

BMC will maintain a safe environment on the surface so as not to impact the recreational and commercial use of the waterway. At all times while on the water, the fleeting crew Tug Captain will conduct visual and radar watches monitoring commercial, ferry, and recreated traffic near the vessels deployed by BMC. The Tug Captain will broadcast a general Notice to Mariners every hour on the Marine Emergency Channel 16, and will maintain direct radio communications with any commercial traffic within 1-hour transit of the assembly work-site.

The vessels, including the barge assembly, will fly the appropriate symbols to indicate the limited maneuverability and dive operations.

By maintaining constant awareness of other watercraft and communicating BMC's operations by reasonable means, BMC will take the precautions available to it to keep 3rd party a safe distance from the worksite.

4. Installation of lakebed anchors

With the foregoing protocols in place and maintained through the duration of BMC's work, BMC will proceed with the installation of lakebed anchors in a safe and thoughtful manner designed to protect its workers, the environment, the integrity of the existing pipeline, and avoid interference from the public.

The screw anchor assembly will be installed with a custom tool designed by BMC and personnel (both fleeting and divers) experienced in the planned construction activities. BMC will supply enough material to complete 22 screw anchor assemblies. An appropriate amount of materials will be staged on BMC's barge for the day's activities. The barge will maintain sufficient open space for a safe working environment, and sufficient lighting for all operational areas. The barge will be fully USCG compliant for operations on the Great Lakes. Mounted to the deck of the barge (and secured for marine activity) will be a crane with capacity to operate BMC's custom tool. Tug boat(s) will accompany the barge for towing and live-boat operations. The tug boat(s) will be fully USCG compliant for operations on the Great Lakes.

The barge will be positioned over the assembly location and maintained by no less than 2-point mooring secured by placing maximum bollard pull by the tugs. The barge's position will

be constantly monitored so that the dive equipment and tools remain in a position under water that will not impact the existing pipeline.

Once the barge is secured in place, nearly all functions will be checked prior to operation with ongoing monitoring thereafter, including dive bell location and operation, tool placement and operation, video and monitoring equipment, and the condition and quantity of assembly materials. The ROV operators will collect a detailed video inspection of the pre-assembly location and will document the pipe condition at the pre-assembly location and 20 linear feet on either side. The divers will be briefed on the particular installation conditions and objectives of their dive activities before entering the water.

The dive bell will be slowly lowered into the water and not allowed to move more than 5 to 8 feet in any direction so that the diver can access the assembly location without the dive bell interfering or inadvertently impacting the pipeline.

Likewise, BMC's custom installation tool will be slowly lowered into position guided by the continuous observations of BMC to ensure the screw anchor assembly is centered on the pipeline keeping anchors at the required distances. Each screw anchor will be placed using an alignment guide to ensure proper location. Each anchor will be drilled into the lakebed at the appropriate position and at the depth required to achieve the torque necessary for the anchor's performance as specified by the anchor manufacturer. BMC's custom tool measures the torque value being applied to ensure achieving the anchor manufacturer specifications.

Once an anchor is placed, the installation tools will be disconnected from the screw anchor assembly and slowly raised vertically off the pipeline. When not in use, the BMC's installation tool will placed no closer than 15 feet from the pipeline to avoid inadvertent contact.

After the anchors are placed, divers will complete the remaining assembly with hand tools. The top saddle will first be placed on top of the pipeline with the bottom saddle subsequently secured to it. All connections will be hand-torqued prior to tool-torqueing to specified settings allowing the saddles to remain level throughout completion of the assembly. Lastly, an identification placard will be placed on the completed assembly.

A detailed video inspection of the assembly, as installed, will document the pipe condition at the assembly location and 20 linear feet on either side.

After BMC's work is completed, the tools and dive team will be recovered to the surface by slowly ascending. The safe distance that the dive bell and tool will be maintained prior to its ascent will ensure no inadvertent contact with the pipeline.

Conclusion

BMC is committed to a safe and efficient installation of screw anchor assemblies on behalf of Enbridge. BMC's installation procedure is thoughtfully designed to protect the lives of its employees, the environment, and Michigan's use and enjoyment of the Great Lakes.

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Appendix B:
Enbridge Work Instruction for Coating Inspection

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Line 5 Coating Inspection During Screw Anchor Installation

Work Instruction

Effective Date:	2018-05-17
Version #:	1.0
Version Date:	2018-05-17

Purpose

The purpose of this work instruction is to provide a step-by-step process that ensures consistent and efficient inspection of the coating of the Line 5 Dual Pipelines during each screw anchor installation conducted in the Straits of Mackinac. This work instruction supplements Appendix A – Ballard Screw Anchor Installation Procedure and Appendix C – Enbridge Coating Repair Application Procedure.

Scope

This work instruction applies to the inspection of the coating on the Line 5 Dual Pipelines before, during, and after each screw anchor installation in the Straits of Mackinac.

General

This work instruction will be used to identify any coating damage caused by the process to install screw anchors on the Line 5 Dual Pipelines' crossing of the Straits of Mackinac. "Coating damage," as that term is used in this work instruction, is defined as areas of the Line 5 Dual Pipeline's coating that are confirmed by residual thickness measurements to be less than 40 mils thick as a result of activities associated with screw anchor support installation. This work instruction also addresses any areas of bare metal that are visual or discovered during the coating inspection.

Roles & Responsibilities

Table 1: Roles and Responsibilities

Role	Responsibility
Screw Anchor Installation Project Manager	• Communicate the work instruction to the contractor installing the screw anchors • Communicate the work instruction to the contractor inspecting the coating by ROV before, during and after screw anchor installation • Communicate the work instruction to the contractor inspecting the coating by diver during and after screw anchor installation • Ensure coating inspection videos and coating inspection reports of the coating taken prior to and after anchor placement are retained for at least 10 years
Coating Subject Matter Expert (SME)	• Provide technical support for coating repairs if required
Construction Manager	• Ensure that a coating inspection report is compiled by the dive contractor • Communicate the coating inspection report as required
Contractor	• Follow this work instruction • Where additional clarification is required, contact the Screw Anchor Installation Project Manager or Coating SME prior to proceeding

Activity Description

Table 2: Activity Description

Activity	Details	Inputs	Outputs	Safety Critical Decision	
1.0 ROV Survey of Screw Anchor Installation Site	Prior to installation of the screw anchor, ROV contractor deploys the ROV and records a video survey of the proposed installation site. Contractor records the coating condition within 20 feet on either side of the proposed installation site.[1]	Document or drawing identifying proposed screw anchor locations in GPS WGS83 coordinates	ROV Video Data	Yes ☒	No ☒
1.1 Identify Areas of Potential Bare Metal	ROV contractor identifies and documents any areas of potential bare metal for further inspection by a diver post-installation.	Document or drawing identifying proposed screw anchor locations in GPS WGS83 coordinates	Document locations of areas of potential bare metal	Yes ☐	No ☒
2.0 Install the Screw Anchors	Diver completes installation of the screws for the screw anchors in accordance with the approved Screw Anchor Installation Procedure issued by Ballard Marine Construction.	Screw Anchor Installation Procedure issued by Ballard Marine Construction	Document identifying installed screw anchor locations in GPS WGS83 coordinates	Yes ☐	No ☒
2.1 Clear Biota off of the Saddle Installation Area	Diver clears biota off of the area of the pipeline where the screw anchor saddle will be installed using gloved hands or hand-held tools.	Screw Anchor Installation Procedure issued by Ballard Marine Construction		Yes ☐	No ☒
2.2 Inspect area of saddle installation	Diver inspects the coating in the area where the biota was cleared for saddle installation to identify any areas of (i) bare metal or (ii) coating damage caused by screw anchor installation steps 1.0 to 2.1 set forth above.		Diver video of installation after biota cleared for saddle installation	Yes ☐	No ☒
2.3 Screw Anchor Saddle Installation	Diver installs saddles per the approved Screw Anchor Installation Procedure issued by Ballard Marine Construction.	Screw Anchor Installation Procedure issued by Ballard Marine Construction	Diver video after saddle has been installed	Yes ☐	No ☒

Activity	Details	Inputs	Outputs	Safety Critical Decision	
3.0 Confirm any disturbance to the pipeline	Diver inspects the pipeline for any coating damage or bare metal resulting from the saddle installation process set forth in step 2.3 above.	Visual observation of disturbed areas		Yes ☐	No ☒
3.1 Clear Biota wherever disturbance to the pipeline took place during screw anchor installation	To the extent that the diver observes any biota disturbance during step 3.0 above, the diver is to use gloved hands or hand-held devices to clear-off any remaining biota from the pipeline adjacent to areas with biota disturbances to further inspect for any coating damage or bare metal.		Diver video after biota is cleared	Yes ☐	No ☒
4.0 Post screw anchor installation inspection	Following installation of the screw anchor, diver performs a detailed video inspection of the screw anchor as-installed and the surrounding coating +/- 6 feet on either side of the anchor location (or to the edges of disturbance noted in step 3.0 if greater than 6 feet from anchor). If the ROV examination produced insufficiently good quality images for video analysis, the diver examination will include an additional 14 axial feet of inspection on each side of the anchor. Record any bare metal or coating damage discovered. [1]		Video inspection	Yes ☐	No ☒

[1] This instruction is taken directly from the Anchor Inspection Work Plan

Records Generated

Table 4: Records

Record Name	Record Location	Retention Time
ROV Video	Enbridge secure server	Minimum 10 years
Diver Video	Enbridge secure server	Minimum 10 years
As-built Screw Anchor Location drawing based on ROV data	Enbridge secure server	Minimum 10 years
Screw Anchor Installation Inspection – L5 Straits of Mackinac Compliance Verification Checklist (Appendix D to Work Plan)	Enbridge secure server	Minimum 10 years

Reference Documents

Table 5: Reference Documents

Document Name	Document Location
Ballard Screw Anchor Installation Procedure Summary	Enbridge secure server
Enbridge Coating Repair Application Procedure	Enbridge secure server

All PIMS documents must adhere to the IMS Governing Policies and Processes. Each PIMS document controlled within the Governance Document Library (GDL) must demonstrate conformance to the Liquids Pipelines Document Control Standard and process. Any changes to PIMS documents must be managed through the Liquids Pipelines and/or Pipeline Integrity Management of Change Process. All acronyms and definitions utilized throughout this document must conform to IMS and the PIMS Acronyms and Definitions documents.

Document Version Register

Table 6: Document Version Register

Version Number	Version Date (yyyy-mm-dd)	Approved By	Section Number and Title	Details of Version	PI MOC #
1.0	2018-05-03	[redacted]	All	Initial Release of Work Instruction	

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Appendix C:
Enbridge Coating Repair Application Procedure



APPLICATION OF UNDERWATER REPAIR COATINGS FOR LINE 5 STRAITS

Version #: 3.0

Version Date: May 17, 2018

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1.0 Scope

This procedure defines the requirements for application of repair coatings to pipe previously coated with coal tar enamel (parent coating) that are located underwater (e.g., lake bottom, straits crossing). Coating repairs consist of the following approved methods that include:

- Method 1 – Epoxy Filler/ Full Circumferential Composite Wrap Repair/Release Film
- Method 2 – Epoxy Filler/ Composite Patch Repair/Release Film
- Method 3 – Epoxy Filler/ Release Film

2.0 General

2.1 Manufacturer Support

This procedure was developed with support of the product Manufacturers. The Manufacturer's instructions and technical datasheet form an integral part of this procedure and have been incorporated herein.

2.2 Operator Qualifications and Training

Any contractor that is performing an OQ task is required to complete training modules and hands-on training to demonstrate qualifications. This training process is designed to deliver the basic skills required for each task. After completion of the OQ training, the results are uploaded to ISNET to verify compliance.

To supplement the OQ certification process, the coating manufacturer shall perform specific training for the materials and coating applications that will be used for the L5 Straits underwater coating repairs. Upon successful completion of the manufacturer's training, the Manufacturer shall issue a certificate of training or other documentation that supports the competency of the individual divers with application of the product.

Note: At its discretion, the coating Manufacturer may designate in writing a representative to conduct this training on its behalf.

2.3 Pipe Excavation

If pipe is buried in the lake floor, full circumferential access at the repair area may be accomplished by water blasting or other appropriate excavation methods to allow the circumferential application of the composite wrap and/or the release film.

2.4 Deviations

Any deviations from this procedure shall be brought to the Pipeline Integrity (PI) Coatings Specialist for resolution. The PI Coatings Specialist will consult with the key stakeholders that include, but are not limited to, the Independent Third Party, the onsite Company Inspector, the Diver, and the coating Manufacturer. If the deviation is accepted, the requested deviation, key

stakeholder inputs and risk assessment associated with the deviation will be uploaded into the Company's Business Information Management (BIM) system.

Note: No deviations will be accepted if they are not supported by the coating Manufacturer.

3.0 Approved Materials

The list of company approved products is shown in Table 1.

Table 1. Company Approved Product by Method and Manufacturer

Method	Manufacturer	Lowest Application Temperature (°F)	Epoxy Filler	Composite Epoxy/Wrap	Release Film
1	PRTI	40	BIO-DUR™ 563 SW	X-100/E-Glass	Stricture Banding™
2	PRTI	40	BIO-DUR™ 563 SW	X-100/E-Glass	Stricture Banding™
3	Belzona	38	Belzona 1161	N/A	Belzona 9382

4.0 Surface Preparation

4.1 Pre-Preparation

4.1.1

The steel surface shall be cleaned using scrapers, hydroblasting cleaning, wet abrasive blasting, and/or power wire wheel brush. The majority of the existing primer shall be removed.

4.1.2

The repair area shall be abraded to bare metal using wet abrasive blasting, power wire wheel brush, and/or hand tools that are capable of providing a surface profile of 2.5 – 5 mils.

4.1.3

The surface profile shall be measured using replica tape and shall meet the surface profile requirements of 4.1.2.

4.2 Parent Coating

4.2.1

Feathering shall remove the sharp edge at the transition from the parent coating.

4.2.2

The parent coating shall be roughened (abraded) using a wire brush, cup brush, wheel brush, and/or scouring pads to remove the loosely adherent biota, coating and provide a surface for transition.

4.2.3

For full circumferential composite wrap repairs (Method 1), the roughening shall extend at least 6 inches from the upstream and downstream edge of the repair area and around the entire circumference of the pipe.

For composite patch repairs (Method 2), the roughening shall extend onto the parent coating at least 6 inches from the edge of the repair area.

For epoxy only repairs (Method 3), the roughening shall extend onto the parent coating at least 2 inches from the edge of the repair area.

5.0 Coating Application

5.1 Surface Condition for Coating

Immediately prior to coating application, the Diver shall remove any flash rust and/or accumulated debris (silt, clay, etc.) using a wire brush or other method approved by the Manufacturer.

Note: The surface of the pipe shall meet all preparation requirements listed in Section 4.0 before the coating application.

Hold Point: Diver cannot proceed without approval from the Company Inspector that the surface preparation is acceptable for coating.

5.2 Preparation and Application of the Epoxy Filler

5.2.1

The epoxy filler shall be prepared by thoroughly mixing the appropriate ratio of base and hardener as per the Manufacturer's written procedures.

5.2.2

The diver shall apply the epoxy using a gloved hand or other method approved by the Manufacturer so that the bare steel is completely covered and the repair area is flush with the adjacent parent coating.

5.2.3

The diver shall confirm that the thickness of the epoxy filler is sufficient using a straight edge tool that bridges the adjacent parent coating on each side of the repair. If the epoxy filler is below the straight edge tool, additional filler shall be added to ensure the repair area is at least flush with the adjacent parent coating.

5.3 Preparation and Application of Full Circumferential Wrap Repairs (Method 1)

5.3.1

The composite epoxy shall be prepared by thoroughly mixing the base and the hardener as per the Manufacturer's written procedures.

5.3.2

The composite fabric is supplied in rolls. The rolls shall be cut into approximately 12 feet long strips and impregnated with the composite epoxy to form the composite wraps.

5.3.3

Prior to application of the composite wrap, the composite epoxy shall be hand applied to the surface of the abraded adjacent parent coating. If the epoxy filler is sufficiently setup to resist movement, composite epoxy shall also be applied over the epoxy filler.

5.3.4

The composite wrap shall be applied 360 degrees around the pipe to a minimum thickness of 4 full layers and shall extend over the epoxy filler and abraded adjacent parent coating. Wider repairs will require additional side by side layups that are each 12 inches wide with a minimum two inch overlap at the seams.

5.3.5

Release film will be tightly applied in the same direction as the composite wrap to a minimum of three (3) layers to assure the radial compression and retention of the repair in place during cure.

Note: alternative protective wraps or encasements are allowed if approved by the coating Manufacturer.

5.3.6

The release film shall extend at least 4 inches upstream and downstream of the repair.

Note: the release film is applied in the same direction of the composite wrap and shall have tension in order to secure the composite wrap.

5.4 Preparation and Application of Composite Repairs (Method 2)

5.4.1

The composite epoxy shall be prepared by thoroughly mixing the base and the hardener as per the Manufacturer's written procedures.

5.4.2

The composite fabric shall be cut sufficiently large enough to cover the repair area. An individual patch shall not exceed approximately 24 inch x 24 inch. The composite fabric shall be impregnated with the composite epoxy to form the composite patch.

5.4.3

Prior to application of the composite patch, the composite epoxy shall be hand applied to the surface of the abraded adjacent parent coating. If the epoxy filler is sufficiently setup to resist movement, composite epoxy shall also be applied over the epoxy filler.

5.4.4

Composite patch repairs shall consist of a minimum of 4 layers of the patch applied directly over the epoxy filler and abraded adjacent parent coating. The patches shall be applied in 4 layer patches until the entire repair area (filler and abraded adjacent parent coating) is coated. A minimum two inch overlap at the seams is required between patches.

5.4.5

Release film will be tightly applied 360 degrees around the pipe over the composite patch repairs to a minimum of three (3) layers to assure the radial compression and retention of the repair in place during cure.

Note: alternative protective wraps or encasements are allowed if approved by the coating Manufacturer.

5.4.6

The release film shall extend at least 4 inches upstream and downstream of the edge of the coating repairs.

5.5 Application of Release Film (Method 3)

5.5.1

After the application of the epoxy filler in Section 5.2, release film will be tightly applied 360 degrees around the pipe over the epoxy filler to a minimum of three (3) layers to assure the radial compression and retention of the repair in place during cure.

Note: alternative protective wraps or encasements are allowed if approved by the coating Manufacturer.

5.5.2

The release film shall extend at least 2 inches upstream and downstream of the edge of the coating repairs.

5.6 Cure Time

After application, the coating system will be allowed to cure. The diver shall record a sufficient number of hardness measurements to determine cure. The release film shall be removed when the average Shore D hardness reaches a value of 70 or higher.

6.0 Quality Control

6.1 Diver

The Diver shall be responsible for the quality of the coating repair work.

6.2 Company Inspector

6.2.1

The Company Inspector shall have access to and shall be allowed to witness or audit the Diver's work, equipment, and records.

6.2.2

The competency requirements for the Company Inspector are as follows:

a) Minimum NACE-certified CIP Level 2 (or equivalent certification such as SSPC)
b) Trained and knowledgeable with regard to the application techniques, materials, and product data sheets covered by this specification

6.2.3

The Company Inspector reserves the right to stop any or all work at any time for non-compliance with the stated requirements of this procedure, during emergency situations, or for other justifiable reasons.

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Appendix D:
Screw Anchor Installation Inspection - L5 Straits of Mackinac Compliance Verification Checklist

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Screw Anchor Installation Inspection - L5 Straits of Mackinac

Pre-Installation ROV Inspection 20' On Either Side of Anchor Location			
Date:		**Diver:**	
AFE / W.O.#:		**Company Rep / Inspector:**	
Pipe Support Anchor:		**Water Depth (ft):**	
Anchor Longitude:		**Anchor Latitude:**	
Is Excavation Necessary For Saddle Placement			☐YES ☐ NO
If Excavation Is Necessary, What Is The Location Of Lake Bed With Respect To Pipe			
Is Anchor Location Within 75' of Adjacent Anchors / Touchdowns:			☐YES ☐ NO
ROV Inspection Complete At Installation Location and 20' on Either Side:			☐YES ☐ NO
Has Biota Been Cleaned From The Pipe In Saddle Placement Area:			☐YES ☐ NO
Bare Metal Present:	☐YES ☐ NO	**Deposits Present:**	☐YES ☐ NO

Note ROV Inspection Findings 20' On Either Side of Support Location				
Feature Number	**Location of Feature** (w.r.t. anchor location)	**Circumferential Position of the Feature** (o'clock position)	**Measured Feature size** (ft^2)	**Visual Classification of Feature**
				☐Bare metal ☐ Deposit ☐ Coating Damage
				☐Bare metal ☐ Deposit ☐ Coating Damage
				☐Bare metal ☐ Deposit ☐ Coating Damage
				☐Bare metal ☐ Deposit ☐ Coating Damage
				☐Bare metal ☐ Deposit ☐ Coating Damage
Insert table rows as necessary to identify all features observed. Feature numbering starts at top row (for detailed video images)				

Post Installation Diver Inspection 20' On Either Side Support Location			
Was a modification of the srew anchor location required? (if so, provide comments on reason for modification and outline agreement with ITP):			☐YES ☐ NO
If yes, how many feet and in what direction?			
Biota Cleared from Pipeline In all areas of Disturbance During Installation:			☐YES ☐ NO
Diver Inspection Complete at installation location and 20' on Either side:			☐YES ☐ NO
Bare Metal Present:	☐YES ☐ NO	**Deposits Present:**	☐YES ☐ NO

Note Diver Inspection Findings 20' On Either Side of Support				
Feature Number	**Location of Feature** (w.r.t. anchor location)	**Circumferential Position of the Feature** (o'clock position)	**Measured Feature size** (ft^2)	**Visual Classification of Feature**
				☐Bare metal ☐ Deposit ☐ Coating Damage
				☐Bare metal ☐ Deposit ☐ Coating Damage
				☐Bare metal ☐ Deposit ☐ Coating Damage
				☐Bare metal ☐ Deposit ☐ Coating Damage
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				☐Bare metal ☐ Deposit ☐ Coating Damage
				☐Bare metal ☐ Deposit ☐ Coating Damage
Insert table rows as necessary to identify all features observed. Feature numbering starts at top row (for detailed video images)				

Measurement From Existing Support or Natural Touchdown to New Support			
Adjacent Anchor / Touchdown ID South:		Distance from Adjacent Anchor / Touchdown South:	
Adjacent Anchor / Touchdown ID North:		Distance from Adjacent Anchor / Touchdown North:	
Comments/Issues/Discussion			

Hydraulic Pressure and Torque Values			
Final Hydraulic Pressure (R/L in PSI):		Correlated Torque Value (R/L in ft/lbs):	
Comments/Issues/Discussion			
	Contractor Signature	Enbridge Representative/ Inspector Signature	