

# 2018 Straits of Mackinac Pipeline Inspection Report

Enbridge Energy
Superior, WI

**Date: 9/5/2018**

Prepared By:
Ballard Marine Construction, Inc.
Chris Bauer
Chris.Bauer@BallardMC.com
866.762.6750

BALLARD MARINE CONSTRUCTION

www.BallardMC.com

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Steve Letko
Enbridge Energy
1409 Hammond Avenue, Second Floor
Superior, WI 54880-1726
(715) 398-4832 Office
(715) 394-1405 Fax
(715) 718-1243 Cell
Steve.letko@enbridge.com

Re: 2018 Straits of Mackinac Pipeline AUV & ROV Inspection Report

Dear Mr. Letko,

Attached you will find the inspection overview report. This report contains detailed information from the Enbridge Energy, Limited Partnership (Enbridge Energy) Straits of Mackinac pipeline inspection project. Included with this report is an excel spreadsheet detailing the current span information and screw anchor locations based on the 2018 inspection.

Autonomous Underwater Vehicle (AUV) data collection services took place between June 27, 2018 and July 22, 2018. Remotely Operated Vehicle (ROV) and video inspection services took place July 16, 2018 – July 24, 2018. Initial data review and submittal of the current span information was provided to Enbridge Energy on August 17, 2018.

Thank you for allowing Ballard Marine Construction, Inc. (BMC) to perform the services stated above. If there are any questions, please don't hesitate to contact me by which means you deem necessary.

Sincerely,

Chris Bauer
Sr. Project/Operations Manager
Ballard Marine Construction
2395 American Drive
Neenah, WI 54956
(360) 844-6868 Office
(920) 257-9938 Cell
chris.bauer@ballardmc.com



**Project Overview**

BMC was retained by Enbridge Energy Inc. to inspect the east and west, 20-inch diameter, steel pipelines which cross the Straits of Mackinac near Mackinaw City, Michigan. These two pipelines, located in water depths that range from 0 to 260 Feet of Fresh Water (FFW), run parallel to each other and are separated by approximately 1200 feet along the 4.6-mile length of the crossing. Both lines are buried from the shoreline extending out to water depths between 66 and 69 ft.

The focus of this project was to inspect and identify existing conditions, which may not meet the Consent Decree or Easement requirements of the Straits of Mackinac crossing or could potentially compromise the safety of the pipelines. Examples of these conditions could include but are not limited to; uncovered or unsupported areas of pipeline, items such as fish traps or cable lying on or next to the pipeline or other items that may be of concern. Past surveys and historical data have showed that intermittent areas of uncovered pipeline have become unsupported along the crossing.



AUV inspection services mobilized to Mackinaw City on June 26, 2018, while ROV inspection services mobilized on July 16, 2018. Inspection services were conducted with a combination of AUV and ROV method that included Multi-beam and Side-Scan survey systems, acoustical tracking system and video recording devices. After an initial review of the data, no span was identified as having exceeded 75 ft. in length. The attached spreadsheet contains updated results completed after BMC's initial review. It is BMC's understanding that Enbridge Energy would submit request in 2018 for permits allowing for installation of additional anchors as needed. BMC is prepared to install additional anchors as directed once all required permitting and approvals have been received.

**Operations**

BMC completed mobilization of the AUV and ROV inspection vessel at the Mackinaw City Dock. From the Mackinaw City dock, the inspection vessel would mobilize to the work site where BMC went through a series of equipment calibration procedures to insure accurate data collection. After the calibration proses was complete, the AUV and ROV inspection equipment and personnel would continue to mobilize from Mackinaw city to perform inspection services.

AUV inspections and data collection began on June 27, 2018 and were completed on July 22, 2018. ROV inspections and data collection began on July 16, 2018 and were completed on July 24, 2018. After data review, BMC supplied Enbridge Energy with a preliminary spreadsheet outlining current span information on August 17, 2018.

Based on the review of the 2018 ROV and AUV inspection data, it was determined that no unsupported pipeline spans exceeding 75 ft in length, are currently present. It is BMC's understanding that Enbridge Energy will install 51 preventative screw anchor supports in 2019 pending permit approval, based off the 2016 inspection results, which were further confirmed by the span data based on the 2018 inspection.

**Survey/Inspections Summary of Methods / Equipment Limitations**

**Autonomous Underwater Vehicle –Kongsberg "Munin" & Remotely Operated Vehicle – SeaBotix "vLBV 950"**

The Kongsberg Munin Autonomous Underwater Vehicle (AUV) was utilized to collect Multi-Beam and Side-Scan Survey Data. The technicians are able to preprogram mission topside for the AUV to carry out underwater after it is deployed. Through these missions the technicians are able to communicate with the vehicle to insure proper operations. Once a mission is complete the technicians are able to download the collected data by the AUV before redeployment for the next mission. Since the AUV is a free flying vehicle, weather constraints are minimal. In addition, since the AUV can collect multi-beam data within a couple of meters of the pipeline, these factors make this a more versatile and useful data collection system than traditional topside survey data collection methods.

For the AUV inspection, the vehicle was equipped with a multi-beam system, side-scan system and internal positioning systems that included Global Positioning System (GPS), Inertial Navigation System (INS) and Doppler Velocity Logger (DVL) systems. AUV technicians were then able to deploy the vehicle for data collection of the pipeline, recover the vehicle to download data and then redeploy for additional data collection. Two separate missions were run on each pipeline to insure accurate and ample data collection. The limitations for this equipment are minimal. This is what makes this vehicle such a beneficial tool to do the inspection at the Straits.

The "vLBV 950" is a Remotely Operated Vehicle (ROV) system and is an extremely versatile ROV system. It can be employed to carry out a variety of tasks including surveying, searching and inspections. A pilot on the surface controls the vehicle remotely by sending commands to the vehicle tether. The vehicle can be moved in any direction, or by using the autopilot facility, remain accurately on course and depth to provide a stable platform. The pilot can also control the vehicle's video system, lighting and any other equipment fitted to the unit.

For the ROV inspection, the vehicle was fitted with a Linkquest USBL tracking system in concert with an RTK GPS system and Hypack software. In operations, the ROV was fitted with a Linkquest acoustic transponder, which sends out a sound signal to be picked up by a hydrophone mounted on the side of the surface support vessel. The offsets of the vehicle as calculated by Hypack, is fed to the navigation computer that plots a corresponding XY position based on Real Time Kinematics (RTK) information from the GPS. Video from the on-board camera is recorded in a digital format, with the surveyor following position information from the Hypack navigational software.

In operation, the vessel is positioned over the pipeline using a live boat operation for the survey. With evidence of a strong fixed RTK lock as well as a solid return from the vehicle tracking system, the vehicle is launched from the surface to begin its descent to the bottom. Once on bottom, the operator utilizes the navigation system to guide the vehicle to the pipeline. With the pilot free to fly the vehicle, the survey supervisor takes notes with further direction given by the client representative on site. ROV inspection services were used only to obtain videos of the pipelines to look for visual anomalies, coating delamination, obstructions or items endangering the pipeline and the inspections of previously installed anchors.

The main limitations for ROV operations are typically related to water clarity (visibility), water current, surface weather and wave conditions. In highly turbid water conditions, an acceptable video record is impossible to generate. Fortunately water clarity for this project was exceptional, allowing for a very clear video record. Water velocities (currents) can sometimes pose difficulties in keeping the vehicle on station, or even getting it to the target.

The most prevalent limitation of this equipment is imposed by weather conditions. High winds/waves make for difficulties in launch and recovery of the equipment. Throughout the survey period weather was ideal without issues.

**Equipment Overview (Inspection Operations)**

BMC mobilized the AUV, ROV, Hydrographic survey vessel and additional equipment from at the Mackinaw City, MI State Dock for the inspection. This package consisted of the following:

- Kongsberg Munin – Autonomous Underwater Vehicle with all associated equipment
  - EM 204 Multi-beam system
  - EdgeTech Side-Scan Sonar System
  - Doppler Velocity Logger (DVL)
  - Inertial Navigation System (INS)
  - Global Positioning System (GPS)
  - Forward Looking Sonar System
  - Depth Sensor
  - Long Base Line (LBL) acoustic tracking system
- ROV LARS – Launch and Recovery System
- vLBV 950 - Remotely Operated Vehicle with all associated equipment
  - 2- Camera (1 Black and White and 1 Color)
  - Tilt Unit
  - Lighting
  - Compass
  - Depth Sensor
- Comprehensive field spares kit
- Linkquest tracking, Ultra short base line acoustic tracking system
- Trimble SPS 461 Heading
- Motion Reference Unit (MRU)
- Trimble R5-R6 GPS System - Real Time Kinematics (RTK) (centimeter accuracy)
- Computer navigation system
- Computerized and digital video recording equipment
- Offshore safety package
- Hydrographic Survey Vessel (Miss Geodesy)
- Hypack Hydrographic Survey Software

**Findings**

Data obtained during the 2018 AUV and ROV survey inspection were found to be similar to past findings, including the data obtained during the 2016 survey and inspection campaign. Both the east and west pipelines show intermittent spans over the length of uncovered pipeline. However, no spans exceeding 75 ft in length were noted. Grout bags that were previously used (pre-anchor support design) for span support were noted on the east and west lines at several locations but as of the 2018 inspection, no grout bags are still being used or considered as span supports as those grout bag supports have been replaced by mechanical anchor supports. In addition, mechanical anchor supports installed during previous mitigation programs were found to be stable and in good condition.

The enclosed spreadsheet containing detailed span information is also included within this report. This spreadsheet identifies span identifiers, location of all spans, span lengths as measured during the 2018 inspection, span touchdown point information including depth and bottom type.

**Conclusions**

Upon the completion of the 2018 AUV and ROV inspection and data review process, no spans in excess of the 75 ft in length were observed. Furthermore, the ROV video inspection and AUV data collection showed that the pipeline currently appears to be in stable condition.

Enbridge Energy did receive a permit in 2018 to install 19 preventative anchors and these supports were installed during the 2018 mitigation campaign. Based on the 2018 inspection as well as the inspection and mitigation campaign performed in 2016, BMC previously concluded and continues to conclude that as of November 5th, 2016, which was when the 2016 screw anchor installation program was completed, there are no spans exceeding 75 ft in length for either the east or west legs of Enbridge Energy's Line 5 crossing the Straits of Mackinac.