
Proposed Enbridge Consent Decree – Civil Action No. 1:16-cv-914
Independent Third Party Review and Evaluation of Enbridge Submittal:
Section VII.F. Paragraph 71
Section VII.C. Paragraphs 24 - 26
Line 5 Straits of Mackinac Hydrostatic Pressure Test Plan

May 8, 2017

Prepared by:
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Independent Third Party

Prepared for:



The United States
Environmental Protection
Agency

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O.B. Harris, LLC, the appointed Independent Third Party (ITP) under the proposed Enbridge Consent Decree (CD), has prepared this report at the request of the Environmental Protection Agency (EPA) and pursuant to CD requirements. In assessing Enbridge's compliance with the CD and in preparing this report, the ITP relied in part on data and information provided by Enbridge. The ITP, though, cannot be responsible for any errors or omissions in this report that are a result of errors or omissions in the data and information provided by Enbridge. This report, and the assessment reflected herein, supersedes any report previously issued by the ITP.

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Executive Summary

The ITP for the Enbridge CD, O.B. Harris, LLC, was engaged effective January 11, 2017. The role of the ITP per the CD is to conduct a comprehensive verification of Enbridge's compliance with the requirements of the CD.¹

On March 1, 2017 Enbridge submitted the original *Line 5 Straits of Mackinac Hydrostatic Pressure Test Plan Rev 1 (Line 5 Hydrotest Plan)* to the EPA. As required by CD ¶132.b, the ITP has reviewed and evaluated the *Line 5 Hydrotest Plan*. On March 22, 2017, the EPA requested the ITP prepare and provide a written report of its evaluation of the *Line 5 Hydrotest Plan*.

The CD provides Enbridge with two options to “reduce or eliminate the potential that any axially-aligned crack features in the Dual Pipelines will result in a leak or rupture”² in the two segments of the Line 5 pipeline that cross the Straits of Mackinac (Dual Pipelines):

- CD ¶71.a - Conduct an in-line inspection (ILI) of the Dual Pipelines using an appropriate ILI tool.
- CD ¶71.b - Perform a hydrostatic pressure test (hydrotest) of each of the Dual Pipelines.

Enbridge elected to hydrotest the Dual Pipelines and submitted the *Line 5 Hydrotest Plan* to the EPA as required by CD ¶71.b and CD ¶24.

The ITP reviewed and evaluated the steps and procedures as described in the *Line 5 Hydrotest Plan* to hydrotest the two 20-inch diameter, 4.09-mile long segments of Line 5. The ITP's analysis of the *Line 5 Hydrotest Plan* applied the following standards that are described in the CD:

1. The ITP evaluated the *Line 5 Hydrotest Plan's* compliance with the prescriptive requirements of the CD and applicable federal pipeline safety regulations.
2. The ITP evaluated whether the *Line 5 Hydrotest Plan* is supported by the facts and best engineering judgement and is of sufficient detail and completeness so that the expected outcome will be achieved.

The ITP's preliminary assessment identified eight additional items of information needed to complete the ITP's analysis. On April 19, 2017, the ITP briefed the EPA and Enbridge on these preliminary findings. On April 25, in response to this briefing, Enbridge submitted to the EPA the *Line 5 Straits of Mackinac Hydrostatic Test Plan Rev 2 (Revised Line 5 Hydrotest Plan)*.

The ITP evaluated the *Revised Line 5 Hydrotest Plan* and finds that it addresses the ITP's additional information needs and meets CD requirements.

¹ CD ¶125.

² CD ¶71.

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Introduction

The ITP for the Enbridge CD, O.B. Harris, LLC, was engaged effective January 11, 2017. As required by CD ¶132.b, the ITP has reviewed and evaluated the Enbridge *Line 5 Straits of Mackinac Hydrostatic Pressure Test Plan Rev 1 (Line 5 Hydrotest Plan)* that Enbridge submitted to the EPA on March 1, 2017. On March 22, 2017, the EPA requested that the ITP review the *Line 5 Hydrotest Plan* and submit this report. On April 19, 2017, the ITP briefed the EPA and Enbridge on preliminary findings of additional items of information needed to complete the ITP's review of the *Line 5 Hydrotest Plan*. Enbridge revised the *Line 5 Hydrotest Plan* and submitted it to the EPA on April 25, 2017. This report presents the results of the ITP's review and evaluation of the April 25 *Line 5 Straits of Mackinac Hydrostatic Test Plan Rev 2 (Revised Line 5 Hydrotest Plan)*.

Summary of the Consent Decree Requirements

CD section VII.J, ¶132.b requires that the ITP review and evaluate all proposed plans, reports, and other deliverables that Enbridge is required to submit to the EPA under the CD. CD ¶132.b also provides that the ITP shall review and evaluate the completeness of the Enbridge submittal and its compliance with requirements of the CD. CD ¶134.e requires that the ITP assess whether Enbridge submittals are supported by the facts and best engineering judgment. CD ¶132.b states that, if the EPA requests, the ITP is to submit to the EPA a written report of its evaluation within 45 days of the request.

CD section VII.F, ¶71 requires that, no later than December 31, 2017, Enbridge shall complete actions specified in either CD ¶71.a or CD ¶71.b to reduce or eliminate the potential that any axially-aligned crack features³ in the Dual Pipelines⁴ will result in a leak or rupture. The option in CD ¶71.a requires that Enbridge investigate the Dual Pipelines using an appropriate ILI tool. The option in CD ¶71.b requires that Enbridge perform a hydrostatic pressure test (hydrotest) in the Dual Pipelines. If Enbridge elects to conduct a hydrotest, CD ¶71.b requires that the test plan and procedures must be provided to the EPA at least 90 days before commencing the test.

CD section VII.C, ¶24 requires that Enbridge prepare and submit to the EPA a plan and schedule that describes, in detail, how Enbridge will conduct the hydrotest. CD ¶25 contains various requirements and procedures for any hydrotest Enbridge plans to carry-out including:

- To segment the pipeline as needed to perform the test.
- To maintain a test pressure at least 1.25 times maximum operating pressure (x MOP) for 4 hours at all locations in the test segment, then maintain a pressure of not less than 1.1 x MOP at all locations for the remainder of the continuous 8-hour test period.
- To complete the test as soon as practicable but not longer than 270 days from the EPA's receipt of the plan.

³ The term 'crack feature' is defined in CD ¶10.l.

⁴ Dual Pipelines is defined as the 4.09-mile portion of Line 5 consisting of two 20-inch diameter seamless pipelines that cross the Straits of Mackinac; CD ¶67.

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- That additional water may not be added to the test segment while the test is underway.
- To provide written notification to federal agencies at least 30 days prior to conducting the test.
- To submit to the EPA a report of the test within 120 days of completing the test.

In the event a leak or rupture occurs in a Dual Pipeline during the hydrotest, CD ¶26 requires the following actions to be taken:

- Take immediate actions to respond to the failure.⁵
- Submit an investigatory report to the EPA within 90 days of the pipeline failure.

Summary of Enbridge *Revised Line 5 Hydrotest Plan*

Enbridge submitted the *Line 5 Hydrotest Plan* to the EPA on March 1, 2017. The transmittal letter for the *Line 5 Hydrotest Plan* states that Enbridge:

- Notified the EPA on February 21, 2017 that it intended to hydrotest the Dual Pipelines to fulfill its obligations under CD ¶71.
- Intends to conduct the hydrotest no earlier than June of 2017.

Enbridge subsequently submitted the *Revised Line 5 Hydrotest Plan* on April 25, 2017. Following is a summary of the major steps provided in the *Revised Line 5 Hydrotest Plan*:

1. **Notices and Reports** – The *Revised Line 5 Hydrotest Plan* includes a section stating that Enbridge will ensure that notifications required by the CD will be completed.
2. **Test Segments** – The Dual Pipelines will be tested in two phases, each of which will follow the same procedures and test parameters:
 - In the first phase, hydrotest the 4.09-mile west segment.
 - In the second phase, hydrotest the 4.09-mile east segment.⁶

The *Revised Line 5 Hydrotest Plan* notes that the segment not undergoing testing will continue to operate.

3. **Test Pressure** – Table 1 (page 6) compares the test pressure levels and duration as:
 - Proposed in the *Revised Line 5 Hydrotest Plan*.
 - Required by CD ¶25.b. and by 49 CFR Part 195, Subpart E.

⁵ The EPA has advised that the ITP will not be responsible for ¶26.a regarding procedures to respond to discharges in the event of a hydrotest failure.

⁶ The *Revised Line 5 Hydrotest Plan* notes the hydrostatic testing sequence of the two segments may be reversed at the discretion of Enbridge.

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The strength test and leak test phases of the hydrotest will be conducted sequentially over a continuous 8-hour period. The test pressure is expressed as the MOP of the line multiplied by a factor. The *Revised Line 5 Hydrotest Plan* specifies the corresponding pressure and pipe stress level, including the acceptable range of the test.

Table 1: Proposed Test Levels and Durations

Requirement	Strength Test		Leak Test	
	Minimum Pressure Factor x MOP (psig)	Duration (hours)	Minimum Pressure Factor x MOP (psig)	Duration (hours)
Enbridge Line 5 Test	2.0	4	1.1	4
CD ¶25.b	1.25	4	1.1	4
49 CFR Part 195, Subpart E	1.25	4	1.1	4

4. **Test Instrumentation and Documentation** – The *Revised Line 5 Hydrotest Plan* specifies that multiple instruments will be used to measure and record temperature and pressure throughout the test.
5. **Test Segment Isolation** – The *Revised Line 5 Hydrotest Plan* identifies locations where valves will be removed and blind flanges will be installed on the north and south ends of the test segment to isolate each segment. Some above ground piping, valves, and the pig traps will be subjected to the hydrotest on the upstream and downstream ends of the test segment.
6. **Oil Removal and Water Fill – West Segment** – The *Revised Line 5 Hydrotest Plan* notes that oil will be removed from the west test segment using nitrogen to push a pig from the launcher on the north side of the Mackinac Straits to the receiver on the south side. Once the oil is removed, water will be injected to push another pig from the north side launcher to the south side receiver using the nitrogen that remains in the line for back-pressure. Nitrogen will be vented through the receiver. The test segment is thereby filled with water and ready for test.
7. **Pressure, Temperature, and Volume Monitoring** – Once filled with water, the test segment will be allowed to reach a state of stable temperature at no more than 50% of the strength test pressure. Following stabilization, pressure will be increased and held to conduct the strength test phase and then partially reduced and held to conduct the leak test phase.

The *Revised Line 5 Hydrotest Plan* specifies that water pressure, water and ground temperature, and water volume will be monitored and recorded throughout the pressure test.

8. **Test Acceptance and Leak Detection** – The strength and leak tests will be accepted if both of the following conditions are met:
 - No leakage occurs.
 - The recorded test pressures remain at levels equal to or above the specified minimums for the duration of the two phases of the test.

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The *Revised Line 5 Hydrotest Plan* notes that procedures in Enbridge's Operations and Maintenance Manual will be used to reconcile pressure changes with temperature or volume change. Section 3.5 of the *Revised Line 5 Hydrotest Plan* specifies that if water is added to the test segment to adjust test pressures to compensate for temperature changes, both phases of the 8-hour test will be reinitiated. In the event of a leak, the leak will be repaired, then both phases of the 8-hour test will be reinitiated.

Appendix C of the *Revised Line 5 Hydrotest Plan* describes the methods Enbridge will use to determine if a leak investigation during the hydrotest is required and the steps to be taken to locate and repair a leak. To reduce the amount of time required to locate a potential leak, a non-toxic fluorescein dye and a non-toxic tracer gas will be added during the hydrotest water fill. An underwater remote operated vehicle with a camera and a long-range fluorescent detector will be used to detect any underwater leaks. Divers also will be deployed to visually detect any underwater leaks.

9. **Depressurization/Dewatering** – The *Revised Line 5 Hydrotest Plan* calls for the test water to be depressurized at a controlled rate using valves. Nitrogen will be used to push a pig to remove water from the line. Hydrotest water will be stored in above ground storage tanks for future use or disposal. The west segment will be reconnected to the pipeline, refilled with oil, and returned to service.
10. **Hydrotest the East Segment** – After treatment, water from the west segment hydrotest will be reused for the east segment test. The east segment oil removal, water fill, test, and water removal procedures will follow the same steps as for the west segment test.
11. **Test Failure Notifications and Reports** – In the event of a test failure (leak or rupture), the pipe will be repaired and both phases, the strength test and the leak test, will be reinitiated. The *Revised Line 5 Hydrotest Plan* requires Enbridge to complete and submit an investigatory report of the pipeline failure to the EPA and to the Pipeline and Hazardous Materials Safety Administration within 90 days of the failure. The applicable Enbridge Operation and Maintenance Manual repair procedures, relating to pipe either above or below the water line, will be followed to complete the repairs.

Analysis of the Enbridge Line 5 Hydrotest Plan

Scope

In its analysis of the *Revised Line 5 Hydrotest Plan*, the ITP applied the following standards that are described in the CD:

1. Evaluate the *Revised Line 5 Hydrotest Plan's* compliance with the prescriptive requirements of the CD and applicable federal pipeline safety regulations.
2. Evaluate whether the *Revised Line 5 Hydrotest Plan* is supported by the facts and best engineering judgement and is of sufficient detail and completeness so that the expected outcome will be achieved.

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The ITP's review and analysis did not include an assessment of:

- Enbridge's election to conduct a hydrotest versus an ILI as provided for in the CD.
- Contingency plans required by CD ¶26.a to respond to any pipeline leak or rupture.
- Management and disposal of water used for the hydrotest after completion of testing of the final segment.
- Section 5.5 Safety Precautions of the *Revised Line 5 Hydrotest Plan*.

Analysis of Major Steps of the Plan

The categories of the following discussion correspond with the major steps of the *Revised Line 5 Hydrotest Plan* as summarized in the Summary of Enbridge *Revised Line 5 Hydrotest Plan* section of this report.

Test-Related Notices and Reports

Section 3.2 of the *Revised Line 5 Hydrotest Plan* states that the CD-required notices and reports will be completed.

Test Pressure

As noted in Table 1 (page 6), the pressure level and duration for the strength and leak phases of the hydrotest, as proposed in the *Revised Line 5 Hydrotest Plan*, fulfill the requirements of the CD and 49 CFR Part 195, Subpart E.

Appendix A of the *Revised Line 5 Hydrotest Plan* presents the Enbridge rationale for selection of 1200 psi or 2 x MOP for the strength test versus 1.25 x MOP as required by the CD and 49 CFR Part 195, Subpart E. The technical analysis described by Enbridge examined various factors to support the election to test the pipeline to 2 x MOP.

Test Instrumentation and Documentation

The instrumentation and documentation described in the *Revised Line 5 Hydrotest Plan* to record the parameters of the hydrotest are in accordance with generally accepted industry practice.

Test Segment Isolation

The plans illustrated in section 3.7 of the *Revised Line 5 Hydrotest Plan* to isolate the test segments are in accordance with generally accepted industry practice.

Oil Removal and Water Fill of the Test Segments

Appendix B of the *Revised Line 5 Hydrotest Plan* provides a description of how nitrogen will be:

- Used with pigs to remove the oil and fill the test segments with water.
- Displaced and vented from the test segment during water fill and refilling with oil.

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Appendix D of the *Revised Line 5 Hydrotest Plan* describes the quality standards for the municipal water supply to be used for the hydrostatic test water.

Pressure, Temperature, and Volume Monitoring

The *Revised Line 5 Hydrotest Plan* pressure, temperature, and volume monitoring during the test is in accordance with generally accepted industry practice.

Test Acceptance and Leak Detection

The approach that Enbridge proposes for leak investigation and detection during the hydrotest is in accordance with generally accepted industry practice.

Relevant Standards and Procedures

The *Revised Line 5 Hydrotest Plan* incorporates by reference four Enbridge Operations and Maintenance Manual standards and procedures that are described in the List of Information Considered section of this report. The ITP reviewed these procedures in connection with its review of the *Revised Line 5 Hydrotest Plan*.

Hydrotest Observation

The ITP intends to observe the execution of the hydrotest.

Findings

The ITP evaluated the March 1, 2017 *Line 5 Hydrotest Plan Rev 1* and briefed the EPA and Enbridge on eight additional information needs with respect to the *Line 5 Hydrotest Plan* on April 19, 2017.

In response to this briefing, Enbridge submitted the *Revised Line 5 Straits of Mackinac Hydrostatic Test Plan Rev 2* to the EPA on April 25, 2017. The ITP evaluated this *Revised Line 5 Hydrotest Plan* and determined that it addresses the ITP's additional information needs and meets applicable CD requirements.

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List of Information Considered

The EPA requested that the ITP apply CD ¶133.a and identify all information considered by the ITP, identify all persons interviewed by the ITP, and summarize all relevant oral communications.

Federal Documents and Regulations

49 CFR Part 195: Code of Federal Regulations, Transportation, *Transportation of Hazardous Liquids by Pipeline, Subpart E*.

Proposed Consent Decree: *United States of America v. Enbridge Energy, Limited Partnership, et al*; Civil Action No. 1:16-cv-914.

Industry Standards and Papers

Hydrostatic Pressure Testing as Part of an Integrity Management Program: A Case Study. Presented at 2016 International Pipeline Conference. IPC2016-64566.

Enbridge Documents

05-03-08: Enbridge Operations and Maintenance Manual; Book 3: Pipeline Facilities; Section: Procedures; *Determining Remediation Method*. Revised September 1, 2015.

06-02-12: Enbridge Operations and Maintenance Manual; Book 3: Pipeline Facilities; Section: Standards; *Subsea Pipeline Repair*. Revised 2017-05-01.

07-03-03: Enbridge Operations and Maintenance Manual; Book 3: Pipeline Facilities; Section: Procedure; *Calculating Theoretical Pressure-Volume Relationship*. Revised April 1, 2006.

07-03-04: Enbridge Operations and Maintenance Manual; Book 3: Pipeline Facilities; Section: Procedure; *Calculating Pressure-Temperature Reconciliation*. Revised March 31, 2009.

Conservation Commission of the State of Michigan Easement Approval Letter to Lakehead Pipe Line Company, Inc. Straits of Mackinac Pipe Line Easement. April 23, 1953

Enbridge Notification Letter to Landowners of Pipe Line Name Change from Lakehead Pipeline to Enbridge Energy Partners. September 17, 2001

Line 5 Straits of Mackinac Hydrostatic Pressure Test Plan Rev 1. March 1, 2017

Line 5 Straits of Mackinac Hydrostatic Pressure Test Plan Rev 2. April 25, 2017

Presentation: Line 5 Hydrotest Plan. Presented by Enbridge at the March 8, 2017 ITP Introduction and Orientation Session.

Step toe & Johnson Transmittal Letter. March 1, 2017

Step toe & Johnson Transmittal Letter. April 25, 2017

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Other Communications

Online Meeting; ITP briefed EPA and Enbridge on the preliminary findings from the ITP's preliminary assessment of the original *Line 5 Hydrotest Plan*; April 19, 2017.