# Enbridge Consent Decree – Civil Action No. 1:16-cv-914
# Independent Third Party Review and Evaluation of Enbridge Submittal
# Section VII(C) Paragraph 25 and
# Section VII(E) Paragraph 71
# Line 5 Dual Pipelines Hydrostatic Pressure Tests

**November 16, 2017**

Prepared by:

O.B. Harris, LLC
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 Enbridge Consent Decree (CD) (Civil Action No. 1:16-cv-914) 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 requirements contained in the CD, the ITP has in part relied on data and information supplied 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 prepared by the ITP.

To the extent in this report that the ITP finds that Enbridge is in compliance with, or not in compliance with, the CD requirements addressed by this report, such finding is for the sole purpose of informing the EPA of the ITP's independent conclusions. The EPA remains, in all circumstances, the party which will officially determine whether Enbridge is in compliance with, or is not in compliance with, the CD.

## Definitions[1]

| Item | Definition |
|---|---|
| Axially-Aligned Crack | Defined in the CD as "any type of Crack feature that is oriented in the direction of the pipeline's axis as opposed to the pipeline's circumference." |
| CD | Consent Decree. *United States of America v. Enbridge Energy, Limited Partnership, et al; Civil Action No. 1:16-cv-914*. Defined in the CD to include "this Decree and all Appendices attached hereto (listed in Section XXV [of the Consent Decree])." |
| CD ¶ | Consent Decree Paragraph. Paragraph is defined in the CD as "a portion of this Decree identified by an Arabic numeral." The ¶ symbol is not used to note paragraphs from any other document. |
| Day | Defined in the CD as "a calendar day unless expressly stated to be a business day. In computing any period of time under this Consent Decree, where the last Day would fall on a Saturday, Sunday, or U.S. federal holiday, the period shall run until the close of business of the next business day." |
| Deadweight Tester | An instrument used to measure pressure. Deadweight testers are considered by the National Institute of Standards and Technology to be a primary standard/instrument for pressure measurement. |
| Dual Pipelines | Refers to the two 20-inch diameter pipelines of Line 5 that cross the Straits of Mackinac. Each is approximately 4.09 miles long. The pipelines, individually, are typically referred to as the east segment or west segment of the Line 5 Dual Pipelines. |
| Enbridge | Defined in the CD to include "Enbridge Energy, L.P., Enbridge Pipelines (Lakehead) L.L.C., Enbridge Energy Partners, L.P., Enbridge Energy Management, L.L.C., Enbridge Energy Company, Inc., Enbridge Employee Services Canada Inc., and any of their successors and assigns." |
| EPA | Environmental Protection Agency. Defined in the CD to include "any of its successor departments or agencies." |
| Hydrostatic Pressure Test or Hydrotest | For the purposes of this report, a hydrostatic pressure test (hydrotest) is a process where a section or segment of a pipeline is filled with water, the pressure in the pipeline is raised to a predetermined level, and the pressure in the pipeline is held for a predetermined period of time.<br>A hydrostatic pressure test is typically comprised of two parts. One part is referred to as a strength test, and the second part is referred to as a leak test.<br>CD ¶25b requires that hydrostatic pressure testing of a pipeline segment is to be performed over a continuous 8-hour period. |
| ITP | Independent Third Party. CD Section J outlines the responsibilities of the ITP. O.B. Harris, LLC serves as the ITP for this CD. |
| Leak Test | CD ¶25.b.2 requires that a pressure of at least 1.10 X MOP is maintained at all locations in each test segment for a period of 4 hours during the hydrotest. |

[1] Definitions from the CD are found in CD ¶10.

| Item | Definition |
|---|---|
| MOP | Established Maximum Operating Pressure. Refers to the maximum pressure, generally expressed in pounds per square inch (psi), at which a pipeline may be operated. The CD states that the MOP for a pipeline segment is found "in column C of the spreadsheet located at https://www.epa.gov/enbridge-spill-michigan/enbridge-revised-maximum-operating-pressure-values."<br>For the Line 5 Dual Pipelines, the MOP is 600 psi. |
| Section | Defined in the CD as "a portion of the Decree identified by a Roman numeral." |
| Strength Test | CD ¶25.b.1 requires that a pressure of at least 1.25 X MOP is maintained at all locations in each test segment for a period of 4 hours during the hydrotest. |

## Executive Summary

On March 1, 2017 Enbridge provided to the Environmental Protection Agency (EPA) a copy of a plan to undertake a hydrostatic pressure test of the two pipelines that cross the Straits of Mackinac entitled *Line 5 Straits of Mackinac Hydrostatic Test Pressure Plan Rev 1(Line 5 Hydrotest Plan)* in compliance with Consent Decree (CD) Paragraph (¶) 71.b. At the request of the EPA, the Independent Third Party (ITP) reviewed the *Line 5 Hydrotest Plan* and identified eight additional items of information the ITP needed to complete its analysis of the plan. On April 25, 2017, in response to the ITP's request for additional information, Enbridge submitted to the EPA the *Line 5 Straits of Mackinac Hydrostatic Test Pressure Plan Rev 2* (*Revised Line 5 Hydrotest Plan*). The ITP evaluated the *Revised Line 5 Hydrotest Plan* and found that it addressed the ITP's additional information needs and complied with CD requirements.

The final preparations for performing, and the conduct of, the hydrotests of the west and east segments of the Line 5 Dual Pipelines were carried out over the period of June 5 to June 16, 2017. During the period of June 6 to June 16, 2017 the ITP was on-site and observed the preparations for, execution, and completion of the hydrotests of the Line 5 Dual Pipelines.

The hydrotest of the west segment of the Line 5 Dual Pipelines, which was comprised of a 4.25-hour strength test followed by a 4.25-hour leak test, was conducted and completed on June 10, 2017. The hydrotest of the east segment of the Line 5 Dual Pipelines, which was comprised of a 4.25-hour strength test followed by a 4.25-hour leak test, was conducted and completed on June 16, 2017.

On September 15, 2017, Enbridge submitted to the EPA two reports prepared by Lake Superior Consulting, LLC (Lake Superior Consulting) regarding the two hydrotests:

- *Final Report: Enbridge Line 5–East Straits of Mackinac Hydrostatic Test; Hydrostatic Test # 5-17-153*
- *Final Report: Enbridge Line 5–West Straits of Mackinac Hydrostatic Test; Hydrostatic Test # 5-17-154*

On October 2, 2017, the EPA requested that the ITP review these two reports and provide the EPA with a report of the ITP's review and evaluations in accordance with CD ¶132.b. As part of its reviews, evaluations, and on-site observations of the Line 5 Dual Pipelines hydrostatic pressure tests and in accordance with CD ¶132.b, the ITP applied the following standards in assessing whether the preparations, hydrotests, and results were:

- In compliance with applicable CD requirements and in conformance with the *Revised Line 5 Hydrotest Plan*.
- Supported by the facts and best engineering judgment and of sufficient detail and completeness so that the expected outcome was achieved.

The ITP finds that the final preparations, hydrotests, and results met those two standards. Sufficient detail was provided in Enbridge's hydrotest reports to provide the facts to demonstrate that the hydrotests:

- Complied with applicable federal pipeline safety regulations and conformed with generally accepted industry practice.
- Achieved the expected hydrotest results as provided by CD ¶71.

## List of Applicable Consent Decree Requirements

CD Section VII.C, ¶25

CD Section VII.E, ¶71

CD Section VII.J, ¶132.b & c

CD Section VII.J, ¶134.e

## Introduction

Consent Decree (CD) Paragraph (¶) 71 requires Enbridge to undertake an investigation of the Line 5 Dual Pipelines for Axially-Aligned Cracks by December 31, 2017. CD ¶71.b provides Enbridge the option to perform a hydrostatic pressure test (hydrotest) of each segment of the Line 5 Dual Pipelines to comply with the requirements in CD ¶71. CD ¶71.b also requires that Enbridge provide to the Environmental Protection Agency (EPA) a copy of the test plan and procedure at least 90 Days before commencing the tests.

CD ¶25.f requires that Enbridge provide to the EPA a report describing the hydrotests that were undertaken and the results of those tests within 120 Days of completing the hydrotests.

The following summarizes the ITP's review and evaluation of the test plans Enbridge submitted for conducting the hydrotests:

- March 1, 2017: Enbridge provided the EPA a copy of *Line 5 Straits of Mackinac Hydrostatic Test Pressure Plan Rev 1 (Line 5 Hydrotest Plan)*.
- March 22, 2017: The EPA requested that the Independent Third Party (ITP) prepare and provide to the EPA a written report of the ITP's evaluation of the *Line 5 Hydrotest Plan*.
- April 19, 2017: Following a review and evaluation of the *Line 5 Hydrotest Plan*, the ITP briefed the EPA and Enbridge on the status of the ITP's review, noting eight areas for which the ITP required additional information for the ITP to complete its review.
- April 25, 2017: Enbridge provided to the EPA its response to the ITP's April 19, 2017 comments, along with a copy of *Line 5 Straits of Mackinac Hydrostatic Test Pressure Plan Rev 2* (*Revised Line 5 Hydrotest Plan*).
- May 8, 2017: The ITP completed its review and evaluation of the *Revised Line 5 Hydrotest Plan* and, in a report to the EPA and Enbridge, noted that the *Revised Line 5 Hydrotest Plan* addressed the ITP's additional information needs and complied with CD requirements.

On March 1, 2017, when Enbridge submitted the *Line 5 Hydrotest Plan* to the EPA, Enbridge informed the EPA that they intended to perform the hydrotests in June 2017. On May 9, 2017, pursuant to CD ¶25.e, Enbridge informed the EPA, the ITP, relevant federal agencies, and local emergency providers that Enbridge intended to conduct the hydrotests of the Line 5 Dual Pipelines beginning June 9, 2017.

The final on-site preparations for, and the hydrotests of, the two pipelines were performed over the period of June 5 to June 16, 2017. The ITP observed, on-site, over the period June 6 to June 16, 2017:

- The preparations being made to conduct the tests.
- The hydrotests.

On September 15, 2017 Enbridge provided the EPA with two separate reports of the hydrotests that were performed on the pipelines, one for the east segment and one for the west segment, as follows:

- *Final Report: Enbridge Line 5 – East Straits of Mackinac Hydrostatic Test; Hydrostatic Test #5-17-153 (East Straits Report)*
- *Final Report: Enbridge Line 5 – West Straits of Mackinac Hydrostatic Test; Hydrostatic Test #5-17-154 (West Straits Report)*

The reports and the appendices to those reports were prepared by Lake Superior Consulting of Duluth, Minnesota, and are collectively referred to as the *Hydrotest Reports*.

As requested by the EPA on October 2, 2017, and in accordance with CD ¶132.b, the ITP has prepared this report which presents the results of the ITP's review and evaluation of the:

- Hydrotests of the Line 5 Dual Pipeline.
- *Hydrotest Reports*.

The ITP's review and evaluation are also informed by the ITP's on-site observations of the hydrotests.

# Analysis and Assessment

## Scope

In reviewing and evaluating the *Hydrotest Reports,* and in the ITP's on-site observations of the hydrostatic pressure tests, the ITP applied the following standards that are described in the CD:

1. Evaluate whether the hydrostatic pressure tests of the Line 5 Dual Pipelines were conducted in compliance with the prescriptive requirements of the CD and in conformance with the requirements stated in the *Revised Line 5 Hydrotest Plan*.[2]
2. Assess whether the results of the hydrotests of the Line 5 Dual Pipelines are supported by the facts and best engineering judgment and were of sufficient detail and completeness so that the expected outcome was achieved.[3]

The ITP's on-site observations and its review and evaluations of the *Line 5 Hydrotest Plan* and the *Hydrotest Reports* did not encompass the following subjects:

- Post-test water removal and hydrocarbon refill.

[2] CD ¶134.a
[3] CD ¶134.e

- The return to service of the Line 5 Dual Pipelines.
- Management and disposal of the water used for the hydrotests.
- Safety precautions contained in section 5.5 of the *Revised Line 5 Hydrotest Plan*.

## Compliance of the Hydrostatic Pressure Tests with CD requirements

Regarding the completion of the June 2017 hydrotests of the west and east segments of the Line 5 Dual Pipelines and the compliance of the hydrotests with the requirements of the CD, the ITP observes the following:

**Table 1: Compliance with applicable CD requirements**

| No | CD¶ | Item | References |
|---|---|---|---|
| 1 | 71.b | In compliance with this requirement, Enbridge submitted the *Line 5 Hydrotest Plan* to the EPA at least 90 Days before commencing the tests. The *Line 5 Hydrotest Plan* was submitted on March 1, 2017 which is:<br>• 101 Days prior to the west segment hydrotest on June 10, 2017.<br>• 107 Days prior to the east segment hydrotest on June 16, 2017. | • March 1, 2017 Steptoe & Johnson Transmittal Letter<br>• *Line 5 Hydrotest Plan* |
| 2 | 71 | In compliance with this requirement, the hydrotests of the Line 5 Dual Pipelines were completed prior to December 31, 2017.<br>• The strength and leak tests of the west segment were completed on June 10, 2017.<br>• The strength and leak tests of the east segment were completed on June 16, 2017. | • *Hydrotest Reports*: Sections 3.1, 3.3, and 3.4<br>• ITP on-site observations |
| 3 | 25.a | In compliance with this requirement, the west and east segments of the Line 5 Dual Pipelines used blind flanges to divide the pipeline into separate test segments and physically isolate the test segments from the Line 5 segments upstream and downstream of the Line 5 Dual Pipelines. | • *Hydrotest Reports*:<br>– Section 2.1<br>– Appendices 1.1, 1.2, 2.1, 2.2 & 5<br>• ITP on-site observations |
| 4 | 25.b | In compliance with this requirement, the hydrostatic testing (strength and leak tests) of the west and east segments was conducted over a minimum continuous 8-hour period, as follows:<br>• West segment: June 10, 2017 beginning at 8:30 AM and finishing at 7:00 PM<br>• East segment: June 16, 2017 beginning at 7:15 AM and finishing at 5:30 PM | • *Hydrotest Reports*:<br>– Sections 3.1, 3.3, 3.4, and 4.3.1<br>– Appendices 1.3, 1.4, and 1.6<br>• ITP on-site observations |

| No | CD¶ | Item | References |
|---|---|---|---|
| 5 | 25.b.1 | In exceedance of this requirement to maintain a pressure of at least 1.25 X Maximum Operating Pressure (MOP) for 4 hours at all locations in the test segment and as approved in the *Revised Line 5 Hydrotest Plan*, a pressure of at least 1200 psi (i.e., 2.00 X MOP) was maintained on all locations of both the west and east test segments for a period of 4 hours 15 minutes (4.25 hours). | • *Hydrotest Reports*:<br>– Sections 3.1, 3.3, and 4.3.1<br>– Appendices 1.3, 1.4, and 1.6<br>• ITP on-site observations |
| 6 | 25.b.2 | In compliance with this requirement to maintain a pressure not less than 1.10 X MOP on all locations for the remainder of the continuous 8-hour test a pressure greater than 660 psi (i.e., 1.10 X MOP) was maintained on all locations of both the west and east segments for a period of 4.25 hours. | • *Hydrotest Reports*:<br>– Section 3.1, 3.4, and 4.3.1<br>– Appendices 1.3, 1.4, and 1.6<br>• ITP on-site observations |
| 7 | 25.c | In compliance with this requirement, the tests were completed within 270 Days from the date the EPA received the *Line 5 Hydrotest Plan* and schedule (as noted in item 1 of this table) | • March 1, 2017 Steptoe Transmittal Letter<br>• *Line 5 Hydrotest Plan*<br>• *Hydrotest Reports*:<br>– Sections 3.1, 3.3, and 3.4<br>– Appendices 1.3 and 1.4<br>• ITP on-site observations |
| 8 | 25.d | In compliance with this requirement, water was not added to the test segments while the hydrotests were underway. | • *Hydrotest Reports*: Section 4.3.1<br>• ITP on-site observations |
| 9 | 25.e | In compliance with this requirement, Enbridge supplied the EPA, other relevant federal agencies, and local emergency providers with written notification 30 Days prior to conducting the hydrotests. | May 9, 2017 Steptoe & Johnson Letter *re: Notice of Planned Line 5 Hydrotest* |
| 10 | 25.f | In compliance with this requirement, Enbridge provided to the EPA two reports describing the hydrotests and summarizing the results of the hydrotests within 120 Days after completing each of the hydrotests. The *Hydrotest Reports* were provided to the EPA on September 15, 2017, which is:<br>• 97 Days after completing the hydrotest of the west segment.<br>• 91 Days after completing the hydrotest of the east segment. | • September 15, 2017 Transmittal Letter of the Hydrotest Reports<br>• *Hydrotest Reports*: Section 3.1 |

## Conformance with Enbridge's *Revised Line 5 Hydrotest Plan*

Regarding the completion of the June 2017 hydrotests of the west and east segments of the Line 5 Dual Pipelines and the conformance of the hydrotests to the requirements of the *Revised Line 5 Hydrotest Plan*, the ITP observes the following:

**Table 2: Conformance with the *Revised Line 5 Hydrotest Plan***

| No | Section | Item | References |
|---|---|---|---|
| 1 | 3.4 | **Piping to be Tested:**<br>In conformance with this requirement, the piping tested as part of the hydrotests was the piping identified in Table 1 of this section of the *Revised Line 5 Hydrotest Plan*. | • *Hydrotest Reports*:<br>– Section 2.1<br>– Appendix 1.1<br>• ITP on-site observations |
| 2 | 3.5 | **Test Pressure and Duration:**<br>In conformance with this requirement, the pressures and duration of the hydrotests were conducted as stipulated in Table 2 of this section of the *Revised Line 5 Hydrotest Plan*. | • *Hydrotest Reports*:<br>– Sections 3.1, 3.3, 3.4, and 4.3.1<br>– Appendices 1.3, 1.4, and 1.6<br>• ITP on-site observations |
| 3 | 3.7 | **Test Isolation:**<br>The manner in which the west and east segments were isolated from the upstream and downstream segments of Line 5 conformed with the requirements stipulated in Figures 1–8 of this section of the *Revised Line 5 Hydrotest Plan*. | • *Hydrotest Reports*:<br>– Section 2.1<br>– Appendices 1.1, 1.2, 2.1, 2.2, and 5<br>• ITP on-site observations |
| 4 | 4.1 | **Test Instrument Calibration:**<br>The test instruments used during the hydrotests of the east and west segments were calibrated in conformance with the requirements stipulated in Table 3 of this section of the *Revised Line 5 Hydrotest Plan*. | *Hydrotest Reports:*<br>• Section 2.5<br>• Appendices 2.2 and 2.3 |
| 5 | 4.2, 4.3 and 4.4 | **Test Instrument Setup and Pressure and Temperature Measurements:**<br>The manner in which the instruments were set-up to monitor and record the results of the hydrotests was in conformance with the requirements of these sections of the *Revised Line 5 Hydrotest Plan*. | • *Hydrotest Reports:*<br>– Section 2.5<br>– Appendices 1.8, 1.9, 2.1, and 2.2<br>• ITP on-site observations |
| 6 | 4.5.2 steps #1-6 | **Filling and Isolating the Test Segments:**<br>The arrangements undertaken to prepare the east and west segments for the hydrotests conformed with the requirements stipulated in steps #1-6 of this sub-section of the *Revised Line 5 Hydrotest Plan*. | • *Hydrotest Reports:*<br>Appendices 2.2, 4, 4.5, and 5<br>• ITP on-site observations |

| No | Section | Item | References |
|---|---|---|---|
| 7 | 4.5.2 #7 | **Water Temperature Stabilization:** In conformance with this requirement, after filling the test segment with water and raising the pressure on the test segment to 50% of the strength test pressure (i.e., approx. 600 psi), the temperature of the water was allowed to stabilize as required in step #7 of this sub-section of the *Revised Line 5 Hydrotest Plan*. | • *Hydrotest Reports:* Appendices 4 and 4.3<br>• ITP on-site observations |
| 8 | 4.5.2 #8 | **Inspection of Piping:** The ITP did not identify any non-conformances with regard to the requirements to inspect the piping at the completion of the water temperature stabilization period, as provided by this sub-section of the *Revised Line 5 Hydrotest Plan*. | ITP on-site observations |
| 9 | 4.5.2 #9 | **New Charts, Zeroing and Checking Instruments:** The requirements to zero the instruments, insert new charts into the chart recorders prior to starting the hydrotests, and to check the recorders periodically were performed in conformance with step #9 of this sub-section of the *Revised Line 5 Hydrotest Plan*. | • *Hydrotest Reports:*<br>– Section 3.2<br>– Appendices 1.3, 1.4, 1.6, and 4.3<br>• ITP on-site observations |
| 10 | 4.5.2 #10 | **Pressurization to Test Pressure:** In conformance with this requirement, the rate of pressurizing the test segments to test pressure was less than 10 psi/minute as stipulated in step #10 of the *Revised Line 5 Hydrotest Plan*. | • *Hydrotest Reports:*<br>– Section 3.2<br>– Appendix 1.5<br>• ITP on-site observations |
| 11 | 4.5.2 #11 | **Isolation and Inspection of Piping on Reaching the Test Pressure:** In conformance with this requirement, once the test pressures were achieved, as required in step #11 of the *Revised Line 5 Hydrotest Plan*, the test segment was isolated from the water fill lines and an initial visual inspection for leaks was undertaken of the above grade piping and instrument connections. | ITP on-site observations |
| 12 | 4.5.2 #12 | **Checking of Pressure Recorders:** The ITP did not observe any non-conformances with the requirement to check the recorders, hourly, as required in step #12 of the *Revised Line 5 Hydrotest Plan*. | ITP on-site observations |
| 13 | 4.5.2 #13 | **Test to be Maintained for 8 Hours:** In conformance with this requirement, and as noted above, the hydrotests were carried out over a minimum of a continuous 8-hour period, with the strength test pressures held for a period of 4.25 hours and the leak test pressures held for a period of 4.25 hours, as required in step #13 of the *Revised Line 5 Hydrotest Plan*. | • *Hydrotest Reports:*<br>– Sections 3.1, 3.3, 3.4, and 4.3.1<br>– Appendices 1.3, 1.4, and 1.6<br>• ITP on-site observations |

## ITP On-Site Observations

The equipment used for the following activities was located at the North Station side of the Line 5 Dual Pipelines:

- Removal of product from the test segments by nitrogen purging
- Filling the test segments with water
- Pressurizing the test segments to their test pressure

Prior to and during the start of each of these processes, the ITP was present at the North Station and observed the:

- Removal of valves and connections to small piping and the fitting of blind flanges.
- Instrument connections.
- Positioning of valves.
- Disconnecting and isolating the pipeline test segment once the test pressure was reached as described in the *Revised Line 5 Hydrotest Plan*.

The ITP did not identify any non-conformances of the physical arrangements relative to the requirements stated in the *Revised Line 5 Hydrotest Plan*.

Once the visual surveys of the arrangements of the equipment at the North Station were completed, the ITP traveled to the Mackinac Station (south) side of the Line 5 Dual Pipelines where the hydrotest command center was located. Test contractor Milbar, through their secure On Test website, provided a real-time feed of the pressure being recorded by a digital gauge fitted to the North Station pig trap (i.e., the test pressure on the test segment) as well as the ambient, pipe, and ground temperatures. Several computers at the command center and a large screen TV projected this live feed throughout the periods of water temperature stabilization and the strength and leak tests. In addition, the ITP was provided with a secure login to the On Test website to remotely monitor the pressure and temperatures during the test water temperature stabilization period.

Throughout the 4.25-hour periods of the strength and leak tests, approximately every 30 to 45 minutes, the ITP conducted a walk around and visual survey of the hydrotest arrangements at the Mackinac Station. The focus of these walk-arounds was to:

- Confirm that no leaks or seepage was occurring from the various connections and/or fittings on the test segment and station piping that was being tested.
- Reconfirm that the instrumentation connections and valve positions remained unchanged.

The ITP did not identify any non-conformances of the arrangements that were in place relative to the *Revised Line 5 Hydrotest Plan*.

# Findings

## West Segment: June 10, 2017

### Strength Test

The *West Straits Report* of the strength test portion of the hydrotest of the west segment notes:

> At 8:18 AM, the strength test pressure of 1240 psi was reached. The start of the strength test began at 8:30 AM with a pressure of 1240 psi. At 11:15 AM, deadweight pressure dropped to 1239 psi. The pressure remained at 1239 psi until the strength test was completed at 12:45 PM.[4]
>
> Strength [t]est pressure was held at a minimum of 1239 psi and maximum of 1240 psi for a duration of 4 hours and 15 minutes. Pressures remained within the allowable [s]trength [t]est range of 1229 psi – 1249, and the minimum 4.25-hour hold was achieved.[5]

Section 4.5.3 of the *Revised Line 5 Hydrotest Plan* established the criteria for accepting the strength test as follows:

> The strength test is accepted if over the test duration the test pressure remains within acceptable limits as outlined in Table 2 (20 psi).

As noted in the *West Straits Report*, the decrease of 1 psi over the duration of the strength test (4.25 hours) was within the pressure criterion (20 psi) for accepting the strength test as set by the *Revised Line 5 Hydrotest Plan*.

The *West Straits Report* also notes that the decrease of 1 psi recorded over the period of the strength test was within the resolution of the pressure measurement instruments. The ITP performed, independently, calculations of the decrease of 1 psi relative to the accuracy of the instruments as provided in Table 3 of *Revised Line 5 Hydrotest Plan* and concurs that the change of 1 psi is within the limits set in Table 3.

### Leak Test

The *West Straits Report* of the leak test portion of the hydrotest of the west segment notes:

> At 2:43 PM, the leak test pressure of 705 psi was reached. The start of the leak test began at 3:00 PM with a pressure of 705 psi. At 3:45 PM, deadweight pressure increased to 706 psi. At 5:30 PM, deadweight pressure increased to 707 psi. The pressure remained at 707 psi until the leak test was completed at 7:15 PM.[6]

[4] *West Straits Report*, section 3.3
[5] *West Straits Report*, section 4.1
[6] *West Straits Report*, section 3.4

> Leak [t]est pressure held at a minimum of 705 psi and a maximum of 707 psi for a duration of [4] hours and 15 minutes.[7] Pressures remained within the allowable [l]eak [t]est range of 689 psi – 709 psi, and the minimum 4.25-hour hold was achieved.[8]

Section 4.5.3 of Enbridge's *Revised Line 5 Hydrotest Plan* established the criteria for accepting the leak test as follows:

> The leak test is accepted if over the test duration the test pressure remains within acceptable limits as outlined in Table 2 (20 psi).

As noted in the *West Straits Report*, the increase of 2 psi over the duration (4.25 hours) of the strength test was within the pressure criterion (20 psi) for accepting the leak test as set by the *Revised Line 5 Hydrotest Plan*.

## East Segment: June 16, 2017

## Strength Test

The *East Straits Report* of the strength test portion of the hydrotest of the east segment notes:

> At 7:05 AM, the strength test pressure of 1240 psi was reached. The start of the strength test began at 7:15 AM with a pressure of 1240 psi. The pressure remained at 1240 psi until the strength test was completed at 11:30 AM.[9]
>
> Strength [t]est pressure was held at a 1240 psi for a duration of 4 hours and 15 minutes. Pressures remained within the allowable [s]trength [t]est range of 1229 psi – 1249 psi, and a minimum of a 4.25-hour hold was completed.[10]

Section 4.5.3 of the *Revised Line 5 Hydrotest Plan* established the criteria for accepting the strength test as follows:

> The strength test is accepted if over the test duration the test pressure remains within acceptable limits as outlined in Table 2 (20 psi).

As noted in the *East Straits Report*, there was no change in pressure (i.e., the pressure as measured by the deadweight tester held constant 1240 psi) over the duration (4.25 hours) of the strength test. This was well within the pressure criterion (20 psi) for accepting the strength test as set by the *Revised Line 5 Hydrotest Plan*.

[7] The West Straits Report at section 4.2 reports that the leak test duration was "4.25 hours and 15 minutes." The ITP believes that the clause should read "4 hours and 15 minutes" given that the leak test commenced at 3:00 PM and concluded at 7:15 PM (see West Straits Report at section 3.4).
[8] *West Straits Report*, section 4.2
[9] *East Straits Report*, section 3.3
[10] *East Straits Report*, section 4.1

## Leak Test

The *East Straits Report* of the leak test portion of the hydrotest of the east segment notes:

> At 12:57 PM, the leak test pressure of 701 psi was reached. The start of the leak test began at 1:15 PM with a pressure of 701 psi. At 1:45 PM, deadweight pressure increased to 702 psi. At 4:45 PM, deadweight pressure increased to 703 psi. The pressure remained at 703 psi until the leak test was completed at 5:30 PM.[11]
>
> Leak Test pressure held at a minimum of 701 psi and a maximum of 703 psi for a duration of 4 hours and 15 minutes. Pressures remained within the allowable [l]eak test range of 689 psi – 709 psi, and a minimum of a 4.25-hour hold was completed.[12]

Section 4.5.3 of the *Line 5 Hydrotest Plan* established the criteria for accepting the leak test as follows:

> The leak test is accepted if over the test duration the test pressure remains within acceptable limits as outlined in Table 2 (20 psi).

As noted in the *East Straits Report*, the increase of 2 psi over the duration (4.25 hours) of the strength test was within the pressure criterion (20 psi) for accepting the leak test as set by the *Revised Line 5 Hydrotest Plan*.

## Conclusions

The ITP has reviewed the *Hydrotest Reports* prepared by Lake Superior Consulting, which Enbridge provided to the EPA as their final reports of the hydrostatic pressure tests that were performed on the east and west segments of the Line 5 Dual Pipelines. On evaluating those reports, as informed by the ITP's on-site observations, the ITP finds:

- The preparations for and conduct of the hydrotests of the west and east segments of the Line 5 Dual Pipelines were in compliance with the applicable requirements of the CD.
- The final preparations and the hydrotests of the west and east segments of the Line 5 Dual Pipelines conformed to the requirements stipulated in the *Revised Line 5 Hydrotest Plan*.
- The *Hydrotest Reports* that discussed the results of the hydrotests of the west and east segments of the Line 5 Dual Pipelines were submitted in compliance with the timing requirements of the CD.
- The reported results of the hydrotests of the west and east segments of the Line 5 Dual Pipelines, as described in the *Hydrotest Reports*, show that the tests conformed with the requirements for accepting the tests, as provided by the *Revised Line 5 Hydrotest Plan,* in that the pressure did not vary more than 20 psi over the entire period of the strength test and over the entire period of the leak test, as shown in Table 3 (on page 8).

[11] *East Straits Report*, section 3.4
[12] *East Straits Report*, section 4.2

**Table 3: Pressure changes during hydrotesting**

| Segment | Test | Pressure* at Start | Pressure* after 4.25 Hours | Change |
|---|---|---|---|---|
| West | Strength | 1240 psi | 1239 psi | -1 psi |
| West | Leak | 705 psi | 707 psi | +2 psi |
| East | Strength | 1240 psi | 1240 psi | 0 psi |
| East | Leak | 701 psi | 703 psi | +2 psi |

*The pressure was measured with a deadweight tester.

Based upon the ITP's experience, the ITP finds that the final preparations and the hydrotests of the Line 5 Dual Pipelines that were carried out over the period of June 5 to June 16, 2017:

- Conformed with:
  - The steps and requirements contained in the *Revised Line 5 Hydrotest Plan*.
  - Generally accepted industry practices.
- Complied with:
  - Applicable CD requirements.
  - Applicable federal pipeline safety regulations.

The ITP also finds that the *Hydrotest Reports* that presented the results of the hydrotests were supported by the facts and best engineering judgment and were of sufficient detail and completeness so that the expected outcome of the hydrotests was achieved as provided by CD ¶71.

# List of Information Considered

## Federal Documents and Regulations

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

Consent Decree: *United States of America v. Enbridge Energy, Limited Partnership, et al*; Civil Action No. 1:16-cv-914. May 23, 2017.

## State of Michigan Documents

*Straits of Mackinac Pipeline Easement*. Conservation Commission of the State of Michigan. April 23, 1953.

## Industry Papers

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

## Enbridge Documents

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

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

*Enbridge ITP Response on Line 5 Hydrostatic Pressure Test*. Enbridge. April 25, 2017.

*Final Report: Enbridge Line 5 – East Straits of Mackinac Hydrostatic Test; Hydrostatic Test #5-17-153*. Lake Superior Consulting, LLC. August 28, 2017.

*Final Report: Enbridge Line 5 – West Straits of Mackinac Hydrostatic Test; Hydrostatic Test #5-17-154*. Lake Superior Consulting, LLC. August 28, 2017.

*Line 5 Straits of Mackinac Hydrostatic Pressure Test Plan, Rev 1*. Enbridge. February 24, 2017.

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

*Ref: Submittal of Line 5 Straits of Mackinac Hydrotest Documentation*. Enbridge. September 15, 2017.

Transmittal Letter. *Re: Proposed Consent Decree – Line 5 Straits of Mackinac Hydrostatic Test Plan*. Steptoe & Johnson, LLP. March 1, 2017.

Transmittal Letter. *Re: Proposed Consent Decree – Straits of Mackinac Hydrostatic Test Plan*. Steptoe & Johnson, LLP. April 25, 2017.

Transmittal Letter. *Re: Proposed Consent Decree - Notice of Planned Line 5 Hydrotest*. Steptoe & Johnson, LLP. May 9, 2017.

## Communications with Key Individuals

Key individuals with whom the ITP communicated while observing the hydrotests of the Line 5 Dual Pipelines over the period June 6 to June 16, 2017 include:

- Scott McEachern: Enbridge, VP Major Projects
- Mike Paradise: Enbridge, PLM Operations Supervisor
- Justin Hoffman: Enbridge, PLM, Supervisor Major Projects
- Matt Fournier: Enbridge, Project Manager - Line 5 Hydrotest
- Dan Chessner: Enbridge, PLM Construction Superintendent
- Trina Salvisberg: Enbridge, Region Engineer
- Luke Schoenecker: Enbridge, Pipeline Integrity – ITP Point of Contact
- Laura Kennett: Enbridge, Pipeline Integrity
- Lichun Zhang: Enbridge, Pipeline Integrity
- Gary Zunkel: Lake Superior Consulting, Senior Director of Integrity Management
- Kory Johnson: Lake Superior Consulting, Pipeline Engineer
- Megan Halver: Lake Superior Consulting, Integrity Engineer
- Carl Hunter: Milbar – On Test, Lead Test Technician
- Matt Bagley: Milbar – On Test, Lead Test Technician
- Harold Winnie: Office of Pipeline Safety, Pipeline and Hazardous Materials Safety Administration
- Valeria Brader: Executive Director, Department of Licensing and Regulatory Affairs, Michigan Agency for Energy
- Dave Chislea: Michigan Agency for Energy

Throughout the time the ITP was on-site observing the hydrotests, the ITP had regular interactions and conversations with the above listed individuals. These conversations typically sought information on the status or prospects for the tests (e.g. when the next phase or step in the hydrotest was planned such as line water fill, pressuring the line to start the water temperature stabilization period, or the location of where a particular instrument was mounted).

During the period the ITP was on-site to observe the hydrotests, three different issues arose that led to a meeting or discussions with some of the key individuals from Enbridge and Lake Superior Consulting. The focus of those meetings was:

- June 8 – A meeting to discuss the physical arrangements of various test gauges and to review equations that were developed to reconcile potential changes in pressure with changes in temperature
- June 10 – A meeting to discuss the possibility of removing water from the west test segment during the leak test portion of the hydrotest
- June 14 – Discussions concerning a situation where the nitrogen purge and water fill pigs stopped at about the 0.81-mile mark of the east segment

A summary of each of those three meetings/discussions follows.

## June 8, 2017 Meeting with Enbridge and Lake Superior Consulting

On June 8 during the period that the water temperature was stabilizing in the west segment, the ITP met with Gary Zunkle and Kory Johnson from Lake Superior Consulting and Luke Schoenecker from Enbridge. The purpose and focus of the discussions in this meeting were:

- To review the physical locations where pressure gauges and recorders and temperature gauges would be mounted to the pipeline for the hydrotest of the west segment.
- To review the equations and calculations Lake Superior Consulting and Enbridge had developed, in conformance with the stipulations in section 4.5.3 of the *Revised Line 5 Hydrotest Plan*, to reconcile changes in pressure using Enbridge's procedures 07-03-03 and 07-03-04.

The ITP did not identify any non-compliances with the requirements of the CD or any con-conformances with the requirements of the *Revised Line 5 Hydrotest Plan* regarding the planned arrangements for the instrumentation or the equations and calculations Lake Superior Consulting developed.

## June 10, 2017 Discussions Regarding the Potential Need to Remove Water During the West Segment Leak Test

When the concern was raised approximately half-way through the west segment leak test that the pressure on the test segment potentially could reach the specified maximum pressure set by Table 2 of the *Revised Line 5 Hydrotest Plan*, discussions were held regarding:

- The possible need to remove water from the test segment should the pressure increase and reach the maximum pressure set by the *Revised Line 5 Hydrotest Plan*.
- If water was removed, whether both the strength and leak tests must be restarted.
- The process and procedures that should be followed to complete the leak test in the event Enbridge decided to remove water from the test segment.

Given, however, that the pressure stabilized and did not approach the maximum pressure for the remaining period of the leak test, these discussions became moot.

## June 14, 2017 Discussions concerning the nitrogen purge and water fill pigs stopping at 0.81 miles - east segment

Both the nitrogen purge pig and the water fill pig stopped at approximately 0.81 miles from the Mackinac Station, necessitating the need in both cases to increase the differential pressure across the pigs to restart them.

Enbridge noted that after the nitrogen purge pig stopped, they reviewed the latest geometry inline inspection results and could find nothing in those results that would indicate an obstruction or other condition in the general area that would be expected to cause a pig to stop.