

Line 5 Straits of Mackinac

Hydrostatic Pressure Test Plan

Project AFE	20007132		
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TABLE OF CONTENTS

TABLE OF CONTENTS **2**

1. Terms & Definitions **4**

2. Project Summary **6**

3. Test Procedure **6**

3.1. General 6

3.2. Notifications 6

3.3. Test Segments 7

3.4. Piping to be Tested 7

3.5. Test Pressure and Duration 8

3.6. Test Sequence 8

3.7. Test Isolation 8

3.8. Elevation Profiles 13

4. Test Procedure Outline **15**

4.1. Instrument Calibration Requirements 15

4.2. Test Instrument Setup 16

4.3. Pressure Measurements 18

4.4. Temperature Measurements 19

4.5. Procedure For Strength/Leak Testing 19

5. Contingency Plans **21**

5.1. Prevention 21

5.2. Emergency Response 21

5.3. Leaks 21

5.4. Test Failures 21

5.5. Safety Precautions 22

6. Schedule **22**

6.1. West Segment 22

6.2. East Segment 23

Appendix A – Test Pressure Selection **25**

1.0 Introduction 25

Appendix B – Nitrogen Purge Plan **29**

1.0 West Straits Hydrotest – Purge Plan 29

2.0 East Straits Hydrotest Purge-Plan 34

Appendix C – Leak Detection Plan **39**

1.0 Overview 39

1.1 Preliminary Preparations 39

1.2 Leak Identification 39

ENBDNR0003263

1.3 Leak Locating 40
1.4 Pressure Requirements 41
1.5 Attachments 42
Appendix D – Water Acquisition Water Quality Standards 44
Appendix E – Minimum Onsite Water Treatment Water Quality Standards 45

ENBDNR0003264

1. TERMS & DEFINITIONS

Company Test Engineer	Engineer on site during the hydrostatic test that is responsible for ensuring the hydrostatic test results are in compliance with all applicable Company specifications, industry standards and test plans and procedures.
Construction Related Equipment	Used as part of construction or operations and maintenance activities within a facility and on the right of way (e.g., cranes, backhoes, vacuum trucks, etc.).
Contaminants	Presence of minor and unwanted constituent air, soil, and water as a result of contact or pressure of a released fluid.
Contract Workers	Persons hired for extended periods of time working under the direct supervision of Company employees.
Environmental Inspector	Company Representative for the project to ensure compliance with all Company standards and specifications, permits, and required notifications.
General Contractor	A contractor who enters into a contract with the Company for the construction of the project and who takes full responsibility for its completion. The contractor may enter into subcontracts with others for the performance of specific parts or phases of the project.
Leak	Pipeline release that is less violent and sudden than a rupture, but has a more pronounced volume and flow than a seep.
Maximum Operating Pressure (MOP)	Pressure or pressure restrictions determined by the lowest value of the following pressure types: static hydrotest pressure data, flowing test pressure data, design pressure values based on pipe steel grade and wall thickness, or pressures or pressure restrictions imposed by a regulator. Determined by Enbridge's Operations and Maintenance Manual 01-02-02 Maximum Operating Pressure Algorithm for Mainline Piping.
Normal Operating Limit	Minimum and maximum set points that provide for the safe operation of the system and include suction pressure and discharge pressure set points.
Oil	Hydrocarbon or mixture of hydrocarbons other than gas or any substance designated as an oil product by regulations.
Operator Qualified (OQ)	Personnel qualification in the natural gas and liquid pipeline business in accordance with 49 CFR 192-Subpart N, 49 CFR 195-Subpart G and the Company US OQ Plan.
PLM/Operations	Enbridge Pipeline Maintenance (PLM) and Operations Personnel.
Release	Loss of containment of pipeline commodity including discharge, spray, spill, leak, seep and pour.

Rupture	Sudden loss of containment (release) event that involves immediate cessation of operations and/or involves extensive damage to pipeline and/or equipment.
Site Inspector	Company representative or appointed representative of the Company responsible for the inspection of the work (construction or maintenance activities).
Site Supervisor	Employee responsible for the location (e.g., PLM coordinator/supervisor, technician, terminal supervisor) or designate.
Specified Minimum Yield Strength (SMYS)	Minimum yield strength prescribed by the specification under which the material is purchased from the manufacturer.
Test Supervisor	Company representative who ensures the hydrostatic test is executed in accordance with all Company specifications and standards, test plans and project plans.
Waterbody	Area holding permanent or seasonal water, including but not limited to drainage channels, ditches, sloughs, wetlands, dugouts, ponds, creeks, streams, rovers or lakes.
Worker	Company employee, contract worker and contractor personnel.

2. PROJECT SUMMARY

The Line 5 Straits of Mackinac hydrostatic pressure test ("hydrotest") fulfills Enbridge's requirements under Paragraph 71.b of the proposed Consent Decree in *U.S. vs. Enbridge Energy, Limited Partnership, et. Al., (Civil Action No: 1:16-cv-914)*. The hydrotest will be performed to reduce or eliminate the potential that any axially-aligned Crack features in the Dual Pipelines could result in a leak or rupture of the dual pipelines that cross the Straits of Mackinac. The Hydrostatic Test Plan shall be in accordance with procedures and submittal timelines outlined in Paragraph 25 of the Consent Decree.

The scope of the hydrotest applies to the 4.09–mile portion of Line 5 consisting of two 20-inch diameter seamless pipelines that cross the Straits from the North Mackinac sending traps to the South Mackinac station receiving traps. The test will be conducted in two phases. The first phase will test the west segment of the Mackinac crossing while the east segment will continue to operate. The second phase will test the east segment while the west segment will continue to operate. The hydrostatic testing sequence may be reversed at the discretion of the Company.

3. TEST PROCEDURE

3.1. GENERAL

This procedure identifies the details of testing each segment of the Line 5 Mackinac Crossing.

3.2. NOTIFICATIONS

Enbridge will ensure the following notifications per the terms of the Consent Decree are issued to the appropriate Consent Decree Parties.

1. *No less than 60 Days prior to any hydrostatic pressure testing undertaken pursuant to the terms of this Consent Decree, Enbridge shall prepare and submit to EPA a plan and schedule for hydrostatic pressure testing of the pipeline. (Paragraph 24)*

2. *Enbridge shall complete the tests as soon as is practicable, but in no event shall testing take longer than 270 Days from the date of EPA's receipt of the plan and schedule. (Paragraph 25c)*

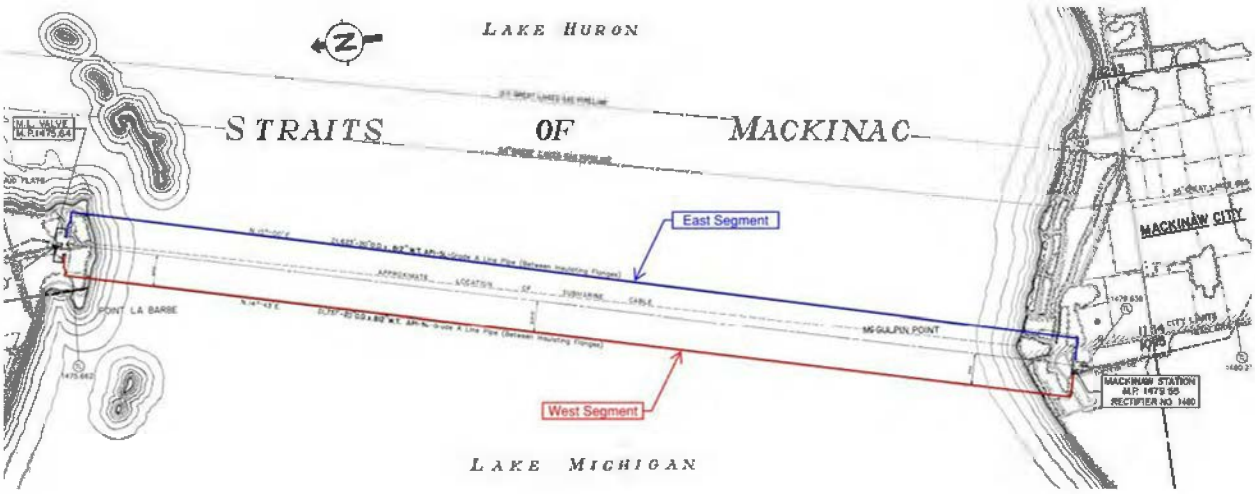
3. *At least 30 Days before conducting any pressure test, Enbridge shall provide written notification to EPA and all relevant federal agencies (e.g. PHMSA and Coast Guard) and relevant local emergency responders. (Paragraph 25e)*

4. *Within 120 Days of completing each required hydrostatic pressure test, Enbridge shall prepare and submit to EPA a report describing the test and summarizing the results of the test, including a description of any features that leaked or ruptured during the test and planned corrective actions, including a schedule of completion, that Enbridge plans to take to address issues identified during the hydrostatic pressure test. (Paragraph 25f)*

5. *In the event of a leak or rupture during the pressure test, Enbridge shall within 90 Days of the rupture or leak complete and submit to EPA an investigatory report of the pipeline failure. The report shall include a discussion of the failure mechanism based upon a laboratory or other investigation of the section of pipe with the rupture or leak. In addition, the report shall present findings and conclusions as to whether Enbridge's ILI tools missed, or underestimated the size of, the metallurgical feature that caused the rupture or leak. If the feature was missed or undersized by such tools, Enbridge shall propose a plan and schedule for undertaking corrective action to ensure that similar features do not pose a threat to any Lakehead System Pipeline. (Paragraph 26b)*

3.3. TEST SEGMENTS

The Line 5 Mackinac Crossing will be tested in two phases, the 4.09-mile west segment and the 4.09-mile east segment.



3.4. PIPING TO BE TESTED

Diameter	Wall Thickness	Grade	SMYS	West Length	East Length
Mainline Piping					
20"	0.812"	A	30,000 psi	21,706 ft	21,617 ft
Facility Piping					
2"	0.218"	A333-6	35,000 psi	23 ft	23 ft
24"	0.625"	X52	52, 000 psi	N/A	22 ft
20"	0.500"	X52	52,000 psi	292 ft	422 ft
20"	0.500"	X60	60,000 psi	130 ft	117 ft
24"	0.500"	X52	52,000 psi	22 ft	N/A
24"	0.500"	X60	60,000 psi	22 ft	22 ft

Table 1: Piping To Be Tested

3.5. TEST PRESSURE AND DURATION

Test pressures will meet or exceed the requirements in Paragraph 25.b. of the Consent Decree. Each segment will be strength tested to a minimum 2xMOP for four (4) hours followed by a leak test at a minimum of 1.1xMOP for four (4) hours, see Appendix A for detailed information for the selection of test pressures. The test shall be performed over a continuous eight (8) hour period. A range of 20 psi will be used for the strength and leak test to allow for fluctuation in the test pressure due to temperature stabilization. In the event that water is added to adjust test pressures to compensate for temperature changes, the eight (8) hour portion of the test will be reinitiated. Test pressures for both segments are listed below.

Test	MOP	Range	Start of Segment Pressure (Test Site)	High Point Pressure	Low Point Pressure	End of Segment Pressure	Duration
Strength	600 PSIG	Min Pressure	1229 psig	1200 psig	1339 psig	1200 psig	4 Hours
		Max Pressure	1249 psig	1220 psig	1359 psig	1220 psig	
Leak	600 PSIG	Min Pressure	689 psig	660 psig	799 psig	660 psig	4 Hours
		Max Pressure	709 psig	680 psig	819 psig	680 psig	

Table 2: Test Pressure and Duration

3.6. TEST SEQUENCE

The west segment will be tested first and then returned to service followed by testing of the east segment.

3.7. TEST ISOLATION

During testing, any valves that are included in the test will be set to the partially closed position.

3.7.1. WEST SEGMENT

The west segment will be isolated on the north end by removing valve 5.2-V-1 and installing blind flanges. The west segment will be isolated on the south end by removing valve 5.2-CV-1 and installing blind flanges. The existing configuration of associated piping on the west segment and the changes that will be made to facilitate the test are identified in the diagrams that follow.

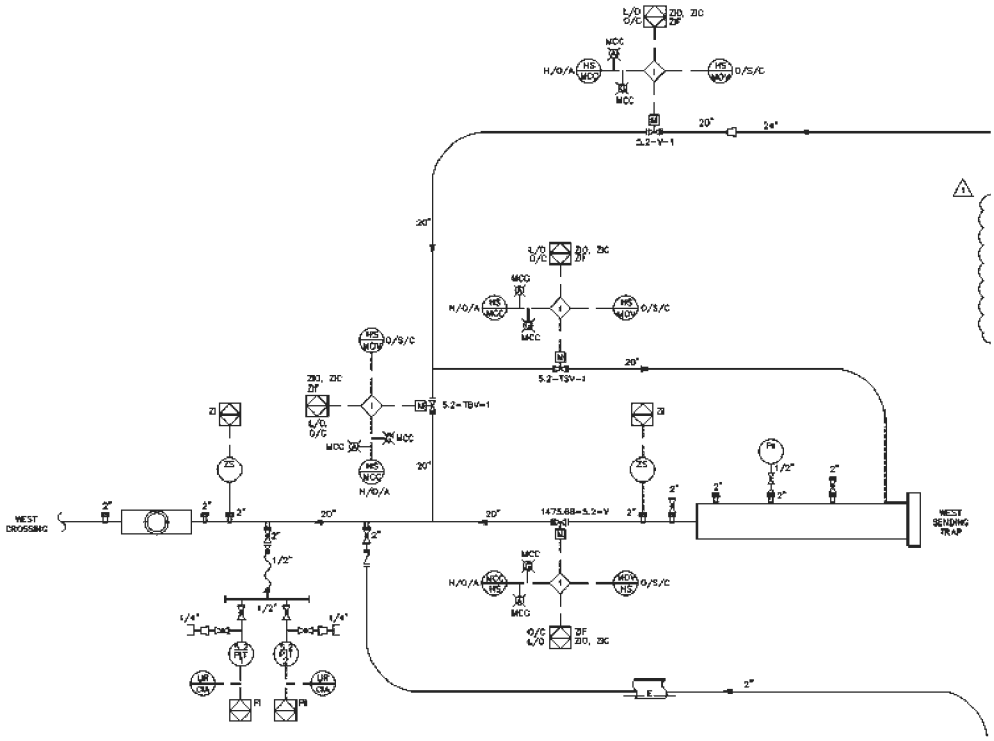


Figure 1: West Straits Segment – Upstream Normal Operation (1475.68-5.2-ST-2 & 5.2-V-1)

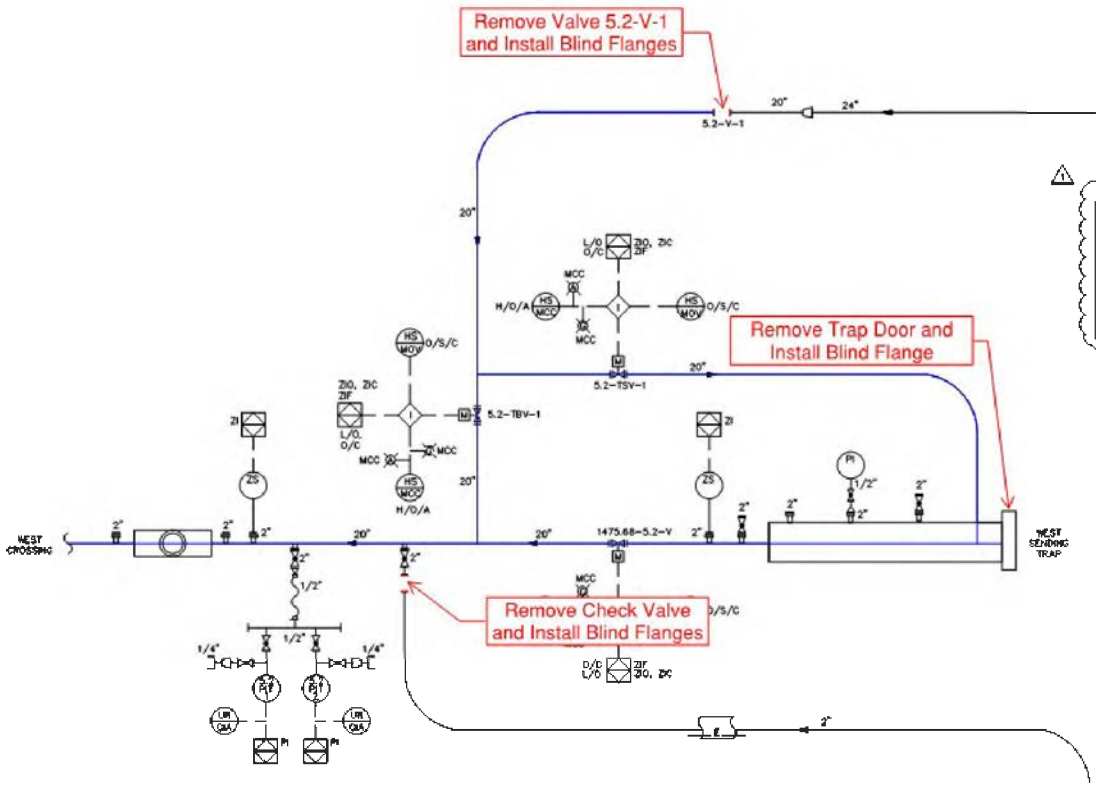


Figure 2: West Straits Segment – Upstream Hydrotest Isolation (1475.68-5.2-ST-2 & 5.2-V-1)

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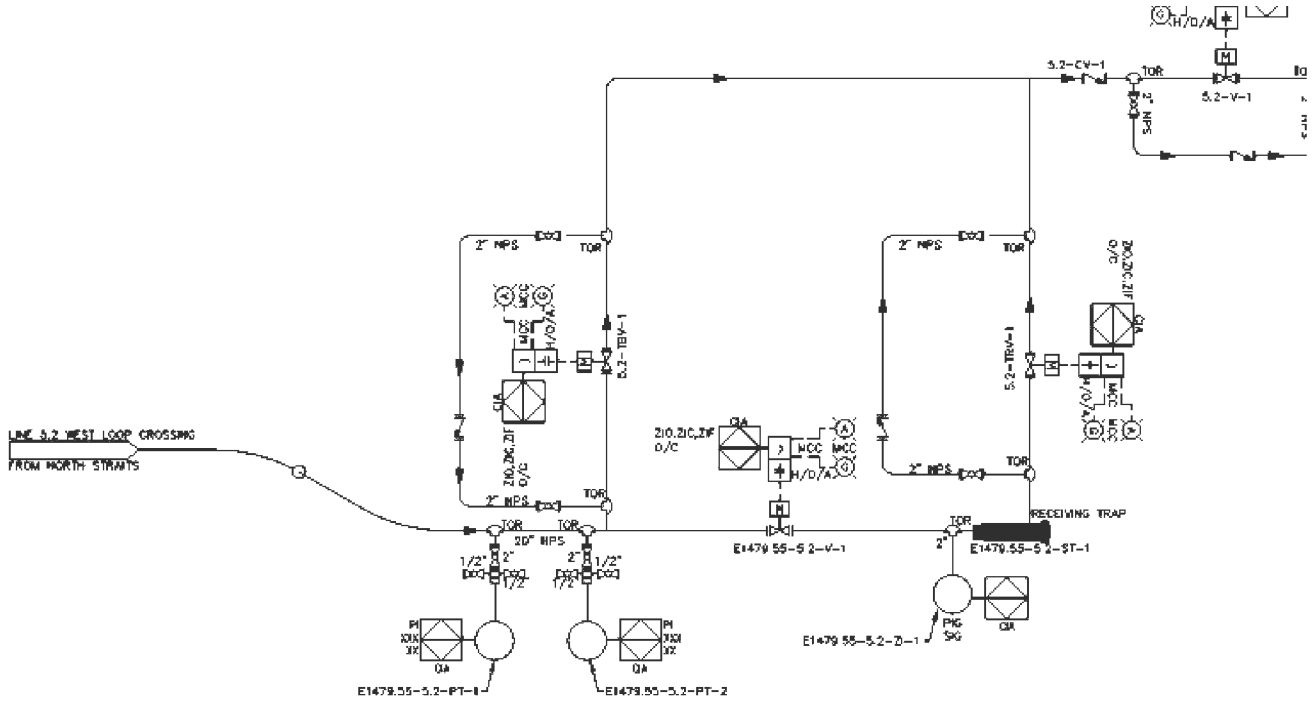


Figure 3: West Straits Segment – Downstream Normal Operation (E1479.55-5.2-ST-1 & 5.2-CV-1)

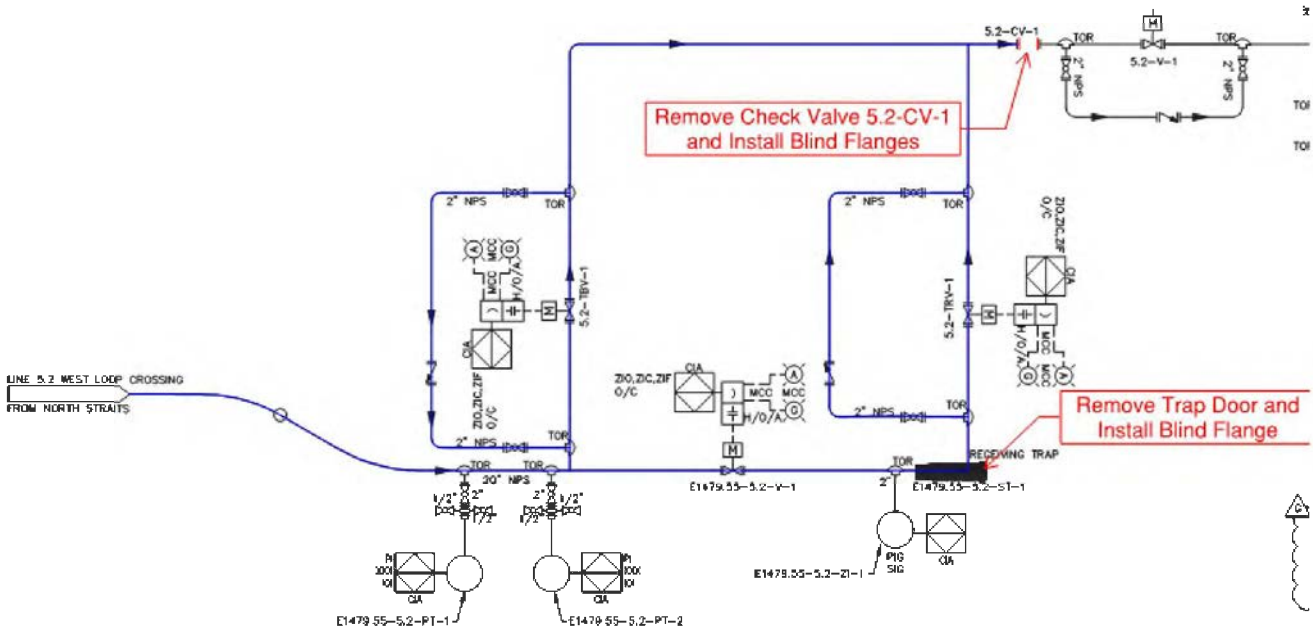


Figure 4: West Straits Segment – Downstream Hydrotest Isolation (E1479.55-5.2-ST-1 & 5.2-CV-1)

3.7.2. EAST SEGMENT

The east segment will be isolated on the north end by removing valve 5.1-V-1 and installing blind flanges. The east segment will be isolated on the south end by removing valve 5.1-CV-1 and installing blind flanges. The existing configuration of associated piping on the east segment and the changes that will be made to facilitate the test are identified in the diagrams that follow.

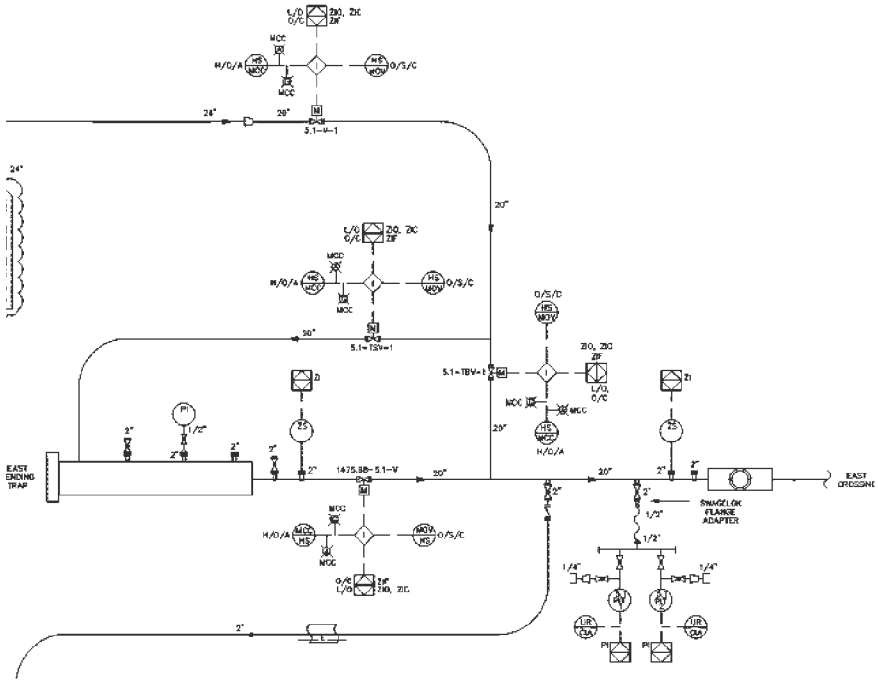


Figure 5: East Straits Segment – Upstream Normal Operation (E1475.68-5.1-ST-2 &5.1-V-1)

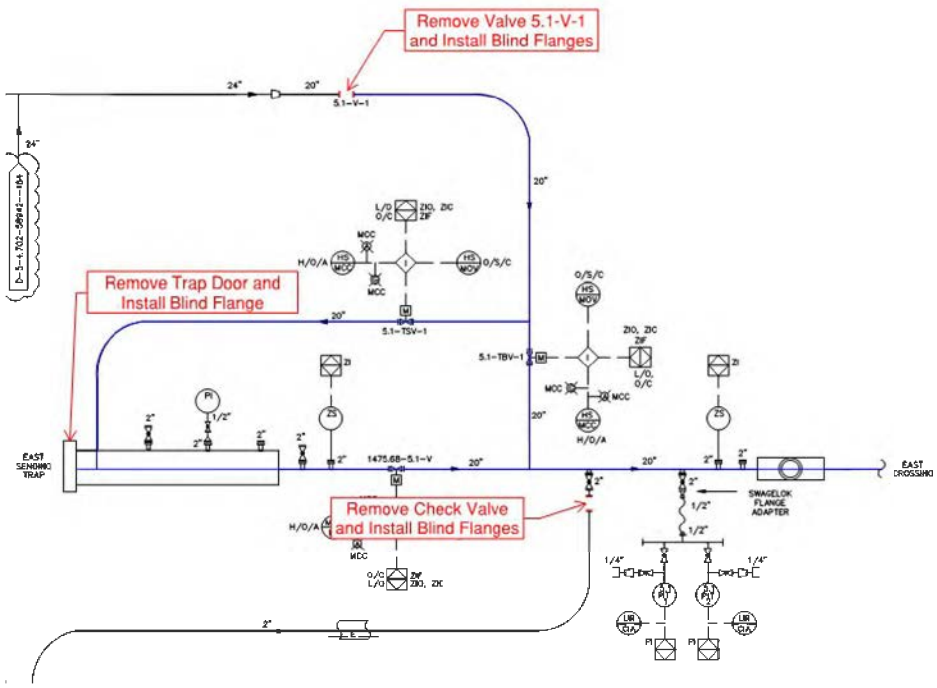


Figure 6: East Straits Segment – Upstream Hydrotest Isolation (E1475.68-5.1-ST-2 &5.1-V-1)

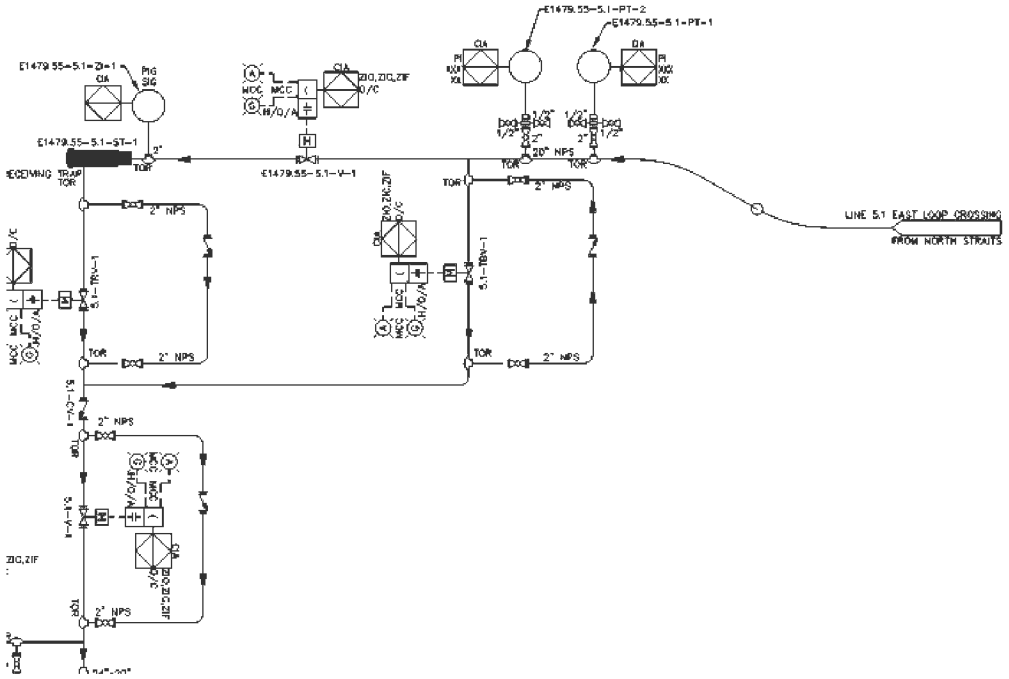


Figure 7: East Straits Segment – Downstream Normal Operation (E1479.55-5.1-ST-1 & 5.1-CV-1)

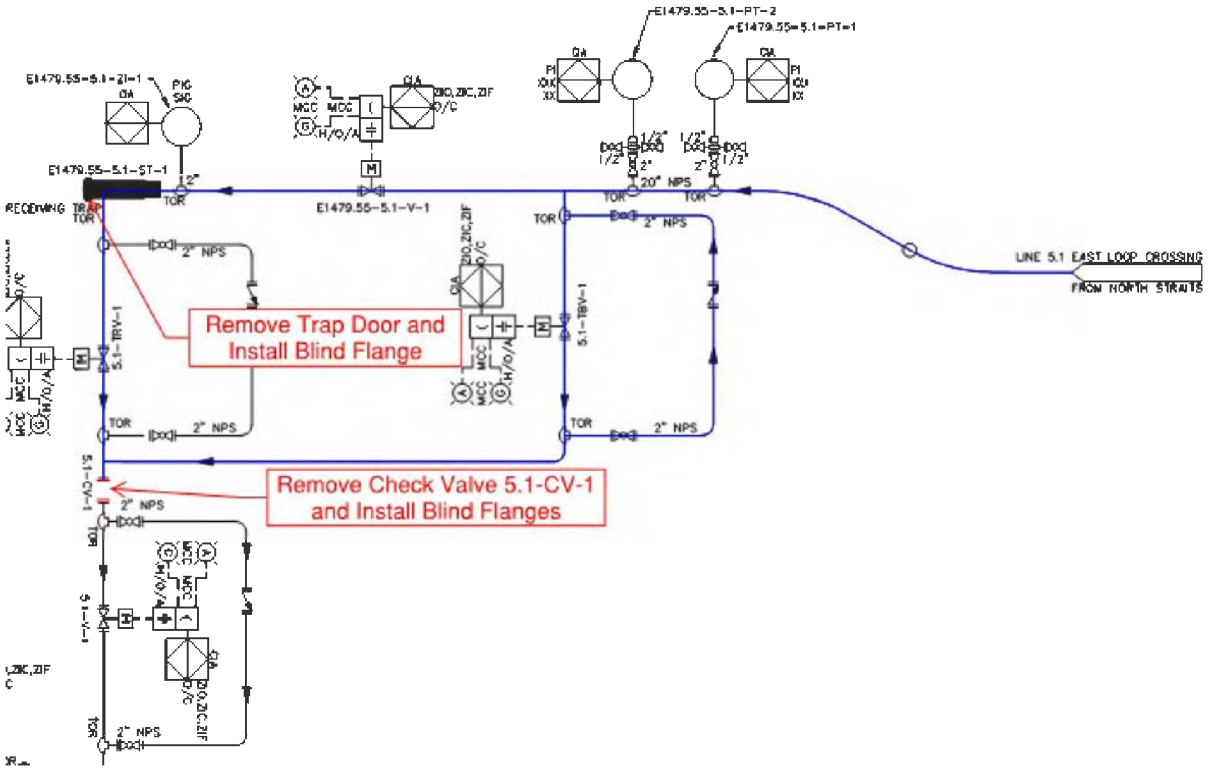
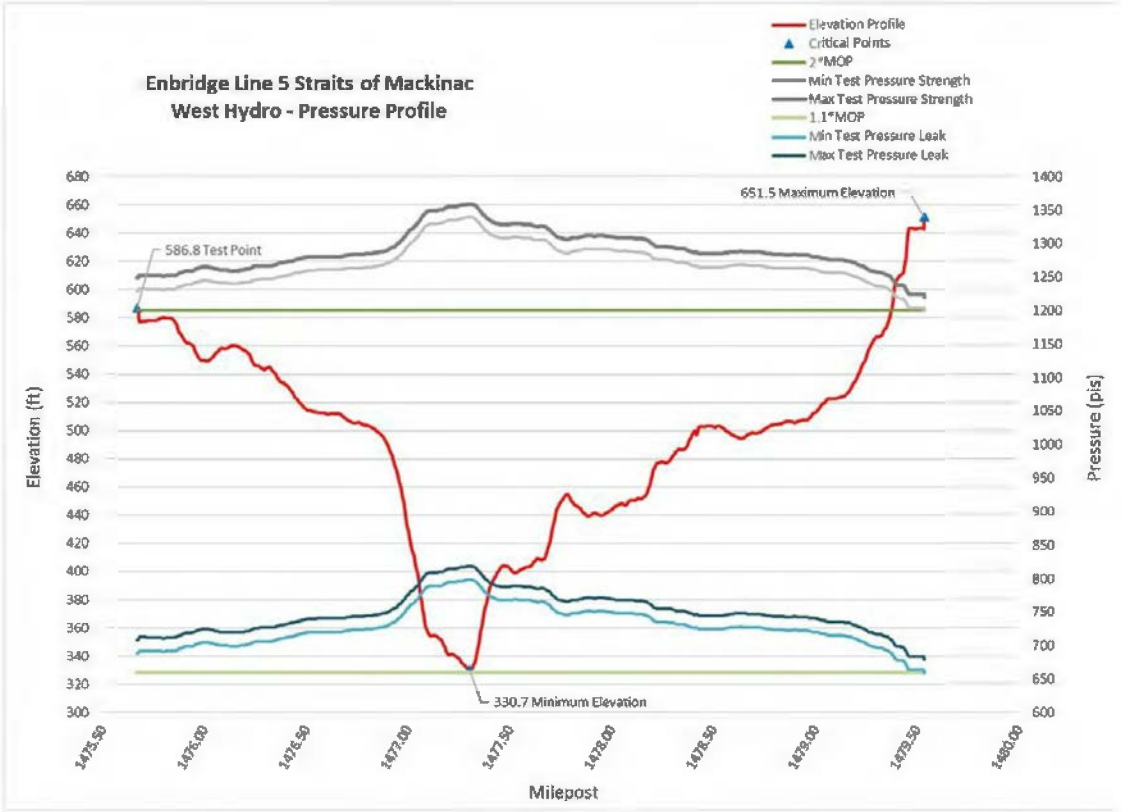
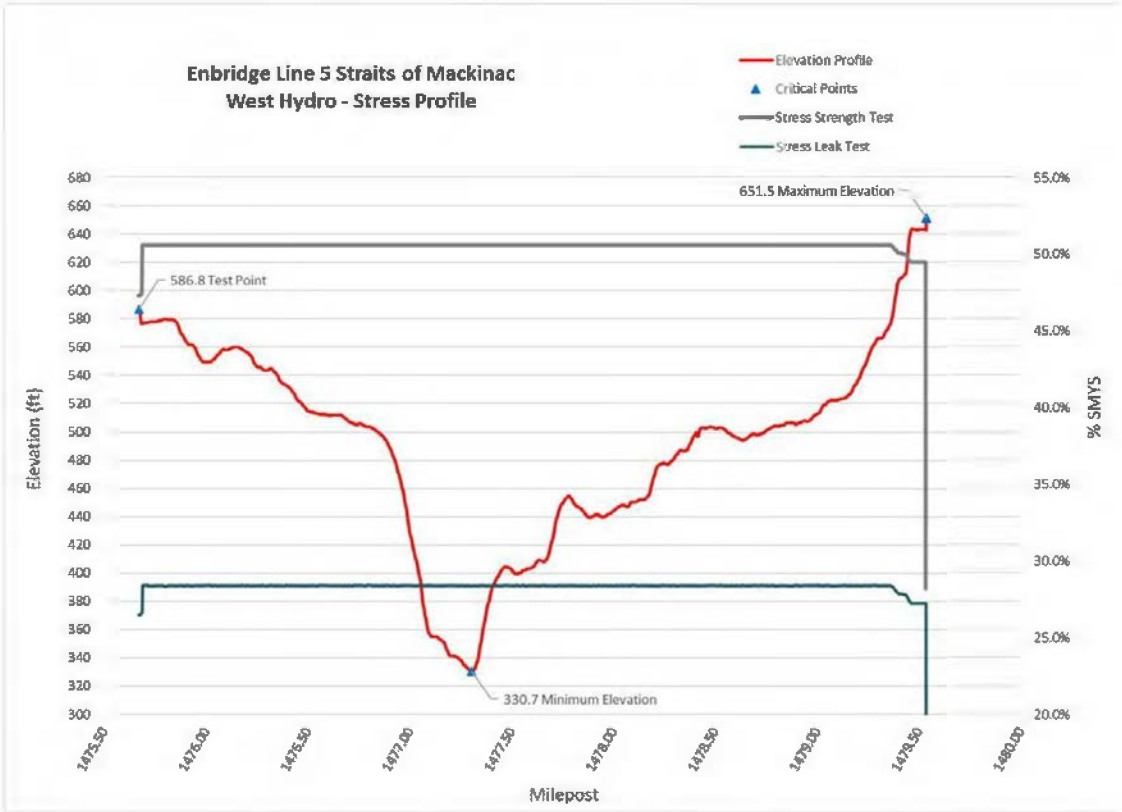


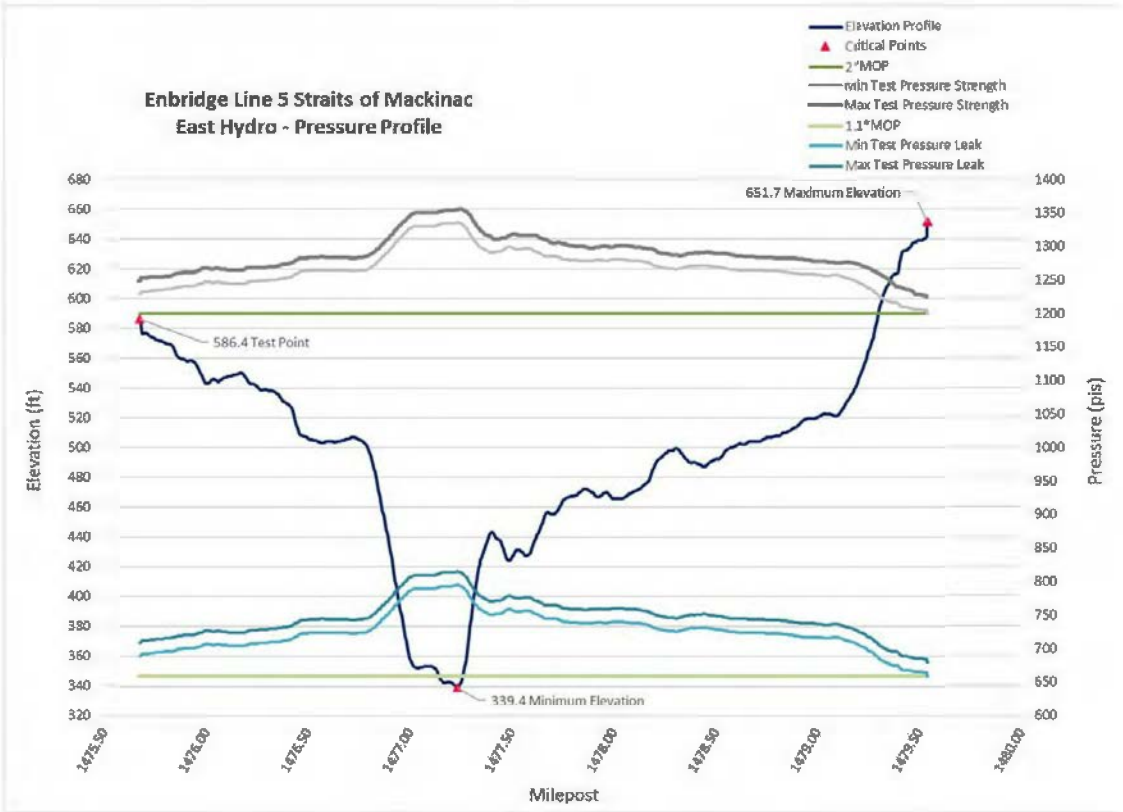
Figure 8: East Straits Segment – Downstream Hydrotest Isolation (E1479.55-5.1-ST-1 & 5.1-CV-1)

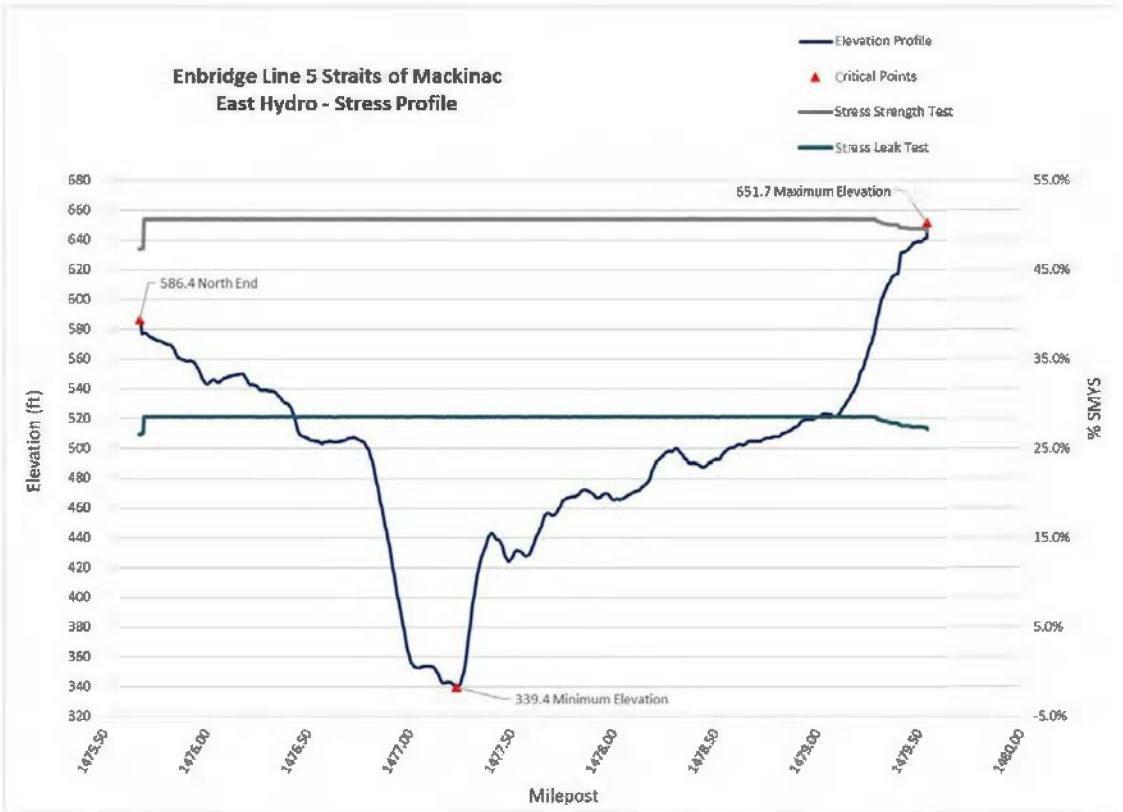
3.8. ELEVATION PROFILES





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Enbridge Line 5 Straits of Mackinac
East Hydro - Pressure Profile
Elevation Profile
Critical Points
2*MOP
Min Test Pressure Strength
Max Test Pressure Strength
1.1*MOP
Min Test Pressure Leak
Max Test Pressure Leak
651.7 Maximum Elevation
586.4 Test Point
339.4 Minimum Elevation
Elevation (ft)
Pressure (psi)
Milepost


Enbridge Line 5 Straits of Mackinac
East Hydro - Stress Profile
Elevation Profile
Critical Points
Stress Strength Test
Stress Leak Test
651.7 Maximum Elevation
586.4 North End
339.4 Minimum Elevation
Elevation (ft)
% SMYS
Milepost

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4. TEST PROCEDURE OUTLINE

4.1. INSTRUMENT CALIBRATION REQUIREMENTS

Enbridge's Operations and Maintenance Manual requires test equipment calibration certificates that shall include the model, serial number, date of certification and shall be signed by a third-party testing Company. The original calibration certificates shall be issued to the Company for review prior to testing. Copies of the certificates shall be included in testing documents turned over upon completion of testing.

Instrument	Calibration Interval (months)	Accuracy	Sizing
Deadweight Tester	12	0.1% of Indicated Pressure	Between 25% and 90% of the Full Range of the Instrument
Pressure Gauge	12	±0.5% of Full Scale Range	Pressure Dial Gauges with 6" Minimum Diameter Face with a Range and Scale Increment Suitable for the Test Parameters
Pressure Recorder	12	±1% of Full Scale Range	Between 25% and 90% of the Full Range of the Instrument
Temperature Recorder	12	±2% of Full Scale Range	
Liquid-in-Glass Thermometer	lifetime	±1% of Full Scale Range	Mercury Thermometer with Increments of 1°F Capable of Accurately Measuring the Full Range of Temperatures Anticipated During the Test.
Other Instruments (e.g. flow meters)	12	±1% of Full Scale Range	

Table 3: Instrumentation Calibration Requirements

4.2. TEST INSTRUMENT SETUP

For connecting test instruments for a typical pressure test, see Figure 1.

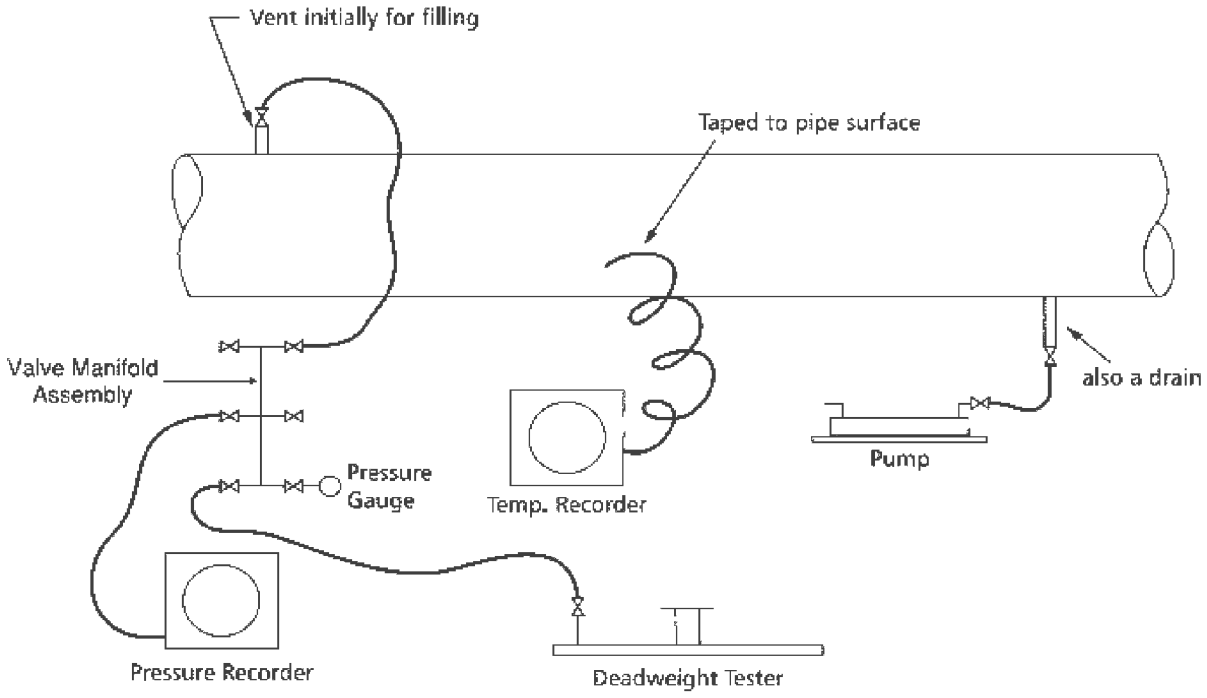


Figure 1
Typical Test Instrument Setup

To ensure the piping is under pressure, separate connections will be made for pressurizing the piping and for recording pressures. The depressurizing point will be different from the point for instrument connections because fluctuations during depressurization may affect the readings.

The test trailer will be set up at the test site on the north end of the straits and the test will be conducted from this location.

The test pressure will be logged from the deadweight tester, which will be set up in the test trailer.

The test pressure will also be continuously recorded on two pressure recorders. One pressure recorder will be placed in the test trailer on the north end and one will be connected to the trap on the south end.

Test pressure will be monitored on each end by a pressure gauge in the test trailer on the north end and on the trap on the south end.

The test medium temperature will be taken as a pipe temperature from a probe that is attached and insulated to the pipe surface. The pipe temperature recorders shall also be a minimum of one-hundred feet from any above grade piping. Two pipe temperature recorders will be used for below grade piping, one will be placed on the north end of the straits and one on the south end. Two pipe temperature

recorders will also be used for above grade piping, one will be placed on the north end of the straits and one on the south end.

The ground temperature will be taken at the same location as the below grade pipe temperature recorders. The temperature probe will be placed at the centerline depth of the pipe and three feet from the outside wall of the pipe. Two ground temperature recorders will be used, one will be placed on the north end of the straits and one on the south end.

The ambient temperature will be taken outside of the test trailer. The probe will be placed under the test trailer to avoid fluctuation from direct sunlight.

The specific locations where instrumentation will be placed to conduct the hydrotest are identified in Tables 4-5 and Figure 2.

Instrumentation	Mile Post	Stationing
Ambient Temp	1475.67	19935+77
Pipe Temp 1 (Above Ground)	1475.67	19935+77
Pressure Recorder 1	1475.67	19935+77
Pressure Gauge 1	1475.67	19935+77
Pipe Temp 2 (Below Ground)	1475.85	19944+96
Ground Temp 1	1475.85	19944+96
Pipe Temp 3 (Below Ground)	1479.51	20138+21
Ground Temp 2	1479.51	20138+21
Pipe Temp 4 (Above Ground)	1479.56	20141+11
Pressure Recorder 2	1479.56	20141+11
Pressure Gauge 2	1479.56	20141+11

Table 4: West Straits Recorder Locations

Instrumentation	Mile Post	Stationing
Ambient Temp	1475.68	19936+01
Pipe Temp 1 (Above Ground)	1475.68	19936+01
Pressure Recorder 1	1475.68	19936+01
Pressure Gauge 1	1475.68	19936+01
Pipe Temp 2 (Below Ground)	1475.84	19944+45
Ground Temp 1	1475.84	19944+45
Pipe Temp 3 (Below Ground)	1479.52	20138+96
Ground Temp 2	1479.52	20138+96
Pipe Temp 4 (Above Ground)	1479.56	20141+22
Pressure Recorder 2	1479.56	20141+22
Pressure Gauge 2	1479.56	20141+22

Table 5: East Straits Recorder Locations

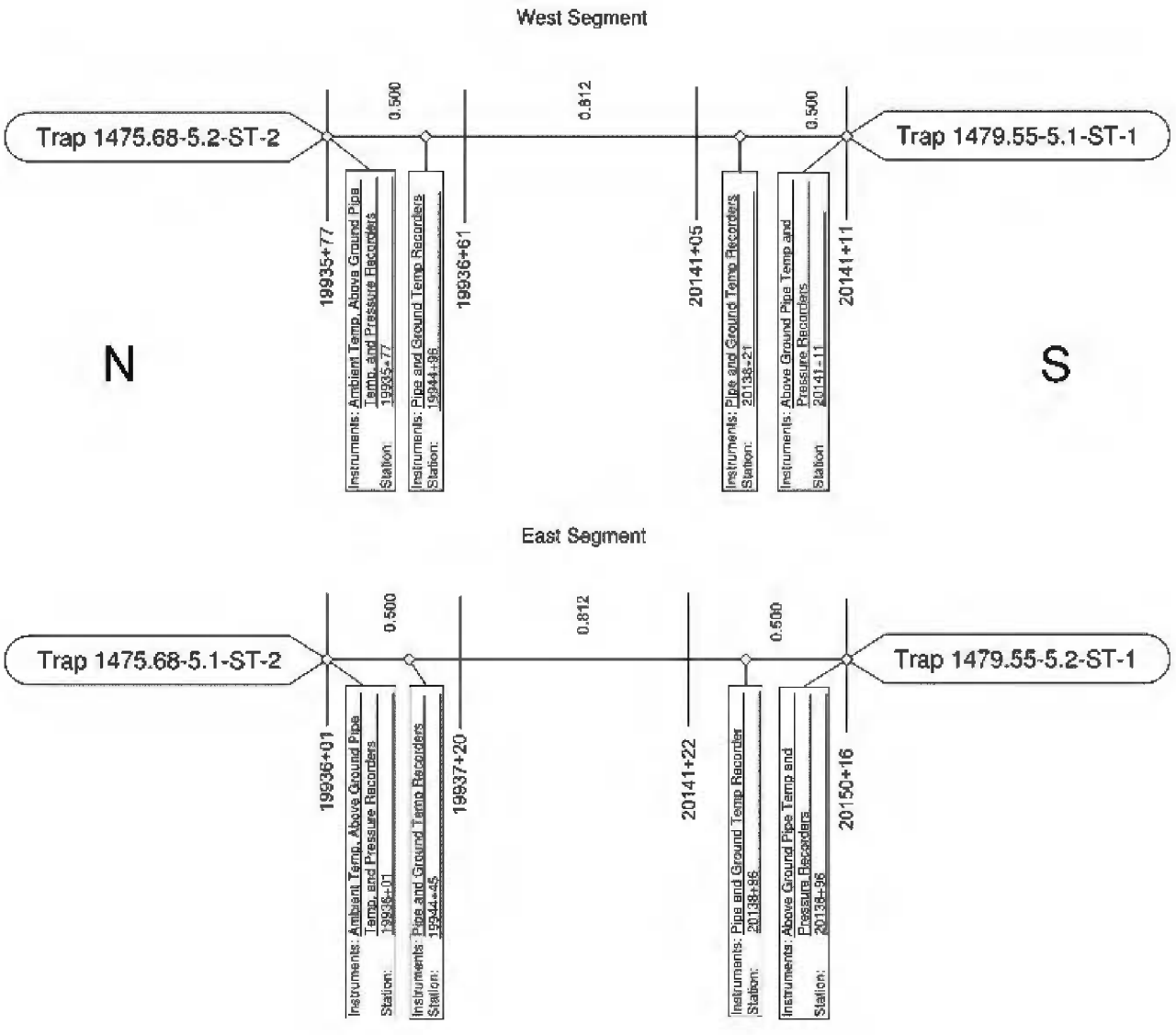


Figure 8: Recorder Location Schematic

4.3. PRESSURE MEASUREMENTS

The accuracy of pressure recorders and pressure gauges will be checked against the deadweight tester at the start and end of the test, at values corresponding to approximately 0%, 50%, and 100% of the test pressure. Deadweight pressures will be logged during the test, at 15 minute intervals on the Pressure Test Data Sheet.

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4.4. TEMPERATURE MEASUREMENTS

Pipe, Ground and Ambient temperature recorders will be installed during filling of the pipeline with water to record the temperature change during filling operations. Temperature will be continuously recorded throughout the stabilization period before the tests commence. Comparison of the Pipe and Ground temperatures will be used to determine if the water has stabilized with the ground temperature. In addition, rate of change of the pressure in response to temperature measurements will also be used to determine stabilization. If the water has not stabilized, temperature recording will be continued until the segment has reached stabilization. Temperatures will be recorded continuously throughout the hydrotest. Temperatures will be logged at the same times as the pressure readings at the hold points and every 15 minutes throughout the test.

4.5. PROCEDURE FOR STRENGTH/LEAK TESTING

4.5.1. WATER ACQUISITION

Hydrotest water will be acquired from a local municipality, delivered to the site of the hydrotest and stored in an above ground storage tank (AST). All work will be completed within approved workspace limits. Reference Appendix D for a summary of the local municipality water quality standards.

4.5.2. PRESSURIZATION AND TESTING

1. Ensure temporary piping used for line fill is adequately designed, installed and inspected.
2. The North section of the segment will be isolated from the pipeline by removing a mainline valve and installing two blind flanges.
3. Oil will be removed from the test segment by purging the segment with Nitrogen. This will minimize the oil and water interface. Reference Appendix B for a detailed Nitrogen Purge Plan.
4. The South section of the segment will be isolated from the pipeline by removing a check valve and installing two blind flanges. Fill test section with test medium (water) from the upstream end.
5. Partially close (50%) any valves in the test section.
6. Bleed any air in test section after filling the traps to ensure a full water column during testing.
7. After filling has been completed the test section shall be allowed to stabilize at no more than fifty percent (50%) of the test pressure until a temperature-time plot is asymptotic to the ground temperature or a period of twenty-four (24) hours, whichever is longer, as verified by the Company Test Engineer. Pressure and temperature recorders shall be started prior to pressurization and run throughout the stabilization period to ensure proper stabilization has taken place before starting the hydro-test.
8. Visually inspect all above ground mechanical joints (e.g., flanges, fittings and seals) and exposed welds for leaks. Do not visually inspect exposed connections for leaks during rain or after dark without adequate protection and lighting. If the test section is hoarded or covered, ensure there is easy access for visual inspection.
9. New charts shall be placed in the pressure and temperature recorders after the initial stabilization period and prior to beginning the pressurization procedure. The valve manifold assembly (Fig. 1) shall be isolated and dead weights and pressure recorders bled off to zero (0) psig for a fifteen (15) minute hold. Pressure will be re-established to chart recorder and dead weights up to fifty percent (50%) of test pressure for a fifteen (15) minute hold.
10. Begin a pressure-volume (PV) plot at 60% of the strength test pressure and plot to strength test pressure. Pressurization rate shall not be more than a ten (10) psi increase per minute, unless otherwise approved by the Company. See Table 2 for test pressure range.

11. Once the specified test pressure is reached the pressure pump shall be shut down, the valve on trap closed, and the pump disconnected. After the valves have been closed, inspect all visible piping for leaks and then begin the test period.
12. On starting the test, recorders must be checked for correct operation. They must be checked again at least every hour during the test.
13. The test shall be held at the specified test pressure for a continuous eight (8) hour period. Buried pipe shall be tested for a minimum of eight (8) hours starting with a four (4) hour strength test and followed by a four (4) hour leak test. During the strength test, remove test medium to maintain test pressure within acceptable limits. Measure the volume of any test medium removed, and record the amounts on the Pressure Test Report Form.
14. If there are any changes in pressure corresponding to a change in test medium temperature during the test, calculate the relationship between pressure to test medium temperature (see Enbridge's Operations and Maintenance Manual 07-03-04 Calculating Pressure-Temperature Reconciliation).

4.5.3. TEST ACCEPTANCE

Strength Test

Maintain test pressure for the duration identified above in Table 2 Test Pressure and Duration.

The strength test is accepted if over the test duration the test pressure remains within acceptable limits as outlined in Table 2 (20psi). Pressure changes can be reconciled with temperature or volume changes according to Enbridge's Operations and Maintenance Manual 07-03-03 Calculating Theoretical Pressure-Volume Relationship and 07-03-04 Calculating Pressure-Temperature Reconciliation.

Leak Test

Maintain test pressure for the duration identified above in Table 2 Test Pressure and Duration.

The leak test is accepted if over the test duration the test pressure remains within acceptable limits as outlined in Table 2 (20psi), and any pressure changes can be reconciled with temperature or volume changes according to Enbridge's Operations and Maintenance Manual 07-03-03 Calculating Theoretical Pressure-Volume Relationship and 07-03-04 Calculating Pressure-Temperature Reconciliation.

4.5.4. DEPRESSURIZATION/DEWATERING

1. Ensure temporary piping used for dewatering is adequately designed, installed and inspected.
2. Begin depressurizing as soon as possible after test acceptance.
3. Discharge water using a designated valve on the trap away from the connection to the pressure reading instrumentation. Only qualified personnel shall be permitted to open depressurizing valves. Extreme caution and care shall be used during this operation. The pressure shall be reduced at a controlled rate, as directed by the Company, to ensure that no vibrations develop. Depressurization below 500 psi may not exceed 90 psi per minute.
4. Discharge piping will be connected to the above ground storage tank (AST). The AST will store the water for future use or discharge.
5. Hydrotest water will be reused between test segments, but will be treated onsite utilizing a carbon treatment unit, traditionally equipped with filter bag(s), carbon filters, pressure gauges, sample ports, piping and valves.
6. Upon completion of the final test segment, hydrotest water will be treated onsite via the method stated above. From the AST, water will be delivered via tanker truck to a local municipality

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wastewater treatment plant for final disposal. Reference Appendix E for a summary of required water quality standards upon delivery to the wastewater treatment plant.

5. CONTINGENCY PLANS

5.1. PREVENTION

A check will be completed of the pressure ratings and condition of components that are not part of the system tested but that are under the test pressure to ensure components are not subject to pressure greater than 90% rated pressure (e.g., pressurizing pump, piping to the test point, expansion tank, test manifold, gauges and fittings).

Appropriate precautions will be made to ensure system components are not over pressured. For example, higher pressures may build up if a valve is closed, especially if the pump connection is separated from the test instruments.

Product will be removed and flushed from the pipeline during the purge and water fill to minimize potential contamination in the event of a test failure.

5.2. EMERGENCY RESPONSE

In the unlikely event of a test medium release during the hydrotest, Emergency Response preparations will be in place. An Incident Action Plan (IAP) will detail the objectives of the overall response, including resources of both people and equipment, and the tactics that will be utilized to respond to a release of test medium during the test. The tactics utilized will be drawn from Enbridge's Tactical Response Plan for the Straits of Mackinac including the establishment of an Incident Command Post and Oil Spill Response Organization (OSRO) Contractor support.

5.3. LEAKS

During the pressurization process, leaks will be detected by using the Pressure Volume Plot (PV Plot). During the hydrostatic test, any change in pressure will be reconciled by temperature as stated in section 3.5.3. If a leak occurs during the strength or leak test and the test pressure cannot be maintained above minimum test pressure, the test will be stopped. Enbridge will repair the leak and then re-start both the strength test and the leak test.

For leaks that cannot be repaired by rethreading or reflanging a connection see section 5.4 Test Failures.

Enbridge will also comply with Paragraph 26 of the Consent Decree in the event of any leak or rupture that may occur as a result of the hydrotest.

Reference Appendix C for a detailed Leak Detection Plan.

5.4. TEST FAILURES

1. In the event of a test failure during a strength or leak test, the pipe shall be repaired, and both the strength test and the leak test shall be repeated.
2. The Company shall maintain sufficient standby personnel and equipment on site for the repair of leaks. Within ninety (90) days of the test failure, Enbridge shall complete and submit to the EPA and PHMSA an investigatory report of the pipeline failure.

3. Leaks or breaks occurring in the pipe wall or in the pipe seam above the water line of the Straits crossing shall be repaired according to Enbridge's Operations and Maintenance Manual 05-03-08 Determining Remediation Method.
4. Leaks or breaks occurring in the pipe wall or in the pipe seam below the water line of the Straits crossing shall be repaired according to Enbridge's Operations and Maintenance Manual Subsea Repair Section Book 3 Tab 6.

5.5. SAFETY PRECAUTIONS

All work will be conducted in accordance with Enbridge's Liquid Pipelines and Major Projects Safety Manual.

5.5.1. SIGNAGE

For mainline pressure tests, place warning signs that read 'DANGER—PIPE LINE UNDER HIGH PRESSURE TEST' at all access roads 1 day before the test, and on Company property on the day of the test. Keep warning signs in place until after the pipeline has been depressurized.

5.5.2. PUBLIC/WORKER SAFETY

All workers not directly involved in the pressure test should remain a minimum of 15 m (50 ft) from the pipe section under test by signs, fencing and/or verbal warnings.

All landowners along the pipeline route will be notified of the hydrotest taking place. For residences with in 100ft of the pipeline an offer will be made to stay in a local hotel during the testing of the pipeline.

6. SCHEDULE

6.1. WEST SEGMENT

6.1.1. DAY ONE

1. Line 5 Shutdown
2. Drain up and Isolate North End
3. Make Connections for Nitrogen Pumper

6.1.2. DAY TWO

4. Purge Oil Out of West Segment with Nitrogen
5. Blowdown Nitrogen Pressure on Pipeline

6.1.3. DAY THREE

6. Line 5 Shutdown
7. Drain up and Isolate South End

6.1.4. DAY FOUR

8. Line Fill with Water
9. Water Temperature Stabilization

6.1.5. DAY FIVE

10. Water Temperature Stabilization

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6.1.6. DAY SIX

11. Water Temperature Stabilization

6.1.7. DAY SEVEN

12. Hydrotest Execution
13. Dewatering of Hydrotest Water

6.1.8. DAY EIGHT

14. Line 5 Shutdown
15. Remove Isolation
16. Make Connections for Nitrogen Pumper

6.1.9. DAY NINE

17. Nitrogen Prepack
18. Oil Line Fill
19. Return to Regular Service

6.2. EAST SEGMENT

6.2.1. DAY ONE

1. Line 5 Shutdown
2. Drain up and Isolate North End
3. Make Connections for Nitrogen Pumper

6.2.2. DAY TWO

4. Purge Oil Out of East Segment with Nitrogen
5. Blowdown Nitrogen Pressure on Pipeline

6.2.3. DAY THREE

6. Line 5 Shutdown
7. Drain up and Isolate South End

6.2.4. DAY FOUR

8. Line Fill with Water
9. Water Temperature Stabilization

6.2.5. DAY FIVE

10. Water Temperature Stabilization

6.2.6. DAY SIX

11. Hydrotest Execution
12. Dewatering of Hydrotest Water

6.2.7. DAY SEVEN

13. Line 5 Shutdown
14. Remove Isolation

15. Make Connections for Nitrogen Pumper
16. Nitrogen Prepack

6.2.8. DAY EIGHT

17. Oil Line fill
18. Return to Regular Service

APPENDIX A – TEST PRESSURE SELECTION

1.0 INTRODUCTION

Enbridge has developed a hydrotest execution plan for the NPS 20 dual pipelines that cross the Straits of Mackinac in Michigan[1]. Enbridge intends to test the Line 5 Straits with a 4 hour strength test pressure of 1200 psi (49% SMYS) followed by a 4 hour leak test pressure of 660psi (27% SMYS). The strength test parameter exceeds those specified in Paragraph 25(b) of the Consent Decree.

Rationale for testing to 1200psi

The rationale for selecting the 1200 psi strength test pressure include the following:

- Exceed compliance with the requirements of the proposed Consent Decree;
- Establish crack program reliability at MOP;
- Establish a safety factor above MOP to provide added assurance that this line is non-susceptible to axial crack rupture for a minimum of 25 years;
- Achieve broad acceptance by stakeholders that, by selecting a test pressure approximately equal to the 1200 psi Installation Test performed in 1953[2], the current hydrotest will demonstrate the safety of the pipelines;
- Establish a 2 times MOP safety factor and achieve a higher level of operating safety and confidence with minimal increase in the likelihood of a hydrotest failure.

1.1 OVERVIEW OF THE TECHNICAL ANALYSIS

The selection of the hydrotest pressures was engineered to exceed the required aspects of the Consent Decree, minimize likelihood of a test rupture, and provide added assurance of integrity for an estimated 25 years of operation with respect to axial cracks. The following integrity details are relevant to the test pressure selection and are discussed further in the subsequent sections:

- The proposed hydrotest will expose the pipes to just below half of their nominal strength (target stress is 49% SMYS). This % SMYS is well within the industry normal range for a hydrotest;
- The previously completed hydrotests include testing to pressure above the proposed 1200 psi. These tests achieved a safety factor above the proposed hydrotest 1.42 Mill Test (1700 psi) and 1.25

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[1] The technical discussion herein is focused on the original 1953 vintage 0.812" wall thickness pipe as the original onshore 0.500" wall thickness piping has been replaced as follows:

- *2011, North side was replaced and hydrotested to a minimum of 1531 psi (approximately 2.5 x MOP)*
- *2016, South side was replaced and hydrotested to a minimum of 2229 psi (approximately 3.7 x MOP)*

[2] As required by the Straits of Mackinac Pipeline Easement; see Easement, § A.(2) at page 4.

- (Assembly Test (1500 psi)) thus demonstrating a safety factor relevant to threats that are stable over time;
- The line is seamless, and operates at 25% SMYS with very light pressure cycling. Based on these characteristics, the line is not considered susceptible to axial fatigue crack growth leading to failure;
- The pipelines are not susceptible to environmental assisted cracking (EAC) or stress corrosion cracking (SCC). The coating performance is excellent based upon the corrosion related in-line inspections, cathodic protection in-line inspections, and visual inspections. Additionally, given the operating conditions and submerged environment, there is a negligible likelihood for initiation or propagation of EAC and SCC;
- From a metal loss perspective, the pipeline is in "like new" condition with no flaws that have a failure pressure < 2436 psi (100% SMYS) and therefore the likelihood of failure during a hydrotest to 1200psi is very low;
- The Enbridge integrity management programs specific to strain and circumferential cracking was completed and concluded that there are no flaws that impede an ability to achieve the 1200 psi test pressure. Importantly, any external forces such as laterally induced strain or vortex induced vibration from water currents are addressed through these programs;
- The Enbridge integrity program to detect deformations was completed and the program concluded that there are no deformations that impede ability to achieve the 1200 psi test pressure;
- The proposed 1200 psi test pressure will not significantly increase axial tensile stress. It is estimated that any increase in stress will be no more than 3 ksi, or 0.01% strain. Thus, there is no change in the likelihood of a buckling threat.

1.2 STRENGTH TEST PRESSURE DETERMINATION

The current strength of the Straits piping is demonstrated through the history of completed hydrotests, analysis to determine if there is any flaw growth over time, and the results of the integrity condition monitoring programs.

1.2.1 Completed Hydrotest Programs

The history of completed hydrotests demonstrates the mechanical strength of the pipe and the absence of significant manufacturing and construction flaws. The pipe was hydrotested a total of four times, each time to a successively lower stress. This approach during commissioning reduced the likelihood to initiate growth to otherwise benign manufacturing flaws.

- Mill test to 1700 psi (70% SMYS) (2.8 X MOP)
- Assembly test to 1500 psi (62% SMYS) (2.5 X MOP)
- Installation test to 1200 psi (49% SMYS) (2.0 X MOP)
- Commissioning test to 790 psi (32% SMYS) (1.3 X MOP)

All of these hydrotests were successful, with no test failures associated with any of the tests. For manufacturing and construction flaws that are not suspected to have been enlarged by pressure-cycle-induced fatigue, the pipe has demonstrated a strength of 1.42 (mill test) and 1.25 (assembly test) times the proposed 1200 psi (49% SMYS) pressure test. Therefore, the previous test history provides supporting evidence that a hydrotest to 1200 psi will not result in a failure due to stable flaws; a summary of the likelihood analysis for flaw growth is included below.

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1.3 AXIAL CRACK THREAT

The relevant flaw growth mechanisms, such as pressure-cycle-induced fatigue, were identified and evaluated to determine if a given mechanism was suspected of compromising the ability to test the pipe to the proposed 1200 psi (49% SMYS) pressure.

The design and operation of the pipeline make it not susceptible to the growth mechanisms associated with axially aligned cracks. The factors contributing to the conclusion that the pipelines are not susceptible to pressure-cycle-induced fatigue, stress corrosion cracking (SCC), and environmentally assisted cracking (EAC) include:

- The line is constructed using heavy wall thickness (0.812") and operates at very low operating stress and the MOP is 25% SMYS;
- The line operates in a very-light pressure cycling regime;
- The pipe is seamless and therefore there is no significant likelihood for initiating sites for fatigue;
- The coating performance is excellent, as this is demonstrated by the absence of external corrosion (metal loss ILI) and the Cathodic-Protection-Current-Measurement results (CPCM ILI tool). Therefore, there is a negligible likelihood for initiating sites for EAC and SCC;
- The submerged environment is low in oxygen and CO_2 and does not contribute to initiation of SCC on the submerged section of the pipelines.

The conclusion that the line is not susceptible to pressure-cycle-induced fatigue, SCC, and EAC has been demonstrated through the fact that no cracks of this nature have been observed on this line.

1.4 METAL LOSS THREAT

Axial threats that are susceptible to growth can cause degradation to the strength of the pipeline and are therefore incorporated into an integrity program that monitors the threat condition. Metal loss (both internal and external) is the only axial threat susceptible to growth on the Straits. Evidence that confirms the line is not susceptible to metal loss from these sources includes the following:

- Multiple ILI tools (4 ILI runs in the last 20 years) are used to detect the presence and severity of corrosion flaws and the current condition is in "like new" state with no flaw with strength below 2436 psi (100% SMYS).
- The Cathodic-Protection-Current-Measurement (CPCM ILI tool) confirmed that the coating is performing effectively.

1.5 METAL LOSS THREAT

In addition to the axially aligned threats that were evaluated Circumferential Cracking , Deformation and Stress/Strain was also assessed against the ability to test the pipe to the proposed 1200 psi (49% SMYS) pressure. No concerns were noted as a result of this assessment.

- **Circumferential crack**: The most recent 2014 circumferential crack inline inspection of the West and East legs did not identify any flaws with a safety factor below 1.25 times the 1200 psi hydrotest pressure. There are no circumferential cracking flaws that impede the ability to achieve the 1200 psi test pressure.

- **Deformation:** The most recent 2016 caliper inspections of the West and East legs did not identify any dents or other flaws that impede the ability to achieve the 1200 psi test pressure.

- **Stress/Strain:** A pressure increase to 1,200 psi for maximum achieved operating pressure of 400 psi results in a maximum axial stress increase of 3,000 psi and strain increase of 0.01% which is

insignificant. Additionally a check for buckling was conducted and no additional risk for buckling exists with the increase in pressure due to the hydrotest level.

APPENDIX B – NITROGEN PURGE PLAN

1.0 WEST STRAITS HYDROTEST – PURGE PLAN

The west Straits of Mackinac crossing of the Line 5 pipeline will be the first segment to be hydrotested by shutting down the pipeline and draining up the upstream section of the west segment. Immediately following the drain up and upstream isolation, The pipeline will be purged of oil, the station piping drained of oil, and isolated from the east segment by removing flanged valves and installing blind flanges. Once isolated the east segment will continue to operate while the west segment is being hydrotested.

1.1 MACKINAC WEST – OIL PURGE PLAN

1. Drain up and Isolate North Straits Pipeyard Piping.

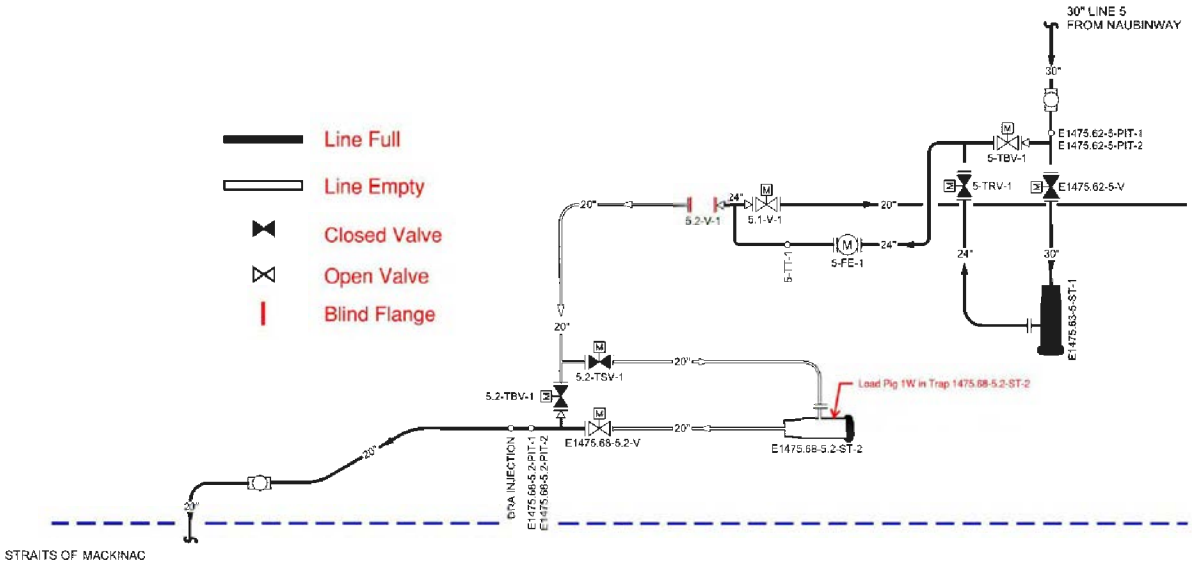


Figure 9: North Straits Pipeyard – Preliminary Conditions

2. Install Pig 1W in Trap 1475.68-5.2-ST-2.
3. Connect Nitrogen Pump Truck to Trap 1475.68-5.2-ST-2.
4. Launch Pig 1W from Trap 1475.68-5.2-ST-2 with Nitrogen.
5. Oil purged will side stream into Line 5 immediately downstream of valve 5.1-V within the Mackinac Station from the start of the Nitrogen injection.
6. Inject Nitrogen until Pig 1W arrives at Trap 1479.55-5.2-ST-1.
7. Land Pig 1W in Trap 1479.55-5.2-ST-1.
8. Capture Nitrogen between valves 1475.68-5.2-V and 1479.55-5.2-V-1 to use for water fill back pressure in front of water fill pig.
9. Drain up and Isolate Mackinac Station Piping.

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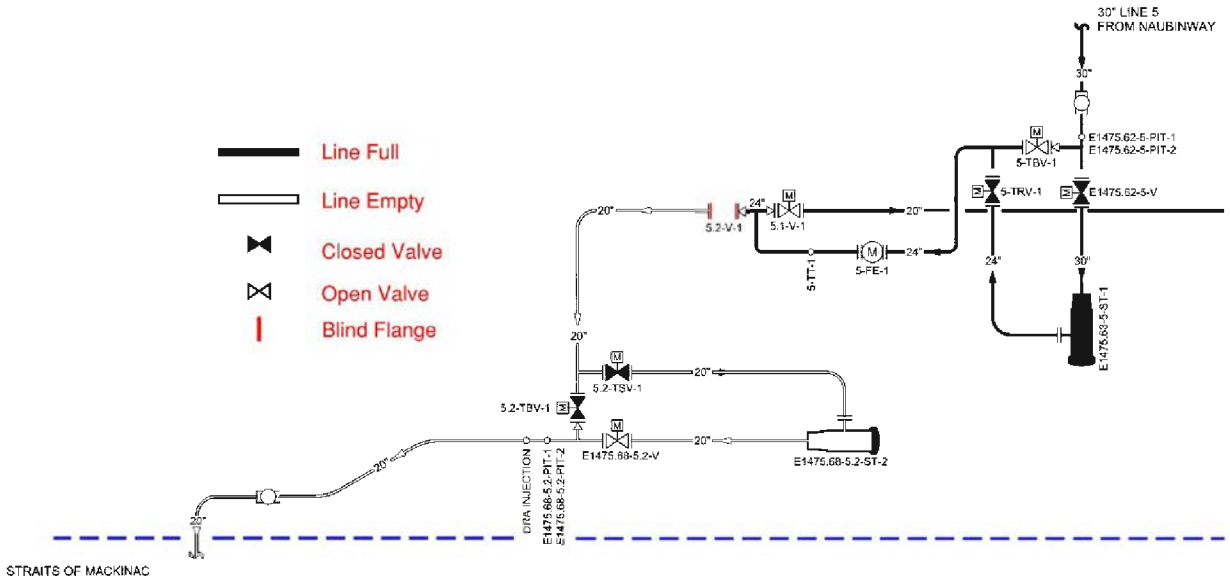


Figure 10: North Straits Pipeyard – Post Oil Purge

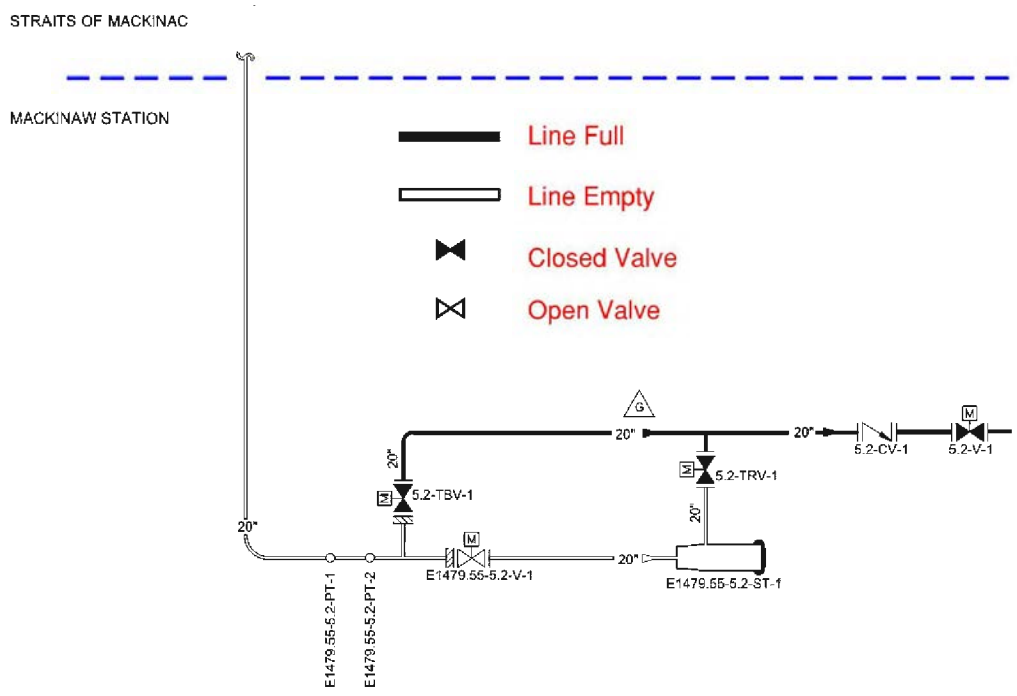


Figure 11: Mackinac Station – Post Oil Purge

1.2 MACKINAC WEST – HYDROTEST PREPACK

1. Install Pig 2W in Trap 1475.68-5.2-ST-2
2. Launch Pig 2W from Trap 1475.68-5.2-ST-2 with Water.
3. Monitor Nitrogen Pressure at Trap 1479.55-5.2-ST-1. Maintain head pressure in front of water fill Pig 2W. Nitrogen pressure will be vented through a 4" valve on trap drain

through frac tanks and the carbon vapor scrubber/sound suppression system until Pig 2W lands in trap 1479.55-5.2-ST-1.

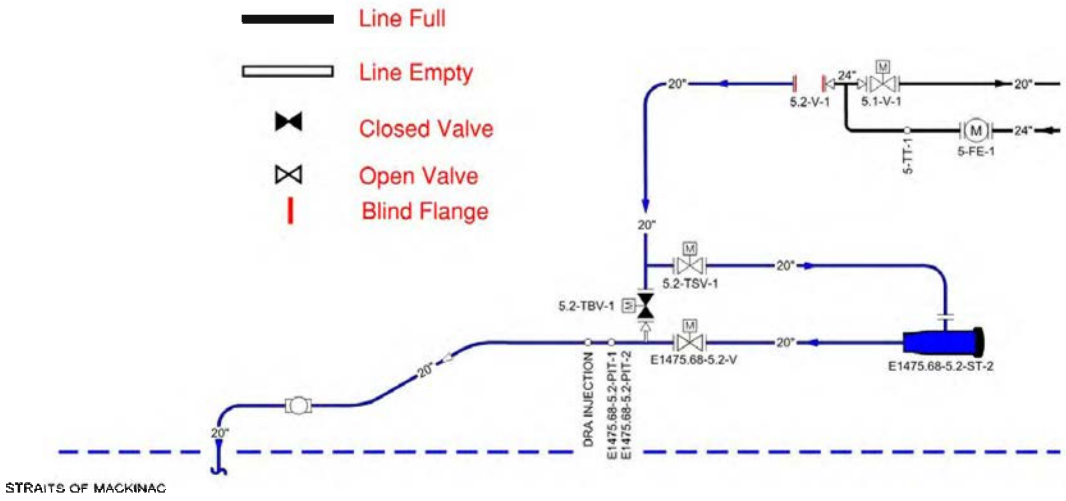


Figure 12: North Straits Pipeyard – Water Linefill

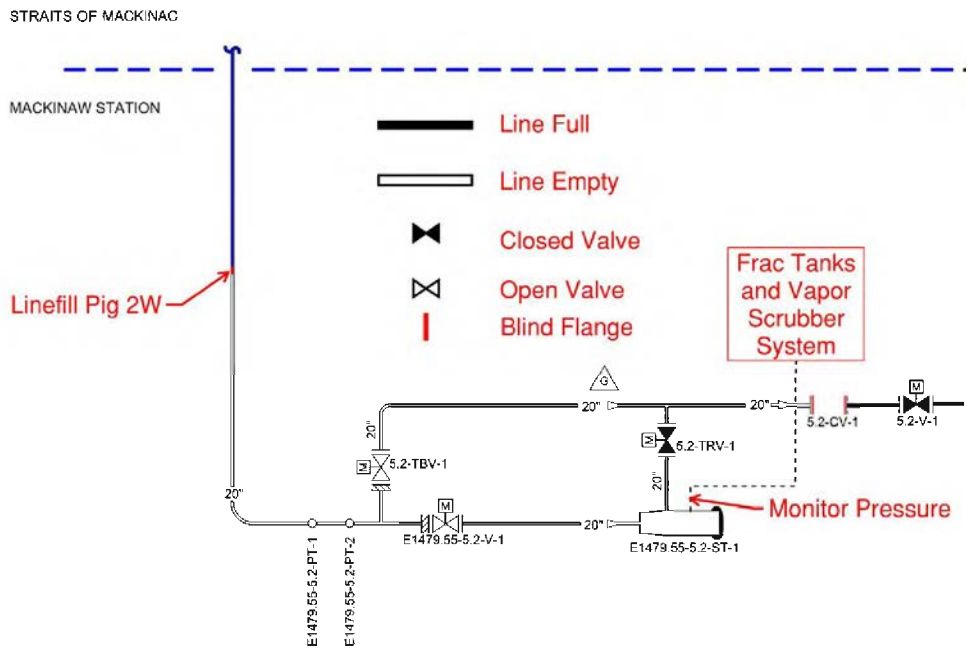


Figure 13: Mackinac Station – Water Linefill

1.3 MACKINAC WEST – HYDROTEST DEWATERING

1. Complete West Straits Hydrotest. Pig 2W remains in pipeline during the hydrotest.
2. Launch Pig 2W from Trap 1479.55-5.2-ST-1 with Nitrogen and monitor nitrogen injection rate at trap 1479.55-5.2-ST-1.

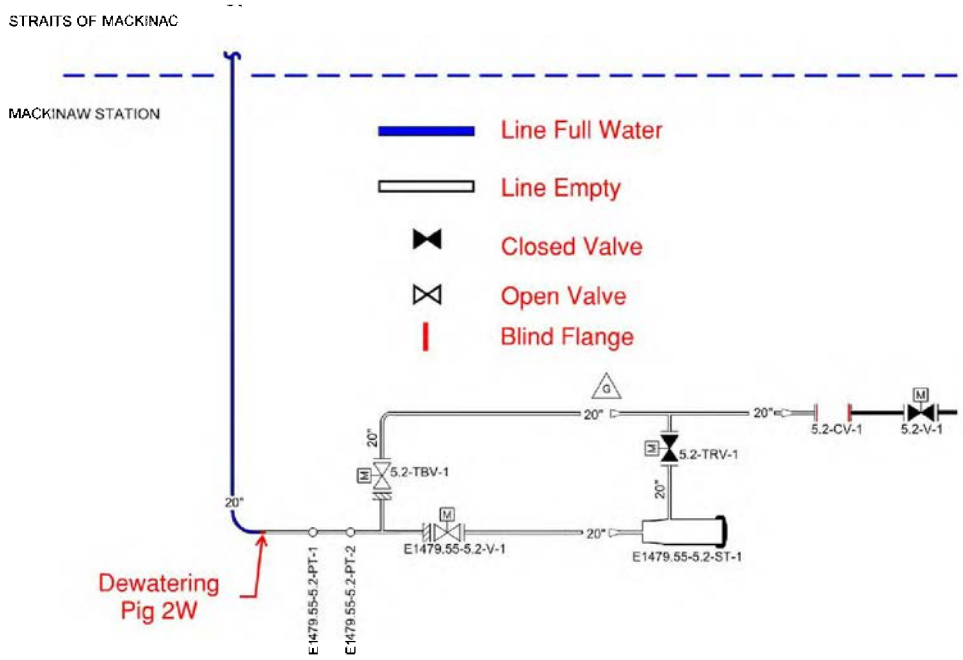


Figure 14: Mackinac Station – Dewatering

3. Water will be purged into a filtration system and then returned to a storage tank at the North Straits Pipeyard.
4. Land Pig 2W in Trap 1475.68-5.2-ST-2
5. Capture nitrogen between valves 1475.68-5.2-V and 1479.55-5.2-V-1 to use for oil fill back pressure in front of oil fill pig.
6. Remove Isolation and prepare for Oil line fill.

1.4 MACKINAC WEST – OIL LINE FILL PREPACK

1. Install Pig 3W in Trap 1475.68-5.2-ST-2
2. Launch Pig 3W from Trap 1475.68-5.2-ST-2 with Oil.
3. Monitor Nitrogen Pressure at Trap 1479.55-5.2-ST-1. Maintain head pressure in front of oil fill Pig 3W. Nitrogen pressure will be vented through a 4" valve on trap drain through frac tanks and the carbon vapor scrubber/sound suppression system until Pig 3W lands in trap 1479.55-5.2-ST-1.

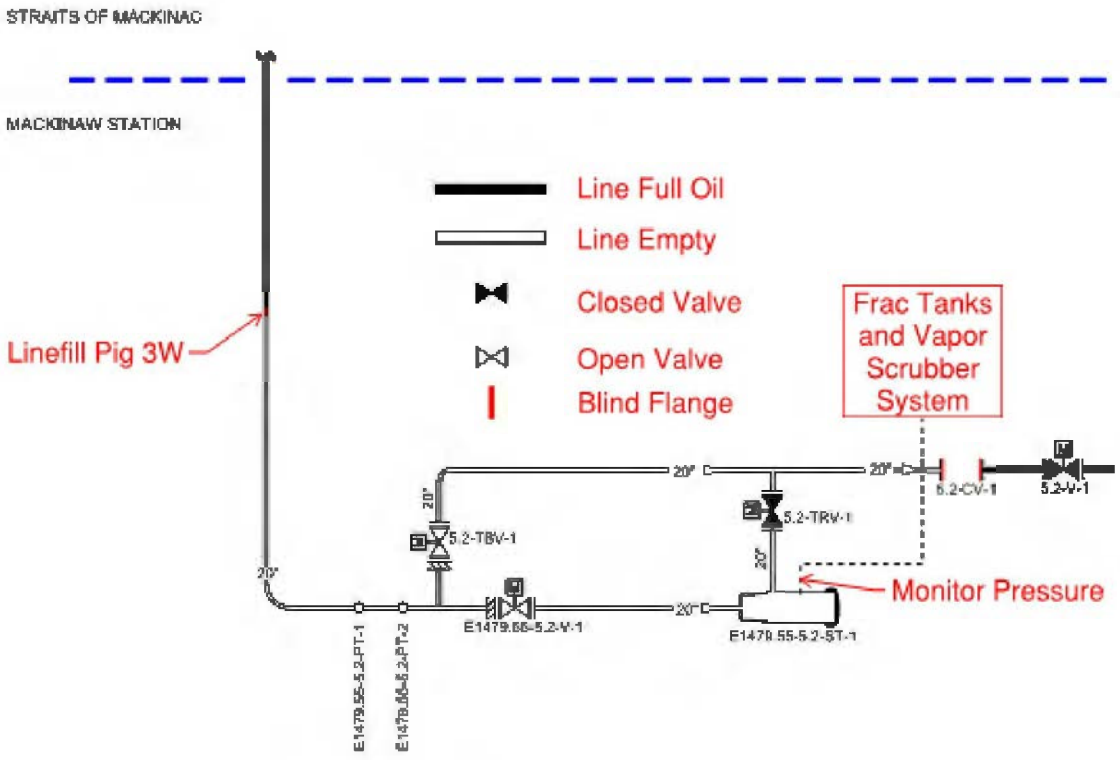


Figure 15: Mackinac Station – Oil Linefill

4. Remove Isolation.
5. West segment returns to service.

2.0 EAST STRAITS HYDROTEST PURGE-PLAN

The east Straits of Mackinac crossing of the Line 5 pipeline will be the second segment to be hydrotested by shutting down the pipeline and draining up the upstream section of the east segment. Immediately following the drain up and upstream isolation, The pipeline will be purged of oil, the station piping drained of oil, and isolated from the west segment by removing flanged valves and installing blind flanges. Once isolated the west segment will continue to operate while the east segment is being hydrotested.

2.1 MACKINAC EAST – OIL PURGE PLAN

1. Drain up and Isolate North Straits Pipeyard.

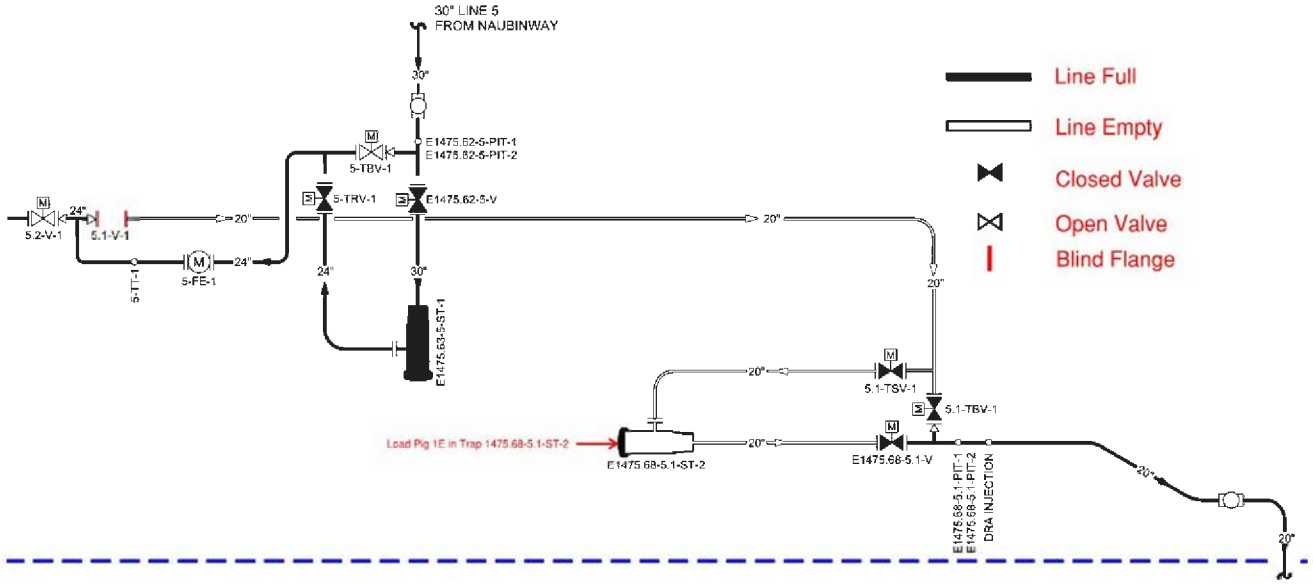


Figure 16: North Straits Pipeyard – Preliminary Conditions

2. Install Pig 1E in Trap 1475.68-5.1-ST-2.
3. Connect Nitrogen Pump Truck to Trap 1475.68-5.1-ST-2.
4. Launch Pig 1E from Trap 1475.68-5.1-ST-2 with Nitrogen.
5. Oil Purged will side stream into Line 5 immediately upstream of valve 5.1-V-1 within the Mackinac Station from the start of the Nitrogen injection.
6. Inject Nitrogen until Pig 1E arrives at Trap 1479.55-5.1-ST-1.
7. Land Pig 1E in Trap 1479.55-5.1-ST-1.
8. Capture Nitrogen between valves 1475.68-5.1-V and 1479.55-5.1-V-1 to use for water fill back pressure in front of water fill pig.
9. Drain up and Isolate Mackinac Station Piping

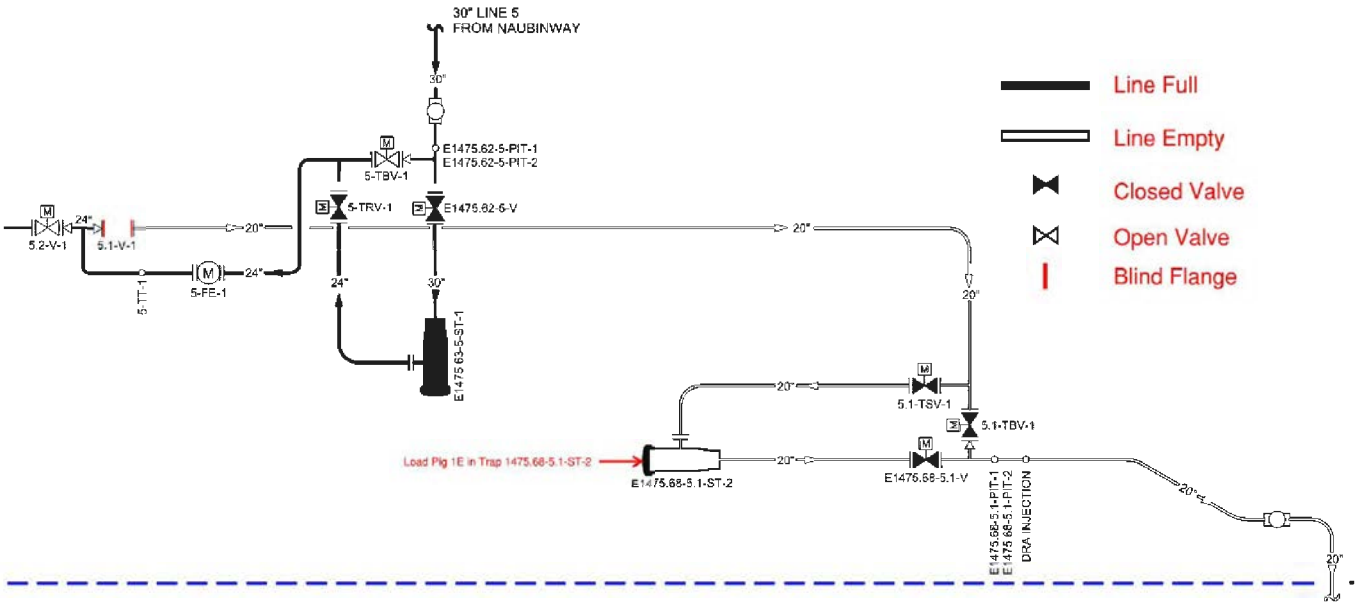


Figure 17: North Straits Pipeyard – Post Oil Purge

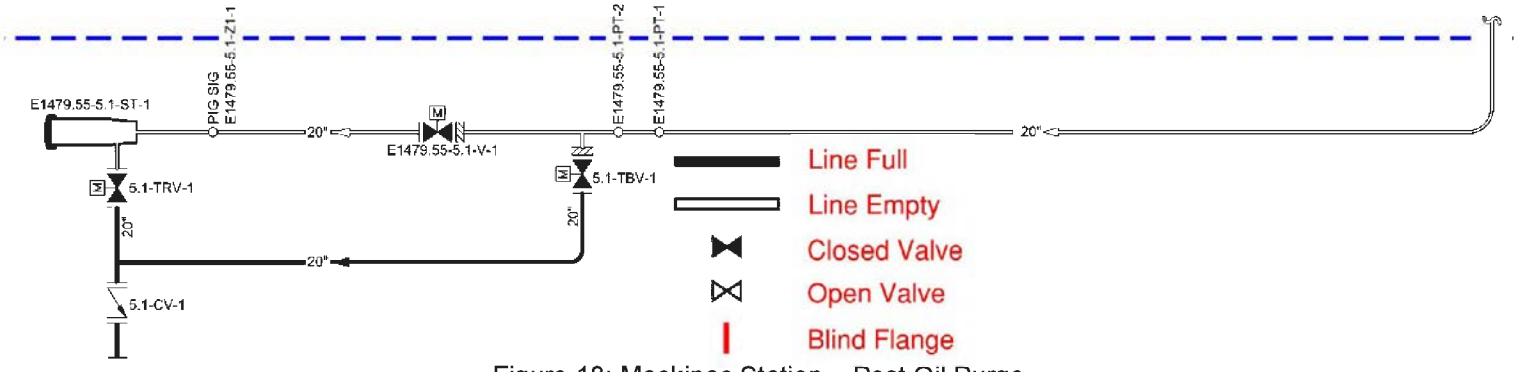


Figure 18: Mackinac Station – Post Oil Purge

2.2 MACKINAC EAST– HYDROTEST PREPACK

1. Install Pig 2E in Trap 1475.68-5.1-ST-2.
2. Launch Pig 2E from Trap 1475.68-5.1-ST-2 with Water.
3. Monitor Nitrogen Pressure at Trap 1479.55-5.1-ST-1. Maintain head pressure in front of water fill Pig 2E. Nitrogen pressure will be vented through 4" valve on trap drain through frac tanks and the carbon vapor scrubber/sound suppression system system until Pig 2E lands in trap 1479.55-5.1-ST-1.

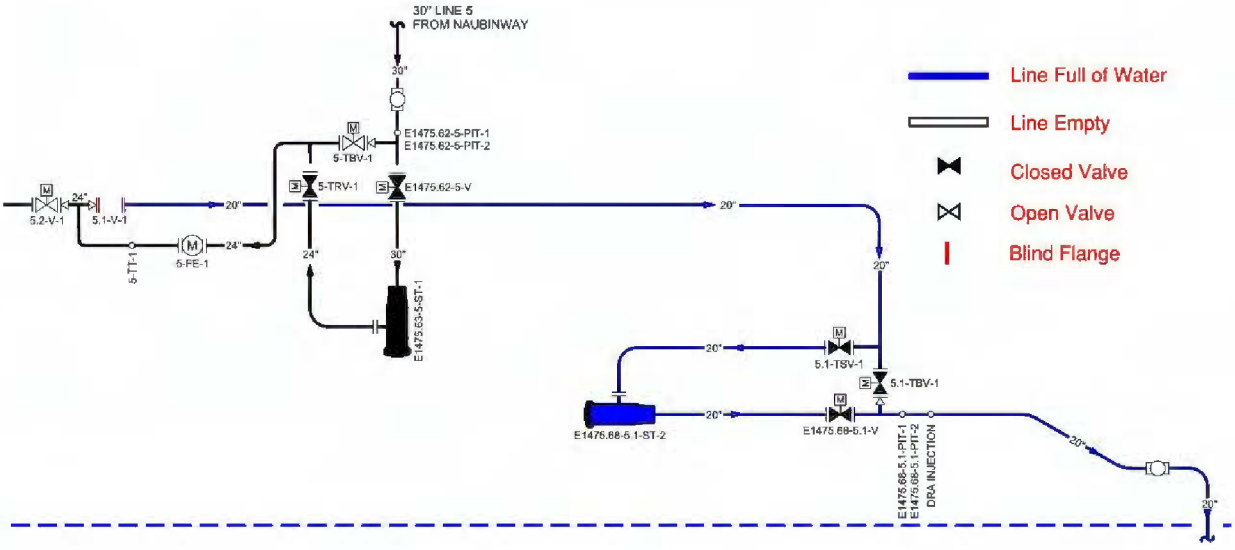


Figure 19: North Straits Pipeyard – Water Linefill

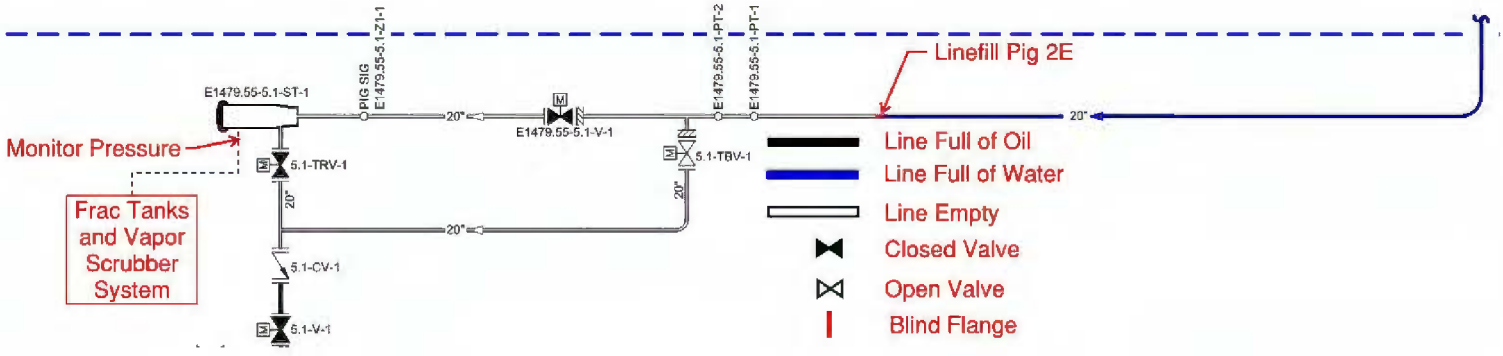


Figure 20: Mackinac Station – Water Linefill

2.3 MACKINAC EAST – HYDROTEST DEWATERING

1. Complete East Straits Hydrotest. Pig 2E remains in pipeline during the hydrotest.
2. Launch Pig 2E from Trap 1479.55-5.1-ST-1 with Nitrogen and monitor the nitrogen injection rate at trap 1479.55-5.1-ST-1.

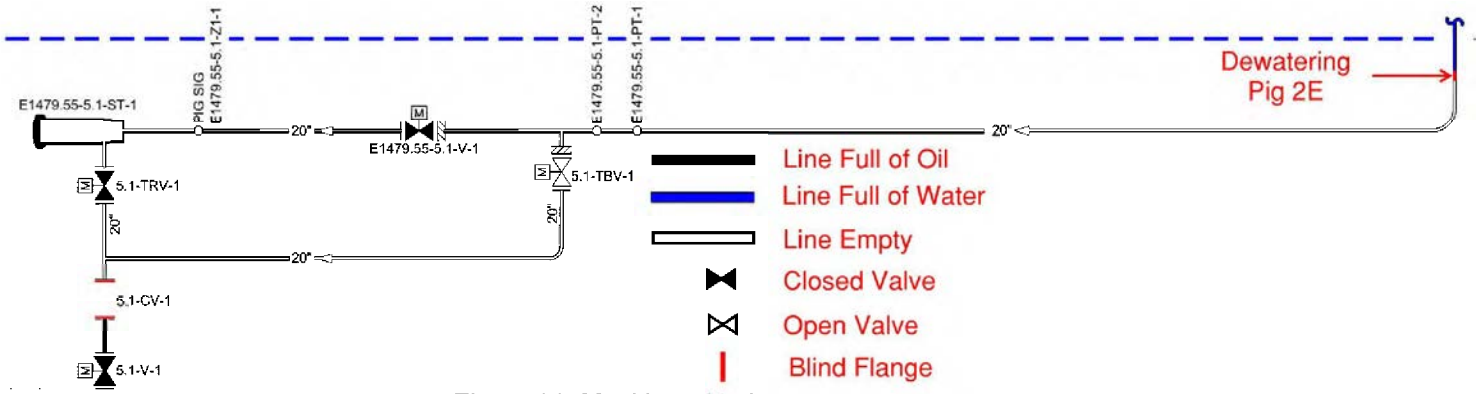


Figure 21: Mackinac Station – Nitrogen Injection

3. Water will be purged into a filtration system and then returned to a storage tank at the North Straits Pipeyard.
4. Land Pig 2E in Trap 1475.68-5.1-ST-2.
5. Capture Nitrogen between valves 1475.68-5.1-ST-2 and 1479.55-5.1-ST-1 to use for oil fill back pressure in front of oil fill pig.
6. Remove Isolation and prepare for Oil line fill.

2.4 MACKINAC EAST – OIL LINE FILL PREPACK

1. Install Pig 3E in Trap 1475.68-5.1-ST-2.
2. Launch Pig 3E from Trap 1475.68-5.1-ST-2 with Oil.
3. Monitor Nitrogen Pressure at Trap 1479.55-5.1-ST-1. Maintain head pressure in front of oil fill Pig 3E. Nitrogen pressure will be vented through a 4" valve on trap drain through frac tanks and the carbon vapor scrubber/sound suppression system until Pig 3E lands in trap 1479.55-5.1-ST-1.

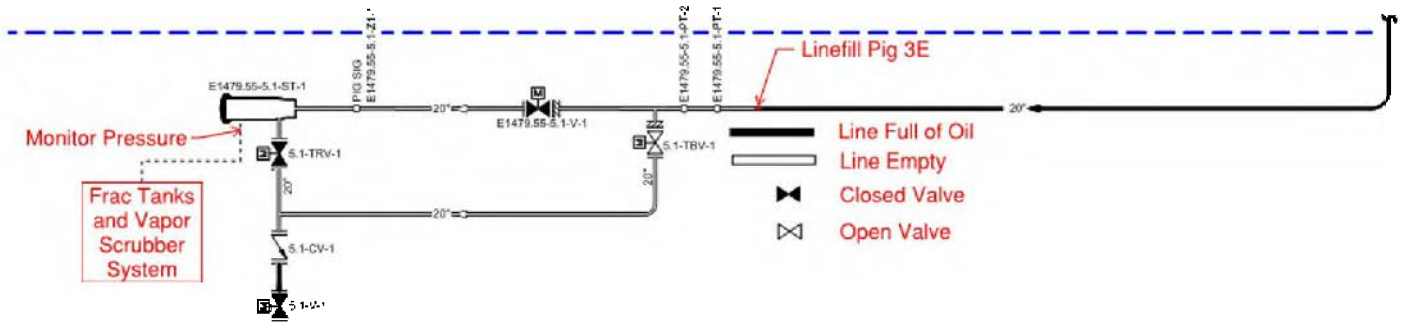


Figure 22: Mackinac Station – Oil Linefill

4. Remove Isolation.
5. East segment returns to service.

APPENDIX C – LEAK DETECTION PLAN

1.0 OVERVIEW

The purpose of this plan is to describe the methods to be used in determining if a leak investigation is required during the Line 5 Straits of Mackinac Hydrotest and the steps to be taken to locate and repair a leak.

1.1 PRELIMINARY PREPARATIONS

To reduce the amount of time required to locate a potential leak, steps will be taken to put locating agents into the pipeline during water line fill. The locating agents will be a non-toxic fluorescein dye and a non-toxic tracer gas. The dye and gas will be injected into the pipeline during line fill at the North Straits Valve Facility. The dye will be injected at a concentration of 1 gallon (gal) dye/40,000 gal water. Tracer gas will be injected in the first 20,000 gal of water at a concentration of 7 parts per million (ppm) by weight to be received in the piping on the south side of the Mackinac Straits Crossing. Tracer gas will then be injected into the last 28,000 gal of water at a concentration of 7 ppm by weight to be included in the piping on the north side of the Mackinac Straits Crossing. Please reference the Attachments in this Appendix for Safety Data Sheets (SDS) for the proposed fluoresce in dye and tracer gas.

1.2 LEAK IDENTIFICATION

1.2.1 PRESSURE-TEMPERATURE CALCULATIONS

During a hydrotest, pressure may drop from a loss in volume (a leak) or from a drop in the temperature of the test medium (water). In order to determine if the pressure drop is due to volume or temperature variation, a pressure-temperature correlation calculation must be completed. The correlation between temperature and pressure change will be calculated according to Enbridge's Operations and Maintenance Manual 07-03-04 Calculating Pressure-Temperature Reconciliation. If a drop in pressure is validated by the calculation in OMM 07-03-04, the test will be accepted. If the drop in pressure is greater than the calculation in OMM 07-03-04 the pipeline will be inspected for leaks by the methods listed in section 1.3 Leak Locating.

$$\Delta P = \frac{\beta - 2\alpha}{\frac{D}{Et}(1 - v^2) + C}$$

(per degree of temperature change)

This calculation assumes the entire segment is subject to the same temperature change. Placement of temperature instrumentation may allow for portions of the test segment to be monitored separately. Similar calculations will be performed dependent upon the response to temperature changes on each portion and the net effect will be the resulting pressure change. The amount of tracer gas used in the test water will have a minimal effect on the water bulk modulus, reducing it by .18% over the pressure range from 900 psi to 1200 psi.

1.2.2 PRESSURE-VOLUME CALCULATIONS

The pressure-volume relationship can be calculated using Enbridge's Operations and Maintenance Manual 07-03-03 Calculating Theoretical Pressure-Volume Relationship. This calculation can be used to estimate the volume loss rate based on the change in pressure. Once the loss rate is determined a calculation of the estimated leak size can be performed to determine the size of the leak feature.

1.3 LEAK LOCATING

1.3.1 ABOVE GRADE PIPING

In the event a pressure drop cannot be reconciled with the temperature variation, the first step in leak locating will be to verify there are no above grade leaking components or pipe. This method, visual inspection, will be completed by assigned competent personnel. The above grade piping and components will be walked along and visually confirmed that there are no leaks. The test section will remain at test pressure during this process to assist in identifying the leak.

Flange and fitting connections are potential leak points due to pressures greater than Maximum Operating Pressure (MOP) and can be remedied by reducing the pressure to static pressure and retorquing the flange connection, or by dewatering and replacing the gasket. If a leak in the piping is identified, the pressure will be reduced to static pressure and the pipeline dewatered. Once the pipeline has been dewatered the pipe segment will be repaired.

If no leaks are found in above grade piping or components as confirmed by visual inspection proceed to step 1.3.2.1

1.3.2 BELOW GRADE PIPING - ABOVE MACKINAC STRAITS WATER ELEVATION

1.3.2.1 No Disturbance Detection

For inspecting the piping that is below grade, but above the Straits of Mackinac water level, the leak detection method will be to walk the pipeline and visually look for the fluorescein dye. The fluorescein dye has a highly visible yellow/green color that is easily detected by the eye.

In addition to looking for the dye a technician with equipment specialized for detecting the tracer gas released through a leak will walk the pipeline and take samples to be analyzed for locating the leak. Equipment will be located on site for analyzing the samples to determine the leak location. The test section will remain at test pressure during this process to help identify a leak.

If a leak is identified, the pressure will be reduced to static pressure and the pipeline dewatered. Once the pipeline has been dewatered the pipe segment will be repaired.

If no leaks are found by the No Disturbance Detection method proceed to step 1.3.2.2

1.3.2.2 Excavated Detection

If Leaks are not detected by walking above the pipeline, critical points such as stopple locations will be excavated to ensure all potential leak sources above the water elevation have been explored. A visual inspection will be completed to look for the fluorescein dye as well as tracer gas detection to ensure no leaks are present in the buried piping before moving to step 1.3.3.

In order to dig on the hydrotest segment the pressure will need to be reduced to static pressure. This will be accomplished in a series of step downs to recalculate the leak flow rate at the different pressures and to ensure the leak does not close at a lower pressure. The pressure will be reduced from test pressure to 75% of test pressure (900 psi). The test section will then be held at pressure for 30 minutes to establish the leak rate. The pressure will then be reduced from 75% of test pressure to 50% of test pressure (600 psi) and held at 30 minutes to establish the leak rate. The pressure will then be reduced from 50% of test pressure to 25% of test pressure (300 psi) and held at 30 minutes to establish the leak rate. The test section will be held at this pressure to keep positive pressure on the leak but will be safe to dig near the pipeline.

If no leaks are found by the Excavated Detection method proceed to step 1.3.3.

1.3.3 BELOW GRADE PIPING - BELOW MACKINAC STRAITS WATER ELEVATION

If the leak is suspected to be in the below grade piping below the Straits of Mackinac Water Elevation the leak detection method will be fluorescence detection and nitrogen.

In order to complete the nitrogen inspection (bubbling) the pipeline will be brought down to static pressure and dewatered. Dewatering is accomplished by pushing a pig with nitrogen, which pushes the water out of the pipeline. Nitrogen will be injected into the pipeline on the south side of the Straits Crossing through the trap. During nitrogen injection, a non-toxic fluorescein dye will be injected into the pipeline. The dye will be injected at rates and quantities as recommended by the supplier. After dewatering is complete the pipeline will have a nitrogen pressure of approximately 150 psi, which is required to push the pig. See Section 1.4 for additional information on nitrogen pressures. With the pipeline having positive pressure, nitrogen would be leaving the leak location and create bubbles in the water. A remote operated vehicle equipped with a camera will be used to detect nitrogen bubbles. The remote operated vehicle will also be equipped with a long-range fluorescent detector to detect the dye. In addition to the remote operated vehicle, divers will be deployed to visually detect the nitrogen bubbles and dye.

If a leak is identified below the water line of the Straits crossing it shall be repaired according to Enbridge's Operations and Maintenance Manual Subsea Repair Section Book 3 Tab 6.

1.4 PRESSURE REQUIREMENTS

1.4.1 WATER IN PIPELINE LEAK DETECTION

Some leaking features are only present under test pressure and close when pressure is reduced. For leak detection methods 1.3.1 and 1.3.2.1 test pressure should be maintained by adding additional volume (water) to the test section. This will ensure the leak location will remain open and have the highest rate of volume through the leak location. The maximum volume out of the leak location will aid in the effectiveness of locating the dye or tracer gas.

If required to use the excavation detection method in 1.3.2.2 and the bubbling leak detection described in Section 1.3.3, reduce the hydrotest in stages of 75%, 50%, 25% of test pressure as described in section 1.3.2.2.

1.4.2 NITROGEN IN PIPELINE LEAK DETECTION

If nitrogen is used to facilitate the bubbling leak detection as described in Section 1.3.3 the nitrogen pressure will be limited to 20% SMYS (430 psi) of the piping in the test segment in order to comply with CFR 195.306.

If the leak closes or reduces to an undetectable rate, as determined in section 1.3.2.2, when the pressure reaches 430 psi or below the nitrogen bubble method in section 1.3.3 will not be feasible. Continue with the fluorescence dye detection method described in section 1.3.3, but with water as the medium instead of nitrogen so pressure can be increased above 430 psi up to test pressure and reopen the leak.

1.5 ATTACHMENTS

1.5.1 FLUORESCEIN DYE SAFETY DATA SHEET

TEXAS ANILINE DYE CO. INC.
1046 Austin Street, P. O. Box 477
Hempstead, Texas 77445 U.S.A.
979 826-2241, 826-2242
TOLL FREE: 1 800 346-5352

FAX NUMBER: 979 826-9462

FACSIMILE TRANSMISSION SHEET

DATE: August 3, 2004 pm

FROM: Al S. Culberson

NO. OF PAGES TO FOLLOW: - 6 -

FAX TO

COMPANY: **MIL-BAR Hydrotest**

ATTENTION: Laygon Bryant

FAX NUMBER: 318-222-2558

COMMENTS: MSDS: TADCO* Tracer Fluro Yellow XL-500-50 Liquid Dye

Information from the MERCK INDEX, Environmental study

B O D Information

If you have any problems receiving this document, or if pages are missing, please call 1 800 346-5352

MATERIAL DATA SHEETS

TEXAS ANILINE DYE COMPANY, INC.

SECTION I - IDENTIFICATION OF PRODUCT

TRADE NAME: TADCO* TRACER FLUR0 YELLOW XL500-50 LIQUID DYE

COLOR INDEX GENERIC NAME: ACID YELLOW 73

COLOR INDEX NUMBER: 45350 CAS NUMBER: 518-47-8

CHEMICAL FAMILY: XANTHENE

FORMULA: C20H1205.2Na

MANUFACTURER/DISTRIBUTOR: TEXAS ANILINE DYE COMPANY, INC.
1046 AUSTIN STREET
POST OFFICE BOX 477
HEMPSTEAD, TEXAS 77445

EMERGENCY PHONE NUMBER: 979 826-2241

FOR CHEMICAL EMERGENCY DURING TRANSPORTATION ONLY:
CALL INFOTRAC: 1-800-535-5053

DATE REVISED: JANUARY 3, 2001

PREPARED BY: AL S. CULBERSON
MARKETING AND TECH SERVICE DIRECTOR

SECTION II - WARNING

MAY CAUSE SKIN AND EYE IRRITATION.

SECTION III - HAZARDOUS INGREDIENTS

COMPONENT	CAS #	%	TLV	REFERENCE
ACID YELLOW	518-47-8	>65	NOT ESTABLISHED	

SECTION IV - PHYSICAL DATA

APPEARANCE: YELLOW-ORANGE LIQUID

ODOR: NO ODOR

SOLUBILITY IN WATER: SOLUBLE

PH: NOT AVAILABLE

SECTION V - FIRE AND EXPLOSION HAZARD INFORMATION.

FLASH POINT: NOT APPLICABLE

EXTINGUISHING MEDIA: FOAM, CO2, DRY CHEMICAL OR WATER SPRAY

SPECIAL FIRE FIGHTING PROCEDURES:
FIRE FIGHTERS SHOULD BE EQUIPPED WITH SELF CONTAINEDBREATHING APPARATUS AND PROTECTIVE CLOTHING.

SECTION V - FIRE AND EXPLOSION HAZARD INFORMATION.

UNUSUAL HAZARDS:
DUST MAY BE EXPLOSIVE IF MIXED WITH AIR IN CRITICAL PROPORTIONS AND IN THE PRESENCE OF SOURCE OF IGNITION.

SECTION VI - HEALTH HAZARDS INFORMATION

TOXOLOGICAL DATA: RAT, ORAL LD50, 6721 mg/kg

EFFECTS OF OVEREXPOSURE:
CANCER: ACID YELOW 73 IS REPORTED TO BE AN EQUIVOCAL TUMORIGENIC AGENT IN RATS (RTECS, NTP).
MUTATUION: ACID YELLOW 73 HAS SHOWN TO CAUSE MUTATIONS IN BACTERIA (RTECS).
BIRTH DEFECTS AND EFFECTS ON REPRODUCTION: REPRODUCTIVE AND NEWBORN EFFECTS HAVE BEEN REPORTED IN RABBITS EXPOSED TO ACID YELLOW 73 (RTECS). NO TERATOGENIC
EFFECTS WERE REPORTED IN OFFSPRING OF MICE EXPOSED TO ACID YELLOW 73 (SHIRAI,

1975, TOXBACK 65) OR IN OFFSPRING OF RATS EXPOSED TO THIS DYE (SALEN, 1979, TOXBACK 76).

EMERGENCY FIRST AID PROCEDURES:
INHALATION: IF INHALED, MOVE TO FRESH AIR. IF DIFFICULTY IN BREATHING, ADMINISTER OXYGEN AND GET IMMEDIATE MEDICAL ATTENTION.

INGESTION: IF SWALLOWED, GIVE SEVERAL GLASSES OF MILK OR WATER AND INDUCE VOMITING. GET IMMEDIATE MEDICAL ATTENTION. NEVER GIVE FLUIDS OR INDUCE VOMITING IF PATIENT IS UNCONSCIOUS OR HAS CONVULSIONS.

EYE CONTACT: FLUSH EYES WITH FLOWING WATER FOR AT LEAST 15 MINUTES. IF IRRITATION DEVELOPS, CONSULT A PHYSICIAN.

SKIN CONTACT: WASH AFFECTED SKIN AREAS THOROUGHLY WITH SOAP AND WATER. IF IRRITATION DEVELOPS, CONSULT A PHYSICIAN. REMOVE AND LAUNDER CONTAMINATED CLOTHING BEFORE REUSE.

SECTION VII - REACTIVITY DATA

STABILITY: STABLE
CONDITIONS TO AVOID: NONE KNOWN

POLYMERIZATION: WILL NOT OCCUR
CONDITIONS TO AVOID: NONE KNOWN

INCOMPATIBLE MATERIALS: NONE KNOWN

HAZARDOUS DECOMPOSITION PRODUCTS:
BURNING WILL PRODUCE OXIDES OF CARBON AND NITROGEN

SECTION VIII - PRECAUTIONS FOR SAFE HANDLING, USE AND DISPOSAL

STEPS TO BE TAKEN IN CASE MATERIAL IS RELEASED OR SPILLED:
WHERE EXPOSURE IS NOT KNOWN, WEAR A NIOSH APPROVED DUST RESPIRATOR AND SWEEP OR SHOVEL SPILLS, USING AN ABSORBENT TO PREVENT DUSTING, INTO A WASTE DISPOSAL CONTAINER. WASH DOWN AREA WITH WATER.

WASTE DISPOSAL METHOD:
DISPOSAL MUST BE IN ACCORDANCE WITH APPLICABLE GOVERNMENTAL REGULATIONS.

TADCO* TRACER FLURO YELLOW XL500-50 LIQUID DYE

SECTION IX - SPECIAL PROTECTION INFORMATION

RESPIRATORY PROTECTION: NIOSH APPROVED DUST RESPIRATOR.

VENTILATION: LOCAL EXHAUST TO MINIMIZE EXPOSURE.

PROTECTIVE GLOVES: WEAR RUBBER GLOVES

EYE PROTECTION: WEAR GOGGLES

OTHER PROTECTIVE MEASURES: WEAR APRON, COVERALLS, BOOTS AND LONG-SLEEVED SHIRT TO PREVENT SKIN CONTACT.

NOTE: EYEWASH FOUNTAINS SHOULD BE EASILY ACCESSIBLE. SHOWER AFTER HANDLING THIS PRODUCT. WORK CLOTHES SHOULD BE WASHED BEFORE REUSE. BEFORE EATING, DRINKING OR SMOKING, WASH HANDS AND FACE WITH SOAP AND WATER.

SECTION X - SPECIAL PRECAUTIONS

IN ACCORDANCE WITH GOOD INDUSTRIAL PRACTICES, HANDLE WITH CARE AND AVOID PERSONAL CONTACT.

SECTION XI - HAZARD RATING

HMIS RATING:

HEALTH - 1
FIRE - 1
REACTIVITY - 0
PERSONAL PROTECTION - SD

DISCLAIMER: Texas Aniline Dye Company, Inc. believes all the information and data given is accurate as of the date of preparation and is offered in good faith. This information is given without warranty or representation solely for your consideration, investigation, and verification. Since conditions of use are beyond our control, Texas Aniline Dye Company, Inc. expressly disclaims all liability for the use or handling of this product.

TEXAS ANILINE DYE CO., INC.
1046 Austin Street, P. O. Box 477
Hempstead, Texas 77445 U.S.A.
409 826-2241, 826-2242
TOLL FREE 1 800-346-5352

Dye Gram for Color Engineering

September 8, 1994

ENVIRONMENTAL DATA

PRODUCT: TADCO* TRACER FLURO YELLOW XL500-50 LIQUID DYE

(Source of Information) Title: Toxicity of Rhodamine B and Fluroescine Sodium to Fish and Their Compability with Antimycin A

Journal/Source: Prog. Fish-Cult. 31 (3):139-142
(Author Communication Used)

Species Identification: Bluegill, fish
Effect Endpoint Type: LC50
Effect Concentration: 3433000 (F)
Confidence Limits: 3922000 to 402800
Units: UG/L (Micro Grams/Liter)

Species Identification: Channel Catfish, fish
Effect Endpoint Type: LC50
Effect Concentration: 2267000 (F)
Confidence Limits: 1928000 to 2670000
Units: UG/L (Micro Grams/Liter)

Species Identification: Rainbow Trout, fish
Effect Endpoint Type: LC50
Effect Concentration: 1372000 (F)
Confidence Limits: 1023000 to 1840000
Units: UG/L (Micro Grams/Liter)

Year of Publication 1969

SELLER WARRANTS TO REPLACE THE PRODUCT DESCRIBED HEREIN TO THE EXTENT THAT SAID PRODUCT IS DEFECTIVE IN MANUFACTURE OR OTHERWISE DOES NOT CONFORM TO THE DESCRIPTION CONTAINED HEREIN. SAID REPLACEMENT SHALL BE THE BUYERS SOLE AND EXCLUSIVE REMEDY AGAINST SELLER. THE FOREGOING WARRANTY IS IN LIEU OF ALL OTHER WARRANTIES, EXPRESS OR IMPLIED, INCLUDING WITHOUT LIMITATION ANY EXPRESS OR IMPLIED WARRANTIES OF MERCHANTABILITY OR OF FITNESS FOR A PARTICULAR PURPOSE OR APPLICATION. IN NO EVENT SHALL SELLER BE RESPONSIBLE FOR CONSEQUENTIAL DAMAGES OR FOR MONEY DAMAGES OF ANY KIND EXCEPT AS STATED IN THIS LIMITED WARRANTY. SELLER SHALL NOT BE LIABLE FOR ANY DEFECTS IN, OR BREACH OF ANY CONTRACT RELATING TO, THE QUALITY OF OR PERFORMANCE OF THE PRODUCT DESCRIBED HEREIN UNDER ANY THEORY OF LAW INCLUDING, WITHOUT LIMITATION, CONTRACT, NEGLIGENCE, TORT, STRICT LIABILITY OR MISREPRESENTATION.

TEXAS ANILINE DYE CO. INC.
1046 Austin Street, P. O. Box 477
Hempstead, Texas 77445 U.S.A.
979 826-2241, 826-2242
TOLL FREE: 1 800 346-5352

February 27, 2001

BIODEGRADATION

TADCO* TRACER FLURO YELLOW XL-500-50 LIQUID DYE

The rate and ultimate potential of a substance to biodegrade is commonly measured by the biochemical oxygen demand (BOD). Bod is the oxygen uptake during breakdown of the material by microorganisms present in the environment. The % Bod compares microbial oxygen usage with the amount of oxygen consumed during complete chemical oxidation.

Based on the results of an independent EPA certified testing laboratory, the following evaluation was achieved for this dye.

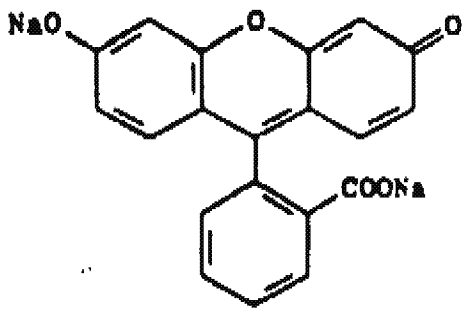
		% BOD After		
CI Name	Texas Aniline Dye Co. Name	7 days	12 days	20 days
Acid Yellow 73	TADCO* Tracer Fluro XL500-50 Liquid Dye	65	68	100

We appreciate this opportunity to be of service.

TADEN FROM PAGE 595 THE MERCK INDEX, TENTH EDITION

our produce; TADCO* Tracer Fluro Yellow XL-500-50 liquid dye

4062. Fluorescein Sodium. *3',6'-Dihydroxyspiro[isobenzofuran-1(3H),9'-[9H]xanthen]-3-one disodium salt;* soluble fluorescein; resorcinol phthalein sodium; uranin(e); uranine yellow; D & C Yellow No. 8; C.I. Acid Yellow 73; C.I. 45350; Funduscein. $C_{20}H_{10}Na_2O_5$; mol wt 376.27. C 63.84%, H 2.68%, Na 12.22%, O 21.26%. Prepn and refs: *C.I.* vol. 4 (3rd ed., 1971) p 4424. Toxicity studies in fish: L. L. Marking, *Progr. Fish Cult.* 31, 139 (1969). *Note:* Structure is depicted as the open tautomer, *cf.* Fluorescein.



Hygroscopic orange-red powder. Freely sol in water with yellowish-red color and intense yellowish-green fluorescence perceptible down to a dil of 0.02 ppm under uv light. The fluorescence disappears when the soln is made acid, and reappears when the soln is again made neutral or alkaline. Absorption max (water): 493.5 nm. Slightly sol in alc. LD_{50} orally in mice, rats: 4738, 6721 mg/kg. S. L. Yankell, J. J. Loux, *J. Periodontol.* 48, 228 (1977).

USE: In examining subterranean waters. Serves to ascertain source of springs, connections between streams and sea, determining approx vol of water delivered by a spring, detecting source of contamination of drinking water, infiltration of soil with waste waters of factories, etc. Approved by FDA for use in externally applied drugs and cosmetics.

THERAP CAT: Diagnostic aid (corneal trauma indicator).

THERAP CAT (VET): In solution as a diagnostic aid in corneal lesions, intra-ocular inflammation.

ENBDNR0003310

1.5.2 TRACER GAS SAFETY DATA SHEET

Product: Tracer E	SDS No. P-19-6371-TE-A October 2012

1. Chemical Product and Company Identification

Product Name: Tracer E		**Trade Names:** Tracer E	
Chemical Name: Trade Secret		**Synonyms:** Trade Secret	
Chemical Family: Trade Secret		**Product Grades:** None assigned.	
Emergency Telephone Numbers: *			**Company Name:** Praxair, Inc. 39 Old Ridgebury Road Danbury, CT 06810-5113
Onsite emergencies:	1-800-645-4633		
CHEMTREC:	1-800-424-9300		

* Call emergency numbers 24 hours a day only for spills, leaks, fire, exposure, or accidents involving this product. For routine information, contact your supplier, Praxair sales representative, or call 1-800-772-9247.

2. Hazard Identification

EMERGENCY OVERVIEW

WARNING! May irritate the eyes, skin, and respiratory tract.

May be harmful if inhaled or swallowed.

Toxic and corrosive vapors will form if exposed to flames or glowing hot surfaces.

In case of fire, rescue workers may need to use self contained breathing apparatus and protective clothing.

Under ambient conditions, this is a colorless, odorless liquid.

OSHA REGULATORY STATUS: This material is considered hazardous by the OSHA Hazard Communications Standard (29 CFR 1910.1200).

POTENTIAL HEALTH EFFECTS:

Effects of a Single (Acute) Overexposure

Inhalation: No effect reported. Liquid or vapor may irritate the respiratory tract.

Skin Contact: No effect reported. Liquid or vapor may irritate the skin.

Swallowing: May be harmful if swallowed. May cause discomfort and distension.

Eye Contact: No effect reported. Liquid or vapor may irritate the eyes.

Effects of Repeated (Chronic) Overexposure: None known. Repeated or prolonged exposure of the skin may cause dermatitis (inflammation of the skin).

←A vertical line in the left margin indicates revised or new material.

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Other Effects of Overexposure: None known.

Medical Conditions Aggravated by Overexposure: No effect reported. The skin irritating properties of this material may aggravate an existing dermatitis. Respiratory irritation may aggravate an existing asthma or other upper respiratory or pulmonary disease.

CARCINOGENICITY: This material is not listed by NTP, OSHA, or IARC.

POTENTIAL ENVIRONMENTAL EFFECTS: None known. For further information, see section 12, Ecological Information.

3. Composition/Information on Ingredients

See section 16 for important information about mixtures.

COMPONENT	CAS NUMBER	CONCENTRATION
Trade Secret	Trade Secret	>99%*

** The symbol > means "greater than."*

4. First Aid Measures

INHALATION: Remove to fresh air. If not breathing, give artificial respiration. If breathing is difficult, qualified personnel may give oxygen. Get immediate medical attention if adverse symptoms are present.

SKIN CONTACT: In case of skin contact, remove contaminated clothing and wash affected area with soap and water. Seek medical attention if symptoms arise.

SWALLOWING: Keep the victim calm, and get immediate medical aid. If conscious, the victim may be given water. Do not induce vomiting unless directed to do so by medical personnel.

EYE CONTACT: Immediately flush eyes thoroughly with water for at least 15 minutes. Hold the eyelids open and away from the eyeballs to ensure that all surfaces are flushed thoroughly. See a physician, preferably an ophthalmologist.

NOTES TO PHYSICIAN: *There is no specific antidote. Treatment of overexposure should be directed at the control of symptoms and the clinical condition of the patient.*

5. Fire Fighting Measures

FLAMMABLE PROPERTIES: Nonflammable.

SUITABLE EXTINGUISHING MEDIA: Use media appropriate for surrounding fire.

PRODUCTS OF COMBUSTION: Not applicable. See section 10 for thermal decomposition products.

PROTECTION OF FIREFIGHTERS: Evacuate all personnel from danger area. Wear self-contained breathing apparatus where needed. In the presence of fire, this material will produce toxic and corrosive vapors. Immediately deluge containers with water spray from maximum

distance until cool; then move them away from fire area if without risk. On-site fire brigades must comply with OSHA 29 CFR 1910.156 and applicable standards under 29 CFR 1910 Subpart L—Fire Protection.

Specific Physical and Chemical Hazards: Heat of fire may build pressure in container, causing rupture. No part of a container should be subjected to temperatures above 125°F (52°C).

Protective Equipment and Precautions for Firefighters: Firefighters should wear self-contained breathing apparatus and full fire-fighting turnout gear.

6. Accidental Release Measures

STEPS TO BE TAKEN IF MATERIAL IS RELEASED OR SPILLED:

Personal Precautions: Do not get on skin, in eyes, or on clothing. Use solid absorbent to pick up spilled material. Ventilate area of spill, or move leaking container to a well-ventilated area. Prevent runoff from contaminating surrounding environment.

Environmental Precautions: Prevent spill from contaminating the surrounding environment. Discard any product, residue, disposable container, or liner in an environmentally acceptable manner, in full compliance with federal, state, and local regulations. If necessary, call your supplier for assistance.

7. Handling and Storage

PRECAUTIONS TO BE TAKEN IN HANDLING: Do not get liquid or vapor in eyes, on skin, or on clothing. Have safety showers and eyewash fountains immediately available to exposed workers. Protect containers against physical damage. Wash thoroughly after handling. Do not eat, drink, or smoke in areas where this material is stored or used. After working with this product, wash face and hands thoroughly with soap and water before eating, drinking, smoking, applying cosmetics, or using the toilet.

PRECAUTIONS TO BE TAKEN IN STORAGE: Store in a cool, dry, well-ventilated area. Keep container closed when not in use and when empty.

8. Exposure Controls/Personal Protection

COMPONENT	OSHA PEL	ACGIH TLV (2012)
Trade Secret	Not Established.	Not Established.

IDLH = Not available.

ENGINEERING CONTROLS:

Local Exhaust: Use local exhaust ventilation with sufficient air flow velocity to keep vapor concentrations low.

Mechanical (General) : May be acceptable under certain conditions, if sufficient, to keep vapor concentrations low.

Special: None

Other: None

PERSONAL PROTECTIVE EQUIPMENT:
Skin Protection: Wear protective gloves and protective clothing where needed. Select in accordance with OSHA 29 CFR 1910.132, 1910.136, and 1910.138.

Eye/Face Protection: Select in accordance with OSHA 29 CFR 1910.133.

Respiratory Protection: Use air-supplied respirators where vapor concentrations are high. Respiratory protection must conform to OSHA rules as specified in 29 CFR 1910.134. Select per OSHA 29 CFR 1910.134 and ANSI Z88.2.

9. Physical and Chemical Properties

APPEARANCE:	Colorless liquid
ODOR:	Odorless
ODOR THRESHOLD:	Not available.
PHYSICAL STATE:	Liquid at normal temperature and pressure
pH:	Not applicable.
MELTING POINT at 1 atm:	<32°F* (<0°C*) Withheld for trade secret protection
BOILING POINT at 1 atm:	>100°F*, <150°F* (>38°C* <65°C*) Withheld for trade secret protection
FLASH POINT (test method):	Not applicable.
EVAPORATION RATE:	Fast
FLAMMABILITY:	Nonflammable
FLAMMABLE LIMITS IN AIR, % by volume:	**LOWER:** Not applicable. **UPPER:** Not applicable.
VAPOR PRESSURE at 68°F (20°C):	>6* psig (400 mbar) Withheld for trade secret protection
LIQUID DENSITY at 77°F (25°C):	>75* lb/ft^3 (>1.2* kg/L) Withheld for trade secret protection
VAPOR DENSITY at 77°F (25°C) and 1 atm:	>0.12* lb/ft^3 (>0.002* kg/L) Withheld for trade secret protection.
SPECIFIC GRAVITY (H_2O = 1) at 77°F (25°C) and 1 atm :	>1.2* Withheld for trade secret protection
SPECIFIC GRAVITY (Air = 1) at 77°F (25°C) and 1 atm:	>2* (calculated) Withheld for trade secret protection
SOLUBILITY IN WATER 68°F (20°C):	Insoluble
PARTITION COEFFICIENT: n-octanol/water:	Not available.

9. Physical and Chemical Properties

AUTOIGNITION TEMPERATURE:	Not applicable.
DECOMPOSITION TEMPERATURE:	>400°C*
PERCENT VOLATILES BY VOLUME:	100

**The symbol > means "greater than." The symbol < means "less than."*

10. Stability and Reactivity

CHEMICAL STABILITY: ☐ Unstable ☒ Stable

CONDITIONS TO AVOID: Fire, hot surfaces (>400°C)

INCOMPATIBLE MATERIALS: Lithium, sodium, potassium, calcium, and barium

HAZARDOUS DECOMPOSITION PRODUCTS: Thermal decomposition may produce toxic and corrosive vapors.

POSSIBILITY OF HAZARDOUS REACTIONS: ☒ May Occur ☐ Will Not Occur

Thermal decomposition may produce toxic and corrosive vapors.

11. Toxicological Information

ACUTE DOSE EFFECTS: None known.

STUDY RESULTS: None known.

12. Ecological Information

ECOTOXICITY: No known effects.

OTHER ADVERSE EFFECTS: This material does not contain any Class I or Class II ozone-depleting chemicals.

13. Disposal Considerations

WASTE DISPOSAL METHOD: Discard any product, residue, disposable container, or liner in an environmentally acceptable manner, in full compliance with federal, state, and local regulations. If necessary, call your supplier for assistance.

14. Transport Information

DOT/IMO SHIPPING NAME: Not regulated.			
HAZARD CLASS: NA*	**PACKING GROUP/Zone:** NA*	**IDENTIFICATION NUMBER:** NA*	**PRODUCT RQ:** None
SHIPPING LABEL(s): NA*			
PLACARD (when required): NA*			

**NA-Not applicable.*

MARINE POLLUTANTS: This material is not listed as a marine pollutant by DOT.

15. Regulatory Information

The following selected regulatory requirements may apply to this product. Not all such requirements are identified. Users of this product are solely responsible for compliance with all applicable federal, state, and local regulations.

U.S. FEDERAL REGULATIONS:

EPA (ENVIRONMENTAL PROTECTION AGENCY)

CERCLA: COMPREHENSIVE ENVIRONMENTAL RESPONSE, COMPENSATION, AND LIABILITY ACT OF 1980 (40 CFR Parts 117 and 302):

Reportable Quantity (RQ): None

SARA: SUPERFUND AMENDMENT AND REAUTHORIZATION ACT:

SECTIONS 302/304: Require emergency planning based on Threshold Planning Quantity (TPQ) and release reporting based on Reportable Quantities (RQ) of Extremely Hazardous Substances (EHS) (40 CFR Part 355):

TPQ: None
EHS RQ (40 CFR 355): None

SECTIONS 311/312: Require submission of MSDSs and reporting of chemical inventories with identification of EPA hazard categories. The hazard categories for this product are as follows:

IMMEDIATE: No
DELAYED: No
PRESSURE: No
REACTIVITY: No
FIRE: No

SECTION 313: Requires submission of annual reports of release of toxic chemicals that appear in 40 CFR Part 372.

This material is not subject to reporting under Section 313.

40 CFR 68: RISK MANAGEMENT PROGRAM FOR CHEMICAL ACCIDENTAL RELEASE PREVENTION: Requires development and implementation of risk management programs at facilities that manufacture, use, store, or otherwise handle regulated substances in quantities that exceed specified thresholds.

This material is not listed as a regulated substance.

TSCA: TOXIC SUBSTANCES CONTROL ACT: This material is listed on the TSCA inventory.

OSHA: OCCUPATIONAL SAFETY AND HEALTH ADMINISTRATION:

29 CFR 1910.119: PROCESS SAFETY MANAGEMENT OF HIGHLY HAZARDOUS CHEMICALS: Requires facilities to develop a process safety management program based on Threshold Quantities (TQ) of highly hazardous chemicals.

This material is not listed in Appendix A as a highly hazardous chemical.

STATE REGULATIONS:

CALIFORNIA: This material is not listed by California under the SAFE DRINKING WATER AND TOXIC ENFORCEMENT ACT OF 1986 (Proposition 65).

PENNSYLVANIA: This material is subject to the PENNSYLVANIA WORKER AND COMMUNITY RIGHT-TO-KNOW ACT (35 P.S. Sections 7301-7320).

16. Other Information

Be sure to read and understand all labels and instructions supplied with all containers of this product.

OTHER HAZARDOUS CONDITIONS OF HANDLING, STORAGE, AND USE: Store and use with adequate ventilation at all times. Keep container closed when not in use, even when empty. Use only with compatible materials and equipment.

Mixtures. When you mix two or more chemicals, you can create additional, unexpected hazards. Obtain and evaluate the safety information for each component before you produce the mixture. Consult an industrial hygienist or other trained person when you evaluate the end product. Remember, chemicals have properties that can cause serious injury or death.

HAZARD RATING SYSTEMS:

NFPA RATINGS:		HMIS RATINGS:	
HEALTH	= 1	HEALTH	= 1
FLAMMABILITY	= 0	FLAMMABILITY	= 0
INSTABILITY	= 0	PHYSICAL HAZARD	= 0
SPECIAL	= None		

Last revised 1 October 2012.

Product: Tracer E	SDS No. P-19-6371-TE-A October 2012

Praxair asks users of this product to study this MSDS and become aware of product hazards and safety information. To promote safe use of this product, a user should (1) notify employees, agents, and contractors of the information in this MSDS and of any other known product hazards and safety information, (2) furnish this information to each purchaser of the product, and (3) ask each purchaser to notify its employees and customers of the product hazards and safety information.

The opinions expressed herein are those of qualified experts within Praxair, Inc. We believe that the information contained herein is current as of the date of this Material Safety Data Sheet. Since the use of this information and the conditions of use of the product are not within the control of Praxair, Inc., it is the user's obligation to determine the conditions of safe use of the product.

Praxair MSDSs are furnished on sale or delivery by Praxair or the independent distributors and suppliers who package and sell our products. To obtain current MSDSs for these products, contact your Praxair sales representative or local distributor or supplier. If you have questions regarding Praxair MSDSs, would like the form number and date of the latest MSDS, or would like the names of the Praxair suppliers in your area, phone or write the Praxair Call Center (**Phone:** 1-800-PRAXAIR; **Address:** Praxair Call Center, Praxair, Inc., PO Box 44, Tonawanda, NY 14151-0044).

Praxair, *Making our planet more productive*, and the *Flowing Airstream* design are trademarks or registered trademarks of Praxair Technology, Inc. in the United States and/or other countries.

Praxair, Inc.
39 Old Ridgebury Road
Danbury, CT 06810-5113

APPENDIX D – WATER ACQUISITION WATER QUALITY STANDARDS

ENBDNR0003320

CITY OF ST.IGNACE
2014
WATER QUALITY REPORT

IS MY WATER SAFE

Last year, as in years past, your tap water meets all U.S.P.A. Env. Protection Agency (EPA) and state drinking water health standards. The City of St.Ignace vigilantly safeguards its water supplies and we are proud to report that our system has never violated a Max. Cont. level or any other water quality standard.

WHERE DOES MY WATER COME FROM?

The City of St.Ignace supplies water from Lake Huron. The water is pumped to the water plant. A chem.. called Alum is added to the water to help clump together particles that make the water supply water cloudy ar turbid. The water then passes through filter to remove these clumps. Fluoride is added to the water daily to prevent tooth decay and cavities. Soda Ash is added to control corrosion. Corrosive water can cause lead and copper to leach out of pipes. Chlorine is added to the treatment process to kill harmful bacteria.

WHY ARE THERE CONTAMINANTS IN MY DRINKING WATER?

Drinking water, including bottled water, may reasonably be expected to contain at least small amounts of some contaminants. The presence of contaminants does not necessarily indicate that water poses a health risk. The sources of drinking water (both tap and bottled) include rivers, lakes, streams, ponds, reservoirs, springs, and wells. As water travels over the surface of the land or through the ground it dissolves naturally occurring minerals and, in some cases radioactive materials, and can pick up substances resulting from the presence of animals or from human activity.

1. Microbial Contaminants, such as viruses and bacteria, which may come from sewer treatment plants, septic systems, farming operations, swimmers and wildlife.
2. Inorganic contaminants, such as salts and metals, which can be naturally occurring or result from urban storm water runoff, industrial or domestic wastewater discharge, oil and gas products, or farming.
3. Pesticides and Herbicides, which may come from a variety of sources such as agriculture, storm water runoff, and residential users.
4. Organic Chemical Contaminants, including synthetic and volatile organic chemicals, which are by-products of industrial processes and storm water runoff, and septic systems.
5. Radioactive contaminants, which can be naturally occurring or be the result of oil and gas production and mining activities. In order to ensure that tap water is safe to drink, EPA prescribes regulations which limit the amount of certain contaminants in water provided by pubic water systems. Food and Drug Administration (FDA) regulations establish limits for contaminants in bottled water which must provide the same protection for public health.
6. If present, elevated levels of lead can cause serious health problems, especially for pregnant women and young children. Lead in drinking water is primarily from materials and components associated with service lines and home plumbing. St. Ignace Water Department is resoponsible for providing high quality drinking water, but cannot control the variety of materials used in plumbing components. When your water has been sitting for several hours, you can minimize the potential for lead exposure by flushing your tap for ½ to 2 min. before using water for drinking or cooking. If you are concerned about lead in your water, you may have your water tested. Contact your local Water Dept. w/questions.

DO I NEED TO TAKE SPECIAL PRECAUTIONS?

Some people may be more vulnerable to contaminants in drinking water than the general population. Immuno-compromised persons such as persons with cancer undergoing chemotherapy, persons who have undergone organ transplants, people with HIV/AIDS or other immune system disorders, some elderly, and infants can be particularly at risk from infections. These people should seek advice about drinking water from their health care providers. EPA/Centers for Disease Control (CDC) guidelines on appropriate means to lessen the risk of infection by Cryptosporidium and other microbial contaminants and Health affects are available from the Safe Drinking Water Hotline (1-800-426-4791)

2014
WATER QUALITY DATA TABLE

The table below lists all of the drinking water contaminants that we detected during the calendar year of this report. The presence of contaminants in the water does not necessarily indicate that the water poses a health risk Unless otherwise noted, the data presented in this table is from testing done in the calendar year of the report. The EPA or the State requires us to monitor for certain contaminants less than once per year because the concentrations of these contaminants do not change frequently. Some of the data though representative of the water quality , may be more than one year old.

TERMS AND ABREVIATIONS USED.

MCLG: Maximum Contaminant Level Goal: The level of a contaminant in drinking water below which there is no known or expected risk to health. MCLG's allow for a margin of safety.

MCL: Maximum Contaminant Level: The highest level of a contaminant that is allowed in drinking water. MCL's are set as close to the MCLG as feasible using the best available treatment technology.

AL: Action Level: the concentration of a contaminant which, if exceeded, triggers treatment or other requirements which a water system must follow.

UNIT DESCRIPTIONS

ppm – parts per million
ppb – parts per billion
nd – not detected
na – not applicable
NTU – Nephelometric turbidity unit
pCi/l – pico curies per liter

CONTAMINANTS	MCLG	MCL	your water	RANGE low	RANGE high	sample date	violations	typical source
ORGANIC CONTAMINANTS (ppb)								
Total Trihalomethanes		80	29	21	39	2014	no	by-product of chlorination
Total Haloacetic Acid		80	9	6	12	2014	no	by-product of chlorination
Radiological (pCi/l)								
Alpha			<3			2003	no	
Ra-226			1.17			2003	no	
Ra228			<1			2003	no	
Inorganic Contaminates (ppm)								
Fluoride	4	4	0.95	0.00	1.32	2014	no	add to promote strong teeth
Unregulated Contaminants (ppm)								
Sodium	na	na	10			2014	no	naturally present / erosion
Nitrates	10	10	ND	na		2014	no	naturally present / erosion
Microbiological Comtaminants (ppm)								
Total Coliform	0	1	0	nd		2014	no	soil runoff
Turbidity	0.3	5	0.05	0.04	0.08	2014	no	soil runoff

*Lead & Copper Monitoring (ppb)	AL	your water	# of sites, out of 10, over AL			
Lead (ppb)	15	1.7	0	2014	no	corrosion of household
Copper (ppb)	1300	370	0	2014	no	plumbing

The "Source Water Assessment Report" for the City of St.Ignace was completed in October of 2003 and is on file at the Water Treatment Plant or City Hall.

Consumer Confidence Reports (CCR) will not be mailed individually.

CCR's can be obtained at City Hall.

FOR MORE INFORMATION – CONTACT – LES THERRIAN

OR TO RECEIVE REPORT

ST.IGNACE WATER DEPARTMENT
999 CHURCH ST.
PHONE – (906) 643-9671 or 7451

APPENDIX E – MINIMUM ONSITE WATER TREATMENT WATER QUALITY STANDARDS

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Ludington, MI 49431

office 231.843.2711
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proact-usa.com

4/21/17

Gary Zunkel, PE

Senior Director of Integrity Management

LAKE SUPERIOR CONSULTING

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Duluth, MN 55802

Cell 515-509-9058

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www.LSConsulting.com

RE: Enbridge – Line 5 – ProAct Treatment System discharge parameters – Water Quality Report

Based on previous hydrostatic test projects with Enbridge, the following parameters will be tested and complied with, even though the water will be hauled from the lake tank to the St. Ignace WWTP. At no time will ProAct send water to the WWTP if it exceeds these set parameters. These parameters are based on the ability to discharge this treated hydro-test water to the ground surface, even though it is going to the WWTP.

Suspended Solids, Total	<30 mg/l
PH: Field Test:	6-9 S.U
Oil & Grease:	<10 mg/l
BTEX, Total:	<750ug/l
Benzene:	<50ug/l
PAHs:	<0.1ug/l

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Ludington, MI 49431

office 231.843.2711
fax 231.843.4081

proact-usa.com

If you have any questions or concerns about these parameters, please do not hesitate to contact me.

Best Regards,

John Britton

John Britton
Hydrostatic Water Treatment Specialist

1140 Conrad Industrial Dr. | Ludington, MI 49431
mobile 231.690.5841 | office 231.843.2711 | fax 231.843.4081

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