OIL PIPELINE RUPTURE
Sun-Canadian Pipe Line Company Ltd.
8 Inch Line, Mile Post 1.044
Sarnia, Ontario
September 10, 2013

SR# 1175446

The Technical Standards and Safety Authority (TSSA) Fuels Safety Program (FS) investigated this occurrence for the purposes of advancing pipeline safety and to determine if mandated regulatory requirements were complied with by the operator, and to assess whether the current requirements are adequate to minimize any possibility of a reoccurrence.

Synopsis:

At 11:28 Eastern Standard Time, on Tuesday, September 10, 2013, a rupture occurred on the Sun-Canadian pipeline: a 219 millimetre outside diameter pipeline designated as the 8" line at mile post 1.044 (intersection of Vidal St. and Churchill St.) in Sarnia, Ontario. Approximately 60 cubic metres (m^3) (which was the final established quantity) of ultra low sulfur diesel was released and gained access to a nearby sewer system. Some of the spilled diesel reached the St. Clair River resulting in precautionary measures being taken by downstream communities to close their drinking water intakes (notably Walpole Island First Nation). During the emergency response approximately 22 m^3 of diesel was recovered by removing the impacted soil as part of the remediation and sediment removal from the storm water system.

The FS program determined that the rupture was caused by excessive external localized corrosion, which was not identified through the company's ongoing pipeline integrity program as the products of corrosion were determined to be magnetic. The magnetic products of corrosion altered the capabilities of the magnetic flux leakage (MFL) based inline inspection tools.

Note: Minor editorial changes relating to style and grammar were made to this report since it was first finalized on May 16, 2014.

Contents

1.0 Factual Information

1.1 The Accident

On September 10, 2013, at 11:28 a.m. the Sun-Canadian Pipe Line Company Ltd. (SCPL) nominal pipe size (NPS) 8 inch (8.625-in OD) main refined petroleum products pipeline, designated as the 8" line, suddenly experienced a simultaneous loss of operating pressure and increased flow rates at the Sarnia Pump Station. The uncontrolled release of ultra low sulfur diesel (the batch being transported at that time) was later found to be at kilometer post 1.044 at the intersection of Vidal Street and Churchill Street in Sarnia, Ontario. The Control Centre Operator (CCO), located in Waterdown, Ontario, remotely operates the Sarnia Pump Station 24 hours a day, seven days a week. The pump station is manned by two maintenance personnel (Sarnia Area Coordinators) during the week (regular business hours).

Diesel Release Timeline:

At 11:30:31 a.m. - The audible leak alarm on the control console in the Waterdown Control Centre (WCC) sounded. The CCO reviewed the pressure trend display.
At 11:31:06 a.m. - The CCO shut off the booster pump at the Sarnia pump station. SCPL's management (Operations Manager) was notified of the suspected leak.
At 11:34:36 a.m. - Activated closure of nearest motor operated valve at Kerwood pump station.
At 11:35 a.m. - The Sarnia Area Coordinator notified dispatch to check the pump station facilities and then close the valves at mile post 4 and mile post 12. These valves were confirmed closed by the Sarnia Area Coordinator at 12:06 p.m.
At 11:36 a.m. - A 911 call regarding the leak at Vidal/Churchill intersection was received, Sarnia Police and Fire Services were mobilized.
At 11:39 a.m. - The Duty Dispatcher called the Suncor Refinery notifying them of the emergency pipeline shutdown of the 8" line.
At 11:42 a.m. - Notification to the Spills Action Center (by others).
At 11:45 a.m. - CVECO Code 5 issued for the Sarnia area.
At 12:06 p.m. - The manually operated isolation valve at mile post 4 was closed.
At 12:39 p.m. - Sun-Canadian notified the Spills Action Centre (they were advised that a call had already been received).
At 12:47 p.m. - Company employees (Sarnia Area Coordinator) located the occurrence site at mile post 1.044, approximately one kilometre north of the Sarnia Pump Station and proceeded to secure the occurrence site. The closest sectionalizing valve upstream of the rupture site is located at the Sarnia pump station, which was remotely closed as part of the pump shutdown. The nearest sectionalizing valve downstream of the site is a manually operated valve located at mile post 4 (MacGregor Road) which was manually closed by 12:06 p.m. The next closest sectionalizing valve downstream of the rupture site is located at the Kerwood pump station and had been remotely closed earlier by the CCO.

At approximately the same time, plans were put in motion by the Deputy Incident Commander SCPL's pipeline staff to activate the spill response as per SCPL Oil Spill Manual in order to:

1. Limit the scope of contamination of the released diesel;
2. Begin the task of containing and collecting the released diesel;
3. Begin the task of storing the released diesel and contaminated water at the occurrence site to portable storage tanks for future removal from the area;
4. Commence the mobilization of the repair team and associated repair equipment to the site; and
5. Cut a segment of the ruptured pipeline and commence initial cleanup.

SCPL was ordered by TSSA to shut the 8" line off until the completion of the investigation and a possible return to service is evaluated.

1.2 Injuries

There were no injuries as a result of this occurrence.

1.3 Damage to Equipment - Product Lost

Damage to the 8" line consisted of approximately 6" (150 mm) of ruptured pipe which had split open in the longitudinal direction, approximately in the five/six o'clock position.

It is estimated that approximately 60 m^3 of diesel was released into the environment. Based on the measurements and calculations completed, total volume of diesel recovered via pumping the impacted water was approximately 22 m^3.

Estimated 22 m^3 does not include:

- Diesel recovered with the liquid waste removed during the site remediation;
- Diesel absorbed and contained in excavated solid (soil/material) removed from the ruptured pipeline site;
- Diesel absorbed by the sediment, which was removed in the process of storm sewer cleaning; and
- Volume loss due to evaporation.

The initial cleanup was completed and no long-term impact on fish, livestock or wildlife habitats was anticipated by SCPL and the authorities having jurisdiction (AHJ).

The section of pipe removed for inspection at the previously approved test laboratory (Kiefner & Associates, Inc.) was replaced with API LX52 pretested pipe and the tie-ins welds (two butt welds) radiographically inspected. The pipe was sand-blasted then coated with a two part epoxy resin.

1.4 Weather

Due to a sudden heat wave, temperatures spiked to a record-breaking 34.8 degrees for September 10, 2013. The previous record in the city for that day was set in 1983 at 34.4 degrees. The winds were out of the southwest at 20 to 25 km/h.

1.5 Particulars of the Pipeline System

Ontario Regulation 210/01 (Oil and Gas Pipeline Systems) issued under the *Technical Standards and Safety Act* governs the use and operation of pipelines in Ontario. O. Reg 210/01 applies to pipelines that start and end in Ontario while the Federal Government and the National Energy Board regulate pipelines that cross provincial or international borders or major waterways. Oil pipelines that are more than 20 kilometres long must be licensed by TSSA. All incidents involving pipelines must be reported to TSSA. Pipelines are audited by TSSA every five years.

The national CSA Z662-11 Oil and Gas Pipelines Systems Code is adopted in Ontario and defines construction, operation, maintenance and upgrades.

Key regulatory requirements for oil pipeline operators are:

- Safety Management;
- Damage Prevention;
- Emergency Management;
- Integrity Management;
- Security; and
- Environmental Protection.

Other AHJs associated with the operation:

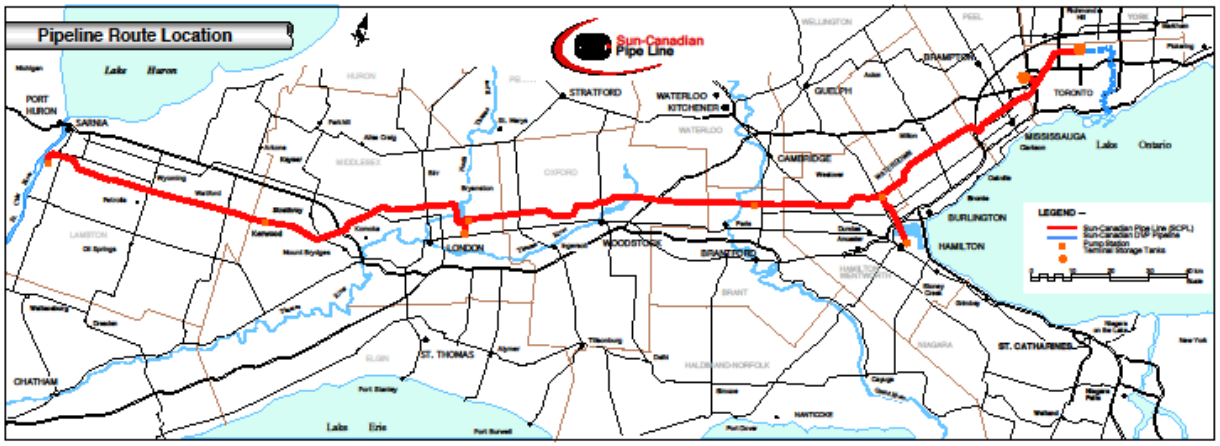
- Ministry of Environment - responsible for contamination and cleanup
- Ministry of Labour - responsible for work related activities

Licensee specific information:

Sun-Canadian Pipe Line Company Ltd. is the holder of license number 000157285.

Size, Location and Characteristics of the Facilities:

SCPL transports low vapour pressure (LVP) refined petroleum products, namely gasoline, diesel, jet fuel and fuel oil from Suncor and Shell refineries in Sarnia to London, Hamilton, and the Greater Toronto Area. The system is composed of two transmission pipeline systems (8" and 12"); it includes a 6 inch supply product spur line to the Hamilton terminal and its total length is approximately 644 kilometres. The products are transported in batches at a rate of 18,000 m^3/day and at a pressure of 9900 kPa in both pipeline systems. Pumping stations at Sarnia, Kerwood, London, Paris and Waterdown maintain the required transportation pressure.



The last audit of the pipeline by TSSA is dated May, 2011. No code or regulation violation was detected. However, TSSA made non-mandatory recommendations to enhance safety and these recommendations were submitted to SCPL for review. SCPL was given the opportunity to accept or challenge the recommendations. The recommendations were accepted. One of the recommendation was to upgrade SCPL pipelines by automating all mainline valves in the pipeline so that the valves can be operated remotely and quickly shutdown in order to minimize leaks in case of pipeline rupture.

The recommendation did not set a deadline for compliance. SCPL included this recommendation in its budget and in 2013 six main line valves were automated based on an assessment to determine the most effective ones to reduce a potential spill. However, the valve at Mile Post 4, required to shut the pipeline segment containing the ruptured section, was not automated. Even if the valves on each side of the ruptured pipeline had been

automated, the spill amount resulting from the ruptured pipe would not have been significantly less than the approx. 60m^3 spilled since the terrain in the Sarnia area is flat.

At the occurrence site, SCPL has two parallel lines of pipe: one designated as Line 12" with a nominal outside diameter of 323.9 mm (NPS 12) and the 8" line with an outside diameter of 219.1 mm, both used principally to transport LVP refined petroleum products, more specifically, gasoline, fuel oil, diesel, and jet fuel. The 8" pipeline is buried in a brownish/grey clay soil, and in that particular area of Sarnia, in a very crowded underground environment, where numerous hydrocarbon pipelines link refineries, petrochemical plants, underground storage facilities and natural gas pipelines feeding industrial customers and power generating stations.

Immediately downstream of and adjacent to the occurrence site, the SCPL pipeline system is in very close proximity, paralleling the 8" line, an abandoned NPS 6 steel Cabot Canada Ltd. (approx. 2 inch apart, as shown in the image found in Appendix D).

The nominal wall thickness of 8" line is 5.56 millimeter (0.219 inches). The pipe was manufactured in 1953 by the Page-Hersey Mill in Ontario, (API) 5LX pipe grade X-46 electric resistance welded (ERW) longitudinal seam weld. The section of 8" line was externally coated at the time of installation with a coal tar coating.

At the time of pipeline construction, the applicable design and installation code was ASA B31.1-1951. The American Standards Association published a more specific liquid pipeline code, B51.4, Oil Pipeline Transportation Systems in 1959.

The section that ruptured had been hydrostatically tested in 1954 to a maximum test pressure of 13,789 kilopascals (kPa) or 2,000 pounds per square inch gauge (psig), which corresponds to approximately 86 per cent of the specified minimum yield strength (SMYS). The line had a maximum allowable operating pressure (MAOP) of 9,930 kPa (1,440 psig), which corresponds to about 61.6 per cent of the SMYS. Since its original construction and until the time of this occurrence, this section of the 8" line had not been hydrostatically re-tested.

Between the Sarnia Pump Station and Kerwood Pump Station, which includes the present occurrence site, there has been no history of ruptures, notwithstanding records of excavation in the vicinity of the site. Starting in 1997 until the end of 2013 (the year of the last major repair at this location), SCPL investigated approximately 18 anomalies at numerous locations on this segment in order to examine the exterior condition of the pipeline (the most recent was line lowering at Ebenezer Road in May 2013). As a result of these excavations, SCPL had performed a variety of repairs. The type of repairs performed ranged from re-coating the exterior surface to installing structural reinforcing sleeves on joints of pipe that had been found to be substandard due to external corrosion similar to the type of external corrosion found at the occurrence site.

1.6 Commodity Pipeline Operations

The SCPL Waterdown Control Centre (WCC) relies on selected telemetric data from pump and meter stations coming from SCPL's SCADA telemetry network across the pipeline system to determine the optimum operating scenarios for moving contracted quantities from Sarnia to Hamilton and to the Greater Toronto Area. Hydrocarbons include refined petroleum products such as gasoline, jet fuel, diesel fuel and heating fuel.

The SCPL pipeline system is an integral system directly under the control of the WCC. The WCC's responsibilities are assigned to a CCO. On the day of the occurrence as well as before the occurrence, the CCO was not managing any unusual situations for the 8" line.

A review of the telemetric data for the day in question shows that, before the break, SCPL's pipeline was flowing approximately 124 m^3 per hour of diesel batch. All functions had been normal for the previous 24 hours and no abnormalities in operating conditions were identified from this review.

1.7 Cathodic Protection on the 8” Line

Cathodic protection (CP) is provided by an impressed current system with anode beds and current rectifiers placed at strategic locations since the pipeline’s installation.

In order to determine the effectiveness of the CP system and to ensure that the existing minimum industrial norm of 850 millivolts (mV) "off" cathodic potential and 100 mV shift potential were met, SCPL's field and contract staff performed annual pipe-to-soil potential surveys throughout the life of the system. The annual survey records for the period between 2011 and 2013 showed that the potential at the rupture site consistently exceeded the minimum industrial norm. Previous CP records were verified through audits of SCPL in October 2004 and May 2011. (See Appendix C for more information on CP surveys).

1.8 Metallurgical Testing of the Pipeline Steel

The chemical composition and mechanical properties of the pipe sections from the 8” line were consistent with the pipe specifications at the time of purchase.

The rupture was examined by an independent U.S.- based laboratory, Kiefner & Associates, Inc. which TSSA determined to have competent staff as metallurgical consultants. The metallurgical examination of the fracture area indicated that the pipe suffered such metal loss due to external corrosion, to the point that remaining wall thickness could not withstand the internal pressure. For more details, please see Appendix A, which contains the whole Kiefner & Associates, Inc. report.

The pipe opened up over a length of 150 mm (6 inches). The coal tar coating showed poor bonding and in the ruptured area exhibited a thickness that is significantly higher than what is considered typical for the pipeline. Removal of the coating revealed general corrosion along the centre of the failure.

An examination of the products of corrosion revealed the presence of magnetite (approximately 10 per cent), which was deemed to alter the capabilities of the magnetic flux leakage (MFL) tool used in the internal inspection performed in 2011. This may explain the lack of detection of such a material loss by the tool.

1.9 Exterior Coal Tar Coating System on the 8” Line

During its original construction, the 8” line was covered with a coal tar coating, which was typical pipelines constructed in the 1950s. The coating was field applied with a one-inch overlap during the taping process, after the pipe surface had been wire brushed to remove any mill scale and primed.

Coal tar coating is known to undermine CP shielding when disbondment occurs. This may be a potential factor in the presence of corrosion affecting the 8” line. Coal tar was widely used from the 1920s to the 1960s but was replaced by superior coating materials in use today. There was no explanation found in SCPL records that could explain why the coating was significantly thicker at the area of the pipeline rupture.

1.10 History of Previous Ruptures, Leaks and Pipe Replacements on 8” Line

Since the time of installation in 1953, six pipeline occurrences have taken place on 8” lines. Two of these occurrences -- and the most significant -- were due to third party damage. None of the previous occurrences happened in the area of the rupture that was subject to this investigation and none was due to the corrosion (metal loss) or stress corrosion cracking. The details from previous failures resulting in spills are as follows:

Year	Location (MP)	Volume (m^3)	Cause
1969	40+535	32	Equipment failure
1971	40+6212	15	Construction damage
1971	40+4200	13	Construction damage
1973	120+725	23	Construction Damage
1975	89+3124	127	Third party damage
1987	100+370	90	Third party damage

1.11 Initiatives Taken after the Occurrence

On September 10, 2013 (the same day as the occurrence), TSSA inspector Patrick O'Connor issued Inspection Report #4611976 instructing SCPL not to proceed with the repairs until they received approval from TSSA.

On September 25, 2013, SCPL replied that it concurred with TSSA's safety concerns expressed in the TSSA order. SCPL responded with the following program:

Phase 1 - Temporary operating pressure restriction to 80 per cent of the MAOP

The 8" line would be operating as per the following details:

- The leak occurred at approximately 8885 Kpa.
- Reduced MOP to 80 per cent of the minimum pressure over a selected 12-hour period within the last 60 days.
- Re-evaluation of existing log reports to determine if any immediate action should be taken to mitigate critical corrosion at the reduced MOP and completion of these actions prior to start-up
- Start-up:
  - Start-up during daytime
  - Additional aerial patrol undertaken daily for the first two days
  - SCPL people stationed or readily available at Sarnia, London and Waterdown for the first 24 hours of operation
  - Additional supervisory support in the control room to analyse the operating conditions and monitor for leak indications for the first 24 hours.

Phase 2 - Evaluation

- Complete the metallurgical analysis of the pipe:
  - This will drive the follow up work and plan
- In-depth review of old inline inspection information:
  - Determine if any additional follow up is required based on this review
- Develop an inspection/testing program to address the findings of the metallurgical analysis
  - MFL HR axial flux tool
  - Evaluate the inspection results
- Conduct a cathodic survey and a log to determine if any improvements are required
  - Evaluate the inspection results

- Engineering assessment on line condition to reflect present knowledge of the system

Phase 3 - Execution

– At this time, the full schedule is to be determined
– Once the previous two steps are completed, the execution plan will be developed and implemented

Phase 4 - Final Assessment

– Engineering assessment of the line condition to determine if it is suitable for the existing service and secondly should it be returned to the original MOP

In response to SCPL, TSSA issued an order granting permission on November 12, 2013 to reopen the 8" line under the following conditions:

1. The pipeline shall be operated at reduced pressure as shown below:
    a. Sarnia discharge 6960 Kpa
    b. Kerwood discharge 6730 Kpa
    c. London discharge 7480 Kpa
    d. Paris discharge Not to be operated.
2. The above pressure limitations shall be programed into the process control logic and set points shall not be adjustable by the operators.
3. Shut downs trips shall be set at 1.5 per cent above new set points and shall not be adjustable by the operators.
4. Start-up shall take place during daytime hours and in the presence of a TSSA inspector. Please contact P. O'Connor at telephone number: (519) 331-3230, email poconnor@tssa.org to make the required arrangements.
5. Aerial patrols shall be conducted on the day of the start up and two days after the pipeline is operated at the reduced maximum operating pressure.
6. Additional SCPL staff shall be present at the Sarnia, London and Waterdown stations on the day of the start up and two days after the pipeline is operated at the reduced maximum operating pressure to provide additional manpower for field activities and SCADA/leak detection supervisory functions.
7. The final report from Kiefner & Associates, Inc. shall be provided to TSSA by November 30, 2014 along with SCPL's analysis and recommendations in response to the findings.
8. An inspection program for the entire 8" pipeline shall be completed within 60 days of the pipeline restart date and shall consist of:
    a. Ultrasonic crack detection tool run
    b. Transverse flux tool run
    c. High resolution magnetic flux tool run
    d. Ultrasonic metal loss run
    e. Cathodic protection system evaluation by either inline or closed space survey
    f. Leak detection ball run.
9. Results of the tests mentioned under item 8 shall be interpreted by a company independent of SCPL and the results of this interpretation along with associated recommendations shall be provided directly to TSSA by the company interpreting the results and making the recommendations. Please send the results to Oscar Alonso, telephone number: (416) 734-3353, email oalonso@tssa.org or alternatively to fsintake@tssa.org.
10. The recommendations shall be reviewed and acted upon within 30 days of having been made and the resulting pipeline repairs shall be completed within 30 days thereafter or at an alternative time approved by TSSA.
11. Only after items 1 to 10 of this letter have been completed can SCPL then apply in writing to the TSSA Fuels Safety Statutory Director in order to increase the pipeline operating pressure.

12. The above conditions may be revised to reflect the final report findings or recommendations made under items 7 to 10 and the approval to operate the pipeline may be withdrawn if the Statutory Director determines that an immediate hazard associated with the continued pipeline operation exists.

2.0 Analysis

2.1 Introduction

The Kiefner & Associates, Inc. report identified external corrosion as the type of defect that reduced the pipe wall thickness and led to the occurrence. As the pipeline rupture occurred in an area close to a storm sewer conduit that discharges drain water into the St. Clair River (approximately one kilometre downstream of the pipeline rupture site), most of the released diesel was recovered via pumping of the impacted surface and groundwater as well as the removal of the impacted soil during the site remediation. The contaminated soil as well as the dirt within the sewer conduit were removed; however, the resulting impact on the environment was limited because the action to install booms to contain the spill was not quick enough to prevent some product from reaching the St. Clair River. This resulted in precautionary measures being taken by communities downstream to close drinking water intakes (notably Walpole Island First Nations, located 40 kilometres downstream of the sewer conduit discharge).

The rupture and loss of internal operating pressure were immediately acted upon by SCPL operations personnel, who shut down the 8" line and triggered a series of emergency procedures by SCPL and CVECO field staff.

From the time that SCPL first identified the pipeline depressurization (leak) until the sectionalizing valves were closed, 36 minutes had elapsed, which TSSA considered an adequate response time taking into consideration that one of the valves to sectionalize the ruptured pipe required manual action. While SCPL has continuously performed CP surveys of the 8" line and continuously obtained favorable results from these surveys, it is believed that the disbonded coal tar coating may have been shielding the positive effects of the CP system, possibly compounded by two factors:

a) Thick and disbonded coal tar coating; and
b) An abandoned Cabot Canada Ltd. NPS 6 steel pipe paralleling the 8" line, installed as close as two inches in certain parts.

The effects of localized ineffective corrosion protection, translated into material loss (reducing the pipe wall's thickness), should have been noted by previous inline tools examinations, i.e. UT metal loss and MFL axial HR tools. However, the fact that the products of corrosion were magnetic (a relatively rare occurrence) the inline tools were affected, because sensors received altered information.

2.2 Consideration of the Facts

2.2.1 Susceptibility Investigation Action Plan for the 8" Line

The 8" line had been internally inspected on two occasions using ILI surveys, one carried out in 2005 (Intratek run) and another in 2011 using a Baker Hughes CFT (circumferential flux).

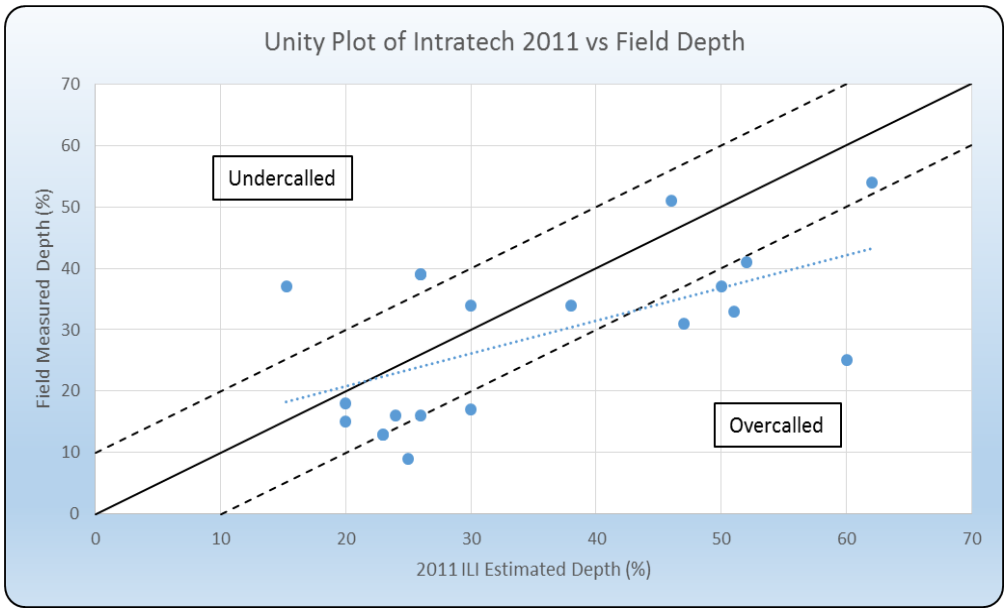
This data was used to evaluate the pipeline for corrosion features with the following process:

1. A unity plot of dig depths versus predicted depths was developed to evaluate the tool performance.
2. Features were combined and evaluated as one if they were within 6T (6 wall thicknesses) by 6T (longitudinal direction x circumferential direction).
3. Growth rates were applied using the following procedure:

a. The first step in the growth modelling was to match anomalies found in previous inspections to the most recent.
b. Inherent in all measurements are errors that cause inline inspection comparisons to have metal loss as well as metal gain. Only the metal loss is considered, as metal gain is not possible.
c. A normal distribution of metal loss was developed and a probability of 99 per cent was used to determine the growth rate.
d. The actual growth rate used for the assessment was the highest value calculated considering the most recent inline inspection runs. This is a growth rate of 0.1524 mm/yr and this was applied to all anomalies delineated by the most recent inspections.

4. Modified B31G was then used to evaluate the burst pressure of the feature.
5. No credit was taken for the increase in elevation between Sarnia and London. Due to the increasing elevation, each segment of pipe sees a lower pressure than the reduced MOP at the respective upstream station even under static conditions.

The following is a summary of the unity plot for this run and the five most significant features from this evaluation. This indicates that there are no features that would fail a hydro test at the reduced operating pressure (1.25 x 6960 kPa). The following features located at 55926.08 m, 25273.46 m, and 11885.15 m will be excavated and repaired prior to operation.



A contributing factor to the rupture was disbonded coal tar exterior coatings that may have shielded the CP. The data would show good values of negative voltage suggesting adequate corrosion protection.

2.2.2 Initiatives Taken after the Occurrence

The September 10, 2013 pipeline rupture on the 8” line at the Sarnia site may suggest that the impressed CP system has been shielded from protecting the exterior surface of the pipe due to the disbonding coating over the other segment of this pipeline. This process could continue to exist and to grow in length and depth with time.

The new safety program should be able to determine that the conditions of the 8” line give enough evidence that the undetected corrosion producing the September 10, 2013 incident is not repeated in any segment of the 8” line. Although the use of hydrostatic re-tests by SCPL would allow for a destructive identification of those locations on the pipeline system, which would be the weak joints in the 8” line, this alternative can cause cracks to

further develop and become a new potential source of failure. For this reason, the use of proper tools in ILI and the verification excavation program are considered more efficient. This approach has been suggested by SCPL using an array of tools, including Transverse Magnetic Flux Loss (TFL) and Ultrasonic Technology (UT).

The safety program has addressed the immediate condition of the 8" line. SCPL is allowed to operate this line under the limitations outlined in item 2.2.1 above. Further, ILI validation work and additional site-specific digs will be required to proceed to Phase 2. However, this investigation does not address the long-term viability of the operation of the 8" line. The safety program will make use of additional ILIs and site-specific digs to confirm the results of the ILI, prior to proceeding with the next step.

3.0 Conclusions

3.1 Findings

1. The rupture of the 8" line is attributable to external metal loss due to corrosion. The corrosion progressed to the point that the remaining wall thickness was not able to withstand the internal pressure, which at the time of rupture was within the limits of the pipeline MAOP.
2. A portion of the corrosion product was determined to be magnetic. The capabilities of the magnetic flux leakage (MFL) inline tool used may have been affected, causing the MFL tool to report this corrosion feature as less severe than it actually was.
3. Coal tar coating applied at the time of installation is known to be prone to shielding (minimizing) the effects of the cathodic protection (CP) system if disbonded.
4. The coal tar coating around the buried pipeline was found to be thicker than what would be expected, a defect that would further limit the beneficial effects of the cathodic protection.
5. There have not been any pipeline ruptures in the 8" line due to defective Electric Resistance Weld (ERW), material defects, stress corrosion cracking or external corrosion prior to this incident.
6. A plan has been developed under which SCPL will operate the 8" line at a reduced pressure (Phase 1). Policies and procedures established in consensus with SCPL for reducing the rupture potential of the 8" line based on the results of inline tools and engineering assessment will dictate further actions.
7. The scope of TSSA's safety directive to SCPL addresses all sections of the 8" line and has not been expanded to the NPS 12 pipeline system, which is 20 years younger and has been coated with different materials.

3.2 Cause

The rupture was caused by undetected external corrosion which was combined with disbonded coal tar coating, a magnetic corrosion product able to alter the capabilities of the magnetic flux leakage (MFL) used in the inline inspection, exacerbated by the shielding effects of the thick coal tar coating.

4.0 Appendices

Appendix A

Kiefner & Associates, Inc. Final Report No. 13-170

Final report from Kiefner Nov 22, 2013

Appendix B

SCPL 2012 Cathodic Protection Report (1)

Annual Cathodic Protection Survey

Appendix C - Glossary

AHJ	Authority Having Jurisdiction
API	American Petroleum Institute
CCO	Control Centre Operator
CP	cathodic protection
CSA	Canadian Standards Association
CVECO	Chemical Valley Emergency Coordinating Organization
ECA	Engineering Critical Assessment
ILI	in-line inspection

ERW	Electric Resistance Weld
IMPs	Integrity Management Programs
Km/h	kilometre(s) per hour
kPa	kilopascal(s)
m	metre(s)
MAOP	maximum allowable operating pressure
MFL	Magnetic flux leakage
mm	millimetre(s)
MP	Mile Post
MPa	megapascal(s)
mV	millivolt(s)
NPS	nominal pipe size
O.D.	outside diameter
psig	pound(s) per square inch gauge

SCADA	Supervisory Control and Data Acquisition
SCPL	Sun-Canadian Pipe Line
TSSA	Technical Standards & Safety Authority
SMYS	specified minimum yield strength
WCC	Waterdown Control Centre
W.T.	wall thickness

Appendix D: Photo of Pipeline Rupture Site