



Rainbow Pipe Line Company Ltd.
Crude Oil Pipeline Failure
Licence No. 6001, Line No. 001
October 10, 2006

EUB Investigation Report

May 9, 2007

ALBERTA ENERGY AND UTILITIES BOARD

**EUB Investigation Report: Rainbow Pipe Line Company Ltd. Crude Oil Pipeline Failure,
October 10, 2006**

May 9, 2007

Published by

Alberta Energy and Utilities Board
640 – 5 Avenue SW
Calgary, Alberta
T2P 3G4

Telephone: (403) 297-8311
Fax: (403) 297-7040
E-mail: eub.infoservices@eub.ca
Web site: www.eub.ca

Incident Overview

At about 1:46 a.m. on Tuesday, October 10, 2006, the Rainbow Pipe Line Company Ltd. (RPL) became aware of a potential release situation from its 24-inch (610 millimetres) Rainbow Pipeline. At that time, the Calgary Control Centre registered a loss of line pressure and 6 minutes later the pumps went down. This pipeline was known to contain crude oil with no hydrogen sulphide content.

The location of the suspected pipeline break was on Crown land in Section 10, Township 72, Range 4, West of the 5th Meridian, about 20 kilometres (km) southeast of Slave Lake (near the Mitsue pump station), south of Highway 2 on Mitsue Hill. Pumping stations within that portion of the Rainbow Pipeline were checked by RPL staff with no problems found, but due to fog and darkness they could not inspect the pipeline.

Aerial surveillance was initiated to locate the spill site and at 10:00 a.m. the specific location was identified. The Alberta Energy and Utilities Board (EUB) St. Albert Field Centre (SAFC) was notified at approximately 11:50 a.m. by the Calgary office of Imperial Oil Limited (IOL), in its capacity as operator of the Rainbow Pipeline, and a field inspector was dispatched. The SAFC notified the EUB Emergency Response Group (ERG), Alberta Environment (AENV), and Emergency Management Alberta (EMA) of the incident.

At about 1:00 p.m., the EUB inspector and representatives from RPL and AENV flew to the spill location to inspect the site. They observed that the spill ran from the pipeline right-of-way into a drainage ditch and then into a pond created by beaver dams. Further examination showed that the spill had migrated through the dams in the pond into another drainage ditch, then travelled through four more beaver dams until it reached a lease road with a blocked culvert (see attached map). The spill was considered contained at this point, about 1.6 km from the release location.

The on-site command post was established by RPL and 24-hour-a-day operations commenced. The CCS Energy Services Ltd. (CCS) Mitsue facility was contracted for processing liquid and solid waste collected from the site.

On October 12, the cleanup of the actual pipeline failure site began, prior to the commencement of the pipeline excavation. Additional measures were taken to ensure that no additional oil would enter the drainage ditch during this phase.

On October 13, the pipeline failure site was fully exposed and on initial observation the break appeared to be a rupture on the underside of the pipe not near a weld. Portions of the exposed pipe were sandblasted to conduct non-destructive testing to determine appropriate locations to cut the pipe and install flanges.

Operations continued during the night and a section of pipe about 15 metres (m) long (about 7.5 m upstream and downstream of the failure location) was identified and cut out of the line using cold-cut procedures. Carber plugs (pressure isolation plugs) were inserted in the open ends of the existing line pipe.

On October 14, a conference call was held between IOL staff and EUB staff to review the repair procedure, plan for putting the line back into service, and plan for monitoring the line until a further inspection procedure could be developed.

A gradient profile was surveyed in between the two open ends of the pipe (this pipe section is on a slight overbend of 9 degrees), and this bend profile was transferred to the replacement

pipe. The new pipe section and the existing pipe had flanges welded onto the ends and welds were radiographed for acceptance.

On October 15, the new pipe was subjected to a one-hour hydro test to 7100 kilopascals (kPa) and after successful testing the new line section was lowered into the ditch. The Carber plugs were removed and the two flange pairs were bolted up and torqued. This was completed at about 3:30 a.m. on October 16.

IOL developed a start-up procedure that involved purging of air from the system, sequential pump start-up, controlled pressure start-up, and flow balance. The line started filling at about 2:30 p.m. and was completed at about 5:00 p.m.

Upon start-up and initial flow, the flange connections were checked for leakage, a re-torque of the flange bolts completed, and the new pipe section was coated using the IOL coating protocol. On October 16 at about 9:30 p.m., the pipeline was successfully returned to service at reduced pressure with product flow to Edmonton.

Cleanup continued with more than 80 workers and on-site monitoring by the EUB. Existing roads were maintained and new roads were built to provide access to recovery locations around the beaver ponds and the channel between the break site and the beaver ponds. Cleanup activities and site manpower were reduced in November. Site security and safety were maintained during the winter season with planned resumption of cleanup in Spring 2007. The EUB and AENV will monitor situation.

The site was visited by Alberta's Energy Minister, the Honorable Greg Melchin, Alberta's Minister of Aboriginal Affairs and Northern Development, the Honorable Pearl Calahasen, and the Lesser Slave Lake Indian Regional Council (LSLIRC). A meeting was held between the LSLIRC, the Honorable Pearl Calahasen, and EUB staff to discuss the incident.

EUB Investigation and Findings

The EUB conducted an investigation focused on the cause of the incident, the risk to public safety, environmental impacts, and the conservation of the resource. The following findings resulted from the EUB investigation.

Cause

The root cause of the failure was stress corrosion cracking (SCC) combined with fatigue cracking near the bottom of a slight overbend. The SCC resulted from the combination of sustained and cyclic (hydrostatic) stresses on the pipe and the presence of corrosive ground waters at the material surface. External coating (double layer of polyethylene tape) failed (wrinkled) at the bottom half of the pipe in the vicinity of the failure. The disbanded polyethylene tape external coating likely prevented the cathodic protection current from reaching the external pipe surface. The failed pipe section had mechanical, metallurgical, and chemical properties consistent with the pipe grade at time of manufacture. The immediate environment near the failure had a neutral pH (approximately 7) and no evidence of bacteria activity or iron oxide (rust) scale.

Public Safety/Emergency Response

This portion of the investigation was to assess the response of RPL and the actions undertaken to manage the incident. All required agencies were contacted (EUB, AENV, Environment Canada, Alberta Sustainable Resource Development [Fish and Wildlife, Lands,

and Forestry] and Alberta Employment, Immigration and Industry [Workplace Health and Safety]).

The EUB concluded that at no time during the response to the incident was public safety at risk. RPL investigated the cause of illness among workers at the cleanup site in October and determined that the cause was not related to the incident.

The RPL leak detection monitoring system provided an appropriate alarm of the pipeline failure, and the subsequent actions to completely shut down the entire pipeline were initiated promptly.

RPL had an appropriate response to the incident and immediately brought in all the necessary resources (Western Canadian Spill Services, oil spill containment and recovery trailers).

Environmental Impact

The spill occurred in a remote wooded area. As of December 18, 2006, a total of 1151 m³ of water has been recovered and sent to the CCS Mitsue facility for disposal. A total of 1450 m³ of soil was excavated from the break site; 250 m³ were sent for disposal to the CCS Mitsue facility and 1200 m³ remain on site awaiting disposition once final cleanup is completed.

Although cleanup has not been completed, the environmental impact has been contained and additional cleanup and remediation under the direction of AENV will commence in Spring 2007.

Resource Conservation

The spill volume was estimated to be 1260 m³ of sweet light crude oil, of which 545 m³ have been recovered to date.

Follow-up Actions

RPL

As a result of the incident and the EUB investigation, RPL has committed to

- 1) temporarily lower the operating pressure of this line segment by 20 per cent (from 5380 kPa to 4300 kPa);
- 2) double the frequency of aerial surveillance (from once per week to twice per week) and increase ground surveillance in high consequence areas (water crossings, creeks, wet areas);
- 3) mix dissimilar crude products, which will result in fewer pressure fluctuations, and evaluate whether any additional pressure reductions will be necessary in the next few months;
- 4) lower the magnitude of pressure fluctuations by implementing a variable frequency drive at Mitsue pumping station;
- 5) run both a caliper in-line inspection (ILI) and ultrasonic ILI in late December 2006 with preliminary results expected mid-January, and late-February, respectively;

- 6) work with the ILI vendor to improve crack detection and growth detection and prediction by incorporating the new field-collected inspection data;
- 7) excavate, analyze, and repair as necessary 22 sites that have similar data characterization to the failed section;
- 8) continue to work with other pipeline operators and the Pipeline Research Council International on cyclic strain and its relationship with SCC;
- 9) evaluate its existing Management of Change process to ensure it is effective;
- 10) work with its corrosion experts on corrosion fatigue modelling, which will include
 - assessment of all pressure, location, and product data over the last 12 months (prior to and post failure),
 - review of past mechanical and metallurgical data on this line, and
 - modelling the effect of pressure on time-to-failure predictions; and
- 11) continue the primary strategy to detect, accurately size, and repair existing SCC cracks, thereby effectively controlling any fatigue cracking issues as fatigue would not represent a critical hazard without the presence of significant SCC.

EUB

- 1) The EUB will continue to work with RPL on an ongoing basis to track the progress of the follow-up actions and update the EUB management.
- 2) The EUB will continue to monitor the progress of the cleanup and maintain communication with RPL and other regulatory agencies.

