

COMMODITY PIPELINE OCCURRENCE REPORT

CRUDE OIL PIPELINE RUPTURE

**INTERPROVINCIAL PIPE LINE INC.
LINE 2 (34-INCH DIAMETER), MILE POST 717.5
NEAR ST. LEON, MANITOBA
03 OCTOBER 1994**

REPORT NUMBER P94H0048

The Transportation Safety Board of Canada (TSB) investigated this occurrence for the purpose of advancing transportation safety. It is not the function of the Board to assign fault or determine civil or criminal liability.

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Summary

Following the start-up of Line 2B after the completion of scheduled maintenance work at Cromer Station, the Interprovincial Pipe Line Inc. (IPL) line ruptured at Mile Post (MP) 717.5, releasing approximately 4,000 cubic metres (m³) of synthetic crude oil into a cultivated field. Approximately 2,860 m³ of oil was recovered.

Ce rapport est également disponible en français.

Other Factual Information

On 03 October 1994, maintenance work on Line 2 at Cromer Station (MP 595.8) and Manitou Station (MP 723.93), scheduled with IPL's Oil Movements in Edmonton, Alberta, was carried out. Manitou Station was bypassed to facilitate the maintenance work. Line 2 is operated as two pipeline systems: Line 2A transports crude oil from Edmonton to Cromer Station where it goes into tankage; crude oil is taken from tankage at Cromer Station and transported on Line 2B to Clearbrook, Minnesota, U.S. and Superior, Wisconsin, U.S.

The bypass at Manitou Station did not require the closure of the Line 2 sectionalizing valves at that station. However, the Manitou Station personnel locally closed the Line 2 sectionalizing valves to carry out additional work that had not been scheduled with Oil Movements. Although the field personnel verbally advised the IPL Control Centre Operator (CCO) in Edmonton of the additional valve closures, the CCO was not aware of the nature of the valves nor did the CCO document this discussion. The CCO had known about the scheduled Manitou Station bypass work and believed that the additional valve closures were part of the scheduled operation and would not have an impact on a line start-up. The CCO did not realize that the valves were mainline sectionalizing valves which would have to be opened before a line start-up could be initiated. One of the valves could be remotely operated through the Edmonton Control Centre (Control Centre); its status was therefore displayed at the Control Centre. The other valve was a hand-operated valve and its status was not displayed at the Control Centre.

Approximately seven hours after Lines 2A and 2B had been shut down, the CCO was notified by field personnel that the work at Cromer Station had been completed and that Line 2B could be re-started. In accordance with IPL's start-up procedures, the CCO visually checked the valve status of Line 2B. Although the CCO noticed that the status of the sectionalizing valve at Manitou Station was "unknown," the CCO knew that the power had been disconnected from that valve and that this would have resulted in the "unknown" status. Since the CCO knew that a line start-up could be initiated while Manitou Station was still on the scheduled bypass, the CCO began to start up Line 2B.

The CCO noticed a pressure build-up upstream from Manitou Station and took action to reduce the pressure in the line. A pressure build-up would be expected during line start-up conditions. However, in spite of the corrective action, the discharge pressure at Glenboro Station (MP 685.55) spiked to 1,127 pounds per square inch (psi), imposing stresses of between 110 and 115 per cent of the specified minimum yield stress of the pipe at MP 717.5.

IPL has two levels of overpressure protection: a local level at the individual pump stations and a system level at the Control Centre. Specific operating conditions would cause the overpressure protection to be activated. These conditions, however, were not

present on 03 October 1994, and the overpressure protection was not activated.

Since Manitou Station was still being bypassed during the line start-up, it was transmitting pressures of 0 psi to the Control Centre. Although these pressures were invalid for leak detection purposes, IPL's Normalized Differential Flow (NDF) leak detection system was such that it continued to calculate flows in Line 2 using these pressures.

IPL is in the process of upgrading its System Control and Data Acquisition (SCADA) system. The two systems are run simultaneously with the information displayed on monitors at the CCO's workstation. On 03 October 1994, the CCO was verifying alarms generated by the new SCADA system. Although alarms were also being generated by the old SCADA system, the CCO was acknowledging the alarms but not verifying their origin. This was a common practice since identical alarms were generated by both systems with the exception of those generated by the NDF leak detection system. The alarms generated by that system appear only on the old SCADA system.

The NDF leak detection system generated alarms advising of flow anomalies between Cromer Station and Souris Station (MP 646.23). These alarms were among the many alarms normally received during line start-up. Since the CCO was operating the pipeline using the new SCADA system, the CCO acknowledged the flow anomaly alarm without checking its origin. The CCO attributed all alarms to changing operating conditions during line start-up.

The CCO continued with Line 2 start-up procedures until advised by Manitou Station personnel that, although the station suction valve was cracked open to flood the station piping, there was no pressure. A line shut-down and isolation were initiated. However, following discussions between Control Centre personnel, Manitou Station personnel and the Manager, Central Region, a decision was made that the lack of flow at Manitou Station was based on an incorrect valve alignment at the station as well as flow conditions between Manitou and Gretna Stations. A Line 2 start-up was again initiated.

During this start-up, the CCO requested a Manitou Station bypass closure to verify line integrity. When the pressure at Glenboro Station did not respond to this closure, a leak was suspected and a line shut-down was again initiated and completed.

The line was sectionalized around the suspected leak area and IPL personnel began to search for the leak site. A resident of the St. Leon, Manitoba, area reported a crude oil smell and the failed pipe was located at MP 717.5.

The TSB Engineering Branch determined that the pipe ruptured in overstress at an area of external corrosion. The corrosion served only to locate the failure initiation point when the pipe was

overpressurized, and would not have burst had the line continued to operate under normal pressure.

The joint of pipe that contained the fracture initiation point had been excavated, examined and recoated twice between 1990 and 1993 in accordance with IPL's procedures for corrosion assessment. Corrosion discovered during a 1989 internal inspection was not severe enough to warrant repair and the pipe was recoated in 1990. The recoating in 1993 was completed on a 3.04 km section of line as part of a rehabilitation pilot project undertaken by IPL to determine the possibility of rehabilitating an in-service crude oil pipeline. An internal inspection in 1993 indicated that there was no growth in corrosion from the time it was first evaluated in 1989.

Analysis

The IPL pipeline control system does not have software controls to ensure that a line start-up cannot be initiated against a closed mainline sectionalizing valve. Rather it is left to the CCO to confirm that all mainline valves have been opened and to initiate a start-up only after all verbal and written confirmation has been received.

Although the CCO had been informed verbally of the valve closure at Manitou Station, the CCO believed that it was part of the scheduled bypass and as such would not have an impact on a line start-up. Before the start-up, the CCO noticed that the sectionalizing valve status at Manitou Station was in the "unknown" mode. The CCO attributed this to the fact that the power had been disconnected from Manitou Station because of the scheduled bypass. Therefore, when the start-up of Line 2 was initiated approximately seven hours after the valve had been closed, the CCO did not question field personnel on the exact status of the valve. If documentation had been made as to the nature of the additional valve closures at Manitou Station, the CCO would have been aware that a line start-up could not be initiated until the valves had been opened.

Findings

1. A scheduled bypass at Manitou Station did not require the closure of the mainline sectionalizing valves at that station.
2. Manitou Station personnel verbally informed the CCO that they would be closing additional valves at that station.
3. The CCO assumed that these additional closures were part of the scheduled bypass operation and as such would not have an impact on a line start-up.
4. The CCO did not document that the mainline sectionalizing valves on Line 2 at Manitou Station were closed in addition to those required for the scheduled bypass operation.

5. The CCO initiated a Line 2 start-up after concluding that the sectionalizing valve at Manitou Station displaying an "unknown" status was in the "open" position.
6. A 10.18 km section of line was overpressured resulting in a rupture at MP 717.5.
7. The rupture initiated at a corrosion pit that had been recoated in 1990 and again as part of a rehabilitation project in 1993. The corrosion had not grown between recoating in 1990 and the rupture in 1994.

Causes and Contributing Factors

The rupture occurred because a line start-up was initiated against a closed sectionalizing valve resulting in an overpressure situation in a 10.18 km section of line.

A contributing factor to the failure initiation point was an area of external corrosion which served only to locate the failure initiation point.

Contributing factors to the line being started up against a closed sectionalizing valve were the "unknown" status display for that valve and the assumption that the additional valve closure at Manitou Station was part of the scheduled bypass and as such would not have an impact on a line start-up.

Safety Action

In March 1995, a TSB Safety Advisory was forwarded to the National Energy Board (NEB) outlining problems identified during the investigation. The Advisory indicated that the NEB may wish to review the applicable communication and line start-up procedures as there may be other pipeline locations with similar unsafe conditions and practices.

This report concludes the Transportation Safety Board's investigation into this occurrence. Consequently, the Board, consisting of Chairperson John W. Stants, and members Zita Brunet and Hugh MacNeil, authorized the release of this report on 05 July 1995.