Pipeline Performance in British Columbia 2010



About the BC Oil and Gas Commission

The BC Oil and Gas Commission (Commission) is an independent, single-window regulatory agency with responsibilities for overseeing oil and gas operations in British Columbia, including exploration, development, pipeline transportation and reclamation.

The Commission's core roles include reviewing and assessing applications for industry activity, consulting with First Nations, ensuring industry complies with provincial legislation and cooperating with partner agencies. The public interest is protected through the objectives of ensuring public safety, protecting the environment, conserving petroleum resources and ensuring equitable participation in production.

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1. Executive Summary

The BC Oil and Gas commission (Commission) regulates more than 37,400 kilometres (km) of pipelines that transport a variety of refined and unrefined products from wells to facilities and from facilities to end markets within British Columbia or other destinations. The safe and secure operation of these pipelines is essential to the preservation of the environment and the protection of British Columbians.

The Commission takes proactive measures to ensure the integrity of British Columbia's pipelines, which include a comprehensive application and review process, required Integrity Management Programs and notification of any operational changes to a pipeline. However, incidents can occur, and each one must be reported to the Commission, even if there is no spillage or release of products.



In 2010, there were 50 pipeline incidents reported to the Commission by Commission-regulated pipeline operators (Table 1). Analysis of the incidents in both 2009 and 2010 shows that the leading factor resulting in pipeline incidents is internal corrosion. The overall incident frequency for 2010 was 1.38 for every 1,000 km of pipeline (as compared to a frequency of 1.03 incidents per 1,000 km in 2009). The highest incident frequency in both 2009 and 2010 occurred on pipelines carrying water (4.96 incidents per 1,000 km with six incidents recorded in 2010, and 6.75 incidents per 1,000 km with nine incidents in 2009).

The Commission notes that no leak is acceptable regardless of the product type. In 2010, the Commission rolled out its compliance assurance program for Integrity Management Programs. At the beginning of 2011, a number of pipeline companies were randomly selected to provide the Commission with an assessment of the adequacy and effectiveness of their Integrity Management Programs. These assessments have been reviewed by Commission staff and follow-up action is being carried out via field verifications and documentation reviews. This process will continue throughout the year with the chosen companies to determine Integrity Management Program compliance.

Table 1: Pipeline incident frequency (incidents/1,000 km) for product-specific pipelines in 2010

Type of Pipeline	Length of Pipelines (km)	Number of Incidents	Frequency
Crude Oil	2,603	2	0.77
Natural Gas	18,717	20	1.07
Sour Natural Gas	11,952	16	1.34
Other	1,663	5	3.01
Water	1,209	6	4.96
HVP	217	1	4.61



2. Report Scope

This report provides a statistical overview of the performance of all pipelines in British Columbia regulated by the Commission. The report does not include piping information on wellsites, or within facility leases. The Commission's jurisdiction extends to all pipelines as defined in the Oil and Gas Activities Act (OGAA). All pipelines under the Commission's jurisdiction must be operated with a permit regardless of whether they have been deactivated or abandoned.

"Pipeline" means, except in Section 9 of OGAA, piping through which any of the following is conveyed:

• Petroleum or natural gas.

• Water produced in relation to the production of petroleum or natural gas or conveyed to or from a facility for disposal into a pool or storage reservoir.

Solids.

- Substances prescribed under Section 133(2)(v) of the Petroleum and Natural Gas Act.
- Other prescribed substances.



The scope of a "pipeline" also includes installations and facilities associated with the piping, but does not include:

• Piping used to transmit natural gas at less than 700 kilopascals (kPa) to consumers by a gas utility as defined in the Gas Utility Act.

• A wellhead.

• Anything else that is prescribed.

Data used in this report was obtained from incident records sent to the Commission by pipeline permit holders, the Provincial Emergency Program (PEP), Commission inspectors and the public. The data includes all operating and deactivated pipelines that have received Leave to Open (LTO) status from the Commission. Summary information for abandoned pipelines and non-operational incidents is included in the report through tables, but has not been used for analysis of incident data for frequencies or figures.

To simplify the data analysis in this report, the uncommon types of pipelines, released materials, and causes for incidents are categorized into a group as "Other", which will be explained further with noted sub-categories.

3. Pipeline Inventory

Figures 1A-1D provide the length and type of pipelines under the Commission's jurisdiction in 2010. As of Dec. 31, 2010 the total length of pipeline regulated by the Commission was 37,474 km¹. In the last three calendar years, an average of 1,295 km of new pipelines went into operation each year.



Figure 1A Length of all pipelines (operating, deactivated and abandoned) by product type as of Dec. 31, 2010

Figure 1B Length of all operating pipelines by product type as of Dec. 31, 2010²



¹ Pipeline inventory data executed on Feb. 28, 2011.

² The various pipeline product types encompass the following: "Crude Oil" includes crude oil, sour crude and LVP; "Natural Gas" includes natural gas, sweet gas and fuel gas; "Sour natural gas" includes natural gas with a hydrogen sulphide (H₂S) concentration of one mole per cent or more; "Other" includes miscellaneous gases and oil effluent; "Water" includes water, freshwater, produced water, saltwater and sour water; "HVP" includes ethylene, propane, pentanes and liquid ethane.



Figure 1D Length of abandoned pipelines by product type as of Dec. 31, 2010



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4. Pipeline Incidents

It is a regulatory requirement that all pipeline incidents are reported to the Commission directly or through the Provincial Emergency Program (PEP). A reportable pipeline incident is any incident resulting in, or having potential to, damage a pipeline, even if there is no spillage of products or substances from the pipeline.

Incident reporting is required regardless of the status of the pipeline or the type of product released. Hits on deactivated or abandoned pipelines, leaks of freshwater from pipelines or spills of any substance within the right-of-way of pipelines must be reported. All reported incidents will be assessed by the Commission to determine what remedial actions must take place and whether the pipeline can continue to operate.

5. Repairs and Investigations

Pipeline permit holders in British Columbia are required to investigate all pipeline incidents to determine the cause and contributing factors. Appropriate remedial actions and repairs must be identified in order to attempt to prevent a recurrence. The permit holder(s) must submit a permit holder post-incident report to the Commission, which summarizes the root cause of the incident, repair methods, operational changes and design changes that are required. Risk assessment is based on the likelihood of an incident happening again, and is determined by examining company safety policies set in place along with compliance inspections and meetings. These pipeline upgrades and changes to the status of a pipeline are detailed through the submission of a Pipeline Permit Amendment or a Notice of Intent (NOI) application by the operator.

Figure 2 Standard process for reporting any incident



6. Integrity Management Programs

Pipeline Integrity Management Programs (IMPs) provide a systematic approach for assuring pipeline integrity throughout the entire pipeline lifecycle: design, construction, operation and maintenance. IMPs have been a regulatory requirement for all pipeline systems in British Columbia since 1999.

Integrity Management in British Columbia supplements the assessments made by the Commission when determining compliance and approvals. Integrity self-assessment plays a key role for operators to ensure that they have a proper mitigation measure implemented in order to reduce the risk of hazards.

Figure 3 History of IMPs in British Columbia

April 1999

- IMPs were introduced into the 1999 edition of CSA Z662 Oil and Gas Pipeline Systems, and through adoption by reference became mandatory for all pipeline systems within British Columbia.
- Clause 10.10.3.2, 1999 Edition stated:

"Operation companies shall establish an effective system for managing the integrity of the pipeline systems so that they are suitable for continued service, including procedures to monitor for conditions that may lead to failures and to eliminate or mitigate such conditions."

December 2005

- CSA published Supplement Number 1 to CSA Z662-03, which included:
 - The non-mandatory Annex N Guideline for Pipeline Integrity Management programs.
 - The mandatory Annex M Sour Service Pipelines.
- Pipelines subject to Annex M were required to follow Annex N.

April 2006

The Commission proposed making Annex N mandatory for all pipeline systems in British Columbia.

August 2006

• Annex N was made mandatory by the Commission. All pipeline permit holders in British Columbia are required to develop and implement IMPs in accordance with Annex N for all pipelines operating under the jurisdiction of the Commission.

September 2009

The Commission published draft self-assessment protocol for IMPs.

January 2011

• The Commission launched the self-assessment protocol for IMPs directive. The Commission will contact selected pipeline permit holders and request that they complete and file a self-assessment of their IMP. Submissions will be reviewed by the Commission to determine if further compliance assurance activities are necessary. The aggregated findings of all assessment reports will be presented in our Pipeline Performance Reports for each calendar year beginning in 2011.

7. Incident Statistics

Table 2 shows the frequency of pipeline incidents under the Commission's jurisdiction. Incident frequency is calculated as the number of incidents per 1,000 km of operational pipeline. The increase seen in the number of incidents in 2010 (when compared to 2009) can be explained by the broader incident reporting criteria after the implementation of the OGAA. Prior to 2010 only incidents causing a release were reported; now, with the increased importance of integrity of pipelines, all incidents that have the potential to affect the integrity of the line are reported.

Table 2 Total number of incidents per 1,000 km of operational pipeline inventory

	2009	2010
Length of Operating Pipelines (km)	35,759	36,361
Number of Incidents	37	50
Incident Frequency (Incidents/1,000 km)	1.03	1.38

Table 3 shows the frequency of incidents by pipeline product type. Pipelines listed as "other" vary from oil well effluents to sweet emulsion based.

Table 3 Total number of incidents per 1,000 km of operational pipeline inventory by product type

Type of Pipeline	Length of Pipelines (km)	Number of Incidents	Frequency
Crude Oil	2,603	2	0.77
Natural Gas	18,717	20	1.07
Sour Natural Gas	11,952	16	1.34
Other	1,663	5	3.01
Water	1,209	6	4.96
HVP	217	1	4.61

Figures 4A-B show the overall distribution of incident types in 2010 compared to 2009 and includes all pipeline incidents classified by leaks, ruptures, hits and spills.



Figure 4A Types of incidents in 2010

Figure 4B Types of incidents in 2009





6. Incident Causes

Table 4 shows pipeline incidents classified by immediate and sub-cause for 2009 and 2010. The number of reported incidents has increased significantly from 2009 following implementation of OGAA, which defines stricter incident reporting procedures. One notable change that has occurred is that more equipment failures were reported over 2010 as these mainly consisted of spills that were not always considered part of the pipeline under previous legislation. OGAA has introduced a broader definition for pipelines and includes equipment that is intended for use with a pipeline, such as pumps. Equipment that was used in conjunction with the physical pipeline body to assist in the function of a pipeline was a large contribution to the number of equipment failure incidents. Three third-party strike incidents occurred on abandoned pipelines. Non-operational incidents had an additional five frac-out incidents during horizontal directional drilling of a pipeline across waterways.

Table 4: Pipeline incidents by cause in 2009 and 2010

Incident Cause	2009	2010	2010 (Non-operational)
Internal Corrosion	15	14	0
External Corrosion	1	2	0
Suspected Corrosion	1	4	0
Metal Loss	17	20	0
Cracking	2	0	0
Construction Defects	3	1	0
Material, Manufacturing, Construction Defects	3	1	0
Company Employee	3	2	0
Third Party	0	5	3
Vandalism	1	0	0
External Interferences	4	7	3
Slope Movement/Weather-Related	3	3	0
Frac-Out	0	0	5
Geotechnical Failure	3	3	5
Improper Operation	7	8	0
Overpressure	0	1	0
Other Cause	7	9	0
Valve and Fittings	1	4	0
Pipe Fittings / Joint Failure	0	3	0
Miscellaneous Equipment	0	3	0
Equipment Failure	1	10	0
Totals	37	50	8

The new edition of CSA Z662-11 has been released and there were a few changes to the ways that primary causes for incidents are reported. Table 5 gives a sample of what may be expected when the new CSA standards come into place.

Incident Cause	2009	2010
Metal loss	17	20
Internal Corrosion	15	14
External Corrosion	1	2
Suspected Corrosion	1	4
Cracking	2	0
Material or manufacturing	5	0
Construction	0	1
External interference	4	7
Company Employee	3	2
Third Party	0	5
Vandalism	1	0
Geotechnical failure	3	3
Slope Movement	3	3
Other cause	7	8
Improper Operation	7	8
Ancillary equipment	1	9
Valve seals or packing	1	2
Gasket	0	0
Totals	40	50

Table 5: Pipeline incidents by expected cause³ in 2009 and 2010

Corrosion and metal loss accounted for 40 per cent of all pipeline incidents in 2010 as illustrated in Figure 6A (next page). Internal corrosion, while a factor in all types of pipeline incidents, becomes prevalent in sour natural gas lines due to the concentration of hydrogen sulphide and carbon dioxide being transported.

^{3 &}quot;Expected cause" refers to expected changes in the new edition of CSA.



Figure 6A: 2010 operational pipeline incidents by immediate cause



Figure 6B: 2009 operational pipeline incidents by immediate cause



Figure 7A: 2010 operational pipeline incidents by sub-cause



Figure 7B: 2009 operational pipeline incidents by sub-cause





Figure 8 shows pipeline incident causes in relation to product type for 2010. Corrosion was the major cause of failure in sour natural gas, sweet gas and water pipelines. Hydrogen sulphide, carbon dioxide and water are the critical components to trigger corrosion of pipelines as most of the pipelines in British Columbia are made of steel. "Other causes" for incidents were listed in Table 3 as being due to improper operation or overpressure. Other pipeline types included sweet emulsion lines and oilwell effluent lines.

Many of the incident causes are deemed hazards to a pipeline, and the IMPs evaluate these hazards to try to associate risks through risk analysis and mitigation processes. As the hazards and risks associated with the line are determined, the IMP acts as an intervention that is to take place prior to a loss of containment on a line.

Figure 8: Incident causes by pipeline type



7. Incident Releases

Figure 9 shows the number of incidents categorized by the type of product that was released and by incidents where no release occurred. The number of product releases is slightly greater than the number of incidents reported for 2010 due to some incidents releasing more than one product at a time⁴. Different pipeline types also did not always leak out the matching product, which caused variation from incident pipeline type and release type. Including multiphase releases, over 45 per cent of release incidents leaked a product that did not match the pipeline product on permit. "Other" products can be explained by the following example: pipelines that are permitted to carry gas may at some points contain liquids as the compression of the line decreases; this causes liquid production such as produced water and some condensate to form in the line. This was mostly a case of produced water and emulsions being flowed through natural gas pipelines. Multiphase products range from natural and sour gases that are flowed through the pipe along with produced water, condensate or emulsions.

Figure 9: Pipeline incidents by product release (includes all leaks, spills, hits and ruptures)



4 For example, a single gas line leak incident may release natural gas, condensate and produced water. These numbers represent all products that were released in 2010 from any incident.

Table 6 shows the type of product releases included in the "Other" category and the number of incidents related to those materials.

Materials	Releases in 2009	Releases in 2010
HVP	0	1
Condensate	2	4
Corrosion Inhibitor	0	1
Methane	0	1

Table 6: Materials released categorized as "Other" in Figure 9

Table 7 shows the total volume of liquid spills in 2010 by product type. The largest incident release was a 60 cubic metre (m³) fresh water leakage due to microbiologically influenced corrosion (MIC). The presence of oxygen and bacteria accelerated the corrosion and led to internal pitting of the pipe. The pipeline was replaced and brought back into operation soon after. In the case of spilled condensate and produced water from the same pipeline incident, the volume released is counted in the "Other" row in Table 6.

Table 7: Liquid spill volume by product in 2010

Spill Liquid	Volume (m ³)
Crude Oil	41
Produced Water	19
Fresh Water	64
Other	53
Emulsion	43

Table 8 shows the total volume of gas released by type of product in 2010. Three significant occurrences resulted in over 98 per cent of the natural gas released by pipeline incidents in 2010. The largest incident was caused by a third party construction company hitting a transmission line resulting in 129,238 m³ of natural gas release. The pipeline was isolated and the damaged portion was replaced. Another incident resulted in the release of 90,600 m³ of natural gas due to geotechnical slope movement. A debris flow had uprooted a 61-metre cedar tree that fell on the pipeline and caused a tensile stress failure at a weld. A small section of the pipe was cut out and replaced. A third incident resulted in 13,970 m³ natural gas release caused by a company hitting their own transmission line.

Table 8: Gas release volume by product in 2010

Spill Gas	Volume (m ³)
Natural Gas	234,829
Sour Natural Gas	625
Other	3,909



Figure 10A shows spill volumes for all pipeline incidents where releases occurred (categorized by substance type in 10B). Eighty-six per cent of incident releases were quickly contained and resolved resulting in less than 100 m³ of released volume, while there were three incidents that occurred where more than 10,000 m³ of substance was released. All three incidents with more than 10,000 m³ of release volume were natural gas incidents. One methane gas incident classified as "Other" occurred and resulted in 3,909 m³ of release.



Figure 10A: Pipeline release by volume in the m³ for all substances

Figure 10B: Pipeline release by substance and volume in m³



The incident frequency for pipelines based on outer diameter ranges of pipe is shown below in Figure 11. The trend for the past two years shows that incidents are more frequent for pipelines with a smaller outer diameter.

Figure 11: Pipeline incident frequency (incidents/1,000 km) for different ranges of outer diameter



Pipeline Diameter (mm)

8. Moving Forward

Regulating pipeline activity in British Columbia is a key role of the Commission, while pipeline integrity is paramount for ensuring safe and environmentally responsible operations. Looking ahead, the Commission will continue to improve the regulation of IMPs by continually engaging with pipeline operators to ensure proper precautions are set in place to prevent pipeline incidents and to ensure that when incidents do occur, they are appropriately managed from emergency response through to final remediation.

Pipeline Performance in British Columbia in 2010 is an annual report that provides a transparent look at all Commission-regulated pipeline activity in British Columbia. It is another tool that the Commission uses to improve its reporting procedures and make information widely available to British Columbians.

We welcome your questions and comments on this report as well as suggestions to improve future reporting.

Appendix A – Glossary

Abandoned Pipeline

Piping that is removed from service and not maintained for later return to service.

Condensate

Hydrocarbon liquids that are present as gaseous components in raw natural gas.

Deactivated Pipeline

Piping that is removed from service but is maintained for later return to service.

Effluent

Wastewater discharge containing different substances transported in the process.

Emulsion

A mixture of multiple immiscible liquids.

Frac-Out

Caused when excessive drilling pressure results in drilling mud propagating toward the surface.

Hit

Line strike resulting in coating damage.

HVP (High-Vapour Pressure)

Defined in CSA Z662 as a pipeline system conveying hydrocarbons or hydrocarbon mixtures in the liquid or quasi-liquid state with a vapour pressure greater than 110 kPa absolute at 38°C, as determined using the Reid method.

IMP (Integrity Management Program)

A program developed by pipeline operators to manage the integrity of their pipeline systems.

Incident

An event that may occur on the pipeline or along the pipeline right-of-way that has the potential to affect the integrity of the pipeline.

KERMIT (Knowledge, Enterprise, Resource, Management, Information, and Technology) The Commission's database application, which provides industry with an electronic submission process for pipelines and facilities.

Leak

Loss of containment event that does not immediately impair the operations of the pipeline.

LVP (Low-Vapour Pressure)

A pipeline system conveying any of:

(a) Hydrocarbons or hydrocarbon mixtures in the liquid or quasi-liquid state with a vapour

pressure of 110 kPa absolute or less at 38°C, as determined using the Reid method.

(b) Multi-phase fluids.

(c) Oilfield water.

NOI (Notice of Intent)

An application that is submitted to inform the Commission of any changes to the pipelines where consultation and notification are not required.

OGAA (Oil and Gas Activities Act)

Current legislation that has been imposed as of October 2010, in order to moderate oil and gas activities in British Columbia.

PEP (Provincial Emergency Program)

A division of the Ministry of Public Safety that works with provincial and federal agencies to provide additional coordination during emergencies.

ROW (Right-of-way)

A strip of land that is temporarily granted to the operator for transportation and activity purposes.

Rupture

Loss of containment event that immediately impairs the operation of the pipeline.

Sour Natural Gas

Refers to all natural gases with an H₂S concentration of one mole per cent or more.

Spill

Release of product not involving direct pipe damage.