National Energy Board | Office national de l'énergie

FOCUS ON
SAFETY AND ENVIRONMENT
A COMPARATIVE ANALYSIS OF PIPELINE PERFORMANCE
2000-2007

JULY 2009

Canada

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Focus on Safety and Environment

A Comparative Analysis of Pipeline Performance

2000–2007

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FIGURES

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CAPP	Canadian Association of Petroleum Producers
CONCAWE	European Oil Companies Association for Environment, Health and Safety
CSA	Canadian Standards Association
EGIG	European Gas Pipeline Incident data Group
ERCB	Energy Resources Conservation Board (formerly Alberta Energy and Utilities Board)
HRSDC	Human Resources and Skills Development Canada
NEB	National Energy Board
NGL	Natural Gas Liquids
OPR-99	Onshore Pipeline Regulations, 1999
PHMSA	Pipeline and Hazardous Materials Safety Administration

FOREWORD

This report, *Focus on Safety and Environment: A Comparative Analysis of Pipeline Performance*, *2000-2007*, examines the number and frequency of various incidents that affect pipeline safety, integrity and the environment. The main objective of this report is to evaluate the pipeline performance of NEB-regulated companies over time and in comparison to pipeline performance in other jurisdictions.

The first of the NEB's annual performance indicators reports, *Focus on Safety: A Comparative Analysis of Pipeline Safety Performance*, was published in April 2003. This seventh edition of the report includes data from 1 January 2000 through 31 December 2007.

The NEB continually seeks input and feedback from stakeholders on the value of this report and ways it can be improved. Any comments or questions pertaining to this report should be directed to:

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INTRODUCTION

1.1 NEB Safety Role

The NEB regulates 104 oil, gas and product pipeline companies that operate approximately 45 000 kilometres of pipelines across Canada under the National Energy Board Act and the Onshore Pipeline Regulations, 1999 (OPR-99). This mandate carries with it a shared responsibility for the safety of the public, pipeline company workers and the environment.

The NEB utilizes a comprehensive, risk based, lifecycle approach to ensure that appropriate actions are taken to identify hazards and that mitigation measures are implemented to reduce risks to as low a level as possible. Risk assessment is based on three elements. The first is an assessment of the adequacy of company safety and environmental management systems through audits. The second is an assessment of adequacy of field implementation through compliance inspections and meetings. The last is an assessment of the effectiveness of company environmental and safety programs through performance indicators.

The NEB gathers information on performance indicators that relate to safety and environmental impacts through both compulsory reporting on an incident basis and on an annual voluntary basis. The performance indicators reported upon relate to:

- Fatalities;
- Injuries;
- Pipeline ruptures;
- Pipeline contacts;
- Liquid releases, leaks and spills; and
- Gas releases.

The voluntary performance data is normalized between companies on the basis of length of pipelines and hours worked. Normalizing of data also allows for comparisons with other agencies. In order to provide a historic trend analysis, the NEB compiles this annual report.

1.2 2000 – 2007 Pipeline Performance Indicators

In 2001, the NEB began the Safety Performance Indicator Initiative, a voluntary reporting initiative to collect detailed information on injuries, leaks, and spills. The analysis of this voluntary data helps both the NEB and the regulated companies to monitor safety and environmental performance. The information gathered under this initiative is only up to the end of 2007 due to timelines surrounding data collection and analysis.

Industry trends and benchmarking comparisons can provide valuable insight into the effectiveness of safety, integrity and environmental management systems. A list of companies that have voluntarily reported environmental and safety information for 2007 is provided in Appendix One, Pipeline Performance Indicator Data. The hours worked and pipeline kilometres operated were also reported to enable comparisons.

For the purpose of evaluating pipeline construction, operation and maintenance performance, the term "pipeline" includes: all branches, extensions, tanks, reservoirs, storage facilities, pipes, pumps, valves, racks, compressors, storage tanks and loading facilities integral to the operation of a hydrocarbon pipeline.

1.3 Reference Organizations

Where similar data is available, the NEB conducts a comparative analysis of performance indicators with that of other organizations. This external data is based mainly on publicly available documents provided on websites and in published reports. In some cases, specific data is acquired through direct correspondence with the reference organizations. Some reference organization information used in previous reports has been determined to not be relevant as benchmarks. The following organizations have been selected for comparison in this report:

- CAPP: Canadian Association of Petroleum Producers; www.capp.ca
- CONCAWE: European Oil Companies Association for Environment, Health and Safety; www.concawe.be
- EGIG: European Gas Pipeline Incident Data Group; www.egig.nl
- ERCB: Alberta Energy Resources Conservation Board; www.ercb.ca
- HRSDC: Human Resources and Skills Development Canada; www.hrsdc.gc.ca
- PHMSA: United States Department of Transportation – Pipeline and Hazardous Materials Safety Administration - Office of Pipeline Safety; http://phmsa.dot.gov

PIPELINE SAFETY PERFORMANCE

The NEB recognizes the efforts regulated companies and their contractors make to operate safe workplaces in order to prevent fatalities and serious injuries. The nature of the industry and the number of persons working in the industry poses a continuous risk. However, strict attention to safe operating procedures has to be a priority for industry to minimize risk to the public and workers.

2.1 Pipeline Fatalities

Fatality data provided by NEB-regulated pipeline companies are evaluated to determine whether the incident involved employees, contactors or members of the public and whether it involved activities related to the construction, operation or maintenance of pipelines.

Figure 2.1 shows the number and cause of all reported fatalities on NEB-regulated pipelines between 1991 and 2007. There were ten consecutive years in which there were no work-related fatalities on NEB-regulated pipelines even though several hundred kilometres of new pipelines were constructed and existing pipelines expanded. One fatality occurred on NEB-regulated pipelines in 2005, however it was determined to be unrelated to work activities. All fatalities reported between 1991 and 1997 shown in figure 2.1 are contract workers conducting construction activities.

2.2 Injuries

Since 2000 the NEB has evaluated worker injury data for contractors and employees submitted by regulated companies. Injury frequency data for NEB-regulated pipelines from 2000 to 2007 shown in Figure 2.2 includes all lost time and restricted workday injuries but excludes fatalities. All injury frequencies are measured in terms of injuries per 200 000 hours of work. Work based on

FIGURE 2.1

Fatalities on NEB-Regulated Pipelines

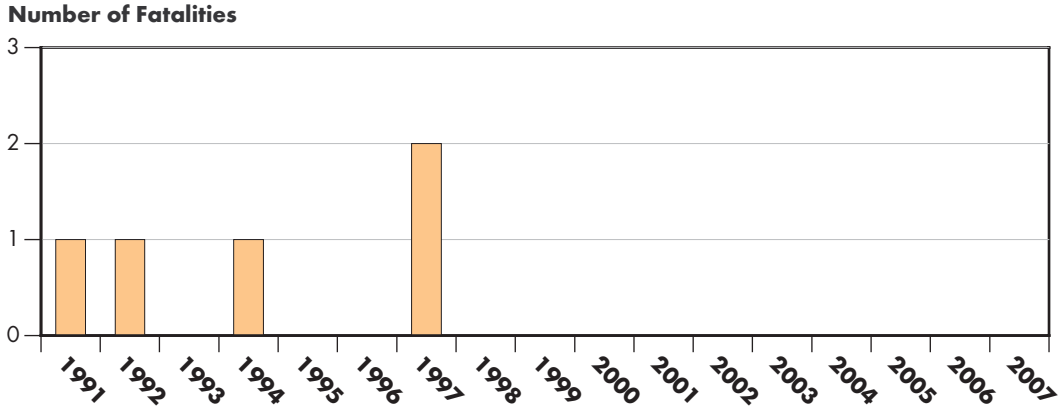
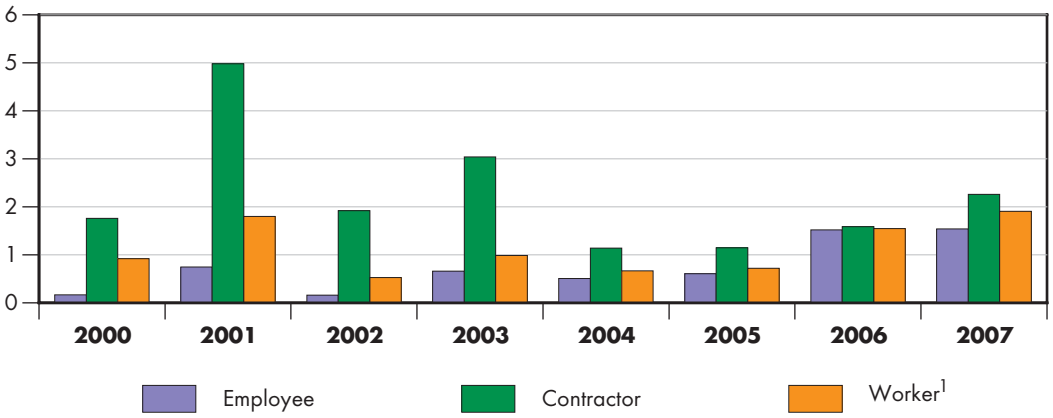


FIGURE 2.2

Injury Frequency

Number of injuries per 200,000 hrs



1 Worker statistics is a combination of contractor and employee statistics.

200 000 hours is widely used in the health and safety industry and is equivalent to the number of hours worked by 100 full-time employees in one year.

Worker injury frequency has increased from 1.6 injuries per 200 000 hours in 2006 to 1.9 in 2007. The increase in injuries in both 2006 and 2007 is of concern. The greatest contributing factor to this increase is the gas pipeline sector, which accounts for 65 percent of NEB-regulated pipelines and has experienced a large increase in injuries in 2006 and 2007. Although there are twice as many kilometres of gas pipelines than liquid, the total hours worked on gas and liquid pipelines in 2007 are of a similar magnitude. A summary of employee and contractor hours and the number of injuries incurred since 2000 is provided in Appendix One Pipeline Performance Indicator Data.

Factors such as increased construction activity, the level of experience of employees, increasing presssure to meet deadlines and workplace complacency may contribute to the higher frequency of injuries.

2.3 Detailed Injury Analysis

To better understand reported injury frequencies, data has been separated into contractor and employee injury frequencies and by type of pipeline In addition, contractor serious injury types and causes, as well as non-compliances observed by the NEB on construction projects is evaluated. Some of the injury data is further separated into liquid and gas pipeline-related injuries to enable analysis of injury data by sector.

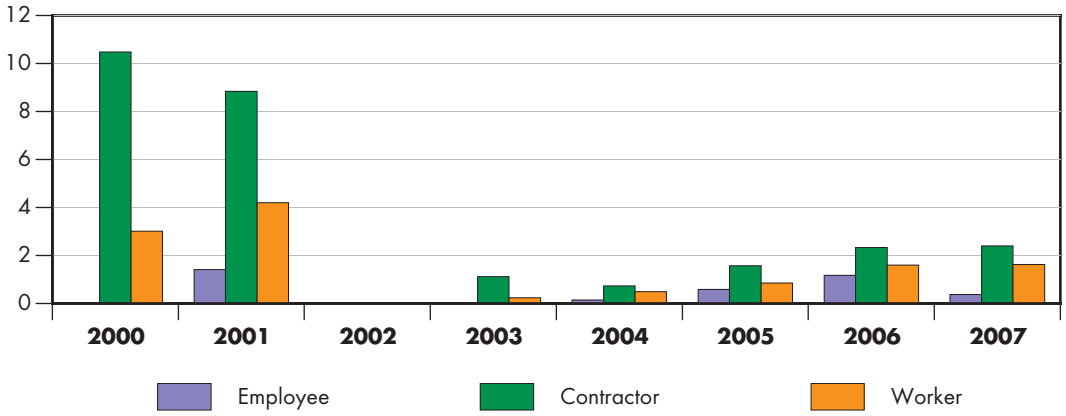
NEB-Regulated Liquid Pipeline Injuries

Liquid pipelines include crude oil, refined product and NGL pipelines. Contractor, employee and worker injury frequencies for NEB-regulated liquid pipelines are illustrated in Figure 2.3. In 2002, there were no contractor or employee injuries reported.

FIGURE 2.3

Liquid Pipeline Injury Frequency

Number of injuries per 200 000 hrs



The employee injury frequency for liquid pipelines has been low for the past four years with a 67 percent reduction in employee injuries in 2007. The contractor injury frequency has been consistently higher than that of company employees and has risen for the past four years. The 2007 contractor injury frequency of 2.4 injuries per 200 000 hours for liquid pipelines is similar to 2006, and is lower than the eight year average of 3.4 injuries per 200 000 hours. The increased rate may be a result of construction undertaken by two major oil pipeline companies in 2007.

NEB-Regulated Gas Pipeline Injuries

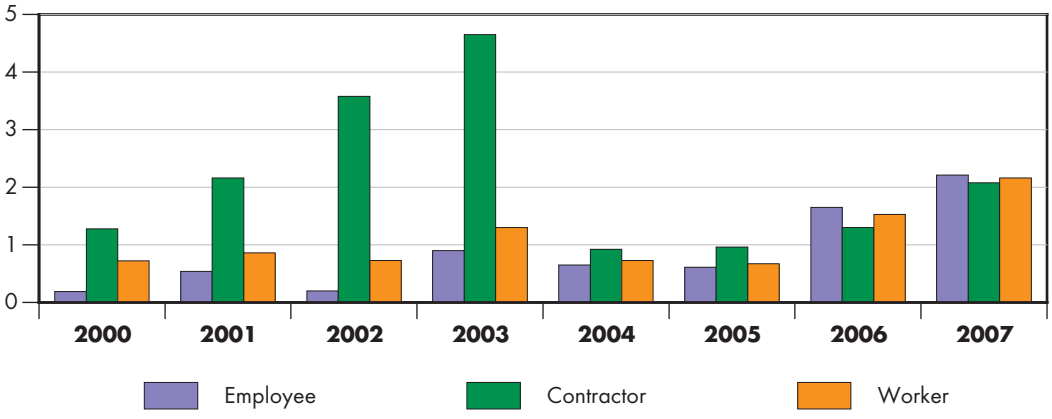
The injury frequency for all workers including contractors and employees for NEB-regulated gas pipelines is shown in Figure 2-4.

The gas pipeline employee and contractor injury frequency in 2007 increased for the second year in a row to 2.1 and 2.2 injuries per 200 000 hours respectively. It is notable that contractor and employee injury frequencies are consistent on an annual basis for the past four years. No significant construction occurred in 2007 so the contractor injuries are related to operation and maintenance activities.

FIGURE 2.4

Gas Pipeline Injury Frequency

Number of injuries per 200 000 hrs



Employee Injury Frequency Comparisons

NEB-regulated pipeline employee injury frequency is compared to reference organizations for the period 2000 to 2007 in Figure 2.5. NEB-regulated pipeline companies show a marked increase in the number of employee injuries between 2005 and 2007, while the CAPP frequency decreased. As previously noted the majority of reported employee injuries were in the gas pipeline sector.

Human Resources and Skills Development Canada (HRSDC) also publishes employee injury frequency data, which includes disabling injuries to employees working in head and regional officesfor all federally regulated workplaces. NEB-regulated pipeline employee injury data does not include head offices. The HRSDC employee injury frequency for 2000 to 2005 ranged from 0.3 to 0.6 injuries per 200 000 hours, a similar range to the NEB frequencies for those years. HRSDC data was not available for 2006 and 2007 at the time of this comparison.

Contractor Injury Frequency Comparisons

A comparison of contractor injury frequency to the same parameter for the Canadian Association of Pipeline Producers (CAPP) for the period of 2000 to 2007 in Figure 2.6 shows that NEB-regulated pipeline injury frequencies are on average very similar to that reported by CAPP that represents the upstream oil and gas sector. The NEB eight-year average indicates that two out of 100 full time contractor workers are injured every year.

Contractor Serious Injuries

The types of serious injuries incurred by contracted workers on NEB-regulated pipelines between 2000 and 2007 that were reported to the NEB have been categorized as to the type of event and cause in Table 2.1. Serious injury is defined as an injury that results in: the fracture of a major bone; the amputation of a body part; the loss of sight in one or both eyes; internal haemorrhage; third degree burns; unconsciousness; or the loss of a body part or function of a body part. There were no

FIGURE 2.5

Employee Injury Frequency

Number of Injuries per 200 000 hours

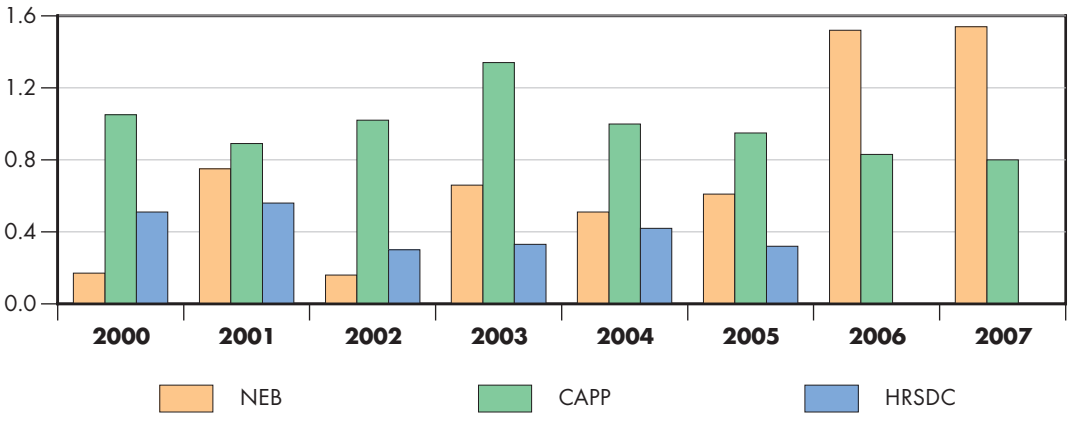
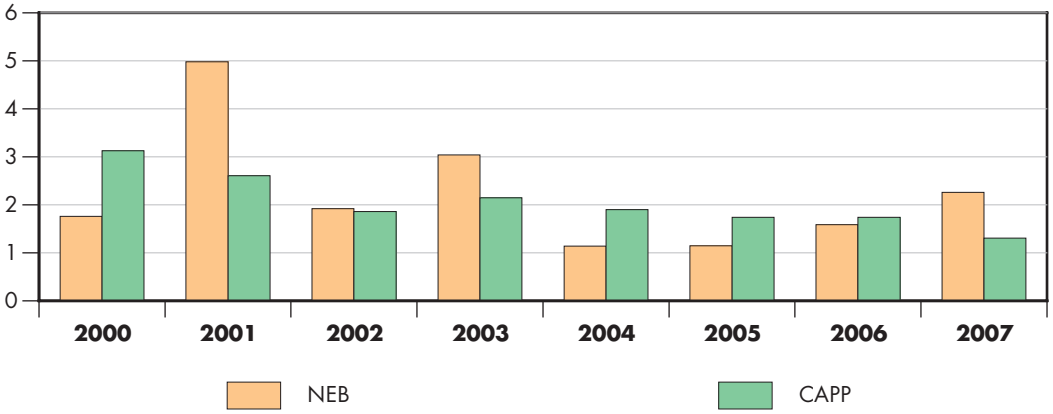


FIGURE 2.6

Contractor Injury Frequency

Number of Injuries per 200 000 hours



serious injuries reported in 2002. In 2007 two serious injuries occurred which is consistent with the eight year average.

The NEB has conducted further analysis on the causes of incidents, particularly in relation to contractors as shown in Table 2.2. The NEB is aware that the historic contractor injury frequency is on average higher than that for employees. However, the Board believes that injury frequencies within employee and contractor populations should be similar. The frequency of hazard exposure among contractors may be greater than for employees but protective measures, safety programs and worker training should be designed to mitigate the increased risks.

TABLE 2.1

Contractor Serious Injuries 2000 – 2007

Type of Event or Exposure	Number of Serious Injuries
Contact with Objects & Equipment	
Struck by Object	7
Caught in Object	3
Struck against Object	1
Contact with Electricity	2
Other	0
Falls	
Fall on Same Level	0
Fall to Lower Level	2
Other	0
Transportation Accidents	1
Fire and Explosions	0
Total Number of Serious Injuries	16

2.4 Construction Safety Inspections

As part of its activities to monitor compliance with the OPR-99 and other safety regulations, the NEB regularly inspects pipeline construction projects. The safety non-compliances observed during inspections are most often corrected immediately on-site. They are recorded and tracked so that special attention is paid by the NEB and companies to those non-compliances which are commonly observed (Table 2.3). In this way, both the NEB and its regulated companies are able to employ a proactive approach to incident prevention and help encourage the development of a safety culture at all construction sites.

The NEB increased its pipeline construction inspections in 2007 to monitor and evaluate field activities so as to better understand and communicate to the industry the measures that can be taken to improve worker safety. The inspections found that non-compliances decreased for the second consecutive year.

TABLE 2.2

Contractor Serious Injury Causes 2000 – 2007

Direct Causes		2000	2001	2002	2003	2004	2005	2006	2007	Total
Substandard Acts	Improper position for task		1			1				2
	Improper placement	1	1		1			1		4
	Using equipment improperly		1				1			2
	Failure to warn	1								1
	Failure to secure				1				2	3
	Failure to follow procedures						1			1
Substandard Conditions	Hazardous environmental conditions						1			1
	Inadequate sign or label					1				1
Total Injuries		**2**	**3**	**0**	**2**	**2**	**3**	**1**	**2**	**15**
Basic Causes										
Job Factors	Inadequate leadership/supervision	1	2							3
	Inadequate tools and equipment				1				1	2
	Inadequate work standards				1	1				2
	Inadequate engineering						1		1	2
Personal Factors	Poor Judgment		1				1	1		3
	Lack of knowledge						1			1
	Improper motivation	1				1				2
Total Injuries		**2**	**3**	**0**	**2**	**2**	**3**	**1**	**2**	**15**

TABLE 2.3

NEB Pipeline Construction Safety Inspections

Type of Non-Compliance	2006	2007
Personal Protective Equipment		
Hearing Protection	1	1
Face Shields or Safety Glasses	5	2
Hard Hats	2	3
High Visibility Vests	1	2
Unsafe Work Practices		
Riding Suspended Pipe/Straddling Pipe	4	0
Pinch Points	3	1
Guidelines/Tag Lines	1	0
Explosion Hazard	0	3
Ingress/Egress	0	0
MSDS	1	2
Danger Zones	1	1
Scaffolding	0	1
Total Number of Non-compliances Observed	**19**	**16**
Number of NEB Construction Safety Inspections Conducted	**14**	**25**

2.5 Pipeline Ruptures

Ruptures are defined as a "loss of containment event that immediately impairs the operation of a pipeline". Pipeline ruptures have the potential to be severely detrimental to the environment as well as the safety of the public and workers. The NEB investigates and analyses ruptures to determine primary causes. The number of ruptures and their primary cause since 1991 for all NEB-regulated pipelines as shown in Figure 2.7 is considered to be both a safety and environment performance indicator.

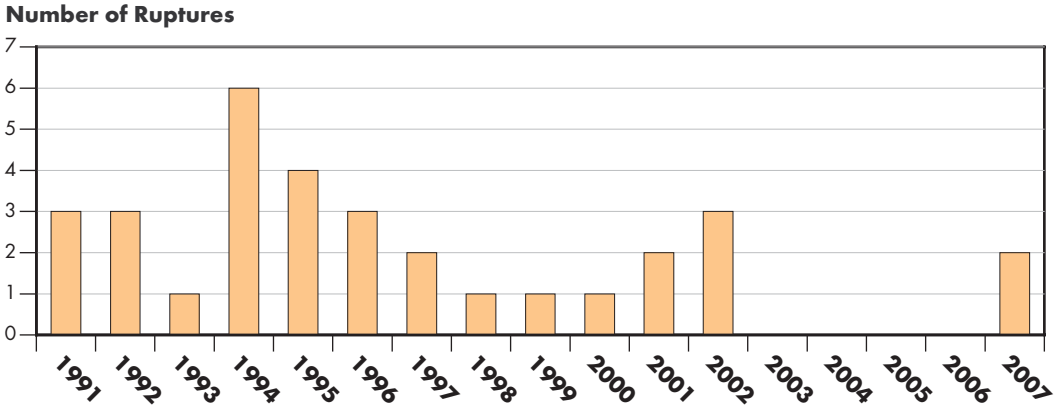
Between 1991 and 2002, there was an average of 2.5 ruptures per year. Beginning in 1999, companies were required under the OPR-99 to have pipeline integrity management programs. The proactive nature and the evolution of individual company integrity management programs may be responsible for the decline in ruptures since 2002. However, in 2007 there were two ruptures on liquid pipelines. One rupture occurred when a third party struck a crude oil pipeline. The other rupture was caused by cracking due to fatigue.

Table 2.4 and Figure 2.8 provide a breakdown of reported ruptures on NEB-regulated pipelines and their primary causes. The primary cause of ruptures on NEB-regulated pipelines between 1991 and 2007 was corrosion due to cracking and metal loss. Cracking includes hydrogen-induced and mechanical damage delayed cracking, stress corrosion, and corrosion fatigue. Metal loss includes both internal and external corrosion. The category of "Other Causes" includes improper operation, fire and yet to be determined causes.

Some pipelines of specific vintage and of certain construction methods have experienced a higher rupture frequency than others.[1] A number of factors have contributed to the absence of ruptures on new pipelines, including the quality of pipeline coatings and cathodic protection, new construction methods, effective pressure testing and well-developed integrity management programs.

FIGURE 2.7

NEB-Regulated Pipeline Ruptures 2000 – 2007



1 Jeglic, F. Analysis of Ruptures and Trends on major Canadian Pipeline Systems. National Energy Board, Calgary, Canada, 2004.

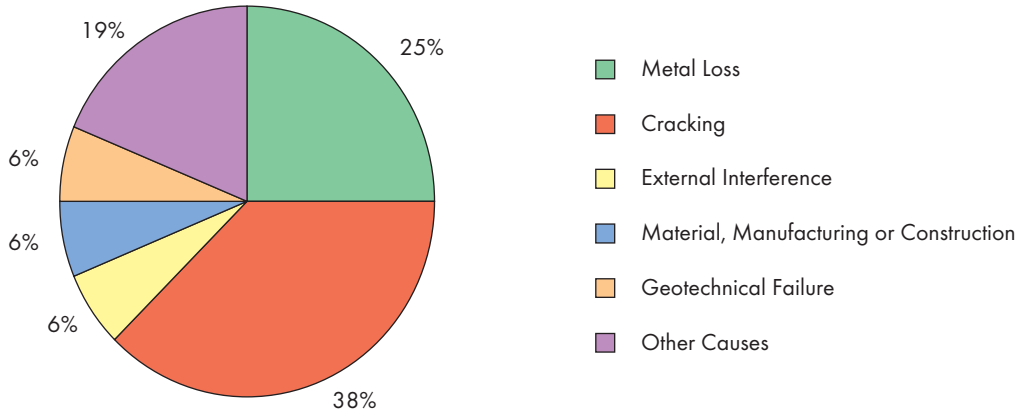
TABLE 2.4

NEB-Regulated Pipeline Rupture Primary Causes 1991 - 2007

Year	Number of Ruptures	Primary Causes					
		Metal Loss	Cracking	External Interference	Material, Manufacturing or Construction	Geotechnical Failure	Other Causes
1991	3		2		1		
1992	3	1	1				1
1993	1			1			
1994	6	2	1			1	2
1995	4	1	3				
1996	3	2	1				
1997	2	1				1	
1998	1						1
1999	1		1				
2000	1				1		
2001	2	1	1				
2002	3		1				2
2003	0						
2004	0						
2005	0						
2006	0						
2007	2		1	1			
%	100	25	38	6	6	6	19
Total	**32**	**8**	**12**	**2**	**2**	**2**	**6**

FIGURE 2.8

NEB-Regulated Pipeline Rupture Causes by Percent



Rupture Cause Comparisons

The cause of NEB-regulated pipeline ruptures is compared to those reported by the Alberta Energy Resources Conservation Board (ERCB), the United States Pipeline and Hazardous Material Safety Administration (PHMSA) and the European Gas Pipeline Incident Data Group (EGIG) since 1991 in Table 2.5. While each organization has different timeframes over which they have examined rupture causes, annual evidence from these organizations suggests that the leading cause of ruptures generally remains constant over time within each organization.

TABLE 2.5

Pipeline Rupture Cause Comparison by Percent

Rupture Cause	EGIG (1970-2007)	EUB (2000-2007)	NEB (1991-2007)	PHMSA (1987-2007)
Corrosion	15	7	63	23
External Interference	50	49	6	24
Material (Manufacturing or Construction)	17	28	6	20
Geotechnical	7	2	6	5
Other Causes	11	15	19	29
Total (Percent)	**100**	**100**	**100**	**100**

To facilitate a more representative comparison between organizations with different reporting criteria, ruptures caused by metal loss and cracking, as defined by CSA Z662, have been combined and compared to ruptures caused by corrosion. Ruptures brought on by natural causes were compared with geotechnical and other causes. In contrast to the NEB, the leading cause of ruptures reported in other jurisdictions is external interference. Because of differences in pipeline content and purpose (i.e., gathering, transmission, distribution), exact comparisons are difficult, which may account for differences in rupture or failure modes. The density of the ERCB-regulated pipeline network coupled with high levels of construction in the Alberta oil and gas sector may account for higher external interference rates in Alberta.

2.6 Pipeline Unauthorized Activities in Rights of Way

Unauthorized activities reported under the NEB Pipeline Crossing Regulations (Part I and Part II) include actions that have the potential to damage a pipeline or that may impede access to a pipeline for the purposes of maintenance or emergency response. As noted previously external interference is a leading cause of ruptures in many jurisdictions.

Unauthorized activities or events considered to be indicators related to pipeline integrity include:

- movement of vehicles or equipment over pipelines;
- construction activities with no soil disturbance;
- construction, landscaping, or grading that results in soil disturbance; and
- construction, landscaping, or grading that results in pipeline contact.

The total number of unauthorized activities in rights of way between 2005 and 2007 has stabilized at approximately 70 per year. This is above the eight-year average of 53 per year (Table 2.6). The number of pipeline contacts is consistently low, ranging from one to two per year. This is less than 5 percent of the total number of unauthorized activities. Increasing urban encroachment on pipeline rights of way is a growing concern and may result in an increased number of unauthorized activities along rights of way.

TABLE 2.6

Unauthorized Activities on NEB-Regulated Pipeline Rights of Way 2000 – 2007

Year	Activities With No Soil Disturbance		Actvities With Soil Disturbance		Pipeline Contacts		Total
	Landowner	Contractor	Landowner	Contractor	Landowner	Contractor	
2000	5	0	12	26	0	2	45
2001	7	0	14	27	1	0	49
2002	2	0	7	13	0	1	23
2003	9	4	7	30	2	0	52
2004	4	2	12	33	1	1	53
2005	11	2	20	37	0	1	71
2006	6	4	23	32	0	1	66
2007	8	9	28	21	0	2	68
Average	7	3	15	27	0.5	1	53

PIPELINE ENVIRONMENTAL PERFORMANCE

3.1 Liquid Pipeline Pipe Body Releases

A liquid hydrocarbon release has the potential to harm wildlife, aquatic life, vegetation and contaminate surface water supplies. It may also percolate to groundwater where water supplies may also be affected. As a performance indicator, any pipe body failure (including ruptures and leaks) resulting in a release of liquid having a volume greater than 1.5 m^3 meets the NEB OPR-99 reporting requirements (Table 3.1). Liquid releases of volumes less than 1.5 m^3 are not considered reportable incidents under the OPR-99. However, data regarding liquid releases of volumes less than 1.5 m^3 were requested under the voluntary reporting initiative.

TABLE 3.1

Pipe Body Liquid Releases 2000 – 2007

Year	Number >1.5 m^3	Volume (m^3)
2000	0	0
2001	2	3650
2002	2	52
2003	0	0
2004	0	0
2005	2	254
2006	4	39
2007	2	1182

NEB-regulated pipelines experienced very few pipe body liquid releases over the period from 2000 to 2005. There were no liquid releases in 2000, 2003 or 2004 from NEB-regulated pipelines. Overall, NEB-regulated liquid pipelines have an eight year average of 0.05 pipe body liquid releases per 1 000 kilometres or one reportable leak per 20 000 kilometres of pipe. However there were two liquid pipe body releases in 2007, both of which were ruptures that released a significant volume of fluid. One rupture caused significant effects on a marine environment and personal property. The site of this spill has been cleaned up to remove immediate risks to the public and the environment and the Board is monitoring the ongoing remediation of any residual contamination. The second rupture released oil beneath a prairie wetland. In this case, the contaminated areas have been remediated to NEB's satisfaction. In the case of a spill, leak or major release, the Board's role is to ensure that the companies responsible conduct environmental site assessments and clean up any contamination at the spill sites. The NEB continues to monitor situations where remediation of residual soil or groundwater contamination is ongoing.

3.2 Liquid Release Frequency Comparisons

The liquid release frequency from pipe bodies for NEB-regulated liquid pipelines was compared to that of reference organizations in Figure 3.1. It is important to consider that reporting criteria for liquid releases may vary slightly from organization to organization as shown in Table 3.2. In an effort to make the comparison as meaningful as possible, data from PHMSA and CONCAWE have been sorted to consider only incidents which meet NEB reporting criteria.

NEB-regulated pipelines have had fewer pipe body liquid releases than in other jurisdictions in every year prior to 2006. This may be due, in part, to the higher frequency of pipeline contacts by third parties experienced by PHMSA. In 2007 NEB-regulated companies reached an eight year high frequency of 0.28 releases per 1 000 km. The CONCAWE data is not available for 2007.

3.3 Liquid Release Volume Comparisons

A single large rupture or break can have a significant impact on the liquid release volume performance indicator. This is particularly evident in Figure 3.2 where in 2001, large events caused this indicator's upper range to be in excess of 200 m^3 per 1 000 km of liquid pipelines. As previously mentioned, NEB facilities had two major releases from ruptures that increased the reported volume for 2007.

FIGURE 3.1

Pipe Body Liquid Release Frequency per 1 000 Kilometres

Number of Releases per 1 000 km

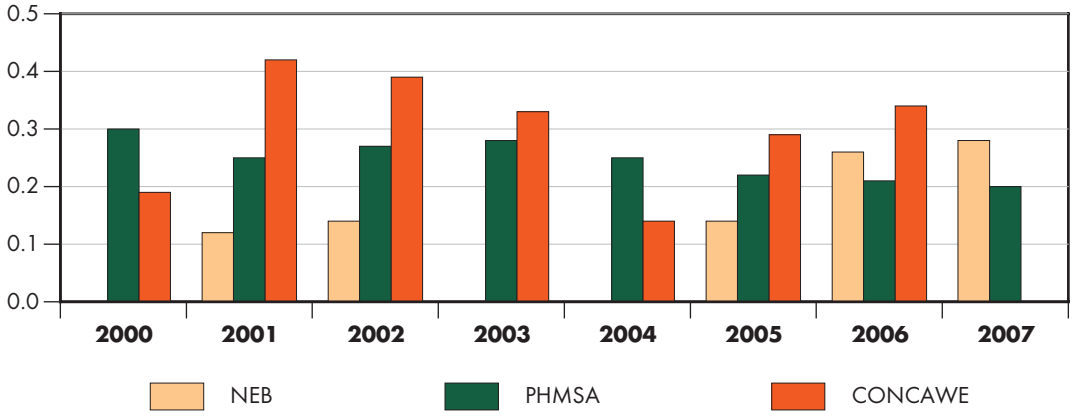


TABLE 3.2

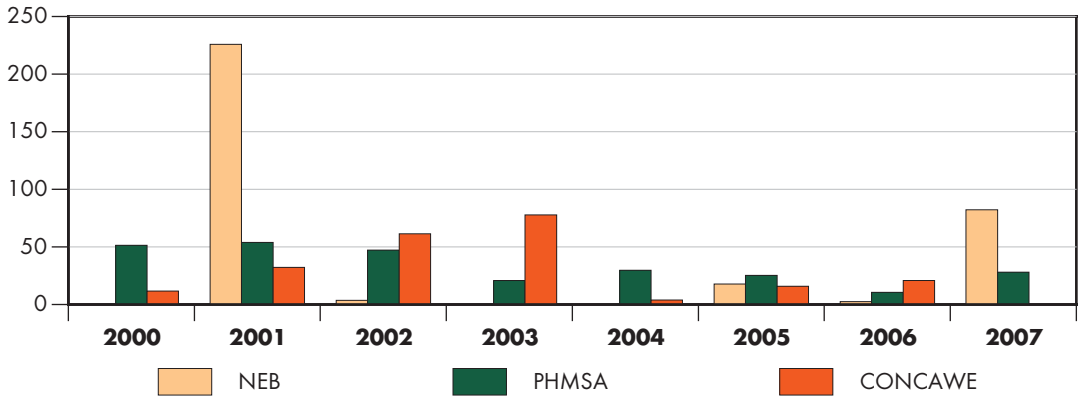
Liquid Release Reporting Criteria

Organization	Liquid Release Reporting Requirements
NEB	Any unintended or uncontained release of liquid hydrocarbons associated with pipe body failure and a release volume in excess of 1.5 m^3.
PHMSA	Loss of 8 or more cubic metres or where property damage costs exceed $50,000 USD and after 7 February 2002; a release of 19 litres or more.
CONCAWE	The minimum spill size has been set at 1 m^3 for reporting purposes unless there are exceptional serious safety / environmental consequences as a result of a less than 1 m^3 spill.

FIGURE 3.2

Pipe Body Release Volume

m^3 of liquid released per 1 000 km



3.4 Operational Liquid Leaks

Operational leaks on liquid pipelines are product leaks associated with pipeline operations and originate from pipeline components such as flanges, valves, pumps and storage tanks. These leaks are usually contained within fenced pipeline facilities and exclude leaks from pipe bodies. Most of these leaks are less than 1.5 m^3 in volume as shown in Table 3.3.

The frequency of liquid leaks from non-pipe body sources has a eight year average of approximately three leaks per 1 000 km of pipeline. Figure 3.3 shows that the frequency in 2007 was the same as the five year low reported in 2006.

A large liquid leak (1 075 m^3) occurred in 2002 at a pump station and a large leak (950 m^3) occurred in 2005 at an oil terminal. This resulted in a high total leak volume for those years. On average,

TABLE 3.3

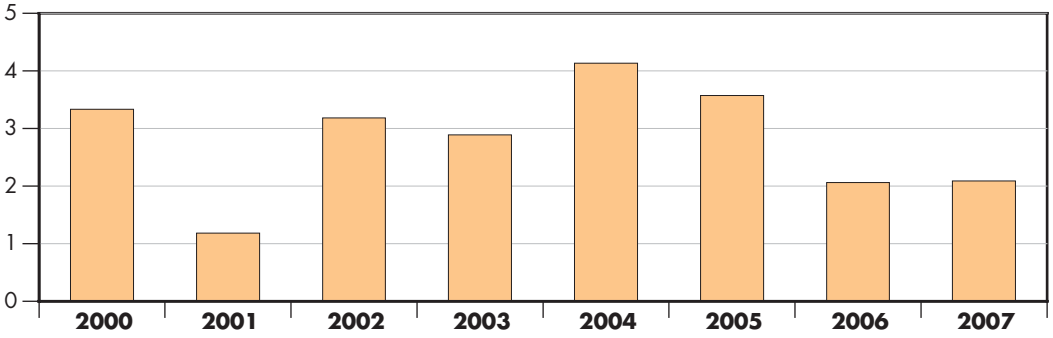
Pipeline Operational Leaks

Year	Number ≤1.5 m^3	Number >1.5 m^3	Total Number	Total Volume (m^3)
2000	42	2	44	102
2001	15	4	19	279
2002	38	9	47	1184
2003	43	1	44	13
2004	57	5	62	34
2005	48	3	51	1269
2006	25	7	32	322
2007	26	4	30	129

FIGURE 3.3

Pipeline Operational Liquid Leak Frequency

Number of leaks per 1 000 km



approximately 44 leaks per year are reported on NEB-regulated pipeline systems. Much like pipe body releases, a single large leak from other pipeline components can have a significant impact on total annual leak volume. No reference organizations publish a liquid leak frequency comparable to that of the NEB.

3.5 Non-Pipeline Liquid Spills

Liquid spills are associated with pipeline construction, maintenance and operations on both liquid and gas pipelines. These spills include small volumes of hydraulic, lubrication, valve operator fluids or equipment fuels, but exclude product leaks from liquid pipeline systems (Table 3.4).

TABLE 3.4

Non-Pipeline Liquid Spills at Liquid and Gas Pipelines

Year	Number ≤1.5m^3	Number >1.5m^3	Total Number	Total Volume (m^3)
2000	227	0	227	16
2001	28	1	29	3
2002	25	0	25	2
2003	48	1	49	5
2004	64	1	65	4
2005	47	1	48	12
2006	125	0	125	3
2007	36	0	36	2

High levels of construction activity in 2000 caused a significant number of reported spills. Overall, the average volume per spill is small, with the eight-year average being 0.6 m^3 per spill. The number of spills and volumes were lower than average for 2007 with only 36 spills with a reported volume of less than 2 m^3.

TABLE 3.5

Pipeline Gas Releases and Leaks

Year	Pipe Body Gas Releases	Operational Pipeline Gas Leaks
2000	1	24
2001	1	23
2002	2	11
2003	0	11
2004	4	19
2005	4	18
2006	1	22
2007	3	58

3.6 Gas Releases and Operational Gas Leaks

Gas releases are the result of pipe body failures and include both ruptures and leaks. Operational gas leaks occur through equipment, including venting from valves and seepage at flanges through gaskets.

The data presented in Table 3.5 does not include the intentional release of gas such as during venting or planned blowdowns. All unplanned, unintended or uncontrolled gas leaks from NEB-regulated pipelines must be reported and there is no minimum reportable volume.

3.7 Gas Release Frequency Comparison

A comparison is made between the frequency of gas releases from NEB-regulated gas pipelines and EGIG regulated gas pipelines in Figure 3.4. The gas release reporting criteria for EGIG and the NEB are summarized in Table 3.6.

The eight-year average of the gas pipe body release frequency for NEB-regulated pipelines was approximately 0.08 releases per 1 000 km or one gas release per 12 500 km. NEB gas release

FIGURE 3.4

Pipe Body Gas Release Frequency Comparison

Number of Releases per 1 000 km

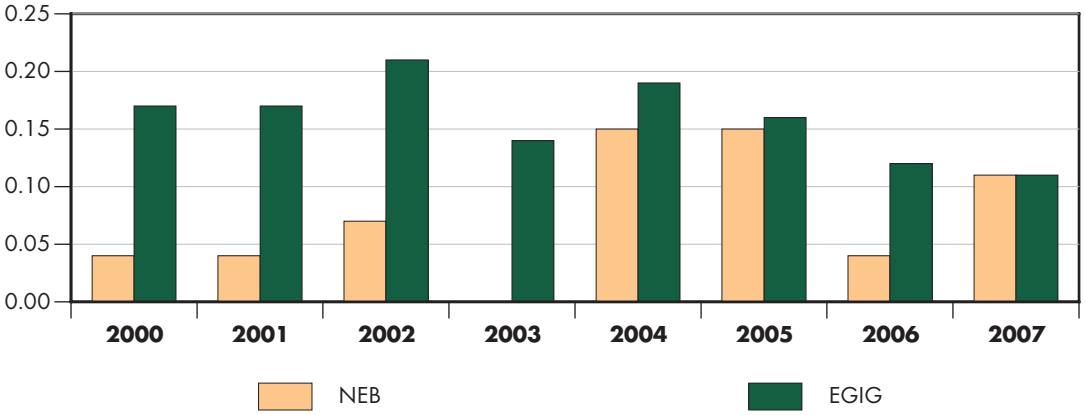


TABLE 3.6

Comparison of Gas Release Reporting Criteria

Organization	Gas Release Reporting Requirements
NEB	Any unintended or uncontrolled release of natural gas.
EGIG	Any unintentional release of gas from an onshore pipeline operating at greater than 1500 kPa outside of the fenced boundaries of installations and excluding all components except the pipe.

frequencies were lower than the EGIG frequencies until 2007. The average NEB-regulated pipe body release frequency for 2007 was 0.11 per 1 000 km.

3.8 Operational Gas Leak Frequency

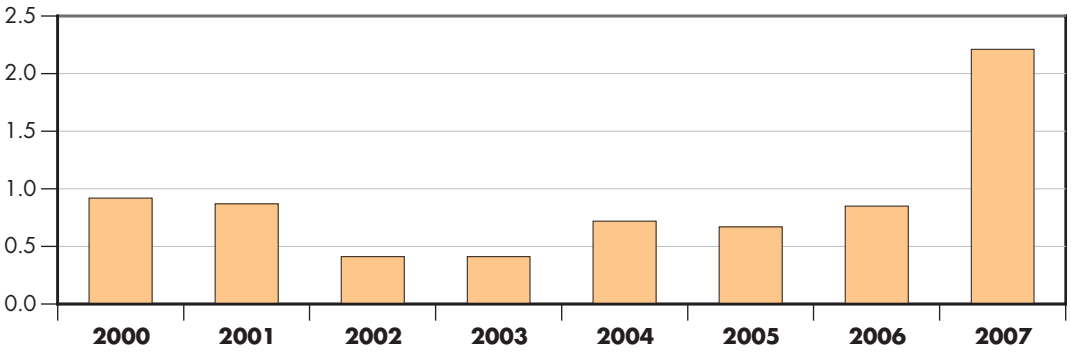
At a frequency of approximately 0.75 leaks per 1 000 km, operational gas leaks on NEB-regulated gas pipelines occur about 10 times more often than pipe body gas releases.

Due to the differences in reporting requirements for gas leaks between the NEB and other agencies no comparison is made for operational leaks. Figure 3.5 shows that 2007 had much higher than normal gas leaks. A review of the occurrences is being conducted.

FIGURE 3.5

Operational Gas Leaks

Number of leaks per 1 000 km



NEB-REGULATED PIPELINE PERFORMANCE INDICATOR SUMMARY

In summary, voluntary reporting by pipeline companies for 2007 showed that several performance indicators did not improve since 2006 (Table 4.1). Safety indicators of concern include contractor

TABLE 4.1

NEB-Regulated Pipeline Performance Indicator Summary

Performance Indicator	2006	2007	Historical Average 2000-2007
Number of Fatalities (employee, contractor and third party)	0	0	0
Worker Injury Frequency (injuries per 200 000 hours)	1.5	1.9	1
Contractor Injury Frequency (injuries per 200 000 hours)	1.6	2.3	2
Employee Injury Frequency (injuries per 200 000 hours)	1.5	1.5	0.7
Liquid Pipeline Worker Injury Frequency (injuries per 200 000 hours)	1.6	1.6	1.5
Gas Pipeline Worker Injury Frequency (injuries per 200 000 hours)	1.5	2.2	1
Total Number of Pipeline Ruptures	0	2	1
Total Number of Pipeline Contacts	1	2	1.5
Pipe Body Liquid Release Frequency (liquid releases per 1 000 km)	0.3	0.3	0.1
Pipe Body Liquid Release Volume Frequency (m^3 of liquid released per 1 000 km)	2.5	82	41
Number of Operational Liquid Leaks (on liquid pipelines)	32	30	41
Operational Liquid Leak Frequency (liquid leaks per 1 000 km liquid pipelines)	2	2	3
Number of Non-pipeline Spills (construction & maintenance liquid spills)	125	36	76
Pipe Body Gas Release Frequency (gas releases per 1 000 km gas pipelines)	0.0	0.1	0.1
Number of Operational Gas Leaks (on gas pipelines)	22	58	23
Operational Gas Leak Frequency (leaks per 1 000 km gas pipelines)	0.8	2.2	1
Total Number of Incidents (reportable under the OPR-99)	37	49	39

injury frequency and a corresponding increase in injury frequency on gas pipeline systems. Two pipeline ruptures were notable occurrences given the lack of ruptures for the previous four years. The safety performance indicators that remained stable were fatalities, employee injuries and injuries on liquid pipelines.

From an environmental protection perspective the number of non-pipeline spills significantly decreased and the number of liquid leaks remained stable. Only the volume of oil released from two ruptures and an increase in the number of minor operational leaks showed a decrease in environmental performance for 2007 over 2006.

PIPELINE PERFORMANCE INDICATOR DATA

Performance Indicator data for the period 1 January 2007 to 31 December 2007 was submitted voluntarily to the NEB from companies owning or operating approximately 93% of the total length of pipelines regulated by the NEB under the *National Energy Board Act*. Companies typically report on all NEB-regulated pipelines systems that they own. The following tables provide raw data from those companies that reported on pipeline length worker hours and injuries. In addition, reference organization data on pipeline lengths and injury frequency is listed here.

TABLE A1.1

Companies Reporting Performance Indicator Data for 2007

Alliance Pipeline Ltd.	NuVista Energy Ltd.
ATCO 6720471 Canada Inc.	Omimex Canada Ltd.
BP Canada Energy Company	Paramount Resources
Canadian Montana Pipeline Company	Pengrowth Corporation
Canadian Natural Resources Limited	Plains Midstream Canada
Corporation Champion Pipeline	Provident Energy
Enbridge Inc.	Spectra Energy Gas Transmission
EnCana Corporation	St. Clair Pipelines Inc.
Energy Fundamentals Group	Suncor Energy Inc.
Harvest Operations Corp.	TransCanada PipeLines Limited
Kaiser Exploration Ltd.	Trans-Northern Pipelines Inc.
Kinder Morgan Canada Inc	Trans Quebec & Maritimes Pipelines Inc.
Manitoba Hydro	Terasen Gas Inc.
Montreal Pipe Line Limited	Union Gas Limited
Niagara Gas Transmission Ltd. (NGTL)	Vector Pipeline Limited Partnership
NOVA Chemicals	

TABLE A1.2

NEB-Regulated Pipeline Lengths

Year	Number of Kilometres Reported on	Total Kilometres Regulated
2000	39 190	42 919
2001	42 670	42 968
2002	41 555	43 124
2003	42 189	43 252
2004	41 386	43 371
2005	41 270	43 440
2006	41 420	43 530
2007	40 642	43 734

TABLE A1.3

Pipeline Contractor and Employee Injury Frequency Data

Year	Contractor Hours	Employee Hours	Contractor Injuries	Employee Injuries
2000	6 255 390	7 034 954	55	6
2001	1 606 271	4 827 678	40	18
2002	1 357 577	5 103 983	13	4
2003	788 466	4 869 253	12	16
2004	1 573 743	4 722 044	9	12
2005	1 218 350	4 925 620	7	15
2006	2 140 650	3 811 330	28	29
2007	2 918 420	2 850 195	33	22

TABLE A1.4

Gas and Liquid Pipeline Worker Hours

Year	Liquid Pipeline	Gas Pipeline	Total
2000	1 124 735	12 165 609	13 290 344
2001	1 808 947	4 625 003	6 433 950
2002	1 822 637	4 638 923	6 461 560
2003	1 655 670	4 002 049	5 657 719
2004	1 615 406	4 680 381	6 295 787
2005	1 398 649	4 745 321	6 143 969
2006	1 625 244	4 326 736	5 951 979
2007	2 707 357	3 061 257	5 768 614

TABLE A1.5

Reference Organization Pipeline Lengths

Year	Organization	Kilometres of Gas Pipeline	Kilometres of Hydrocarbon Liquid Pipeline	Total Reported Kilometres
2000	NEB	25 970	13 220	39 190
2000	ERCB	229 034	16 410	245 444
2000	PHMSA	524 000	249 020	773 020
2000	EGIG	110 236	0	110 236
2001	NEB	26 510	16 170	42 680
2001	ERCB	245 466	16 818	262 284
2001	PHMSA	479 800	255 060	734 860
2001	EGIG	110 236	0	110 236
2002	NEB	26 752	14 803	41 555
2002	ERCB	255 032	17 118	272 150
2002	PHMSA	526 007	258 409	784 899
2002	EGIG	109 524	0	109 524
2003	NEB	26 943	15 245	42 189
2003	ERCB	268 549	17 391	285 940
2003	PHMSA	522 020	258 892	780 912
2003	EGIG	114 285	0	114 285
2004	NEB	27 146	14 812	41 958
2004	ERCB	288 388	17 793	306 181
2004	PHMSA	518 283	270 262	788 545
2004	EGIG	122 168	0	122 168
2005	NEB	27 002	14 269	41 270
2005	ERCB	305 274	18 019	323 534
2005	PHMSA	522 960	266 493	789 452
2005	EGIG	not available	not available	not available
2006	NEB	28 080	15 530	43 610
2006	ERCB	321 940	18 140	340 086
2006	PHMSA	515 108	264 935	780 043
2006	EGIG	not available	not available	not available
2007	NEB	26 275	14 368	40 642
2007	PHMSA	479 872	255 302	735 174
2007	CONCAWE	not available	not available	not available
2007	EGIG	129 719	0	129 719
2007	ERCB	331 891	18 568	350 459

TABLE A1.6

Reference Organization Injury Frequency Data

Year	Source*	Contractor Injury Frequency	Employee Injury Frequency	Worker Injury Frequency
2000	NEB	1.76	0.17	0.92
2000	HRSDC	not available	0.51	not available
2000	CAPP	3.13	1.05	2.49
2001	NEB	4.98	0.75	1.80
2001	HRSDC	not available	0.56	not available
2001	CAPP	2.61	0.89	2.06
2002	NEB	1.92	0.16	0.53
2002	HRSDC	not available	0.30	not available
2002	CAPP	1.86	1.02	1.64
2003	NEB	3.04	0.66	0.99
2003	HRSDC	not available	0.33	not available
2003	CAPP	2.15	1.34	1.80
2004	NEB	1.14	0.51	0.67
2004	HRSDC	not available	0.42	not available
2004	CAPP	1.90	1.00	1.64
2005	NEB	1.15	0.61	0.72
2005	HRSDC	not available	0.32	not available
2005	CAPP	1.74	0.95	1.52
2006	NEB	1.59	1.52	1.55
2006	HRSDC	not available	not available	not available
2006	CAPP	1.74	0.83	1.48
2007	NEB	2.26	1.54	1.91
2007	CAPP	1.31	0.8	1.15
2007	HRSDC	not available	not available	not available

* CAPP data is for Total Recordable Injury Frequency and includes fatalities and medical treatment cases, which are not included in the NEB data.