

National Energy
Board



Office national
de l'énergie

Focus on Safety and Environment

A Comparative Analysis of Pipeline Performance

2000 - 2003

March 2005

Canada

National Energy
Board



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FOREWORD

This report on the safety, integrity and environmental performance of pipelines has been prepared based on data provided by pipeline companies regulated by the National Energy Board. Comparative data from external organizations has been collected from publications and verified (where possible) through direct contact.

For the purposes of this report, a ‘pipeline’ is a line that is used for the transmission of oil or gas which crosses a provincial or national boundary or which extends from a federal to provincial offshore area. A “pipeline” includes all branches, extensions, tanks, reservoirs, storage facilities, pumps, racks, compressors, and loading facilities integral to the operation of the pipeline. This report does not include data pertaining to the performance of processing plants or pipelines carrying commodities other than hydrocarbon liquids or natural gas.

Any comments or questions pertaining to this report should be directed to:

In English:

Mr. Ken Paulson
(kpaulson@neb-one.gc.ca)
Operations Compliance
National Energy Board
444 - 7th Ave. S.W.
Calgary, Alberta
T2P 0X8

Direct: (403) 299-3194
Toll Free: 1-800-899-1265
Facsimile: (403) 292-5503
Toll Free: 1-877-288-8803

In English and French:

Mr. Henri Simoneau
(hsimoneau@neb-one.gc.ca)
Operations Compliance
National Energy Board
444 - 7th Ave. S.W.
Calgary, Alberta
T2P 0X8

Direct: (403) 299-3680
Toll Free: 1-800-899-1265
Facsimile: (403) 292-5503
Toll Free: 1-877-288-8803

EXECUTIVE SUMMARY

Focus on Safety and Environment provides an overview of the safety, integrity and environmental performance of pipeline companies regulated by the National Energy Board (the NEB or the Board) under the *National Energy Board Act* pursuant to the *Onshore Pipeline Regulations, 1999* (the OPR).

The information in this report provides insights on relative performance on specific matters. The report does not paint a complete picture. The true measures of the success of safety, integrity and environmental management programs can only be assessed through a comprehensive review of a company's programs and a thorough assessment of their adequacy and effectiveness.

It should be noted that this report uses 2003 data since there is a one-year lag in the compilation of data.

There were no fatalities or ruptures reported in 2003. Although not included the trend continued through 2004. Injury frequencies reported for that period are close to the historical averages but

TABLE 1

2003 Performance Data

Indicator	Historical Average 2000 to 2003	2002	2003
Fatality Frequency (fatalities per 100 full time equivalent workers)	0	0	0
Combined Injury Frequency (injuries per 100 full time equivalent workers)	1.10	0.49	0.99
Contractor Injury Frequency (injuries per 100 full time equivalent workers)	3.00	1.92	3.04
Employee Injury Frequency (injuries per 100 full time equivalent workers)	0.48	0.16	0.66
Rupture Frequency (ruptures per 1000 km)	0.10	0.07	0
Spill Frequency (spills per 1000 km)	0.32	0.74	0.07
Spill Volume Frequency (volume spilled per 1000 km) (m ³)	31.01	29.71	0.28
Gas Release Frequency (releases per 1000 km)	0.45	0.31	0.21

are elevated over the frequencies reported in 2002. The frequency of liquid and gas releases is well below average for the 2003 reporting period. Table 1 provides a summary of the 2003 performance data along with comparative historical information.

The NEB believes that the performance of federally-regulated pipeline companies within Canada as outlined in this report is comparable with the performance of similar industries in the United States and Europe. Despite this fact, the Board is concerned about contractor safety.

The difference in injury frequencies between employees and contractors is a continuing concern. The Board plans to consult with stakeholders to determine how the NEB can work with regulated companies to address this issue. These consultations will begin at the NEB workshop scheduled to be held in Calgary in June 2005.

We welcome your feedback.



INTRODUCTION

1.1 The National Energy Board

The NEB's purpose is to promote safety, security, environmental protection and economic efficiency in the Canadian public interest within the mandate set by Parliament in the regulation of pipelines, energy development and trade.

The Board regulates the design, construction, operation and abandonment of interprovincial and international pipelines within Canada. The Board has regulatory authority and oversight over matters such as the tolls and tariffs of interprovincial and international pipelines, the construction and operation of international power lines and designated interprovincial power lines, the import and export of oil, electricity and natural gas, and the exploration and development of oil and gas resources in frontier areas where the federal government is responsible for the development of resources.

1.2 Safety Performance Indicators

Performance indicators are used throughout industry and government to assess the performance of specific sectors or departments relative to other sectors or departments. The NEB uses performance indicators to balance regulatory compliance programs by identifying areas where more vigilant oversight is needed as well as identifying those areas where less oversight is required.

In 1999, the Board initiated discussion with the Canadian Energy Pipeline Association (CEPA) and the Canadian Association of Petroleum Producers (CAPP) to determine what measures could be used to assess the safety performance of the pipeline industry. The goal of these consultations was to develop meaningful, comparable and useful performance indicators that could be derived from generally available data. The first Safety Performance Indicator Report, *Focus on Safety and Environment – A Comparative Analysis of Pipeline Performance*, was published in April 2003 and included data for the period between 1 January 2000 and 31 December 2001.

Table 1.1 provides a detailed list of data that the Board has determined through consultation to be useful for the measurement of performance and for the tabulation of Performance Indicators.



TABLE 1.1**Performance Data**

Information Currently Reported Under OPR	Additional Information Required Under SPI Initiative
Serious Injuries	Company Work Injury
Hydrocarbon Liquid Spills > 1.5 m ³	Contractor Work Injury
Gas Releases	Company Employee Hours
Fatalities	Contractor Worker Hours
Pipeline Ruptures	Company Employee Safety Training Hours
Pipeline Contact Damage Incidents	Number of Hydrocarbon Liquid Spills ≤1.5 m ³
	Length of Regulated Pipeline Systems

COMPARATIVE DATA

2.1 Reference Organizations

The following organizations have been selected for comparison purposes within this report:

- Office of Pipeline Safety – United States Department of Transport (OPS);
- Bureau of Labor Statistics – United States Department of Labor (BLS);
- Alberta Energy and Utilities Board (EUB);
- Canadian Association of Petroleum Producers (CAPP);
- Pipe Line Contractors Association of Canada (PLCAC);
- European Gas Pipeline Incident data Group (EGIG);
- CONCAWE, The European Oil Companies Association for Environment, Health and Safety (CONCAWE);
- International Association of Oil and Gas Producers (OGP); and
- National Energy Board, activities regulated under the *Canada Oil and Gas Operations Act* (COGOA).



Detailed information on reference organizations including Web addresses, report references and data can be found in Appendix A1.

Table 2.1 provides a listing of reference organizations and shows how their data is used for comparative purposes within this report.

2.2 Limitations of Comparative Data

The definitions of terms such as ‘injury’ or ‘rupture’ are not precisely comparable between reference organizations. As such, comparisons made within this report may include some degree of inaccuracy. Despite the inherent problems with data comparison, the NEB believes that performance trends are at least comparable between organizations. A further discussion of data comparability can be found in Appendix A2 of this report.

TABLE 2.1**Comparative Data by Source**

Organization	Ruptures	Fatalities	Injury Frequency	Liquid Releases	Gas Releases	Unauthorized Activities on the Right of Way
OPS				X	X	
BLS			X			
EUB	X			X		
CAPP			X			
PLCAC			X			
EGIG	X				X	
CONCAWE				X		
OGP		X	X			
COGOA			X			
NEB	X	X	X	X	X	X

KEY INDICATORS

The Board has identified six key indicators which are grouped under the primary topic areas of safety, integrity and environmental performance. These are:

3.1 Safety Indicators

Fatalities

- Number; and
- Frequency (fatalities per 100 full time equivalent workers).

Injury Frequency

- Frequency (injuries per 100 full time equivalent workers).

3.2 Integrity Indicators

Ruptures

- Number; and
- Cause.

Unauthorized Activities on the Right of Way

- Number.

3.3 Environmental Indicators

Environmental performance is measured through

- Liquid Releases (Spills)
 - Frequency (spills per 1000 km); and
 - Volume (cubic metres per 1000 km); and
 - Number
- Gas Releases
 - Frequency (releases per 1000 km); and
 - Number.



ANALYSIS

4.1 Safety Performance

4.1.1 Fatalities

Fatalities inevitably result in immediate and tragic effects on families, community, companies and the industry. They may also act as a catalyst for changes to legislation, regulations, industry codes and standards.

Fatality data provided by NEB-regulated pipeline companies is separated into three categories:

1. Employee fatalities

These are company employee fatalities occurring during periods where the company employee was actively involved in activities associated with their duties.

2. Contractor fatalities

These are contractor fatalities occurring during periods where a contractor who is performing work for a pipeline company is actively carrying out activities pursuant to a contract with that company.

3. Third party fatalities

These are fatalities involving persons other than contractors or employees

Employee data does not include head office staff but does include the office personnel from other facilities. Contractor data includes contractors performing activities related to the operation or construction of pipelines. The data presented within this report is limited to people involved in the construction and operation of pipelines.



The number and cause of reported fatalities since 1991 is presented in Table 4.1. Comparative frequencies are provided by source organization in Table 4.2.

Discussion

Comparison of the absolute number of fatalities between reference organizations does not provide meaningful information regarding safety performance.

Reference organizations such as the OGP report on more than 1 billion hours of work each year. In contrast, the average annual work hours on

T A B L E 4 . 1

Fatality Data reported to NEB

Year	Company Employee	Contractor	Third Party	Total	Brief Explanation
1991	0	1	0	1	Contractor employee killed when run over by skid-steer loader (bobcat).
1992	0	1	0	1	Contractor employee killed during blasting operations.
1993	0	0	0	0	
1994	0	1	0	1	Contractor employee was fatally injured when he was run over by an aerial work platform.
1995	0	0	0	0	
1996	0	0	0	0	
1997	0	2	0	2	During unloading, a large toolbox rolled off the bed of a truck onto the truck driver causing fatal injuries. Contractor employee was fatally injured when the drilling machine swung towards him knocking him into the pipe trench.
1998	0	0	0	0	
1999	0	0	0	0	
2000	0	0	0	0	
2001	0	0	0	0	
2002	0	0	0	0	
2003	0	0	0	0	

T A B L E 4 . 2

Comparative Fatality Data (Fatalities per 100 Full Time Equivalent Workers)

Year	NEB		OGP ¹	
	Contractor	Employee	Contractor	Employee
2000	0	0	0.0173	0.0094
2001	0	0	0.0128	0.0047
2002	0	0	0.0120	0.0041
2003	0	0	0.0121	0.0060

¹ *Safety Performance of the Global E & P Industry, 2000* by the International Association of Oil and Gas Producers, Report No. 6.93/319, published in June 2001; *Safety Performance of the Global E & P Industry, 2001* by the International Association of Oil and Gas Producers, Report No. 6.59/330, published in July 2002. *Safety Performance of the Global E & P Industry, 2002* by the International Association of Oil and Gas Producers, Report No. 345, published in June 2003. *OGP Safety Performance Indicators 2003*, Report No. 353, published in June 2004.

NEB-regulated pipelines reported under the SPI initiative is approximately 8 million hours. Given the small sample size, a single fatality in an average year would not result in a meaningful frequency. As such, the presentation of annual fatality frequencies may be eliminated from future reports.

4.1.2 Injury Frequency

Injury frequency is defined as the number of injuries per 100 full time equivalent workers per calendar year. For calculation purposes, it is assumed that 100 full time equivalent workers will work 200 000 hours each year.

The total number of hours reported under the SPI initiative was 5.67 million in 2003. The average number of hours per year reported to the NEB is 8 million (based on available data from 1 January 2000 to 31 December 2003).

The injury frequencies reported to the NEB for the period from 1 January 2000 to 31 December 2003 are shown in Figure 4.1.

Combined Injury Frequency

The combined injury frequency for contractors and company employees doubled in 2003 to 0.99 from 0.53 in 2002 (see figure 4.1). The combined injury frequency for 2003 is less than the long term average of 1.1 but remains elevated from the frequencies reported by reference organizations (see figure 4.2).

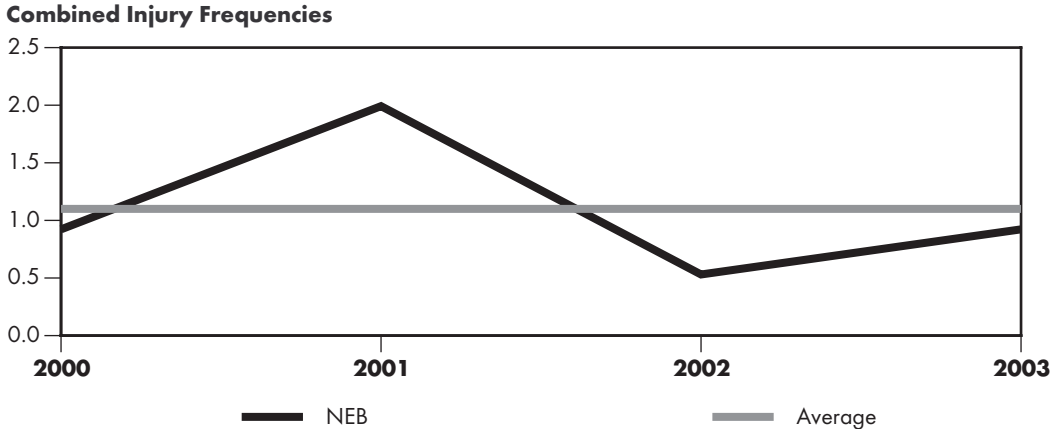
The NEB is planning to engage industry in discussions on ways to minimize the injury frequency rate among regulated companies.

Contractor Injury Frequency

The frequency of contractor injuries reported to the NEB increased to 3.04 in 2003 from 1.92 in 2002 (see figure 4.5). This is a 58.3% increase from 2002 but is similar to the average for the four years for which data is available.

FIGURE 4.1

Employee and Contractor Injuries (combined) per 100 Full Time Equivalent Workers



Although the frequency for 2003 is consistent with the average injury frequency, it remains higher than the frequencies reported by reference organizations (see figure 4.6). The NEB will be exploring ways to improve safety in this area in future consultations with industry such as the June 2005 workshop.

Employee Injury Frequency

The employee injury frequency for NEB-regulated companies increased in 2003 to 0.66 from 0.16 in 2002 and is higher than the average frequency of 0.48. (see figure 4.3)

The frequency remains similar to and within the frequency ranges reported by reference organizations (see figure 4.4).

FIGURE 4.2

Employee and Contractor Injuries (combined) per 100 Full Time Equivalent Workers

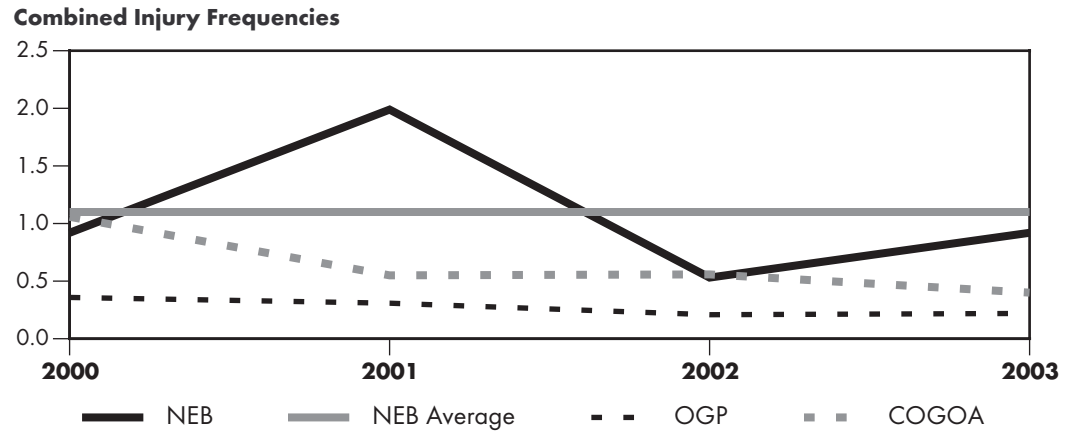


FIGURE 4.3

Employee Injury Frequency per 100 Full Time Workers

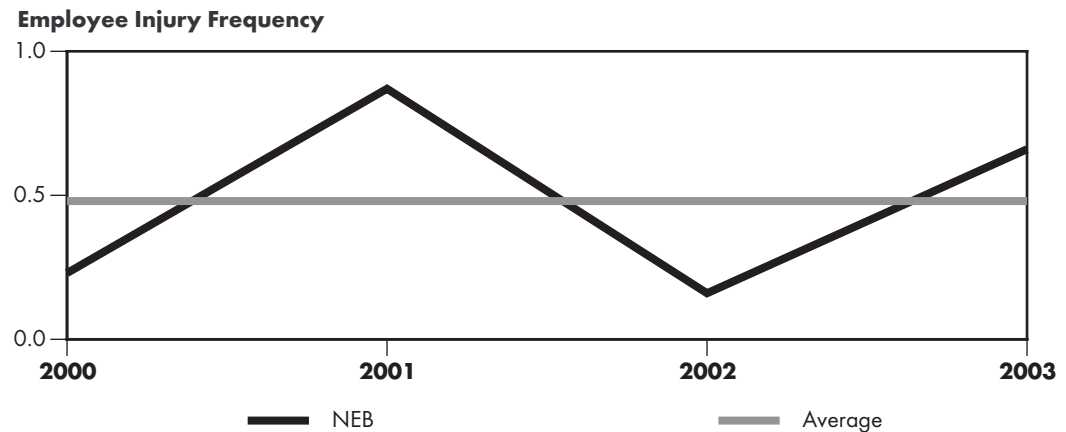


FIGURE 4.4

Employee Injury Frequency per 100 Full Time Workers

Employee Injury Frequency

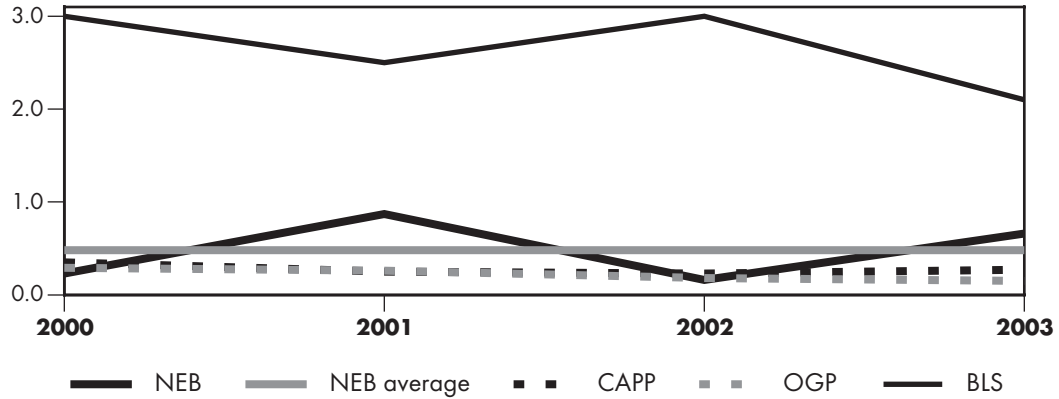


FIGURE 4.5

Contractor Injury Frequency per 100 Full Time Workers

Contractor Injury Frequency

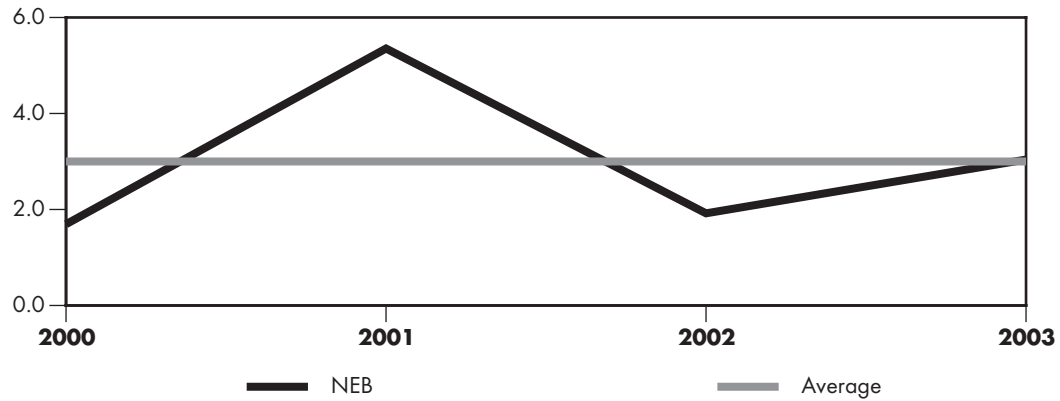
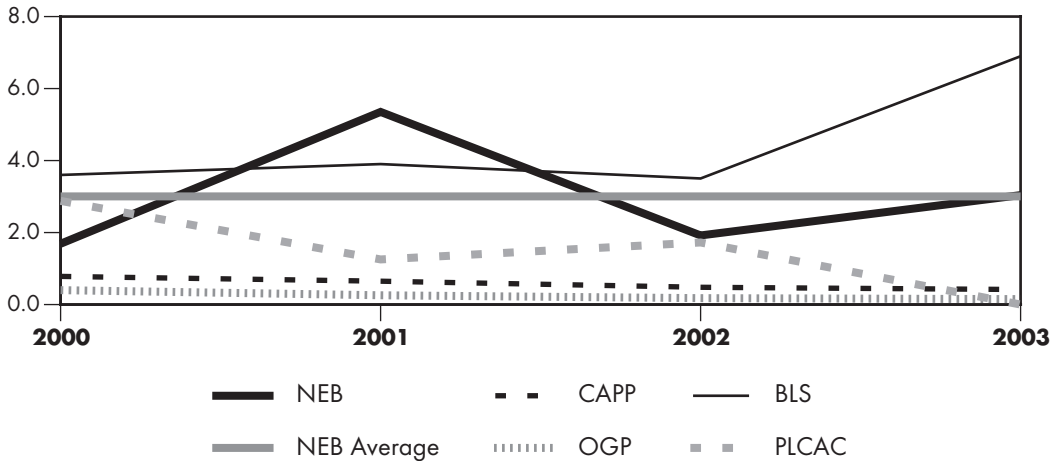


FIGURE 4.6

Contractor Injury Frequency per 100 Full Time Workers

Contractor Injury Frequency



4.2 Integrity Performance

4.2.1 Ruptures

Ruptures are defined as a “loss of containment event that immediately impairs the operation of the pipeline”. These events may result in severe detriments to safety and the environment due to the consequences associated with the spontaneous and uncontrolled release of the contents of a pipeline.

Table 4.3 provides a breakdown of ruptures by cause reported to the NEB from 1991 to 2003.

Figure 4.7 shows the cumulative number of ruptures reported by NEB-regulated pipeline companies between 1991 and 2003. The shape of the curve provides an indication of the success of integrity management programs designed to maintain pipelines and avoid failures. The figure shows that the frequency of ruptures has declined since 1997.

There were no ruptures reported on NEB-regulated pipelines in 2003.

Comparative data on ruptures is provided by source organization in Table 4.4.

Figure 4.8 shows the causes of ruptures on NEB-regulated pipelines based on data for the period 1991 to 2001. Eight of the 27 ruptures that occurred on pipeline systems regulated by the NEB between 1991 and 2001 were attributed to metal loss (corrosion) and



T A B L E 4 . 3

**NEB Pipeline Ruptures
(Number of Ruptures and Causes)**

Year	No. of Ruptures	Cause						
		Corrosion	Operational	External Interference	Natural Forces	Material Defect	Other Causes	Unknown or Under Investigation
1991	2	1						1
1992	3	2	1					
1993	1			1				
1994	6	2	2		1	1		
1995	4	4						
1996	3	2			1			
1997	2	1			1			
1998	1		1					
1999	1	1						
2000	1					1		
2001	2	2						
2002	3	1					1	1
2003	0							
Total	29	16	4	1	3	2	1	2

FIGURE 4.7

Cumulative Number of Ruptures Reported by NEB-Regulated Pipeline Companies
Number of Ruptures

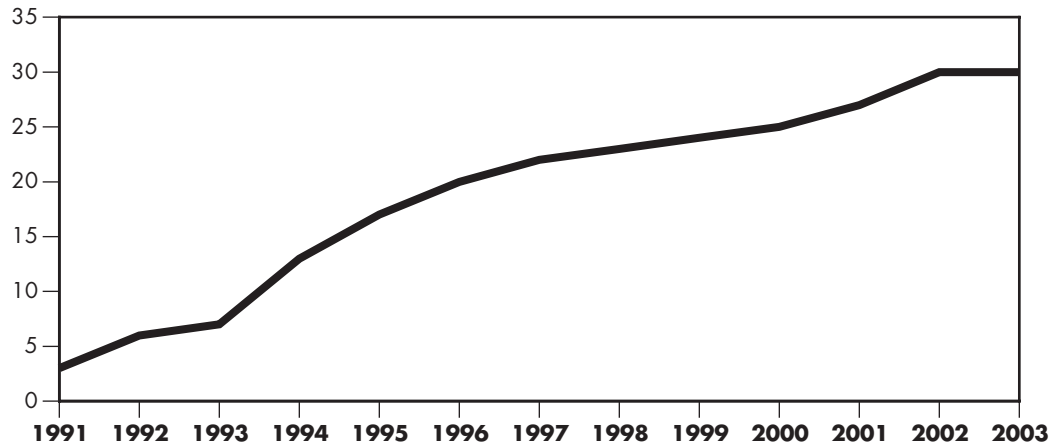


TABLE 4.4

Comparative Rupture Data by Cause
(Percentage of Ruptures, or of Failures, or Incidents)

	EGIG¹ (1970-2001)	EUB² (1980-2003)	NEB (1991-2001)	OPS³ (1997-2001)
Corrosion	15	65	56	26
External Interference	50	8	4	27
Material Defects (Manufacturing)	17	8	11	8
Operational	0	2	15	4
Natural Forces	7	2	11	0
Construction Damage	0	5	0	0
Girth Weld Failure	0	4	0	3
Other	11	6	4	32

- 1 5th EGIG Report, 1970-2001 *Gas Pipeline Incidents*, Document No. EGIG 02.R.0058, published in December 2002.
- 2 *Historical Pipeline Failures by Cause* taken from the report *Field Surveillance Provincial summary, January-December 2003*, Statistical Series (ST) 2004-57, Alberta Energy and Utilities Board, published in April 2004.
- 3 U.S. Office of Pipeline Safety, <http://ops.dot.gov/stats.htm>.

10 were attributed to cracking¹. Note that stress corrosion cracking (SCC) failures are not separated from other types of cracking for the purposes of this report. Figure 4.8 has not been updated for this report as one of the three 2002 ruptures is still under investigation. However, completed Transportation Safety Board (TSB) investigations into the other two 2002 ruptures determined they were caused by SCC and “Other Causes”.

Metal loss is the leading cause of pipeline incidents and failures identified by both the Alberta Energy and Utilities Board and the U.S. Office of Pipeline Safety. The leading cause of pipeline incidents

1 Cracking includes stress corrosion cracking, hydrogen induced cracking, mechanical damage delayed cracking, corrosion fatigue and cracking. (See Annex H.1, CSA Z662-03, *Oil and Gas Pipeline Systems*).

reported by the European Gas Pipeline Incident Data Group is external interference (third party damage).

A report published by Dr. F. Jeglic of the NEB in the fall of 2004 entitled *Analysis of Ruptures and Trends on Major Canadian Pipeline Systems* contains a number of observations which can be made from a historical analysis of reported ruptures over a period of 20 years. These include:

- The number of fatalities and injuries due to ruptures has been decreasing over the last twenty years;
- During the last seven years, there were no fatalities or injuries caused by pipeline ruptures;
- Fatalities and injuries during ruptures are most likely to occur when an ignition takes place;
- HVP liquids ruptures pose the highest safety risks of all rupture events;
- LVP liquids ruptures pose the lowest safety risks of all rupture events;
- The predominant cause of ruptures is the failure of existing defects as a result of time-dependent deterioration;
- The dominant rupture cause in the last ten year and five year periods is corrosion;
- Regulatory interventions, such as inquiries, new requirements within regulations, and orders, can reduce the number of targeted rupture causes; and
- The safety performance of the National Energy Board regulated pipelines is improving.

This report may be viewed in its entirety at http://www.neb-one.gc.ca/safety/AnalysisRupturesTrends_e.pdf.

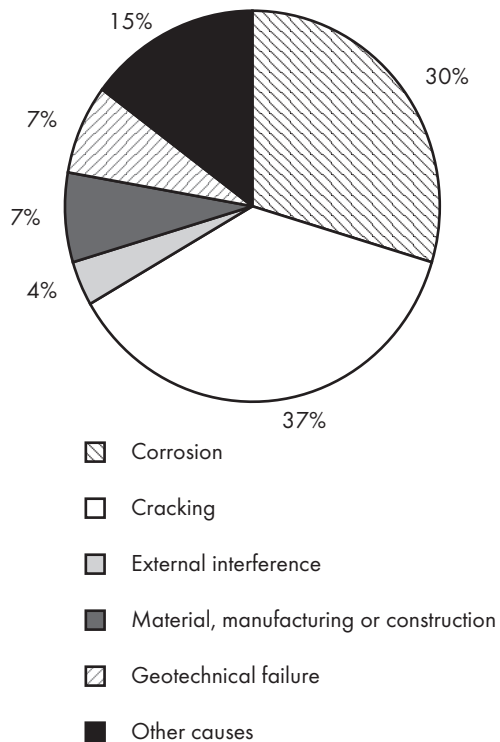
Figure 4.9 provides a comparison of NEB ruptures with failures and incidents reported by the EUB, OPS and EGIG. The OPS data is based on reported incidents from 1997 to 2001. The EUB data is based on data from 1980 to 2003. Data for EGIG is based on the period from 1970 to 2001.

Corrosion (internal and external combined) remains the leading cause of failure among the North American reference organizations shown in Figure 4.9. In Europe, the EGIG data indicates the leading cause of pipeline incidents is external interference. This is consistent with the second leading cause of failure within the EUB and OPS. External interference accounts for 27% of the OPS incidents and 8% of the EUB leaks and breaks. On NEB-regulated pipeline systems, external interference accounts for 4% of ruptures.

Differences in pipeline content and purpose (i.e. gathering, transmission, distribution) make exact comparisons difficult and may account for differences in rupture or failure modes. The population

FIGURE 4.8

Causes of Ruptures on NEB-Regulated Pipelines (1991-2001)



density in the U.S. and Europe is significantly greater than in Canada, which may account for the level of ruptures caused by external interference. The density of the pipeline network regulated by the EUB coupled with high levels of construction activity in the oil and gas sector in Alberta may account for higher third party damage rates in Alberta. Despite these rationalizations, the NEB is concerned that the incidence of third party interference may be under reported and is taking steps to make reporting simpler.

Internal corrosion has not been separated from external corrosion for comparison in Figure 4.9. Internal corrosion is the leading cause of pipeline failures in Alberta. This may be attributed to the unrefined and corrosive nature of products gathered by many of the upstream oil and gas producing companies regulated by the EUB. The majority of NEB-regulated pipelines are long distance, large diameter transmission pipelines carrying processed gas and crude oil that are less corrosive in nature than those carried by pipelines regulated by the EUB.

4.2.2 Unauthorized Activities on the Right of Way

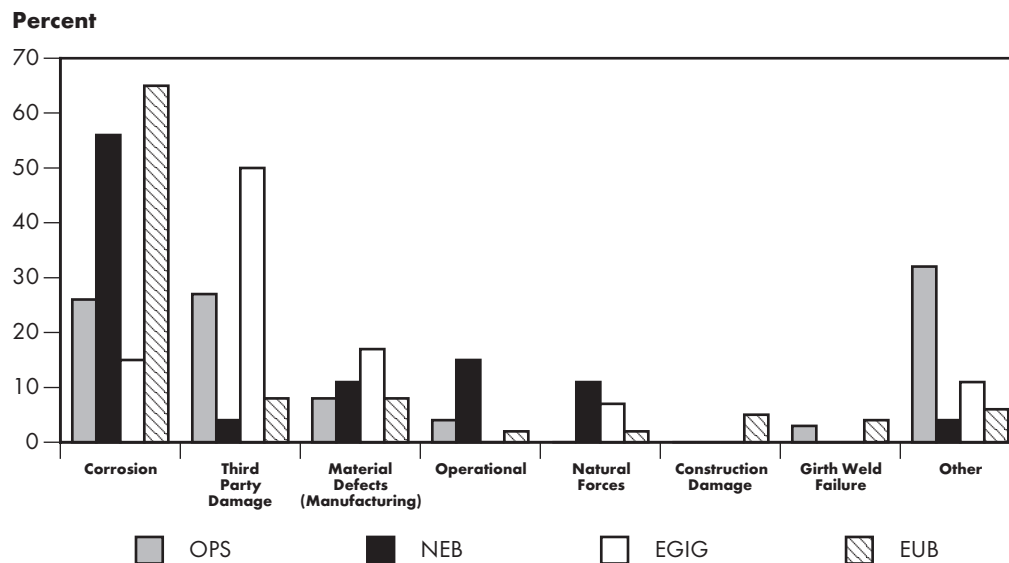
Unauthorized activities that are reported to the NEB under the Pipeline Crossing Regulations include activities that have the potential to damage a pipeline or that may impede access to a pipeline for maintenance or emergency response.

Unauthorized² activities or events considered to be indicators related to pipeline integrity include:

- movement of vehicles or equipment over pipelines;
- construction, or landscaping that does not result in soil disturbance or pipeline damage;
- construction, landscaping or grading that results in soil disturbance; and
- construction, landscaping or grading that results in pipeline damage.

FIGURE 4.9

Comparison of Leak/Break/Rupture by Cause



² An unauthorized activity or event occurs on the right of way without the permission of the pipeline company or without proper notification being given to a pipeline company after permission has been granted.

There appears to be no equivalent data available from external organizations that can be readily compared with an unauthorized activity or event occurring on the right of way.

The number of reported occurrences of activities having the potential to damage a pipeline or interfere with pipeline maintenance for 2000 to 2003 inclusively, are shown in Figure 4.10.

The number of reported occurrences jumped to 59 in 2003. This is well above the average number of reported events of 46.

The raw data pertaining to activities having the potential to damage NEB-regulated pipelines is provided in Table 4.5.

4.3 Environmental Performance

4.3.1 Liquid Releases (Spills)

The number and volume of liquid releases reported under the SPI initiative includes spills associated with construction and maintenance activities. As such, the number of releases does not just represent releases from the pipe body or from the pipeline system as a result of failure.

FIGURE 4.10

Unauthorized Activities on the Right of Way

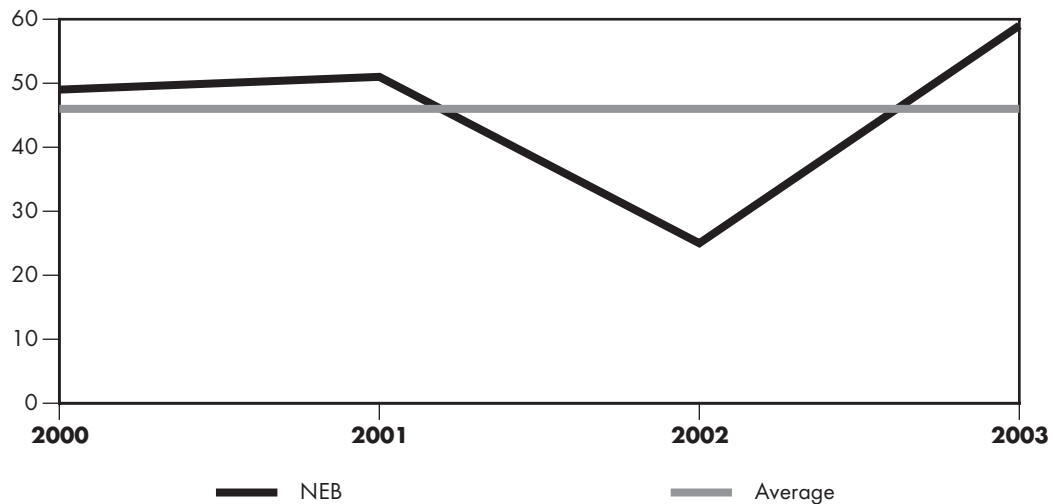


TABLE 4.5

Unauthorized Activities on the Right of Way (Number of Reported Incidents)

Year	Movement of Vehicles or Equipment over Pipelines		Construction, Landscaping or grading - no soil disturbance		Construction, Landscaping or grading - soil disturbance		Pipeline Contacts		Total
	Landowner	Contractor	Landowner	Contractor	Landowner	Contractor	Landowner	Contractor	
2000	2	2	5	0	12	26	0	2	49
2001	1	1	7	0	14	27	1	0	51
2002	0	2	2	0	7	13	0	1	25
2003	1	6	9	4	7	30	2	0	59
Average	1	2,75	5,75	1	10	24	0,75	0,75	46

Reporting of actual volumes associated with spills of 1.5 cubic metres or less on NEB-regulated pipelines is not an NEB regulatory requirement and cannot be reliably determined from available data provided for 2000 and 2001. Voluntary reporting of smaller spill volumes by NEB-regulated companies increased for 2002 and 2003 providing increased confidence in reported data.

The number and relative volume of liquid releases reported by NEB-regulated companies is presented in Table 4.6.

Comparative data on the frequency of spills is provided by source organization in Table 4.7.

Comparative data on the volumes of spills is provided by source organization in Table 4.8.

Figures 4.11 and 4.12 provide comparisons of spill frequencies for spills from operating pipelines.

The frequency of pipeline releases reported by NEB-regulated companies was 0.07 spills per 1000 km in 2003. This is well below the average spill frequency of 0.32 for the period from 2000 to 2003. No. ruptures were reported in 2003.

T A B L E 4 . 6

NEB Liquid Release Data

Year	No. of Releases $\leq 1.5 \text{ m}^3$	No. of Releases $> 1.5 \text{ m}^3$ on Pipeline Not Carrying Liquids	No. of the Releases $> 1.5 \text{ m}^3$ on Pipelines Carrying Liquids	Total No. of Releases
2000	263	1	1	265
2001	48	2	5	55
2002	63	0	11	74
2003	84	1	1	86

T A B L E 4 . 7

Comparative Liquid Release Data on pipelines Carrying Liquids (Releases per 1 000 km of Pipeline)

Year	NEB	CONCAWE ¹	OPS ²	EUB ³
2000	0.15	0.19	0.59	1.22
2001	0.31	0.42	0.51	1.43
2002	0.74	0.39	1.03*	0.76
2003	0.07	n/a	1.02*	0.75

* For 2002, the number of spills as per the new DOT definition is 439 spills. There were 265 spills \leq or $> 1 \text{ m}^3$. For 2003, there were 417 spills of which 265 spills \leq or $> 1 \text{ m}^3$. The frequencies are based on spills \leq or $> 1 \text{ m}^3$. These figures were taken from the DOT database and may not be 100% accurate.

1 Western European Cross Country Oil Pipelines 30 Year Performance Statistics, Report No. 1/02, published in February 2002, page 48. Spills greater than 1 m^3 . Performance of European cross-country oil pipelines – statistical summary of reported spillages – 2001, report no. 1/03. Performance of European cross-country oil pipelines – statistical summary of reported spillages – 2002, report no. 7/04.

2 U.S. Office of Pipeline Safety, <http://ops.dot.gov/stats.htm>.

3 Alberta Energy and Utilities Board, correspondence dated 4 April 2003, 20 hydrocarbon liquid releases from crude oil pipelines in 2000 and 24 releases in 2001; correspondence dated 17 December 2003, 13 hydrocarbon liquid releases from crude oil pipelines in 2002; correspondence dated 17 December 2004, 13 hydrocarbon liquid releases from crude oil pipelines in 2003.

TABLE 4.8

Comparative Liquid Release Data by Volume (Cubic Metres)

Year	NEB	CONCAWE ¹	OPS ²	EUB ³
2000	11	360	17 302	510
2001	3 877	1 150	15 582	183
2002	1 236	2 185	14 737	359
2003	12	n/a	12 774	415

- 1 Western European Cross Country Oil Pipelines 30 Year Performance Statistics, Report No. 1/02 published in February 2002, page 48. Performance of european cross-country oil pipelines – statistical summary of reported spillages – 2001, report no. 1/03. Performance of european cross-country oil pipelines – statistical summary of reported spillages – 2002, report no. 7/04.
- 2 U.S. Office of Pipeline Safety, <http://ops.dot.gov/stats.htm>. For 2002 and 2003, the volumes were calculated from the DOT database. Non-hydrocarbon fluids were eliminated. The volumes are based on spills ≥ 1 m³. These figures were taken from the DOT database and may not be 100% accurate.
- 3 Alberta Energy and Utilities Board, Correspondence dated 4 April 2003, Crude Oil Release Volumes for 2000 and 2001. Correspondence dates 17 December 2004, Crude oil release volumes for 2003.

FIGURE 4.11

Spill Frequency (Liquids Pipelines)

Spills per 1000 km

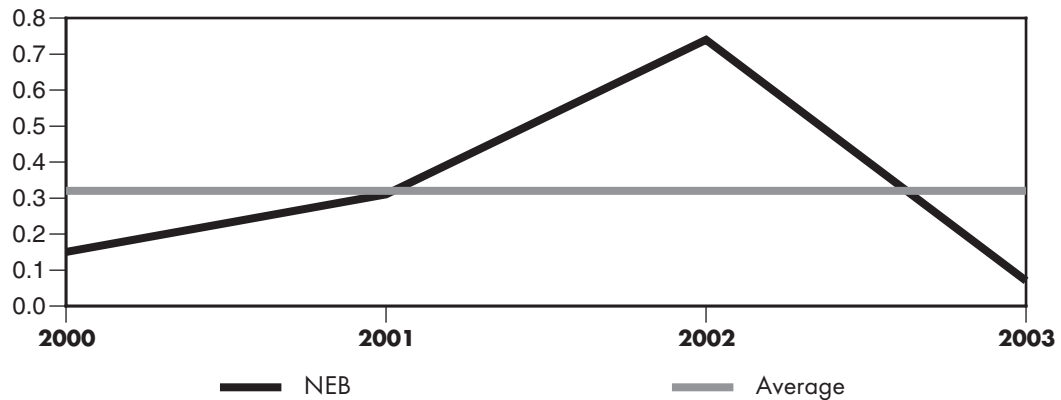
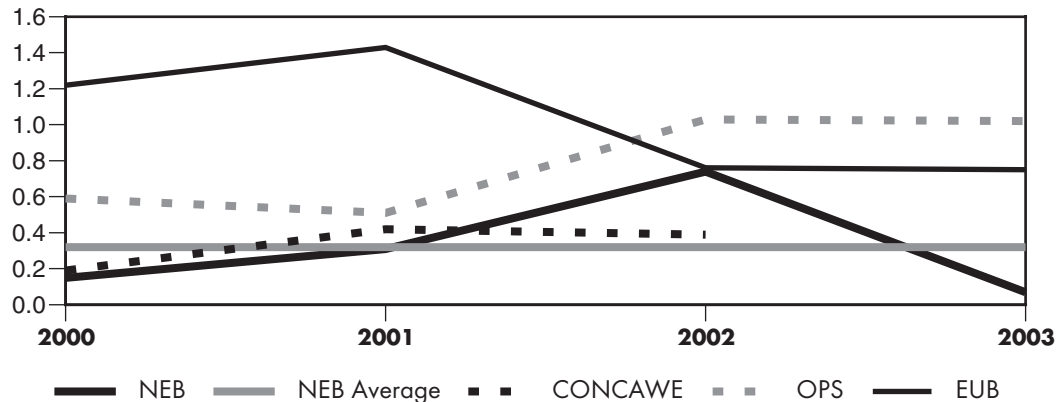


FIGURE 4.12

Spill Frequency (Liquids Pipelines)

Spills per 1000 km



Since the impact of spills is directly related to the volume and type of fluids released, efforts have been made to compare spill volumes per kilometre of pipeline. Unfortunately, because the reporting criteria differ between reference agencies, direct comparisons are impossible. Spill volumes on NEB-regulated pipelines for 2002 and 2003 have been included with the spill data. However, approximately 14% of reported spills in 2000 were less than 1.5 cubic metres, and 9% of the reported spills in 2001 had no volume estimates.

Prior to 2 February 2002, the volume and number of spills less than 8 cubic metres were unavailable from the OPS. After that date, volumes greater than 5 gallons (19 litres) have been reported. Though the frequency of spills reported to the OPS has increased, the total spill volume has continued to decrease slightly from the 2001 volumes.

Figure 4.14 provides a comparison of spill volumes per 1000 kilometres between the reporting agencies referenced in Figure 4.12.

The frequency of spills reported by NEB-regulated companies in 2003 was below the long term average of 0.32 spills per 1000 km. Compared to external organizations the average spill frequency among pipeline companies regulated by the NEB is favourable.

FIGURE 4.13

Spill Volumes (Liquids Pipelines)

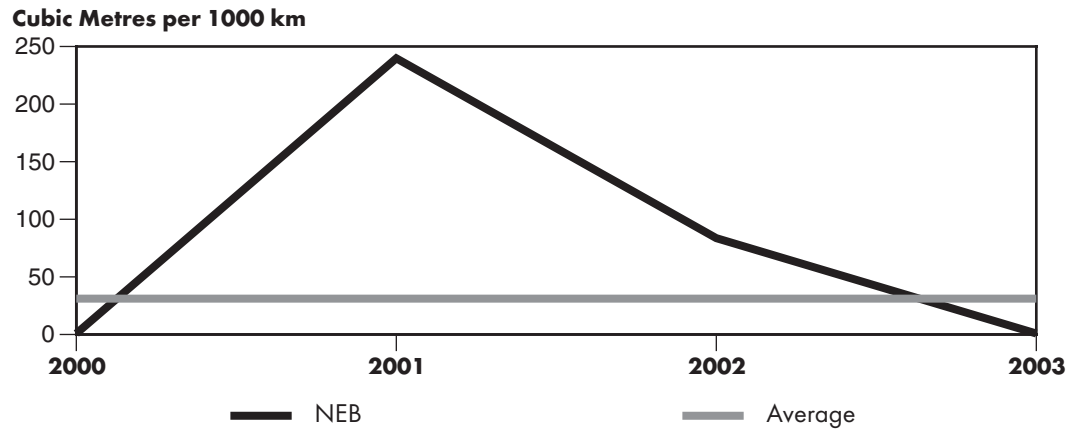


FIGURE 4.14

Spill Volumes (Liquids Pipelines)

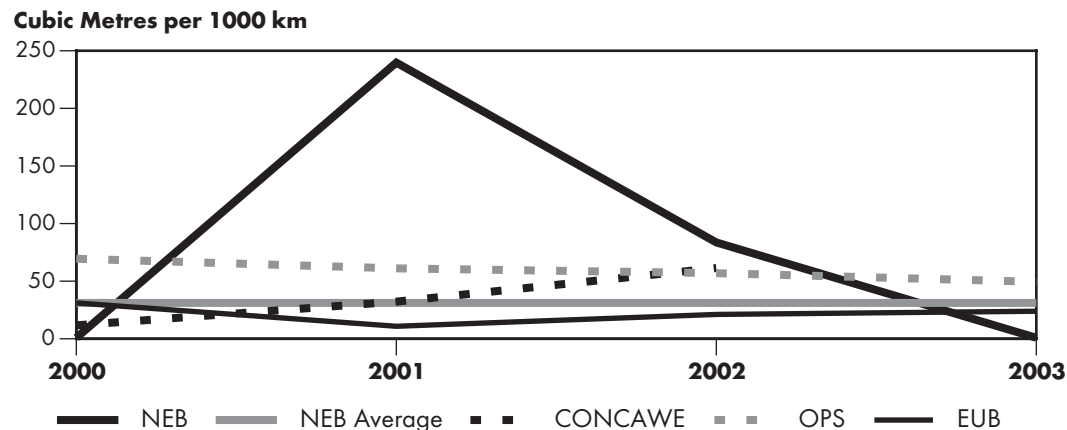
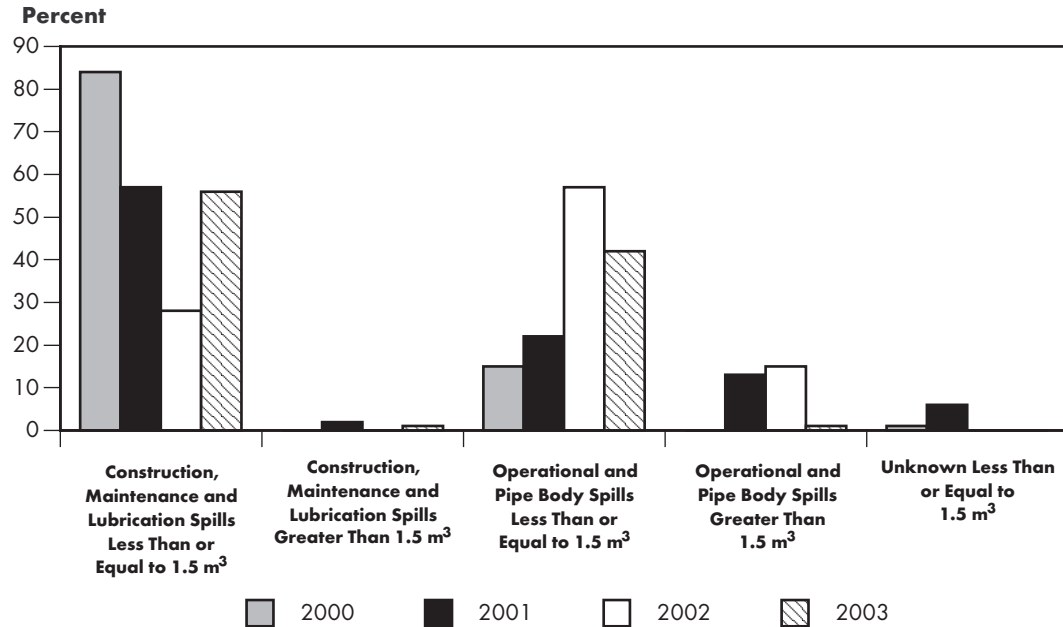


FIGURE 4.15

Reported Spills by Category (NEB-regulated Pipeline Companies)

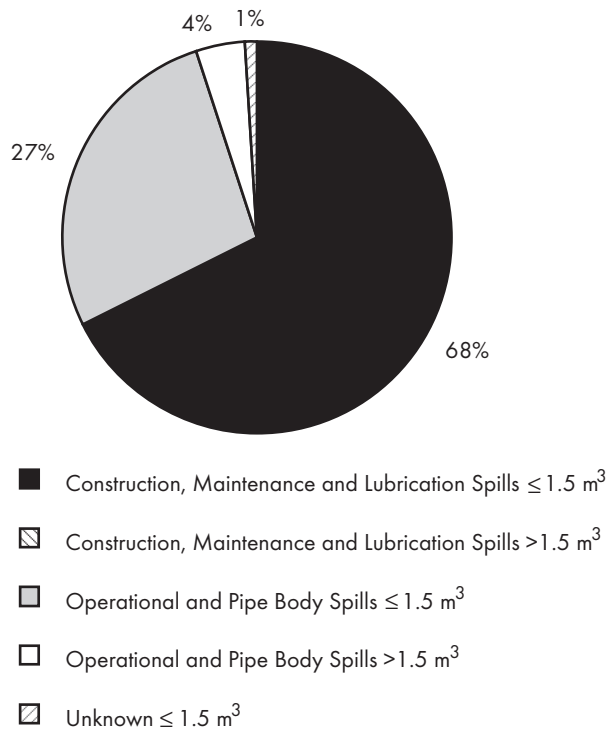


The frequency of spills reported by EUB-regulated pipeline companies as shown in Figure 4.12 is greater than the frequencies reported by the NEB or other reference organizations. However, as shown in Figure 4.14, the volume of fluids released, normalized over the pipeline system length, is much lower among EUB-regulated companies. These pipelines are predominantly small diameter, upstream gathering lines carrying unrefined (and often corrosive products) as opposed to large diameter transportation systems carrying processed gas and crude oil that are more typical of the pipelines regulated by the NEB.

The cumulative percentage of spills experienced among NEB-regulated pipeline companies by cause is presented in Figure 4.16. The figure clearly shows that the majority of reported spills (68%) are related to construction, maintenance and lubrication activities.

FIGURE 4.16

Cumulative Spills by Category (NEB-regulated Pipeline Companies 2000 – 2003)



4.3.2 Gas Releases

Releases of natural gas may occur as a result of loss of containment through the failure of the pipe body or components within the pipeline system. Natural gas releases may also occur through the routine functioning of equipment as well as through seepage at flanges through gaskets.

The reporting criteria for gas releases vary between the reference organizations referred to in section 2.1 of this report. These differences are summarized in Table A2.4 which can be found in Appendix A2

The NEB is undertaking a review of incident reporting to ensure that the data collected through incidents is meaningful and of value. At present, any volume of natural gas release is reportable under the OPR. However, the reporting and tracking of insignificant gas losses through flange connections does little to improve safety or protect the environment. The NEB will be discussing a simplified and practical reporting strategy at the workshop scheduled for June 2005.

The number of pipe body gas releases per 1000 kilometres of NEB-regulated gas pipeline companies is compared with data from the EGIG and the OPS in Figure 4.18.

The data presented in Figures 4.17 and Figure 4.18 is for gas releases from the pipe body of natural gas pipeline companies. Under the OPR, gas releases on NEB-regulated pipeline systems are reportable regardless of volume. This includes leaks at fittings and flanges and includes stations as opposed to simple line pipe. The incident data has been filtered so that the data presented in the figures are for pipe body releases only.

There were no pipe body releases reported on NEB-regulated pipelines in 2003 and the 2003 EGIG data is not yet available.

The raw data used to calculate the gas release frequencies of NEB-regulated companies is presented below in Table 4.9.



Comparative data on the frequency of gas releases is provided by source organization in Table 4.10.

No pipe body gas releases were reported in 2003 by companies regulated by the NEB. The average frequency of releases per 1000 km is 0.08 releases per 1000 km based on data back to 1 January 2000.

The comparable years averages for EGIG is 0.18 and for OPS is 0.15.

T A B L E 4 . 9

NEB Gas Release Data

Year	Total Number of releases	Number of releases (Pipe body)
2000	23	5
2001	29	1
2002	13	3
2003	9	0

TABLE 4.10

Comparative Pipe Body Gas Release Data (Release per 1000 km of Gas Pipeline)

Year	NEB	EGIG ¹	OPS ²
2000	0.19	0.17	0.15
2001	0.04	0.17	0.18
2002	0.07	0.21	0.11
2003	0.00	n/a	0.09

- 1 5th EGIG Report, 1970-2001 Gas Pipeline Incidents, Document No. EGIG 02.R.0058, published in December 2002 plus data available annually on the internet.
- 2 U.S. Office of Pipeline Safety, <http://ops.dot.gov/stats.htm>. These figures were taken from the DOT database and may not be 100% accurate.

FIGURE 4.17

Pipe Body Gas Releases per 1000 km (Gas Pipelines)

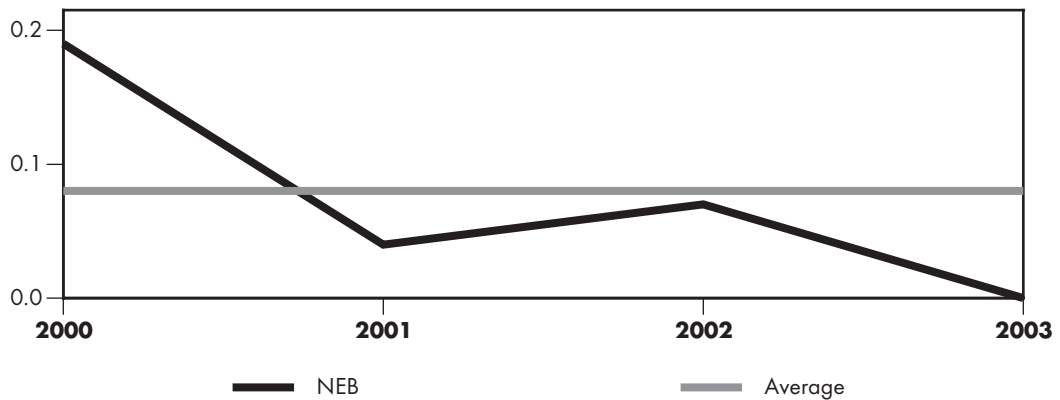
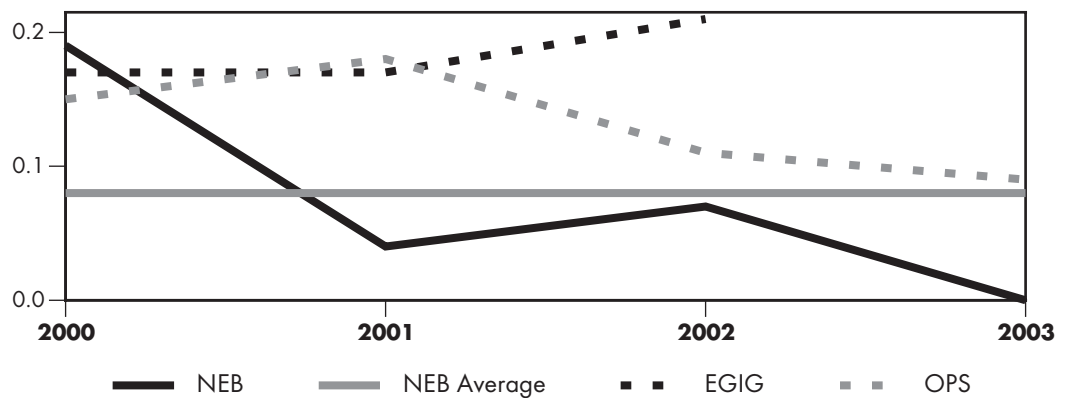


FIGURE 4.18

Pipe Body Gas Releases per 1000 km (Gas Pipelines)



A1. Reference Organizations

Organizations chosen for comparative analysis of data within this report have been selected based on their similarities to the NEB. Sources of reference data are evaluated on an ongoing basis and may be subject to change in future editions of this report.

A1.1 Office of Pipeline Safety – United States Department of Transport

Web site: www.ops.dot.gov/



The Department of Transportation's Research and Special Programs Administration, acting through the Office of Pipeline Safety (OPS), administers the Department's national regulatory program to assure the safe transportation of natural gas, petroleum, and other hazardous materials by pipeline. OPS develops regulations and other approaches to risk management to assure safety in design, construction, testing, operation, maintenance, and emergency response of pipeline facilities.

OPS safety jurisdiction over pipelines covers more than 3 000 gathering, transmission, and distribution operators as well as some 52 000 master meter and liquefied natural gas operators who own and/or operate approximately 1.6 million miles of gas pipelines, in addition to over 200 operators and an estimated 155 000 miles of hazardous liquids pipelines. (For the purposes of this report, only information on gas transmission and hazardous liquids pipelines has been used.)

OPS data is presented within this report for comparative purposes for the following key indicators:

- Liquid Releases; and
- Gas Releases.

A1.2 Bureau of Labor Statistics – United States Department of Labor

Web site: www.bls.gov

The Bureau of Labor Statistics (BLS) is the principal fact-finding agency for the Federal Government of the United States in the broad field of labour economics and statistics. The BLS is an independent national statistical agency that collects, processes, analyzes, and disseminates essential statistical data to the American public, the U.S. Congress, other Federal agencies, State and local governments, business, and labour. The BLS also serves as a statistical resource to the Department of Labor.

BLS data must satisfy a number of criteria, including relevance to current social and economic issues, timeliness in reflecting today's rapidly changing economic conditions, accuracy and consistently high statistical quality, and impartiality in both subject matter and presentation.

BLS began using the 2002 North American Industry Classification System (NAICS) to compile the 2003 Workplace Injuries and Illnesses data. As a result, the classifications used in this report changed slightly from last year and better represent the work activities that occur in relation to pipelines. As such, caution should be taken when comparing to previous years.

BLS data is presented within this report for comparative purposes for the following key indicator:

- Injury Frequency.

A1.3 Alberta Energy and Utilities Board (EUB)

Web site: www.eub.gov.ab.ca

The Alberta Energy and Utilities Board (EUB) is an independent, quasi-judicial agency of the Government of Alberta. Its mission is to ensure that the discovery, development, and delivery of Alberta's resources takes place in a manner that is fair, responsible, and in the public interest.

The EUB regulates the safe, responsible, and efficient development of Alberta's energy resources including oil, natural gas, oil sands, coal, and electrical energy.



Regulation is done through four core functions: adjudication and regulation, applications, surveillance and enforcement, and information and knowledge.

EUB data is presented within this report for comparative purposes for the following key indicators:

- Ruptures; and
- Liquid Releases.

A1.4 Canadian Association of Petroleum Producers (CAPP)

Web site: www.capp.ca

The Canadian Association of Petroleum Producers (CAPP) represents more than 140 member companies who explore for, develop and produce over 97% of Canada's natural gas, crude oil, oil sands and elemental sulphur.

CAPP data is presented within this report for comparative purposes for the following key indicator:

- Injury Frequency.

A1.5 Pipe Line Contractors Association of Canada (PLCAC)

Web site: www.pipeline.ca

The Pipe Line Contractors Association of Canada (PLCAC) represents contractors in labour relations matters and establishes training courses for the development of Canadian workers in special pipeline construction skills.

PLCAC interests and activities extend to issues such as occupational health and safety, legislative review, pipeline standards and codes and a host of other activities.

PLCAC data is presented within this report for comparative purposes for the following key indicator:

- Injury Frequency.

A1.6 European Gas Pipeline Incident Data Group (EGIG)

Web site: www.egig.nl



In 1982, six European gas transmission system operators took the initiative to gather data on the unintentional releases of gas in their pipeline transmission systems. This co-operation was formalized by the setting up of EGIG (European Gas pipeline Incident data Group). Now EGIG is a co-operation between a group of nine major gas transmission system operators in Western Europe and is the owner of an extensive gas pipeline-incident database.

The creation of this extensive pipeline-incident database (1982) has helped pipeline operators to demonstrate the safety performances of Europe's gas pipelines. This information has helped the pipeline operators to improve safety in their gas pipeline transmission systems.

Considering the number of participants, the extent of the pipeline systems and the exposure period involved (from 1970 onwards for most of the companies), the EGIG database is a valuable and reliable source of information. The regional differences are not taken into account so that the result of the database presents an average of all participating companies.

EGIG data is presented within this report for comparative purposes for the following key indicators:

- Gas Releases; and
- Ruptures.

A1.7 CONCAWE, the European Oil Companies Association for Environment, Health and Safety (CONCAWE)

Web site: www.concawe.be

Most oil companies who refine crude oil in Western (OECD) Europe are members of CONCAWE. CONCAWE is founded as an international association with a scientific objective and without profit-making intent. The organization produces sound economic, technical and scientific information.

CONCAWE data is presented within this report for comparative purposes for the following key indicator:

- Liquid Releases.

A1.8 International Association of Oil and Gas Producers (OGP)

Web site: www.ogp.org.uk

The International Association of Oil and Gas Producers (OGP) is a worldwide association of oil and gas companies involved in exploration and production. OGP members include private and state-owned oil and gas companies, national associations and petroleum institutes. OGP's purpose is to:

- provide information to interested bodies on the oil and gas exploration and production industry;
- represent member's interests at global and regional regulatory bodies; and
- develop operating guidelines.

OGP data is presented within this report for comparative purposes for the following key indicators:

- Injury Frequency; and
- Fatalities.

A comparison of the terms used within each reference organization is provided in Appendix 2.

A2. Comparative data clarification

T A B L E A 2 . 1

Comparison of Reporting Criteria for Ruptures

Source	Reporting Requirements
NEB	<p>Rupture</p> <p>Loss of containment event that immediately impairs the operation of the pipeline.</p>
OPS	<p>Incident</p> <p>Gas releases that were associated with a death or personal injury requiring hospitalization, or a total cost of \$50,000 (U.S.) or more.</p> <p>or</p> <p>Loss of 8 or more cubic metres or where property damage costs exceed \$50,000 US, or after 7 February 2003, a release of 5 gallons (19 litres) or more.</p>
EUB	<p>When a leak or break occurs in a pipeline, the licensee shall immediately cause the Board to be informed of the location of the leak or break.</p> <p>“Break” means a rupture in any part of a pipeline and “leak” means the escape of substance from a pipeline</p>
EGIG	<p>Incidents include any unintentional release of gas which occurs on an onshore pipeline operating at greater than 1500 kPa outside of the fenced boundaries of installations and excluding all components except the pipe.</p>

Table A2.2 provides a summary of the ‘injury’ definitions used by reference organizations.

T A B L E A 2 . 2

Injury Definitions of Comparative Data Sources

Organization	Definitions	Comment
BLS	Data presented is taken from industry classification for "Heavy construction, except highway - 162" and from "Gas production and distribution - 492" for injuries resulting in "days away from work, days of restricted work activity, or both for the years 2000 to 2002". Industry classifications changed for 2003. Data presented for 2003 is taken from industry classification for "Utility System Construction - 2371" and from "Pipeline Transportation - 486" for injuries resulting in "days away from work, days of restricted work activity, or both for 2003".	Heavy construction data should be roughly comparable to contractor data under the SPI initiative. Gas production and distribution data and pipeline transportation data should be comparable to company employee data.
CAPP	Data represents "job-related injuries that were fatal or where the worker could not return to work the next scheduled workday".	CAPP members are primarily upstream oil and gas companies and data may not be directly comparable to pipeline transportation companies.
PLCAC	Any work related personal injury or illness that results in time loss from work. Time loss begins on the day subsequent to the day the accident occurs.	PLCAC data does not include non-union pipeline contractor data. Mainline construction data should be roughly comparable to contractor data under the SPI.
COGOA	Data represents "loss time injuries" which prevent an employee from reporting for work or from effectively performing all the duties connected with the employee's regular work on any day subsequent to the day on which the injury occurred, whether or not that subsequent day is a working day for the employee.	The definition is identical to the definition used under the SPI initiative.
NEB	Under the OPR: "serious injury" includes 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 hemorrhage; third degree burns; unconsciousness; or the loss of a body part or function of a body part. For the SPI initiative, "it includes any occupational injury (including fatal injury) that prevents an employee from reporting for work or from effectively performing all the duties connected with the employee's regular work on any day subsequent to the day on which the injury occurred, whether or not that subsequent day is a working day for the employee."	The example provided as guidance to companies by the NEB: "medical aid where the employee can not return to work the following day regardless of the day of the week or injury".
OGP	Injury is referred to as a Lost Workday Case (LWDC). Any work related injury or illness other than a fatal injury which results in a person being unfit for work on any day after the day of occurrence of the occupational injury. "Any day" includes rest days, weekend days, leave days, public holidays or days after ceasing employment.	

T A B L E A 2 . 3

Comparison of Liquid Release Reporting Criteria

Source	Reporting Requirements
NEB	Any unintended or uncontained release of liquid hydrocarbons in excess of 1.5 cubic metres.
OPS	Loss of 8 or more cubic metres or where property damage costs exceed \$50,000 US, or after 7 February 2003, a release of 5 gallons (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 <1 m ³ spill.
EUB	When a leak or break occurs in a pipeline, the licensee shall immediately cause the Board to be informed of the location of the leak or break. "Leak" means the escape of substance from a pipeline and "break" means a rupture in any part of a pipeline.

T A B L E A 2 . 4

Comparison of Gas Release Reporting Criteria

Source	Reporting Requirements
NEB	Any unintended or uncontrolled release of natural gas.
OPS	Gas releases associated with a death or personal injury requiring hospitalization, or a total cost of \$50,000 US or more.
EGIG	Any unintentional release of gas which occurs on an onshore pipeline operating at greater than 1500 kPa outside of the fenced boundaries of installations and excluding all components except the pipe.
EUB	When a leak or break occurs in a pipeline, the licensee shall immediately cause the Board to be informed of the location of the leak or break. "Leak" means the escape of substance from a pipeline and "break" means a rupture in any part of a pipeline.

A3. Data

A3.1 Sample Size

Data for the period 1 January 2003 to 31 December 2003 was submitted voluntarily to the Board from 34 companies . The companies that provided data for the SPI initiative owned or operated approximately 96% of the total length of pipelines regulated by the NEB under the *National Energy Board Act*.

The length and number of companies reporting are compared with the overall length and number of companies regulated by the NEB under the Act in Table A3.1.

The raw data used to calculate the injury frequencies of NEB-regulated companies is presented in Table A3.2.

T A B L E A 3 . 1

NEB-Regulated Company Statistics

Year	Number Companies Reporting	Number Kilometres Reporting
2000	24	39 190
2001	37	42 680
2002	33	41 555
2003	34	42 189

T A B L E A 3 . 2

NEB Injury Frequency Data

Year	Contractor Hours	Employee Hours	Contractor Injuries	Employee Injuries
2000	6 255 390	7 031 437	53	8
2001	1 606 271	4 827 678	43	21
2002	1 357 577	5 103 983	13	4
2003	787 666	4 863 013	12	16

Table A3.3 provides comparative data for the reference organizations cited within this report.

T A B L E A 3 . 3

Reference Organization Statistics

Year	Organization	Kilometres of Gas Pipeline	Kilometres of Hydrocarbon Liquids Pipeline	Total Kilometres
2000	NEB ¹¹	25 970	13 220	39 190
2000	OPS ¹	524 000	249 020	773 020
2000	CONCAWE ²	n/a	30 800	30 800
2000	CAPP ³	n/a	176 000	176 000
2000	EGIG ⁴	110 236	n/a	110 236
2000	EUB ⁵	229 034	16 410	245 444
2001	NEB ¹¹	26 510	16 170	42 680
2001	OPS ¹	479 800	255 060	734 860
2001	CONCAWE ²	n/a	35 575	35 575
2001	CAPP ³	n/a	183 000	183 000
2001	EGIG ⁴	110 236	n/a	110 236
2001	EUB ⁵	245 466	16 818	262 284
2002	NEB ¹¹	26 752	14 803	41 555
2002	OPS ¹	526 007	258 409	784 899
2002	CONCAWE ⁷	n/a	35 592	35 592
2002	CAPP ⁸	n/a	225 000	225 000
2002	EGIG ⁹	109 524	n/a	n/a
2002	EUB ⁶	255 032	17 118	272 150
2003	NEB ¹¹	26 943	15 245	42 189
2003	OPS ¹	522 020	258 892	780 912
2003	CONCAWE	n/a	n/a	n/a
2003	CAPP	n/a	226 000	226 000
2003	EGIG ⁹	n/a	n/a	n/a
2003	EUB ¹⁰	268 549	17 391	285 940

1 U.S. Office of Pipeline Safety, <http://ops.dot.gov/stats.htm>

2 *Western European Cross Country Oil Pipelines 30 Year Performance Statistics*, Report No. 1/02, published in February 2002.

3 *2002 Stewardship Progress Report – Changing Behaviour – ONE Focus. ONE Direction*, published by the Canadian Association of Petroleum Producers in December 2002.

4 5th EGIG Report, *1970-2001 Gas Pipeline Incidents*, Document No. EGIG 02.R.0058, published in December 2002.

5 *Field Surveillance Provincial Summary, April 2001/March 2002*, Statistical Series 57, Alberta Energy and Utilities Board, published in July 2002.

6 *Field Surveillance Provincial Summary, January-December 2002*, Statistical Series 57, Alberta Energy and Utilities Board, published in May 2003.

7 *Performance of European cross-country oil pipelines*, Report No. 1/03, published in February 2003.

8 *2002 Stewardship Progress Report*, published by the Canadian Association of Petroleum Producers in December 2003.

9 Data published at www.egig.nl (the EGIG Web site). Mileage interpolated from the incident frequency rate.

10 *Field Surveillance Provincial Summary, January-December 2003*, Statistical Series (ST) 2004-57, Alberta Energy and Utilities Board, published in April 2004.

11 NEB data is for comparison reporting and does not represent the total length of pipeline regulated by the NEB.

Comparative data is provided by source organization in Table A3.4

TABLE A3.4

**Comparative Injury Frequency Data
(Number of Injuries per 100 Full Time Equivalent Workers)**

Year	Source	Contractor Injury Frequency	Employee Injury Frequency	Overall
2000	NEB	1.69	0.23	0.92
2000	CAPP ¹	0.78	0.35	n/a
2000	OGP ²	0.40	0.29	0.36
2000	BLS	3.60	3.00	n/a
2000	COGOA	n/a	n/a	1.06
2000	PLCAC ⁴	2.88	n/a	n/a
2001	NEB	5.35	0.87	1.99
2001	CAPP ¹	0.65	0.25	n/a
2001	OGP ²	0.33	0.26	0.31
2001	BLS	3.90	2.50	n/a
2001	COGOA	n/a	n/a	0.55
2001	PLCAC ⁴	1.25	n/a	n/a
2002	NEB	1.92	0.16	0.53
2002	CAPP ¹	0.48	0.23	n/a
2002	OGP ²	0.22	0.18	0.21
2002	BLS	3.50	3.00	n/a
2002	COGOA	n/a	n/a	0.56
2002	PLCAC ⁴	1.72	n/a	n/a
2003	NEB	3.04	0.66	0.92
2003	CAPP	0.42	0.27	n/a
2003	OGP ²	0.25	0.15	0.22
2003	BLS	6.90	2.10	n/a
2003	COGOA	n/a	n/a	0.40
2003	PLCAC ⁴	0.00	n/a	n/a

- 1 2002 Stewardship Progress Report, published by the Canadian Association of Petroleum Producers in December 2003.
- 2 Safety Performance of the Global E & P Industry, 2000 by the International Association of Oil and Gas Producers, Report No. 6.93/319, published in June 2001; Safety Performance of the Global E & P Industry, 2001 by the International Association of Oil and Gas Producers, Report No. 6.59/330, published in July 2002. Safety Performance of the Global E & P Industry, 2002 by the International Association of Oil and Gas Producers, Report No. 345, published in June 2003. OGP Safety Performance Indicators 2003, Report No. 353 June 2004.
- 3 Table 1, Incidence rates of non-fatal occupational injuries and illnesses by industry and selected case types, 2000, and Table 1, Incidence rates of non-fatal occupational injuries and illnesses by industry and selected case types, 2001, 2002. (Contractor is "heavy construction, except highway", employee is "gas production and distribution".) Table 1, Incident rates Contractor's "2371 Utility System Construction", employee is "486 Pipeline Transportation" (U.S. Department of Labor, <http://stats.bls.gov>).
- 4 Mainline Contractor Injury Frequencies, Safety Statistics Web page from <http://www.pipeline.ca/>.

