



National Energy
Board

Office national
de l'énergie

**FOCUS ON
SAFETY AND ENVIRONMENT**
A COMPARATIVE ANALYSIS OF PIPELINE PERFORMANCE
2000-2004



MARCH 2006

National Energy
Board



Office national
de l'énergie

Focus on Safety and Environment

A Comparative Analysis of
Pipeline Performance

2000-2004

March 2006

Canada

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FOREWORD

This report on pipeline safety, integrity and environmental performance has been prepared based on data provided by pipeline companies regulated by the National Energy Board (the Board or the NEB). Comparative data from reference organizations has been collected from publications and verified (where possible) through direct contact. All data pertain to the performance of hydrocarbon liquid and natural gas pipeline systems.

The first of the NEB's annual Safety Performance Indicators reports, *Focus on Safety – A Comparative Analysis of Pipeline Safety Performance*, was published in April 2003.

This report includes data from 1 January, 2000 through 31 December, 2004.

In keeping with its goal to fulfill the NEB mandate with the benefit of effective public engagement, the Board continually seeks input and feedback from stakeholders on the value of this report and ways it can be improved. The response indicates that although this report is valuable, more detailed information on injuries and the causes and environmental impact of releases and leaks would be beneficial.

The following improvements have been incorporated into this report:

1. The fatality frequency indicator and its direct comparison to the International Association of Oil and Gas Producers (the OGP) has been discontinued. Indirect comparisons have been made to a disabling injury frequency indicator which includes fatalities with lost time and restricted workday injuries.
2. OGP injury frequencies have been reported for onshore activities only.
3. The employee injury frequency has been compared to the Human Resources and Skills Development Canada (the HRSDC) Disabling Injury Incidence Rate.
4. Injury frequencies for liquid and gas pipelines have been analyzed separately.
5. Analysis of rupture causes on U.S. pipelines has been expanded to include the period from 1 January, 1991 to 31 December, 2004.
6. Analysis of EUB-regulated pipeline failure incidents are focused only on pipeline ruptures within the five-year reporting period from 2000 through 2004.
7. Primary causes of ruptures have been aligned with the cause classifications given in Annex H to the CSA Z662-03.
8. Liquid and gas releases are reported on a 'pipe body' and 'pipeline system' basis.
9. A summary of OPR reportable incidents has been included.

The NEB welcomes your feedback. Any comments or questions pertaining to this report should be directed to:

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EXECUTIVE SUMMARY

Focus on Safety and Environment is a report on the safety, integrity and environmental performance of pipeline companies regulated by the Board pursuant to the *Onshore Pipeline Regulations, 1999* (the OPR). Table 1 compares the performance of NEB-regulated pipelines in 2004 to their performance in 2003 and to the five-year average performance.

Data for this report was obtained through the OPR's mandatory reporting requirements and voluntary reporting under the Safety Performance Indicators initiative. Companies responsible for

TABLE 1

Performance Indicator Comparison

Performance Indicator	Historical Average 2000 to 2004	2003	2004
Number of Fatalities (number of employee, contractor and third party fatalities)	0	0	0
Worker Injury Frequency (injuries per 200,000 worker hours)	1.0	1.0	0.7
Contractor Injury Frequency (injuries per 200,000 contractor hours)	2.6	3.0	1.4
Employee Injury Frequency (injuries per 200,000 employee hours)	0.5	0.7	0.5
Liquid Pipeline Worker Injury Frequency (injuries per 200,000 worker hours)	1.6	0.2	0.5
Gas Pipeline Worker Injury Frequency (injuries per 200,000 worker hours)	0.9	0.9	0.9
Number of Ruptures (total number of pipeline ruptures)	1.2	0	0
Number of Contacts (total number of pipeline contacts)	1.6	2	2
Liquid Release Frequency (no. of liquid releases per 1000 km liquid pipelines)	0.05	0	0
Liquid Release Volume Frequency (m ³ of liquid released per 1000 km)	46	0	0
Number of Liquid Leaks (number of leaks on liquid pipelines)	35	40	39
Liquid Leak Frequency (number of leaks per 1000 km liquid pipelines)	2.4	2.6	2.6
Gas Release Frequency (number of gas releases per 1000 km gas pipelines)	0.03	0	0.1
Number of Gas Leaks (number of leaks on gas pipelines)	16	9	15
Gas Leak Frequency (number of leaks per 1000 km gas pipelines)	0.6	0.3	0.7
Number of Spills (number of construction & maintenance liquid spills)	65	38	50
Number of Incidents (total number of reportable OPR incidents)	38	28	37

approximately 94 per cent of the total length of NEB-regulated pipelines have volunteered their results.

Although some of the data volume is small, the Board is satisfied the information is a solid performance indicator of the pipeline companies it regulates. Different organizations will have different definitions and reporting requirements. Although this makes direct comparison challenging, the performance indicators used here are intended to demonstrate trends and illustrate some measure of relative performance.

In 2004, the equivalent of approximately 3,000 full time workers (both employees and contractors, excluding head office employees) were involved with pipeline construction, maintenance and the operation of liquid and gas pipelines.

The following key observations are made in the report:

- There were no fatalities or ruptures reported in 2003 or 2004. The year 2004 is the seventh consecutive year in which there have been no fatalities on NEB-regulated pipelines.
- The ongoing commitment to integrity management appears to be paying dividends. The sophistication and proactive nature of company programs has ended a rupture pattern averaging 2.5 ruptures per year from 1991 to 2003. Despite an increase in unauthorized activities on rights of way, NEB-regulated pipelines still have the lowest number of ruptures due to external interference of all the reference organizations.
- The 2004 contractor injury frequency decreased by more than 50 per cent compared with 2003. However, these results are still nearly three times higher than the employee injury frequency, which has leveled off to the five-year average of about one injury per 400,000 hours worked.
- There have been very few gas or liquid releases due to pipe body failure in the last five years. The goal is to have zero releases from ruptures.
- Both the Liquid Leak and Gas Leak Frequency indicator moving averages have increased slightly over the last three years.
- Five-year averages have stabilized for most of the NEB performance indicators presented in this report.

Although there is room for improvement, the NEB acknowledges that progress is being made in making contractor safety comparable to employee safety. The goal is to create a safer working environment for everyone.

A better understanding of injury definitions and reporting requirements would enhance the NEB's ability to compare the worker disabling injury frequency indicator with more reference organizations. This harmonization across Canadian jurisdictions would be an important step towards promoting safer working environments. The Board is prepared to actively participate in harmonization discussions with interested parties and would consider changes to the OPR, if required.

The Board introduced several performance indicators to increase its understanding of releases, leaks and spills by NEB-regulated pipelines. The leak and spill performance indicators are difficult to benchmark as other reference organizations have few directly comparable indicators. More detailed reporting of environmental performance indicators would improve comparison.

The Board uses performance data as one element in the development of compliance prioritization plans. These plans ensure that the safety and environmental protection programs run by NEB-regulated pipeline companies are adequate and effective. There are several areas where performance indicators could be improved. These include:

- Harmonization of reporting across Canadian regulators and associations;
- Injury cause analysis with particular focus on contractor injuries;
- Development of leading indicators for safety, integrity and protection of the environment;
- Analysis of the economic cost and environmental impact of liquid and gas releases / leaks; and
- Use of throughput data for normalizing liquid and gas releases, leaks and spills.



The NEB will seek more dialogue and input regarding improvements to future reports.

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 is responsible for ensuring that pipeline companies comply with regulations concerning the safety of persons and protection of the environment, as these may be affected by the design, construction, operation, maintenance and abandonment of pipelines.

The NEB regulates 104 oil, gas and product pipeline companies that operate approximately 45,000 kilometres of pipelines, of which approximately 1,000 kilometres were constructed from 2000 through 2004.

The NEB has additional regulatory responsibilities under the *Canada Oil and Gas Operations Act* (COGOA) for oil and gas exploration and production activities in the North (excluding the Yukon) and in those offshore areas that are not subject to a federal-provincial shared management agreement.

1.2 Performance Indicators

Performance indicators are used throughout industry and government to assess the performance of specific industry sectors relative to other sectors. Of particular interest are the benchmarking comparisons and industry trends. These provide valuable insight into the effectiveness of safety and integrity management programs. The NEB uses performance indicators to balance regulatory compliance programs by identifying areas where more vigilant oversight is needed as well as those areas where less oversight is required.

In this report, performance indicators are used to evaluate the safety of pipeline workers, including both employees and contractors. Performance indicators are also used to evaluate the effect of pipeline integrity programs on operating safety and environmental protection.

The Board has identified eight performance indicators which are grouped under safety, integrity, environment or incidents. These are summarized in Table 1.1.



T A B L E 1 . 1

Performance Indicator Summary

Safety		Integrity			Environment		Incidents
Fatalities	Injuries	Ruptures	Contacts	Unauthorized Activities	Liquid Releases	Gas Releases	OPR Reportable
Number	Number	Number	Number	Number	Number and Volume	Number	Number
Cause	Frequency	Primary Cause		Type	Frequency	Frequency	Type

1.2.1 Safety

The number of fatalities and injuries are monitored for both employees and contractors. Fatalities are also monitored for third parties. This report refers to two frequency indicators: disabling injury and injury. Frequencies are defined as the number of injuries per 200,000 hours worked.

Disabling Injury Frequency – the number of fatalities plus lost time injuries plus restricted workday injuries multiplied by 200,000 and divided by the corresponding employee, contractor or combined employee and contractor (worker) hours worked.

Injury Frequency – the number of lost time and restricted workday injuries multiplied by 200,000 and divided by the corresponding employee, contractor or worker hours worked.

1.2.2 Integrity

Ruptures are investigated and analyzed to determine their primary cause. This report contains the number of ruptures and their primary cause from 1991 onwards for all NEB-regulated pipelines. The age of the pipeline at the time of rupture has also been included.

The primary rupture causes are compared on a percentage basis with each cause, as defined in Annex H to the CSA Standard Z662-03, representing a fraction of the total rupture causes.

As an indicator of damage prevention and pursuant to the *Pipeline Crossing Regulations Part 1* and *Part 2*, the number of unauthorized activities on pipeline rights of way and any associated pipeline contacts are presented in this report.

1.2.3 Environment

For the purpose of comparison, a pipeline includes all branches, extensions, tanks, reservoirs, storage facilities, pipes, pumps, valves, racks, compressors, storage tanks and loading facilities integral to its operation.

In this report, environmental performance indicators are grouped into three categories: releases, leaks and spills. Releases are associated with the failure of the pipe body. This failure is typically caused by ruptures or breaks. The minimum volume defining a liquid pipeline release is 1.5 m³. There is no minimum volume associated with gas releases or leaks.

Leaks are associated with the operation of pipeline systems and arise from other components such as flanges, valves, compressors and pumps. Typically, liquid leaks are less than 1.5 m³ but, they can be larger. The number of releases and leaks is reported, as well as the volume.

Spills are associated with the construction, maintenance and operational activities of gas pipelines. They typically include very small volumes of lubrication and hydraulic oils and fuel. In this report, liquid and gas pipeline spills have been combined and the number and volume of spills is shown.

The following six frequency indicators were developed by normalizing the number or volume of releases, leaks and spills per 1,000 kilometres of corresponding pipeline.

Liquid Release Frequency – the number of releases exceeding 1.5 m³ caused by liquid pipeline body failure multiplied by 1,000 and divided by the total kilometres of liquid pipelines.

Liquid Release Volume Frequency - the volume released from a liquid pipeline body failure multiplied by 1,000 and divided by the total kilometres of liquid pipelines.

Liquid Leak Frequency - the number of liquid leaks caused by components integral to the operation of liquid pipelines multiplied by 1,000 and divided by the total kilometres of liquid pipelines.

Liquid Spills Frequency – the number of liquid spills from integral gas pipeline components and the number of liquid spills caused by pipeline construction and maintenance activities multiplied by 1,000 and divided by the combined total kilometres of liquid and gas pipelines.

Gas Release Frequency - the number of releases caused by gas pipeline body failure multiplied by 1,000 and divided by the total kilometres of gas pipelines.

Gas Leak Frequency - the total number of gas leaks caused by components integral to the operation of gas pipelines multiplied by 1,000 and divided by the total kilometres of gas pipelines.

1.2.4 Incidents

This report contains the number by type of reportable incidents pursuant to the OPR. These numbers do not include incidents reported under the SPI Initiative. Incidents which must be reported include:

- Death or serious personal injury;
- A significant adverse effect on the environment;



-
- An unintended fire or explosion;
 - The unintended or uncontained release of low vapor pressure hydrocarbon liquids (LVP) in excess of 1.5 m³;
 - The unintended or uncontained releases of gas or high vapor pressure hydrocarbons (HVP); and
 - The operation of a pipeline beyond its design limits as determined under CSA Z662, CSA Z276 or any operating limits imposed by the Board.

1.3 Moving Averages

The moving averages found in this report have been used to smooth out data and demonstrate trends. Since there is only five years of data, the year over year moving average is currently the best indicator for comparing trends and relative performance between reference organizations. The average in year one is the frequency for that year; year two is the average of the first two years and so on. Year five represents the five-year average. As more data become available, the year over year moving average can be replaced with the five-year moving average.

COMPARATIVE DATA

2.1 Reference Organizations

Data from the following organizations have been selected for comparison with the NEB performance indicators contained in this report:

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



Detailed information on reference organizations including web addresses and data sources are listed in Appendix One.

Table 2.1 shows which reference organization data was used for comparative purposes within this report.

T A B L E 2 . 1

Comparative Data by Source

Organization	Ruptures Causes	Injury Frequency	Liquid Releases, Leaks and Spills	Liquid Leaks	Gas Releases
OPS	X		X		X
BLS		X			
EUB	X		X		
CAPP		X	X	X	
PLCAC		X			
EGIG	X				X
CONCAWE			X		
OGP		X			
COGOA		X			
HRSDC		X			
NEB	X	X	X	X	X

2.2 Limitations of Comparative Data

The performance indicators used in this report to make direct comparisons between reference organizations have two limitations. The first is their very definition. Currently, there are different definitions and reporting standards for work related injuries throughout Canadian jurisdictions.

The second limitation is the difference between the industry sectors. Two pipeline sectors are being compared in this report – transmission and production. These sectors each have a different scope and thus, different probabilities of an event occurring.

These two limitations introduce a certain level of subjectivity into making direct comparisons. However, the performance indicators in this report are intended to be demonstrative of trends and illustrate some measure of relative performance.

A further discussion of data comparability is provided in Appendix Two.

ANALYSIS

3.1 Safety Performance Indicators

3.1.1 Fatalities

Fatalities have an immediate and devastating effect on families, communities, 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 pipelines has been separated into three categories:

1. Employee fatalities

These are fatalities which occur while an employee is involved in activities associated with their job duties.

2. Contractor fatalities

These are fatalities which occur while a contract worker is involved in activities pursuant to his/her contract with a pipeline company.

3. Third party fatalities

These are fatalities involving persons other than contractors or employees.

NEB-regulated pipeline employee data does not include head office staff but does include staff from other facility offices.

Contractor data includes contractors performing activities related to the operation or construction of NEB-regulated pipelines.

Table 3.1 shows the number and cause of all reported fatalities since 1991. The year 2004 is the seventh consecutive year in which there have been no fatalities on NEB-regulated pipelines. All fatalities reported between 1991 and 1997 involved construction activities. Since 1997, several new pipelines and pipeline expansions have been constructed with no fatalities.

The comparison of fatality frequencies between the NEB and reference organizations has been found to be meaningless given that NEB-regulated pipelines have a relatively small sample size for hours worked.



An indirect way to compare fatality frequency is to examine the disabling injury frequency indicator for appropriate organizations. Figure 3.1 compares the worker disabling injury frequency for NEB-regulated pipelines, NEB exploration and production activities regulated under COGOA, and the OGP.

The Board notes that, other than the NEB, no external organization publishes a worker disabling injury frequency for onshore pipelines. The OGP worker disabling injury frequency was calculated from readily available data.

TABLE 3.1

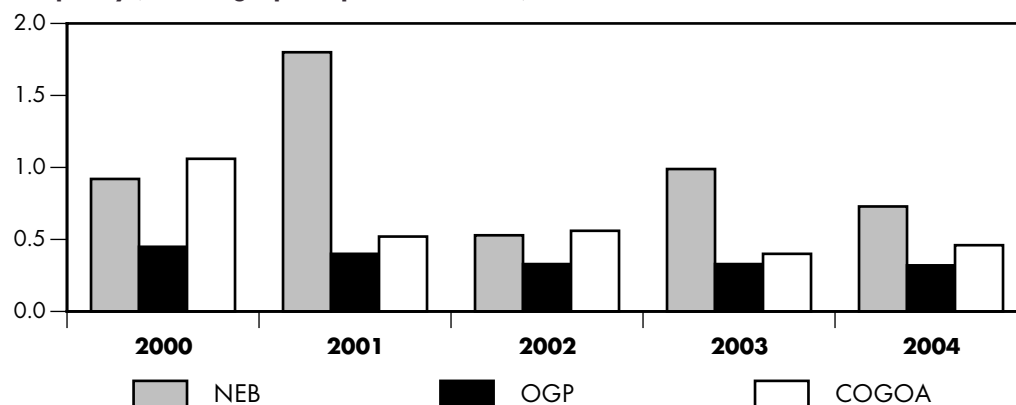
NEB-Regulated Pipeline Fatalities

Year	Employee	Contractor	Third Party	Cause
1991	0	1	0	Construction machinery
1992	0	1	0	Blasting operations
1993	0	0	0	
1994	0	1	0	Construction machinery
1995	0	0	0	
1996	0	0	0	
1997	0	2	0	Unloading construction equipment Construction machinery
1998	0	0	0	
1999	0	0	0	
2000	0	0	0	
2001	0	0	0	
2002	0	0	0	
2003	0	0	0	
2004	0	0	0	

FIGURE 3.1

Worker Disabling Injury Frequency Comparisons

Frequency (disabling injuries per 200,000 hrs)



This comparison indicates that NEB-regulated pipelines have a higher worker (combined employee and contractor) disabling injury frequency than COGOA and the OGP. However, the 2004 rate dropped by 25 per cent compared with 2003.

CAPP publishes a total recordable worker injury frequency indicator that includes head office employee injuries, medical treatment cases and injuries related to offshore activities. Because of the CAPP frequency indicator's broader scope, the 2004 value is approximately twice as high as the NEB frequency value. It does provide some context into the magnitude of NEB-regulated pipelines' disabling injury frequency.

3.1.2 Injuries

NEB-Regulated Pipeline Injuries

Figure 3.2 shows the worker, employee and contractor injury frequencies for NEB-regulated pipelines from 1 January, 2000 to 31 December, 2004. This includes lost time and restricted workday injuries. The year over year moving average for the worker injury frequency demonstrates the industry trend. The five-year average is shown in 2004.

The worker injury frequency decreased from 1.0 in 2003 to 0.7 in 2004. The contractor injury frequency decreased from 3.0 to 1.4. The injury frequency for contractors remains approximately twice the employee injury frequency.

In the March 2005 Focus on Safety and Environment report, the Board indicated further consultations were warranted regarding contractor injuries. These consultations began at the June 6-8, 2005 Workshop.

This workshop brought together NEB staff and stakeholders to discuss technical and regulatory initiatives. Attendees identified several challenges in managing contractor safety, including training issues caused by high turnover rates, fatigue due to tight construction schedules and remote construction sites. The NEB acknowledges the progress being made in making worksites safer for contractors. The goal is to have a safe working environment for all.

FIGURE 3.2

NEB Injury Frequencies

Frequency (number of injuries per 200,000 hrs)



FIGURE 3.3

NEB Liquid Pipeline Injury Frequencies

Frequency (number of injuries per 200,000 hrs)



A summary of employee and contractor hours and the number of injuries since 2000 is provided in Table A3.2 of Appendix Three. Table A2.2 in Appendix Two is a summary of ‘injury’ definitions used by the NEB and the reference organizations. Generally, all definitions reflect either the inability of a worker to report to work the next day, or from effectively performing all their regular work duties.

NEB-Regulated Liquid Pipeline Injuries

Liquid pipelines include crude oil, refined product and natural gas liquid (NGL) pipelines.

Figure 3.3 shows the worker, contractor and employee injury frequencies for NEB-regulated liquid pipelines. Also shown is the worker injury frequency year over year moving average.

The liquid pipeline contractor injury frequency has decreased in the last five years from more than 10 injuries per 200,000 hours worked to about one injury per 200,000 hours worked. There were no contractor or employee injuries reported for 2002. The year over year worker moving average has decreased by more than 50 per cent from the peak frequency of about four injuries per 200,000 hours worked.

NEB-Regulated Gas Pipeline Injuries

Figure 3.4 shows the worker, contractor and employee injury frequencies for NEB-regulated gas pipelines. Also shown is the worker injury frequency year over year moving average.

The gas pipeline contractor injury frequency has decreased substantially from approximately five injuries per 200,000 hours worked in 2003 to about one injury per 200,000 hours worked in 2004. The 2004 contractor injury frequency is aligned with the gas pipeline worker five-year average.

Both oil and gas pipeline companies are currently experiencing a downward trend in the contractor injury frequency indicator.

Injury Frequency Comparisons

Figure 3.5 compares the NEB-regulated pipeline worker injury frequency to the same parameter for the reference organizations. This chart shows the year over year moving averages from 1 January, 2000 to 31 December, 2004.

FIGURE 3.4

NEB Gas Pipeline Injury Frequencies

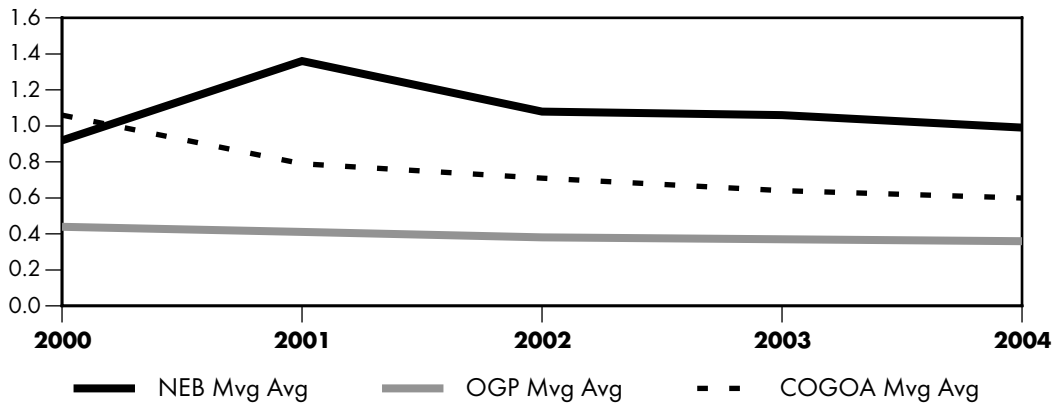
Frequency (number of injuries per 200,000 hrs)



FIGURE 3.5

Worker Injury Frequency Comparisons

Frequency (number of injuries per 200,000 hrs)



Although the worker injury frequency for NEB-regulated pipelines continues to be higher than the reference organizations, the moving average for all these organizations is on the decline. A worker injury frequency of one implies that NEB-regulated pipelines will lose the combined productivity of one person per 200,000 hours worked.

Figure 3.6 compares the NEB-regulated pipeline employee injury frequency to the same parameter for the reference organizations. This chart shows the year over year moving average for 1 January, 2000 to 31 December, 2004.

The Human Resources and Skills Development Canada (HRSDC) report includes disabling injuries to employees working in head and regional offices, while NEB-regulated pipeline data does not. The HRSDC data includes one fatality in 2002.

As discussed in Table A2.2 of Appendix Two, the 2003 and 2004 injury data for the U.S. Bureau of Labor Statistics (BLS) is for the U.S pipeline transportation industry. It is considered comparable to employee data from NEB-regulated pipelines. The NEB is unaware of the reasons behind the U.S. pipeline transportation industry's higher employee injury frequency.

Figure 3.7 compares the NEB-regulated pipeline contractor injury frequency to the same parameter for the reference organizations. This chart shows the year over year moving average for 1 January, 2000 to 31 December, 2004. The PLCAC frequency indicator includes lost time injuries and illnesses.

The injury frequency rate for contractors working on NEB-regulated pipelines is neither the lowest nor the highest compared to other organizations. The NEB five-year average indicates that every year, two to three persons are injured for every 200,000 hours worked.

As further discussed in Table A2.2 of Appendix Two, the 2003 and 2004 BLS frequency indicators shows data for the U.S. utility system construction industry. It is considered comparable to contractor data for NEB-regulated pipelines. The PLCAC reported no injuries in 2003 or 2004 primarily due to low mainline construction activity. During this time frame, the minimum person hours worked threshold was not met.

FIGURE 3.6

Employee Injury Frequency Comparisons

Frequency (number of injuries per 200,000 hrs)

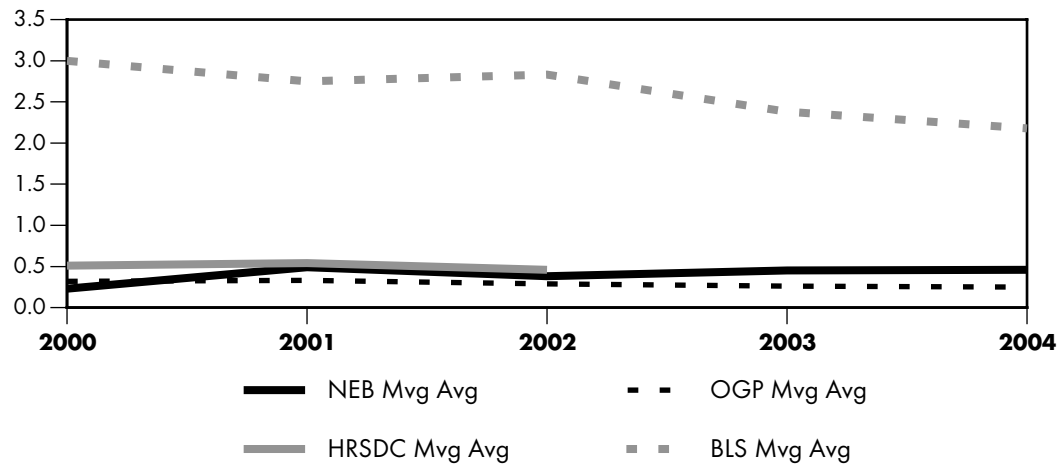
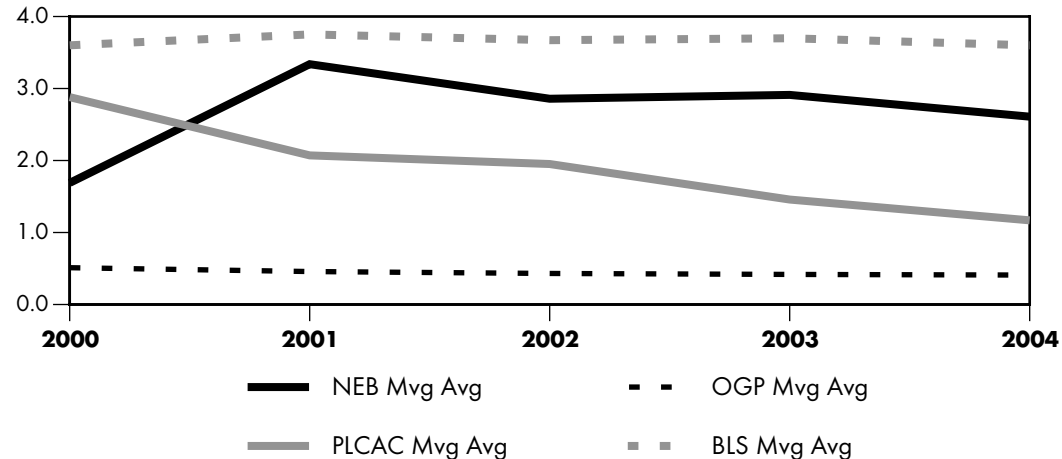


FIGURE 3.7

Contractor Injury Frequency Comparisons

Frequency (number of injuries per 200,000 hrs)



3.2 Integrity Performance Indicators

3.2.1 Ruptures

NEB-Regulated Pipeline Rupture Causes

Ruptures are defined in Annex H to CSA Z662-03 as a “loss of containment event that immediately impairs the operation of the pipeline”. Pipeline ruptures, fires and releases can be severely detrimental to safety and the environment.



Table 3.2 provides a breakdown of reported ruptures and their primary cause over the last 15 years (1991-2004).

2004 is the second consecutive year in which there were no reported ruptures on NEB-regulated pipelines. Since 1997 there has been a visible decline in the frequency of pipeline ruptures, an indication that integrity management programs have been successful.

Figure 3.8 is a graphic representation of the data in Table 3.2. Metal loss includes both internal and external corrosion. Other causes include improper operation, fire and yet to be determined causes.

T A B L E 3 . 2

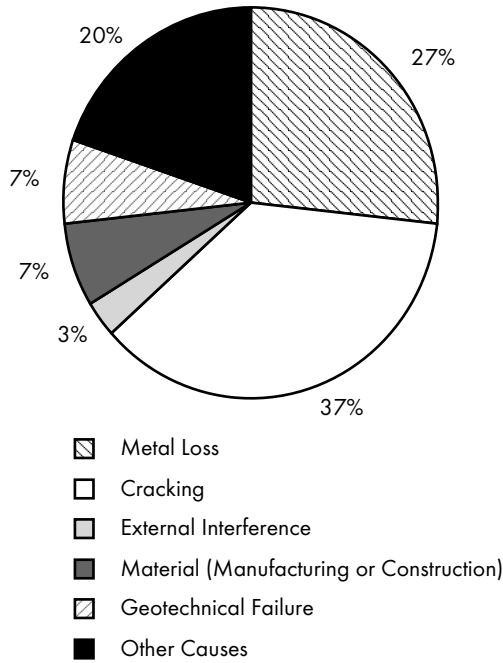
Rupture Primary Causes¹

Year	No. 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						
Total	30	8	11	1	2	2	6

¹ Third rupture included in 1991 upon further review of data.

FIGURE 3.8

NEB Rupture Primary Causes (1991-2004)



The leading primary cause of ruptures on NEB-regulated pipelines from 1991 to 2004 was cracking. Metal loss was the second leading cause of ruptures, followed by other causes.

Cracking includes stress corrosion, hydrogen induced and mechanical damage delayed cracking, corrosion fatigue and cracking. See Figure H.1 of Annex H, CSA Z662-03.

NEB-Regulated Pipeline Rupture Age

Figure 3.9 shows the age of NEB-regulated pipelines at the time of rupture from 1991 through 2004. The primary cause of failure has not been taken into account in this graph and ranges have been set at five-year intervals. The age of pipelines at rupture is the number of operating years, beginning at the year of installation until to the year of the rupture.

The graph approaches a normal distribution with an average age of 30 years. There have been no ruptures on pipelines operating for less than

12 years. A number of factors may have contributed to the absence of ruptures on new pipelines, including the quality of materials, better construction methods, effective pressure testing and well developed integrity management programs.

Figure 3.9 shows a peak in the number of ruptures between 31 and 35 years. The peak is credited to the deterioration of tape and asphalt coatings, which causes time dependent ruptures. The drop in the number of ruptures in older pipelines is attributed to the decline of time dependent causes.

FIGURE 3.9

Pipeline Age at Rupture

Number of Ruptures

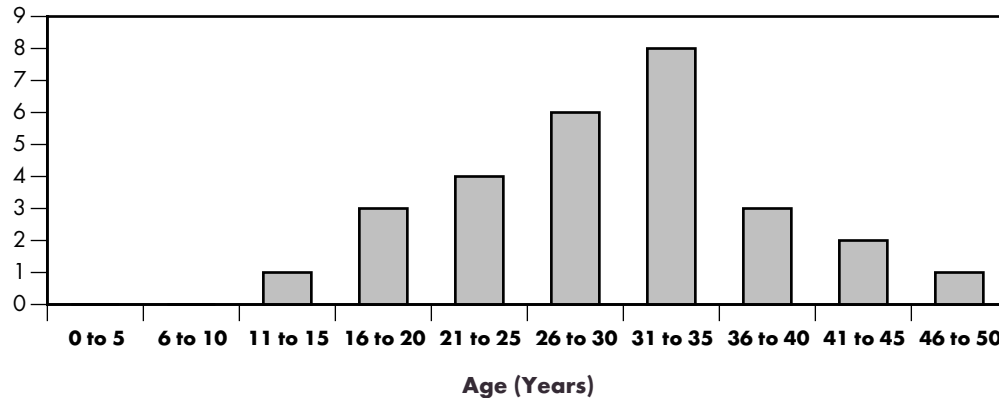
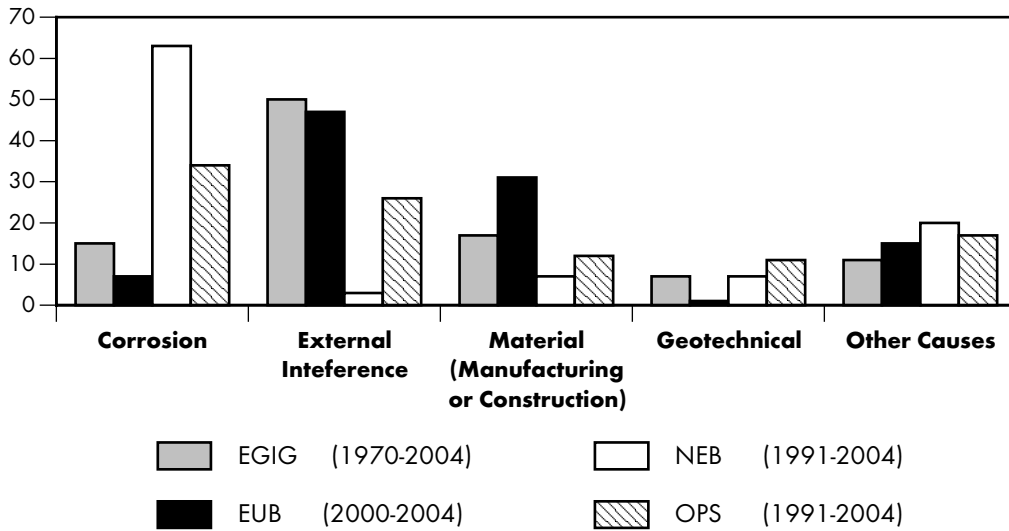


FIGURE 3.10

Rupture Primary Cause Comparisons

Percent of All Causes



Rupture Cause Comparisons

Figure 3.10 compares the distribution of NEB-regulated pipeline ruptures per cause to those reported by the EUB, OPS and EGIG. The OPS data include ruptures reported from 1991 through 2004. The EUB data include ruptures reported from 2000 through 2004. Data for EGIG ruptures are from 1970 to 2004. To facilitate comparison, ruptures caused by metal loss and cracking have been combined and compared to ruptures caused by corrosion. Ruptures brought on by natural causes were aligned to geotechnical and other rupture causes.

As mentioned previously, each of the organizations shown in Figure 3.10 use different timeframes. However, some of these organizations have evidence suggesting that the leading cause of ruptures does not vary a great deal over time. For example, the EGIG indicated in its 1970-1997 report that the leading cause (50 per cent) of ruptures was external interference compared to 47 per cent for the period from 1993-1997.

A comparison of the EUB’s five-year period totals to individual year totals provides similar results. External interference was the leading primary rupture cause over both the five-year period and year over year from 2000 to 2004.

For the time or generational effects on NEB-regulated pipeline ruptures, we look to the work published by Dr. Franci Jeglic for the 2004 International Pipeline Conference¹. Dr. Jeglic compared rupture causes over two consecutive decades, from 1984 to 2003. Although corrosion (metal loss and cracking) was the leading cause of pipeline ruptures in both decades, ruptures due to metal loss increased almost five fold from 1994 to 2003. Ruptures caused by cracking remained relatively flat during both decades. The second leading cause of pipeline ruptures from 1984 to 1993 was external interference - an occurrence that dropped to zero over the next decade.

Since the leading cause of ruptures is, on average, the same, regardless of the different timeframes, the comparisons in Figure 3.10 are meaningful and useful.

¹ Analysis of Ruptures and Trends on Major Canadian Pipeline Systems, Dr. Franci Jeglic, published in the Proceedings of IPC 2004, International Pipeline Conference, IPC04-0272.

The leading cause of ruptures on NEB-regulated pipelines is stress corrosion cracking followed by external corrosion. Similarly, corrosion is the leading cause of pipeline ruptures in the United States, followed by external interference.

Because of differences in pipeline content and purpose (i.e. gathering, transmission, distribution), exact comparisons are difficult. This may account for differences in rupture or failure modes. The population density in the U.S. and Europe is significantly greater than Canada’s, which may account for the increased number of ruptures caused by external interference. The density of the EUB-regulated pipeline network coupled with high levels of construction in the Alberta oil and gas sector may account for higher third party damage rates in Alberta.

3.2.2 Unauthorized Activities on Rights of Way

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

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 damage.

The number of reported, unauthorized activities with the potential to damage pipelines is provided in Table 3.3.

The number of occurrences increased slightly in 2004 to 62 from 59 in 2003. Unauthorized activities in both years are above the five-year average of 49. The percentage of pipeline contacts per total number of unauthorized activities ranges between two and four per cent.

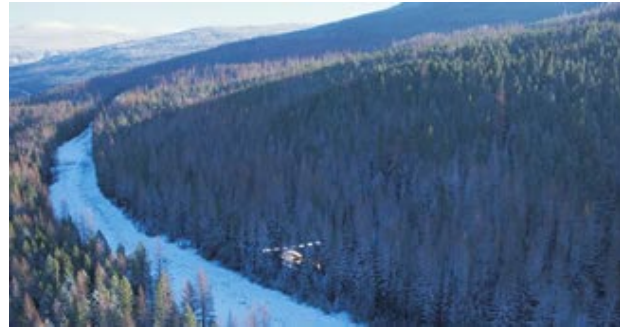
There appears to be no equivalent data available from reference organizations with which unauthorized activities on rights of way can be readily compared. As such, it is difficult to assess whether the number of pipeline contacts relative to the number of unauthorized activities is cause for concern.

T A B L E 3 . 3

Unauthorized Activities on Rights of Way

Year	Movement of Vehicles or Equipment Over Pipelines		Activities With No Soil Disturbance		Activities With 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
2004	2	7	4	2	12	33	1	1	62
Average	1.2	3.6	5.4	1.2	10.4	25.8	0.8	0.8	49.2

It is worth noting that notwithstanding pipeline contacts resulting from unauthorized activities, there were no other reported pipeline contact incidents from 1 January, 2000 to 31 December, 2004.



3.3 Environment Performance Indicators

3.3.1 Liquid Releases and Leaks

NEB-Regulated Liquid Pipeline Releases and Leaks

For the purposes of this report, Liquid Releases are pipe body failures that exceed 1.5 m³. Liquid Leaks are associated with pipeline operations and are related to other pipeline components such as flanges, valves, pumps and storage tanks. Typically, these are less than 1.5 m³; however, they can be much larger. Liquids are both Low Vapor Pressure and High Vapor Pressure pipeline quality products.

Table 3.4 shows the number and volume of Liquid Releases and Liquid Leaks for NEB-regulated liquid pipelines for the five-year period from 2000 through 2004.

The large Liquid Leak in 2002 occurred at a pump station.

The Liquid Release Frequency, the Liquid Release Volume Frequency and the Liquid Leak Frequency indicators are determined using the numbers in Tables 3.4 and A3.3.

Liquid Release Frequency Comparisons

Figure 3.11 compares the Liquid Release Frequency for NEB-regulated liquid pipelines and reference organizations. The year over year moving average for NEB-regulated pipelines is also shown as a trend indicator. Releases reported by CONCAWE are at least 1 m³ in size while the minimum release volume used by all other reference organizations is 1.5 m³.

TABLE 3.4

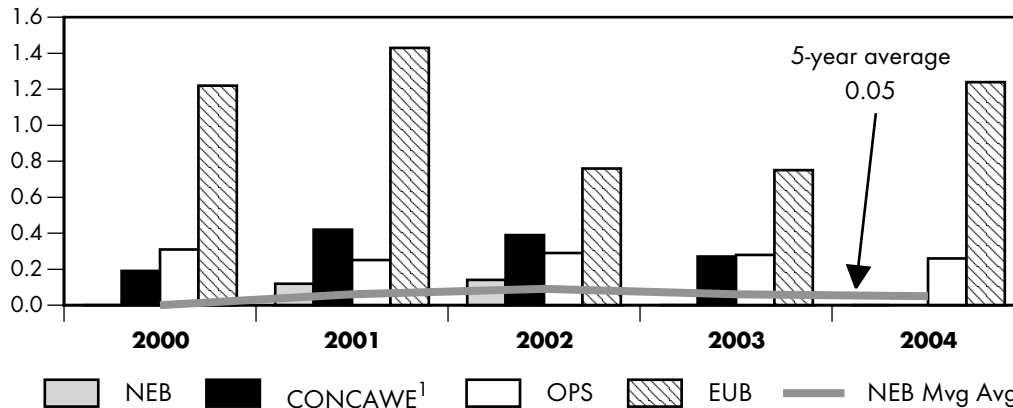
Liquid Releases and Leaks

Year	No. of Leaks (≤1.5 m ³)	No. of Leaks (>1.5 m ³)	Total Leaks	Leak Volume (m ³)	No. of Releases (>1.5 m ³)	Release Volume (m ³)
2000	40	2	42	13	0	0
2001	15	3	18	21	2	3,650
2002	28	9	37	1,184	2	52
2003	39	1	40	11	0	0
2004	34	5	39	33	0	0

FIGURE 3.11

Liquid Release Frequency Comparisons

Frequency (number of liquid releases per 1,000 km)



1 CONCAWE 2004 release data will be made available in the next issue of this report.

TABLE 3.5

Liquid Release Volume Comparisons

Year	NEB	CONCAWE	OPS	EUB
2000	0	360	13199	510
2001	3650	1150	13803	183
2002	52	2185	12847	359
2003	0	2830	6625	415
2004	0	n/a	8218	2792

n/a: not available

NEB-regulated pipelines have experienced very few liquid releases during the past five years. There were no liquid releases in 2000, 2003 and 2004. As a result, NEB-regulated pipelines have a very low frequency with a five-year average of 0.05 releases per 1,000 km of liquid pipelines. The graph shows an expected release frequency of about one release per 20,000 kilometres of liquid pipelines.

Liquid Release Volume Comparisons

Table 3.5 shows the Liquid Release volumes for NEB-regulated liquid pipelines and reference organizations from 2000 through 2004. All volumes are in cubic metres (m³).

Figure 3.12 shows the Liquid Release Volume Frequency for NEB-regulated pipelines and reference organizations from 2000 to 2004. The year over year moving average for NEB-regulated pipelines is also shown.

The graph shows that individual ruptures or breaks on NEB-regulated and EUB-regulated pipelines have a significant impact on the Liquid Release Volume Frequency indicator. These larger events set this indicator's upper range, which is in excess of 200 m³ and 150 m³ per 1,000 km of liquid pipelines for the NEB and EUB respectively.

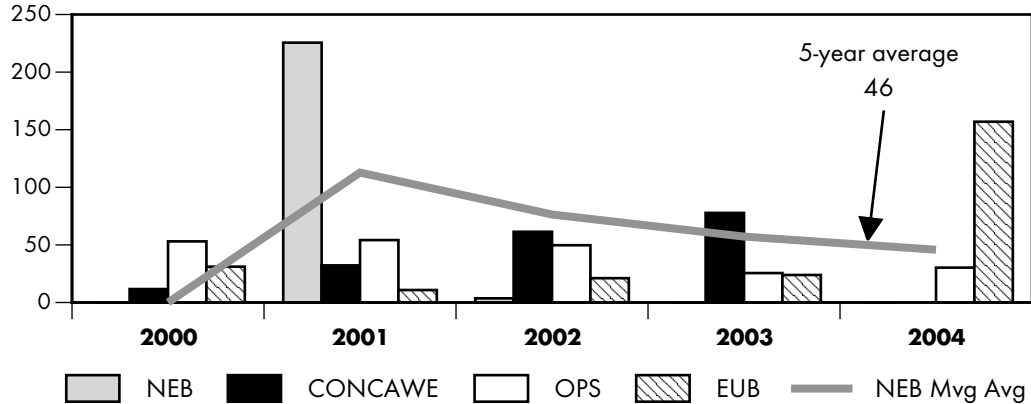
NEB-Regulated Pipeline Liquid Spills

For the purposes of this report, Liquid Spills are associated with pipeline construction, maintenance and gas pipeline operations. They typically include small volumes of lubrication and hydraulic oils and fuel. They exclude product leaks from liquid pipeline systems. Spills occur on both liquid and gas pipelines and Table 3.6 shows the volume and combined numbers of spills from each for NEB-regulated pipelines.

FIGURE 3.12

Liquid Release Volume Frequency Comparisons

Frequency (m³ of liquid releases per 1,000 km)



High construction activity in 2000 caused a significant number of reported spills. The average volume per spill is small, with the five-year average being 0.09 m³ (90 litres) per spill.

CAPP publishes a non-pipeline spill indicator, which has a considerably larger scope than spills caused by construction and maintenance activities. For CAPP, non-pipeline spills include spills from any well site, battery, compressor station, processing plant, oil sands mine or plant and trucking incident. This indicator also includes spills related to offshore construction, drilling and production. For perspective only, the CAPP average volume per spill from 2000 through 2004 was approximately 22 m³ (22,000 litres).

TABLE 3.6

Liquid Spills

Year	No. of Spills (≤1.5 m ³)	No. of Spills (>1.5 m ³)	Total Spills	Total Spill Volume (m ³)
2000	222	0	222	16
2001	28	0	28	10
2002	35	0	35	2
2003	52	1	53	5
2004	88	0	88	5

The Liquid Spill Frequency is calculated from the numbers in Table 3.6 and is shown in Figure 3.13 for comparison to liquid leaks. While the number of spills reported in 2004 was greater than the number of spills reported in 2003, the volume remains very small.

Liquid Leak Frequency Comparisons

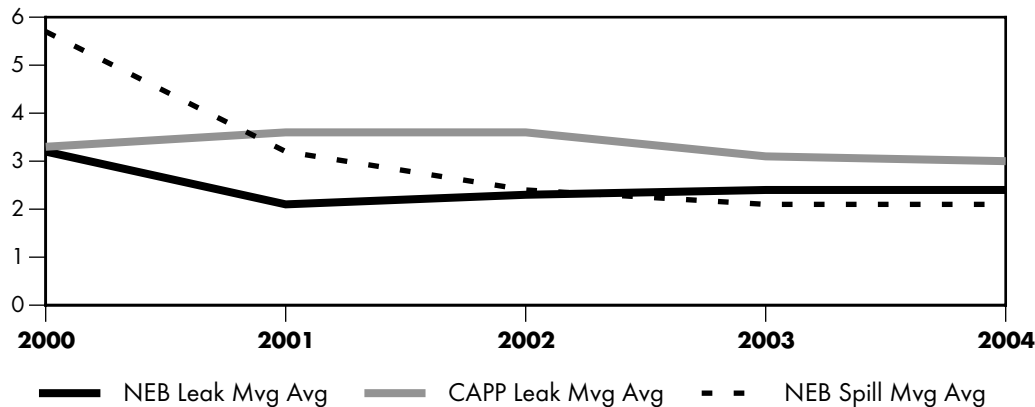
Figure 3.13 compares the Liquid Leak Frequency indicator for NEB-regulated pipelines and CAPP. Shown are the year over year moving averages from 2000 through 2004. The Liquid Spill Frequency moving average for NEB-regulated pipelines is also shown for comparison.

The averages for CAPP operated pipelines include all leaks in upstream and midstream pipelines used to transport raw or treated crude oil, natural gas liquids or water. It does not include leaks from on-lease process piping. The number of leaks is normalized with the total kilometres of CAPP operated pipelines.

FIGURE 3.13

Liquid Leak Frequency Comparisons

Frequency (number of liquid leaks per 1,000 km)



The frequency of Liquid Leaks reported by NEB-regulated liquid pipelines has increased slightly in the last four years. The frequency of Liquid Spills has leveled off to approximately two spills per 1,000 kilometres of pipelines, decreasing significantly from 2000 when there was a significant amount of construction.

The CAPP liquid leak frequency moving average is shown for perspective. The probability of leaks on upstream and midstream pipelines is greater than for transmission pipelines. This helps explain why pipelines carrying more processed and thus less corrosive liquids, such as those regulated by the NEB, have a lower Liquid Leak Frequency compared to CAPP-operated pipelines. What is not clear from the CAPP leak frequency indicator is whether those leaks are primarily from crude oil pipelines, gas liquid rich pipelines or both. In 2002, CAPP reported a combined number for ruptures and leaks; hence, a separate number for leaks cannot be included in Figure 3.13.

3.3.2 Gas Releases and Leaks

NEB-Regulated Gas Pipeline Releases and Leaks

Natural gas releases may occur as a result of a pipe body rupture or hole. Natural gas leaks can occur through routine equipment functions such as seepage at flanges through gaskets or venting. This does not include the venting of gas from planned events. Leaks can also occur through small pinholes or cracks in the pipe body.

TABLE 3.7

Gas Releases and Leaks

Year	Number of Leaks	Number of Releases
2000	23	1
2001	23	1
2002	11	2
2003	11	0
2004	19	0

The data used to calculate the gas release and leak frequencies for NEB-regulated pipelines is shown in Table 3.7.

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 found in Appendix Two. Pursuant to the OPR, all gas releases including leaks from NEB-regulated pipelines are reportable, regardless of volume.

Gas Release Frequency Comparisons

Figure 3.14 shows the Gas Release Frequency for NEB-regulated gas pipelines and reference organizations. The NEB year over year moving average is also shown. The U.S. Office of Pipeline Safety data have been separated into pipe body ruptures for comparison to NEB-regulated gas pipeline data. In this report, the primary failure frequency reported by the European Gas Incident Group (EGIG) has been adjusted down to show that approximately 52 per cent of pipe failures are due to ruptures and holes.

The five-year average of the Gas Release Frequency indicator for NEB-regulated pipelines continues to drop and is approximately 0.03 releases per 1,000 km or one release per 30,000 kilometres.

Gas Leak Frequency

Figure 3.15 shows the Gas Leak Frequency for NEB-regulated gas pipelines. The NEB year over year moving average is also shown.

FIGURE 3.14

Gas Release Frequency Comparisons

Frequency (number of gas releases per 1,000 km)

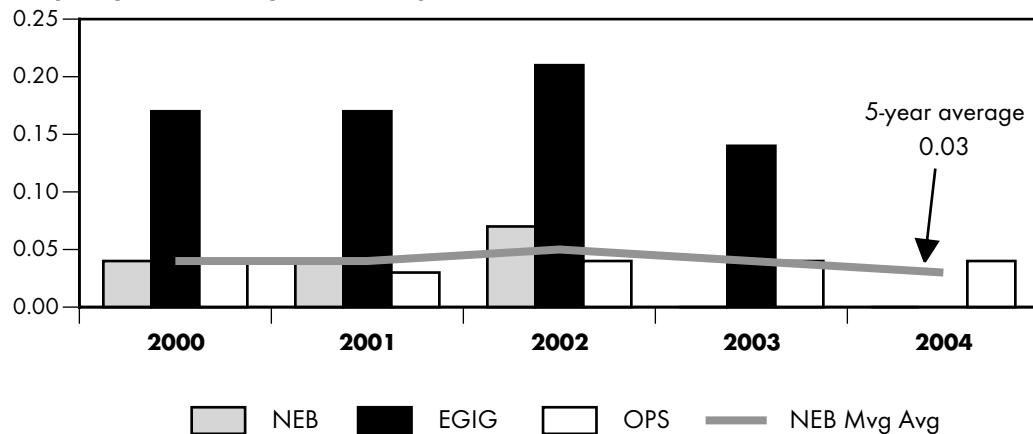
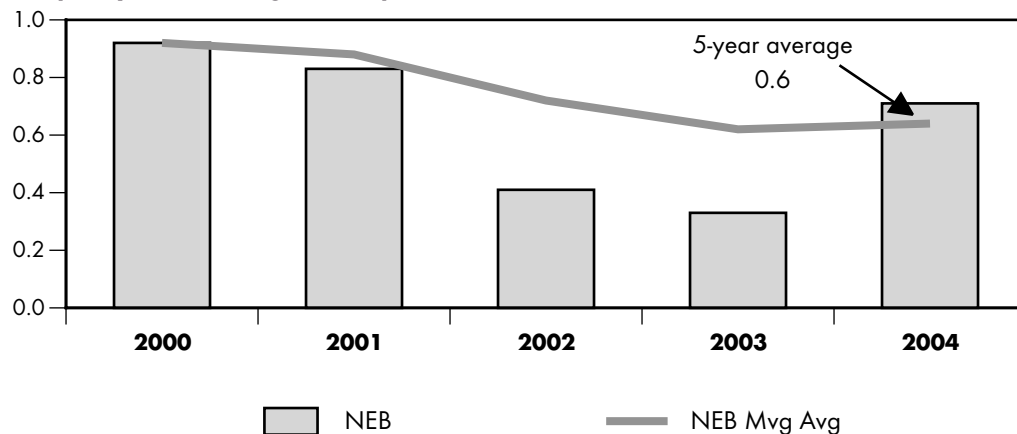


FIGURE 3.15

Gas Leak Frequency

Frequency (number of gas leaks per 1,000 km)



At a frequency of approximately 0.6 leaks per 1,000 km, leaks on NEB-regulated gas pipelines occur 20 times more often than pipe body releases.

The different reporting requirements for gas releases between the NEB and the OPS make comparison of the Gas Leak Frequency inconsequential. Although some gas leaks are reported, only those resulting in a fatality or a property loss of US\$50,000 are required to be reported to the OPS. As such, the Gas Leak Frequency for the OPS is approximately an order of magnitude less than for NEB-regulated gas pipelines.

3.4 Incidents Performance Indicator

Figure 3.16 shows all reportable pipeline incidents pursuant to the OPR, by occurrence type from 1 January, 2000 to 31 December, 2004.

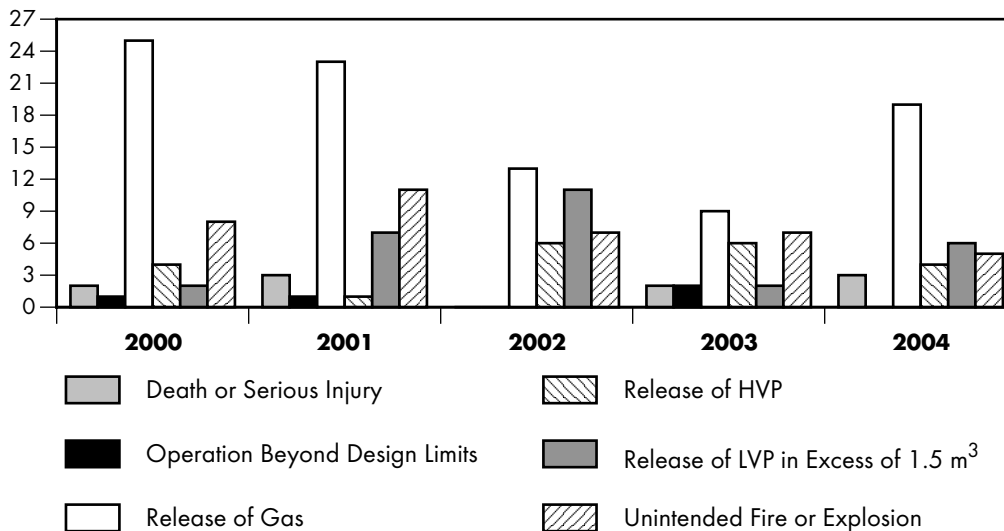
A total of 190 incidents were reported during this five-year period. The release of gas is the most common incident. The second most common occurrence is unintended fire or explosion. On average, the NEB processes 38 incidents per year.

The NEB intends to conduct further analysis to determine the causes for each type of occurrence. The results of the analysis are expected to be published in the next issue of this report.

FIGURE 3.16

OPR Incidents by Occurrence Type

Number of Incidents



A1.1 Reference Organizations

Organizations chosen for comparative analysis of data within this report have been selected based on their similarities to the NEB. A comparison of the terms used within each reference organization is provided in Appendix Two.

A1.1.1 Human Resources and Skills Development Canada (HRSDC)

Website: www.brsdc.gc.ca

Under the Canadian constitution, labour legislation is primarily a provincial responsibility. The federal government, however, administers labour affairs in specific sectors including certain works and industries such as pipelines which have inter-provincial or international character.

The Labour Program of Human Resources and Skills Development Canada (HRSDC) is responsible for developing, administering and enforcing legislation and regulations related to the workplace, including the Canada Labour Code Part II – Occupational Health and Safety (CLC Part II).



HRSDC collects, researches and analyses data pertaining to health and safety at all federally regulated workplaces, including those regulated by the NEB.

HRSDC data is presented within this report for comparative purposes for the following performance indicator:

- Injury Frequency

A1.1.2 Alberta Energy and Utilities Board (EUB)

Website: 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 performance indicators:

- Ruptures; and
- Liquid Releases.

A1.1.3 Canadian Association of Petroleum Producers (CAPP)

Website: www.capp.ca

The Canadian Association of Petroleum Producers (CAPP) represents more than 150 member companies who explore for, develop and produce natural gas, natural gas liquids, crude oil, oil sands, and elemental sulphur throughout Canada. CAPP member companies produce more than 98 per cent of Canada's natural gas and crude oil. CAPP also has 125 associate members that provide a wide range of services that support the upstream crude oil and natural gas industry. Together, these members and associate members are an important part of a \$90-billion-a-year national industry that affects the livelihoods of more than half a million Canadians.



CAPP data is presented within this report for comparative purposes for the following performance indicators:

- Injury Frequency;
- Liquid Leaks; and
- Spills.

A1.1.4 Pipe Line Contractor Association of Canada (PLCAC)

Website: 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 performance indicator:

- Injury Frequency.

A1.1.5 United States Department of Transportation, Pipeline and Hazardous Materials Safety Administration - Office of Pipeline Safety (OPS)

Website: 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 liquid pipelines.



For the purposes of this report, only information on gas transmission and hazardous liquid pipelines has been used. OPS data is presented within this report for comparative purposes for the following performance indicators:

- Ruptures;
- Liquid Releases; and
- Gas Releases.

A1.1.6 United States Department of Labor - Bureau of Labor Statistics (BLS)

Website: 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 labor 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 labor. 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 represents 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 performance indicator:

- Injury Frequency.

A1.1.7 European Gas pipeline Incident data Group (EGIG)

Website: 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 performance indicators:

- Ruptures; and
- Gas Releases.

A1.1.8 European Oil Companies Association for Environment, Health and Safety (CONCAWE)

Website: 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 performance indicator:

- Liquid Releases.

A1.1.9 International Association of Oil and Gas Producers (OGP)

Website: 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 performance indicator:

- Injury Frequency.

A1.2 Reference Organization Data Sources

A1.2.1 Human Resources and Skills Development Canada (HRSDC)

Occupational Injuries Among Canadian Federal Jurisdiction Employers, 1998-2002.

A1.2.2 Alberta Energy and Utilities Board (EUB)

Written correspondence:

Dated 4 April, 2003, 20 hydrocarbon liquid releases from crude oil pipelines in 2000 and 24 releases in 2001 and corresponding crude oil release volumes;

Dated 17 December, 2003, 13 hydrocarbon liquid releases from crude oil pipelines in 2002 and corresponding crude oil release volumes;

Dated 17 December, 2004, 13 hydrocarbon liquid releases from crude oil pipelines in 2003 and corresponding crude oil release volumes;

Dated 31 October, 2005, 22 hydrocarbon liquid releases from crude oil pipelines in 2004 and corresponding crude oil release volumes.

Statistical Series 57 - Field Surveillance Provincial Summary:

April 2001/March 2002, published in July 2002;

January–December 2002, published in May 2003;

January–December 2003, published in April 2004;

January–December 2004, published in May 2005.

A1.2.3 Canadian Association of Petroleum Producers (CAPP)

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

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

2004 Stewardship Progress Report, 2004-0021, published in February 2005.

2005 Stewardship Progress Report, published by the Canadian Association of Petroleum Producers in January 2006.

A1.2.4 Pipe Line Contractor Association of Canada (PLCAC)

Mainline Contractor Injury Frequencies, Safety Statistics Page from <http://www.pipeline.ca/>.

A1.2.5 United States Department of Transportation, Pipeline and Hazardous Materials Safety Administration - Office of Pipeline Safety (OPS)

PHMSA website:

Natural Gas Transmission Incident Data – mid 1984 to 2001 and 2002 to present;

Hazardous Liquid Accident Data – 1986 to January/2002 and January/2002 to present.

A1.2.6 United States Department of Labor - Bureau of Labor Statistics (BLS)

U.S. Department of Labor website:

Table 1, Incidence rates of non-fatal occupational injuries and illnesses by industry and selected case types, 2000 through 2002 inclusive. Contractor is “Heavy construction, except highway”, and employee is “Gas production and distribution”;

Table 1, Incidence rates of non-fatal occupational injuries and illnesses by industry and selected case types, 2003 and 2004. Contractor is “2371 Utility System Construction”; and employee is “486 Pipeline Transportation”.

Lost workday injuries where total lost workday cases involve days away from work, days of restricted work activity or both.

A1.2.7 European Gas pipeline Incident data Group (EGIG)

3rd EGIG Report, 1970-1997 Gas Pipeline Incidents, Document No. EGIG 98.R.0120 published in December 1998.

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

6th EGIG Report, 1970-2004 Gas Pipeline Incidents, Document No. EGIG 05.R.0002, published in December 2005.

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

A1.2.8 European Oil Companies Association for Environment, Health and Safety (CONCAWE)

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.

Performance of European cross-country oil pipelines, Report no. 1/03, published February 2003.

A1.2.9 International Association of Oil and Gas Producers (OGP)

Safety Performance of the Global E & P Industry, 2000 by the International Association of Oil and Gas Producers, Report No. 6.93/319, published 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 July 2002.

Safety Performance of the Global E & P Industry, 2002 by the International association of Oil and Gas Producers, Report No. 345, published June 2003.

Safety Performance Indicators 2003, Report No. 353, published in June 2004.

Safety Performance Indicators, 2004, Report No. 367, published in May 2005.

A2. Comparative Data Clarification

T A B L E A 2 . 1

Comparison of Reporting Criteria for Ruptures

Source	Reporting Requirements
NEB	Rupture "Loss of containment event that immediately impairs the operation of the pipeline." (per CSA Z662-3, Annex H)
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. "Break" means a rupture in any part of a pipeline and "leak" means the escape of substance from a pipeline
OPS	Incident Gas releases that were associated with a death or personal injury requiring hospitalization, or a total cost of \$50,000 (U.S.) or more. Loss of 8 or more cubic metres of hazardous liquids or where property damage costs exceed \$50,000 USD. After 7 February 2003, a release of 5 gallons (19 litres) or more.
EGIG	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.

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
NEB	<p>Under the SPI Initiative: “Any occupational 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.”</p> <p>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.</p>	<p>Guidance provided 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”.</p>
COGOA	<p>Data represents “lost 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.</p>	<p>The definition is identical to the definition used by the NEB for the SPI Initiative.</p>
HRSDC	<p>Disabling Injury: “Any occupational injury that:</p> <ul style="list-style-type: none"> a) prevents an employee from reporting for work or from effectively performing all the duties connected with the employee’s work on any day subsequent to the day on which the occupational injury occurred, whether or not that subsequent day is a working day for that employee; b) results in the loss by an employee of a body member or a part thereof or in a complete loss of the usefulness of a body member or part thereof; or c) results in the permanent impairment of a body function of an employee.” <p>Disabling injury incidence: disabling plus fatal injuries</p>	<p>The definition is similar to the combined definition under the NEB OPR and SPI Initiative.</p>

TABLE A 2.2 (CONTINUED)

Injury Definitions of Comparative Data Sources

<p>CAPP</p>	<p>Any cut, fracture, sprain, amputation, loss of consciousness, etc, which results from an exposure involving a single event in the work environment.</p> <p>Lost Time injuries – include fatalities, permanent total disabilities and lost workday cases resulting from work-related injuries</p> <p>Recordable injuries – include fatalities plus permanent total disability plus lost workday cases plus restricted work cases plus medical treatment cases.</p> <p>Lost Workday Cases (LWC) – lost workday cases are work-related injuries, which render the injured person temporarily unable to perform any regular job or restricted work activity on any normally scheduled workday after the day on which the injury occurred.</p> <p>Restricted Work Cases (RWC) – a work-related injury or illness which results in an individual being unable to perform all normally assigned work functions during any scheduled work shift; or being assigned to another job on a temporary or permanent basis after the day of the injury or illness.</p>	<p>CAPP members are primarily upstream oil and gas companies and data may not be directly comparable to pipeline transmission companies.</p>
<p>PLCAC</p>	<p>Any work related personal injury or illness that results in time lost from work. Time lost begins on the day subsequent to the day the accident occurs.</p>	<p>PLCAC data does not include non-union pipeline contractor data. Mainline construction data should be roughly comparable to contractor data under the SPI Initiative.</p>
<p>BLS</p>	<p>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”</p> <p>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”</p>	<p>Heavy construction and Utility System construction data should be roughly comparable to NEB contractor data.</p> <p>Gas production and distribution data and pipeline transportation data should be comparable to NEB company data.</p>
<p>OGP</p>	<p>Injury is referred to as a Lost Workday Case (LWDC) and Restricted Workday Case (RWDC). Any work related injury other than a fatal injury which results in a person being unfit for work or severe enough to prevent a person from performing normal duties 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.</p>	

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 associated with pipe body failure and a release volume in excess of 1.5 cubic metres.
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. "Break" means a rupture in any part of a pipeline.
CAPP	A pipeline rupture is defined as an "instantaneous tearing or fracturing of pipe material, immediately impairing the operation of the pipeline" [EUB, 1998] A pipeline leak is defined as "a small opening crack or hole in the pipeline causing some product loss, but not immediately impairing the line's operation" [EUB, 1998]
OPS	Loss of 8 or more cubic metres or where property damage costs exceeds \$50,000 USD. 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.

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.

A3. Data

A3.1 Sample Size

Data for the period 1 January, 2004 to 31 December, 2004 was submitted voluntarily to the Board from 38 companies. The companies that provided data for the SPI initiative owned or operated approximately 94 percent of the total length of pipelines regulated by the NEB under the *National Energy Board Act*.

The number of companies reporting and the length of pipeline reported upon are provided in Table A3.1.

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

TABLE A3.1

NEB-Regulated Pipeline Statistics

Year	Number Companies Reporting	Number Kilometres Reported Upon	Total Kilometres
2000	24	39,190	42,720
2001	37	42,680	42,920
2002	33	41,555	43,050
2003	34	42,189	43,961
2004	38	41,985	44,074

TABLE A3.2

NEB-Regulated Pipeline Injury 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
2004	1,573,743	4,722,044	11	12

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

TABLE A3.3

Reference Organization Statistics

Year	Organization	Kilometres of Gas Pipeline	Kilometres of Hydrocarbon Liquids Pipeline	Total Reported Kilometres
2000	NEB	25,970	13,220	39,190
2000	EUB	229,034	16,410	245,444
2000	CAPP	n/a	n/a	175,646
2000	OPS	524,000	249,020	773,020
2000	EGIG	110,236	n/a	110,236
2000	CONCAWE	n/a	30,800	30,800
2001	NEB	26,510	16,170	42,680
2001	EUB	245,466	16,818	262,284
2001	CAPP	n/a	n/a	182,818
2001	OPS	479,800	255,060	734,860
2001	EGIG	110,236	n/a	110,236
2001	CONCAWE	n/a	35,575	35,575
2002	NEB	26,752	14,803	41,555
2002	EUB	255,032	17,118	272,150
2002	CAPP	n/a	n/a	225,481
2002	OPS	526,007	258,409	784,899
2002	EGIG	109,524	n/a	n/a
2002	CONCAWE	n/a	35,592	35,592
2003	NEB	26,943	15,245	42,189
2003	EUB	268,549	17,391	285,940
2003	CAPP	n/a	n/a	266,355
2003	OPS	522,020	258,892	780,912
2003	EGIG	114,285	n/a	n/a
2003	CONCAWE	n/a	36,422	36,422
2004	NEB	27,146	14,812	41,958
2004	EUB	288,388	17,793	306,181
2004	CAPP	n/a	n/a	259,993
2004	OPS	518,283	270,262	788,545
2004	EGIG	122,168	n/a	122,168
2004	CONCAWE	n/a	n/a	n/a

n/a: not available

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

TABLE A 3.4

**Injury Frequency Data
(Number of Injuries per 200,000 Hours Worked)**

Year	Source	Contractor Injury Frequency	Employee Injury Frequency	Overall
2000	NEB	1.69	0.23	0.92
2000	COGOA	n/a	n/a	1.06
2000	HRSDC	n/a	0.51	n/a
2000	CAPP	3.36	1.04	2.58
2000	PLCAC	2.88	n/a	n/a
2000	BLS	3.60	3.00	n/a
2000	OGP	0.40	0.29	0.36
2001	NEB	5.35	0.87	1.99
2001	COGOA	n/a	n/a	0.52
2001	HRSDC	n/a	0.56	n/a
2001	CAPP	2.76	0.87	2.14
2001	PLCAC	1.25	n/a	n/a
2001	BLS	3.90	2.50	n/a
2001	OGP	0.33	0.26	0.31
2002	NEB	1.92	0.16	0.53
2002	COGOA	n/a	n/a	0.56
2002	HRSDC	n/a	0.30	n/a
2002	CAPP	2.16	1.01	1.83
2002	PLCAC	1.72	n/a	n/a
2002	BLS	3.50	3.00	n/a
2002	OGP	0.22	0.18	0.21
2003	NEB	3.04	0.66	0.99
2003	COGOA	n/a	n/a	0.40
2003	HRSDC	n/a	n/a	n/a
2003	CAPP	2.15	1.34	1.91
2003	PLCAC	0.00	n/a	n/a
2003	BLS	6.90	2.10	n/a
2003	OGP	0.25	0.15	0.22
2004	NEB	1.40	0.51	0.73
2004	COGOA	n/a	n/a	0.46
2004	HRSDC	n/a	n/a	n/a
2004	CAPP	1.91	1.00	1.65
2004	PLCAC	0.00	n/a	n/a
2004	BLS	6.00	2.50	n/a
2004	OGP	0.22	0.17	0.22

n/a: not available



GOALS 1 AND 2

NEB-regulated facilities and activities are safe and secure, and are perceived to be so.

NEB-regulated facilities are built and operated in a manner that protects the environment and respects the rights of those affected.