

Alberta Pipeline Safety Review

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1. Executive Summary

Recent pipeline-related incidents, combined with international focus on pipeline regulation and public safety, have resulted in increased questions about how and whether ERCB regulated pipelines in Alberta are safely operated by industry and effectively regulated by the ERCB. The purpose of this Pipeline Safety Review is to review and assess the available information and to provide comment and guidance on answers.

The approach taken to achieve this was by assessing the current ERCB regulatory requirements and framework; then comparing them to those of similar jurisdictions and regulators firstly within Canada, and then to regulatory approaches beyond Canada's borders.

The specified main subject areas are as follow:

- Public safety and response to pipeline incidents
- Pipeline integrity management
- Safety of pipelines near water bodies

The comparison of the ERCB regulatory requirements was undertaken against the requirements of the British Columbia – Oil and Gas Commission (B.C. OGC), the Saskatchewan Ministry of the Economy (Engineering Services Branch), the National Energy Board (NEB), Alberta Government (Alberta Environment and Sustainable Resources Development (ESRD)), Canadian standards (CSA), the U.S. pipeline regulatory requirements specifically the Pipeline and Hazardous Materials Safety Administration (PHMSA, national regulator); as well as Alaska and Texas as local jurisdictions. There was also a broad review of the regulatory environments in the UK, Netherlands, France, Brazil and Australia.

The review was also extended to assessing available industry best practices and how they contribute to pipeline safety. The industry organizations included the Canadian Energy Pipeline Association (CEPA), the Canadian Association of Petroleum Producers (CAPP), the Interstate Natural Gas Association of America (INGAA), the National Offshore Petroleum Safety and Environmental Management Authority (NOPSEMA – Australia), the Conservation of Clean Air and Water in Europe (CONCAWE) and the UK Onshore Pipeline Operators' Association (UKOPA).

Pipeline licensees were also canvassed for their input to the question: Are pipelines in Alberta safely operated and effectively regulated? They contributed substantial knowledge and value to the review process (section 4.6). Sixteen owners were randomly selected based on criteria such as operating under multi-jurisdictions, as well as industry sector (upstream and transmission) and product transported (gas and liquids).

The outcomes of the overall review can be summarized as follows:

1. Alberta (the ERCB) provides the most thorough overall regulatory regime of all the assessed Canadian jurisdictions. This is evident from the comparisons of the regulations, acts, directives, etc. as recorded in Appendix B and summarized in Table 1.

This is most likely due to the fact that Alberta has a very mature (well established) pipeline industry and the largest number of pipelines; and the ERCB, as a regulator, has evolved over time to regulate and manage the industry as appropriate. The other provincial jurisdictions have comparatively fewer pipelines under their authority and a younger pipeline industry with the growth realistically only occurring since 2000. An example of this is the fact the since the 1970's all regulated oil and gas pipelines in Alberta have been identified, mapped and

licensed; whereas in some Canadian and U.S. jurisdictions portions (i.e. upstream gathering sections) of the pipelines still do not require registration or licensing.

2. The requirements regarding the regulation of pipelines, specifically with regard to integrity management and safety near water bodies, are not harmonized or consistent across Canadian jurisdictions. This was evident from the analysis of the regulation of each jurisdiction and stated by the pipeline licensees. The tendency is for the licensees to perform to the dominant regulators' requirements; which, in most instances was the ERCB with supplemental requirements from the other jurisdictions included and addressed. This did; however, still lead to some inconsistency in the application and compliance assessment of the regulation in some areas.
3. The presentation and comparison of pipeline leak or failure statistics for Alberta with other Canadian and international jurisdictions is not possible, as each jurisdiction has unique requirements as to which incidents, and what detail is reported. Alberta appears to demonstrate the most mature and complete approach to incident reporting and statistical comparison.

The incident statistics, as collected and presented by the ERCB, are constantly evolving to include additional detail and as such need to be carefully reviewed and well understood when comparing one year to the next.

4. A common and harmonizing point to all Canadian regulators is the adoption of the Canadian Standards Association document CSA Z662, Oil and Gas Pipeline Systems, as the standard that is in force. This does provide consistency with respect to design and construction, and somewhat to operations and maintenance, integrity management and risk management. Each jurisdiction does however, have requirements in their respective acts and regulations that are over and above those required by CSA Z662.
5. Safety of pipelines near water bodies appears to be an area without clear definition or consistent regulatory direction, as licensees must conform to the requirements of multiple regulators. The prescriptive requirement in Alberta to identify a river crossing calls for a 1:1 000 000 map to be used (*Directive 056*), which may be generally acceptable for gas pipelines but could be inadequate for liquids pipelines. It was noted that licensees meet the ERCB requirements for the minimum annual surface inspection of river crossings. Most additionally identify river crossings and water bodies in their risk assessment process with more detail than required by regulation. The risk assessment typically identifies these as higher risk areas, and lead to specific integrity management and inspection requirements. It was additionally noted that, in some cases, the emergency response procedures used higher resolution maps and water body identification protocols than the integrity management process.
6. Assessment of the regulatory requirements for "Public safety and response to pipeline incidents" and the preparedness of the regulators (including the ERCB) and licensees determined an overall consistency in competence, understanding and preparedness for an incident. Emergency preparedness in the oil and gas industry extends beyond just pipelines (includes exploration, wells and facilities) and as such the industry has recognized the need for strong emergency response and crisis management competency and preparedness, often having groups or departments dedicated to these functions.

7. All licensees in Alberta comply with the requirements of ERCB *Directive 071*, which is presently, also referenced by the B.C. OGC (*OGC-OD-C&E-2700, ref 71*). As emergency response planning is applied corporately to more than just pipelines, there is a general approach amongst the licensees to use the Incident Command System (ICS) as the guide for their corporate ERP.
8. When a major industrial incident occurs, such as the Piper Alpha platform fire, Texas City refinery explosion or the Macondo well blow out, the industry learns from the ensuing investigations which are made public and beneficially shared; thereby allowing others to improve stakeholder and environmental safety through improved design and response capabilities. It was apparent there is still opportunity for improving shared learning within the pipeline operational and integrity management realms, which would contribute to the safety of pipelines in Alberta, and improve knowledge on response requirements plus overall public safety.

The assessment of the various regulatory, operational and jurisdictional environments has highlighted that no single right answer exists on how to best ensure pipeline safety. There are many varying pipeline environments and each has its own unique requirements with respect to life cycle management (design, construction, operation (including maintenance and integrity management) and decommissioning).

The United Kingdom, Norway, Netherlands and Australia have adopted what is commonly referred to as the safety case approach to risk management, which recognizes that the pipeline owner/operator has the best knowledge on how to design, operate and manage their own assets (pipelines) and business. As such, duty of care is recognized as the responsibility of the owner/operator. This approach is very much a performance and management system based approach to risk management and one that includes asset risk management right from the concept stage through the life cycle.

The Canadian jurisdictions and the U.S. national regulator apply a hybrid approach to regulatory requirements, namely prescriptive in certain aspects (such as enforcing the requirements of CSA Z662) and performance or goal based in other aspects. A notable difference between this and the above (safety case approach) is that in the Canadian and U.S. scenario, risk management is only applied in the operational phase, whereas the safety case approach is used right from the concept and design phase of the asset's life cycle.

It is apparent that there is a strong tendency toward the use of a performance or goal based risk management systems worldwide, somewhat in an attempt to relieve the regulatory responsibility with the approach that the person or organization that creates the risk should manage the risk and be responsible for the consequences. This approach is sensible in many ways, but will also require a mature operational and regulatory environment to succeed, as well as specific competencies to support regulatory oversight.

To quote the Alaska Risk Assessment of Oil and Gas Infrastructure report by CYCLA Corporation (November 2010) (Appendix C, Ref 124), "Strengthen Regulatory Oversight by Evolution not Revolution." The evolution is already occurring toward performance based and management system based risk management.

The Canadian regulators are also evolving toward this approach, and being mindful of industry in its goal of remaining competitive in business, considerations should be given to a progressive (tiered) regulatory approach. This could be in the form of semi-prescriptive or prescriptive regulation similar to what the ERCB presently has in place. However, there would be additional regulation such that the ERCB could audit (assess) and certify licensees as firstly having the

necessary management systems in place, and secondly having the competence, to pursue a substantially performance or goal based risk management approach.

This would be a novel approach to pipeline integrity management and regulatory management in Alberta. It would require careful determination of both the competency and the regulatory compliance verification requirements. This would place a responsibility on both the regulators and licensees for some time to get the competencies in place; but, given that this approach is used successfully in Alberta in the pressure equipment environment, learning could be shared to support an effective transition to this risk based integrity management approach.

This tiered approach would accommodate the smaller licensees with fewer resources by having defined prescriptive criteria for them to operate within, while allowing the larger licensees to operate more effectively and efficiently operate under performance-based regulation.

2. Recommendations

There are some key differences between upstream producers and pipeline transmission companies which result in a significant difference in the number of failures between the two. For example, there is a real difference between the type of products managed by producers (provincially regulated by the ERCB) and the transmission companies (typically federally regulated by the NEB). Production lines usually range from 2" to 12" diameter with an average length of 1.6 km (per the ERCB *Report 2007-A* titled *Pipeline Performance in Alberta, 1990-2005*, 80 per cent of ERCB licensed pipeline length is 6" and smaller (Appendix C, Ref 31)). They generally contain raw product (oil emulsion, raw gas – with produced water, produced water brine, solids and wax contaminated product, etc.) and have low intermittent velocities. Transmission pipelines on the other hand typically range from 12" to 42" diameter with a much greater length, operate continuously and contain sales quality product of oil or gas.

In Alberta, production pipelines are unique in that they are the only component of oil and gas production systems, from formation to sales valve, where there are no specified minimum frequencies and requirements for inspection, or testing to confirm their integrity (there are frequency requirements to inspect for potential hazards, such as slope movement or erosion at river crossings; as well as regulated requirements to assess the need for, or effectiveness of, internal and external corrosion mitigation procedures; but, not directly to assess the condition of the pipeline itself). Well bores, tanks and on lease pressure equipment and piping are all respectively regulated to a prescribed inspection requirement and frequency. Tanks and pressure equipment also have prescribed competencies for the inspectors.

The listed recommendations are based on key learnings from the review, and are presented below without priority or guidance on timeline for consideration or potential implementation;

Public Safety and Response to Pipeline Incidents:

Emergency response and planning was assessed consistently as adequate but could be further enhanced by consideration of the following:

1. Regulators and licensees could jointly develop a stakeholder education/awareness program on the consequences of right-of-way encroachment and how to react in the event of an emergency.
2. The Call Before You Dig (Alberta 1 Call) membership requirement is legislated as compulsory in Alberta for pipeline licensees; but this is not the case nationally. Consideration should be given to instituting this as a Canada wide program. Not only would this benefit other jurisdictions where it is not a requirement, but it would also ensure that new Albertans are consistently aware of these requirements.
3. ERCB staff should consider increased participation in stakeholder hosted emergency response exercises, as these present an opportunity to share knowledge as well as provide an opportunity to the regulatory staff to informally review ERP documents and processes (It is noted that the ERCB participates in many ERP exercises, but when it comes to pipeline specific exercises, licensees indicated there was opportunity for more attendance).

Pipeline Integrity Management:

1. Institute the risk ranking of all pipelines based on standardized methodology to be developed by Canadian regulators and stakeholders. *(Must be standardized so that all stakeholders are using the same basis for comparison and have a common level of understanding and definition of risk.)*

2. Integrity Management Programs for all companies under the ERCBs jurisdiction should be audited on a routine basis for compliance with respect to adequacy, implementation and effectiveness. Given the number of licensees in Alberta, this is potentially a near impossible task for the ERCB to achieve on its own. Consideration should be given to accepting self or third party audits from licensees; complemented by random and risk assessed requirements for ERCB led audits (which could vary in intensity or focus as required).
3. Set minimum requirements for comprehensive inspection and testing programs for pipelines to establish the current condition of pipelines in assessed high-risk areas as identified in recommendation 1 above. (*Leak detection, depth of cover, inline inspection, direct assessment and right of way surveillance. Used with recommendation 5 below, this will allow licensees with solid performance records to meet these requirements on a risk managed and performance based approach.*)
4. Work with appropriate education or industry institutions to develop certification programs for individuals (operators, construction and integrity inspectors and supervisors) in the areas of pipeline safety, including construction, operation, inspection and integrity management.
5. Where appropriate the ERCB should consider using performance-based regulation for those licensees whose performance warrants such an approach (this approach is used by the pressure equipment regulator in Alberta and is the trend among major regulators such as PHMSA and in the EU). This process should be evolutionary with compliance audits providing the necessary confidence for the transition to a performance-based system.
6. ERCB should be staffed appropriately to manage and enforce regulations (whether prescriptive or performance based) to ensure pipeline safety and integrity.
7. ERCB should work collaboratively with stakeholders to set clear goals and objectives to focus and manage the reduction of pipeline failures to a level as low as reasonably practicable (ALARP).
8. Record retention and transfer requirements, specifically during takeovers, mergers, acquisitions and sales, should be clearly defined in the regulation.
9. The ERCB should work with other regulators to harmonize regulatory requirements and support a consistent regulatory basis for stakeholders (for example the recently stated key performance indicators required by the National Energy Board could be considered for adoption by the ERCB). The use of a standard such as CSA Z662 is a valuable tool in promoting harmonization.
10. Third party encroachment and pipeline interference is still a major concern to licensees. Additional education of industries and the public as to the risks and regulatory requirements of working near pipelines could be promoted. Some licensees stated the setback requirements are inadequate for class 4 areas (where there is presently municipal development, or a high future potential for municipal development).

Safety of Pipelines Near Water Bodies:

1. Definition should be provided on what constitutes a water body. More clarity with regard to expectations for design, inspection, mitigation and monitoring at water bodies could be provided (in an ERCB directive or in CSA Z662).
2. The ERCB should require an inventory be kept by licensees of all pipeline water crossings and water bodies to a 1:50 000 map scale as a minimum, (this provides a more stringent level of identification of water crossings and water bodies, and more refined input for risk ranking). An example of this taken from interviews is Company "A" who had 2200 crossings on a 1:1 000 000 mapping scale; but at a 1:50 000 scale it identified 16 000 crossings.
3. The ERCB should require that all integrity management programs contain a process for identifying and mitigating the risk associated with high consequence areas, including for the safety of pipelines near water bodies.

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4. ERCB should require depth of cover determinations on a scheduled basis on all critical and high-risk water crossings. Recommendations 1 and 3 in Pipeline Integrity Management, if implemented, will guide this recommendation.

3. Background

The Energy Resources Conservation Board (ERCB) is an independent, quasi-judicial administrative tribunal established under the *Energy Resources Conservation Act*. The ERCB reports to the Government of Alberta through the Minister of Energy. The ERCB's mission is to ensure that the discovery, development, and delivery of Alberta's energy resources take place in a manner that is fair, responsible, and in the public interest.

The ERCB is Alberta's primary energy regulator. The ERCB regulates the public safety, environmental protection, orderly development, and resource conservation of Alberta's energy resources: oil, natural gas, oil sands, coal and pipelines.

3.1. Canadian Pipeline Industry Oversight

Pipelines are widely considered as being the safest and most economic means of delivering hydrocarbons overland in large quantities. However, notwithstanding its safety record, there is a place for objective, external physical oversight of the pipeline licensees obligations and performance, provided by regulatory bodies such as the ERCB. To Canada's favor, both federal and provincial pipeline regulators adopt, for the most part, the requirements of the *Canadian Standards Association Pipeline Standard, CSA Z662, (Appendix C, Ref 171)*, thus giving the standard the force of law. When a CSA standard is insufficient or unclear, provincial/federal regulators will go beyond it, issuing specific directives and on occasion, advisory notes and guidance following a formal hierarchy. The ERCB uses the following hierarchy:

- Pipeline Act
- Regulation (including standards)
- Directives
- Manuals and bulletins

It is important to understand that a CSA standard is a consensus document; created using a balanced interest committee structure and in the case of Z662, is best regarded as being a minimum standard (Clause 1.4, CSA Z662-11 refers). Thus, while the use of the term "standard" signifies and encourages a common approach among regulatory jurisdictions, it is important to realize that the pipeline industry within Canada in general, and Alberta in particular, is highly diverse. The ERCB, for example, licenses pipeline companies of widely varying size and product complexity ranging from multi-nationals to very small enterprises. Clearly the physical extent of pipelines and the means by which these disparate enterprises ensure their technical oversight is also diverse. Some licensees have sizeable departments devoted to managing pipeline integrity, while others depend upon contracted service providers. The ability to manage risk to public safety and environmental protection varies widely across the licensees.

In summary, a "one size fits all" approach to the provision of regulatory oversight is impractical. Instead Canadian pipeline regulators tend to use an equitable tailored "fit-for-purpose" approach that meets the overall needs of their jurisdictions. This allows the regulators to focus oversight in areas where risk is, or is perceived to be, higher.

3.2. The Regulatory Responsibility

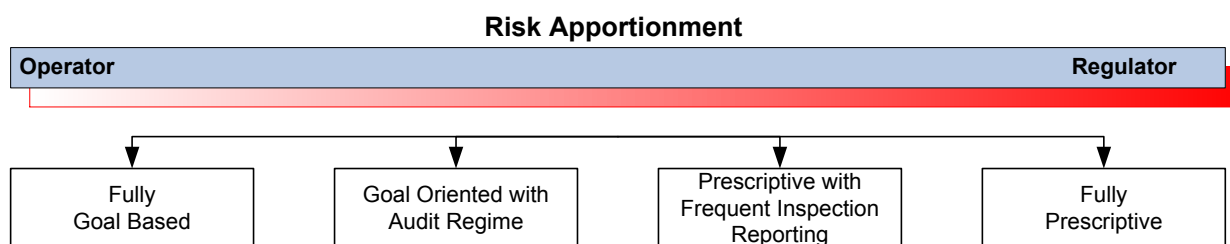
Figure 1 illustrates the spectrum of regulatory oversight; ranging from the fully prescriptive to a goal based or outcomes based approach. The prescriptive approach provides detailed instructions on what is to be done and how it is to be done. The underlying belief is that by following rigorous protocols, a good outcome will result. This contrasts with the goal based approach which sets out specific desired measurable outcomes, e.g. "pipelines are safe and perceived to be safe" with limited guidance to stakeholders as to how such outcomes are to be achieved. The underlying assumption is

that pipeline licensees know more about their pipeline system and its attributes than the responsible regulator.

Goal oriented approaches lie somewhere between the prescriptive and the goal based regimes. The exact determination depends upon the amount of direction and guidance provided by the regulator.

Recently in North America and elsewhere (and in many sectors of the economy), there has been a demand to reduce the regulatory responsibility. This insistence proposes that government oversight should be minimized and companies given increased freedom to operate; in the belief that their self-interest is sufficient to prudently constrain their actions. The extreme counterview is that government knows best and that strict adherence to rules will provide the required prescription for stability and success. History has shown that neither of these views is sustainable, whether it is the near collapse of the U.S. financial system, or the adherence to procedures that culminated in 165 deaths on the Piper Alpha platform in the North Sea (Appendix C, Ref 218). Rather, some middle ground appears to make sense – a mix of prescription, company innovation and regulatory oversight in the form of inspections and audits.

Figure 1: Spectrum of Regulation



In the UK sector of the North Sea and for onshore pipelines in Australia, this approach has taken the form of the development of the so called Safety Case, which requires a high degree of judgment from the operator and the regulator to establish sufficiency or fitness for purpose.

The requirements for federally regulated pipeline companies in Canada to have a pipeline integrity management program (PIM) has been in existence since 1999 Onshore Pipeline Regulations (Appendix C, Ref 19) with a similar, though phased-in, requirement on federally regulated gas, and then liquids, pipelines in the United States starting in 2000 (Appendix C, Ref 141, 142).

The need for **all** pipeline companies operating in Canada to have a PIM program became mandatory with its inclusion in the 2003 version of CSA Z662. Guidance on the elements of such programs may be found in *Annex N of Z662* as well as *API 1160* (Appendix C, Ref 115) for liquids pipelines and the supplement *American Society of Mechanical Engineers (ASME) B31.8S* (Appendix C, Ref 116) for gas pipelines.

From a regulatory perspective, it is insufficient that companies have merely developed a PIM program; rather they must also demonstrate its implementation and effectiveness. Gaps in any of these three facets would constitute non-compliance. How compliance is determined varies widely across the various jurisdictions in Canada. For example, in British Columbia the licensee makes a form of self-declaration/audit; while in Alberta, regular field inspections are the norm. Federally regulated companies are subjected to inspections and detailed audits, albeit on an infrequent basis. (IPC2012-90046 paper titled *Trends on Integrity Management Programs (IMP) and Management Systems (MS) Audit and Incident Findings* authored by members of the NEB and B.C. OGC, provides additional current information into audits and the results).

3.3. Definitions of Pipeline Risk

This review, at its core, is an examination of pipeline risk as it pertains to pipeline regulation. The Government of Alberta, through the ERCB and in consultation with its stakeholders, defines “risk” as it relates to pipeline integrity using qualitative measures of consequences in four categories (refer to the ERCBs *Compliance Assurance Risk Assessment Matrix*, dated Oct 21, 2005, for details (Appendix C, Ref 37):

- Health and safety
- Environmental impact
- Conservation
- Stakeholder confidence in the regulatory process

Four qualitative measures of likelihood of occurrence are also applied:

- Unlikely (less than once every 20 years)
- Moderate (once every 20 years)
- Likely (once every 3 years)
- Almost certain (once or more per year)

These subjective categories are then combined into a risk assessment map to produce a numeric risk rating, which is used to assign a level of enforcement based on the scores obtained, either high risk (score 5 to 8) or low risk (score 2 to 4).

Risk is a subjective term that depends upon the point of view of the stakeholder and whether such risk is voluntarily, or involuntarily acquired. Members of the public are typically willing to accept only a minor subjective level of risk of pipeline failure, approaching zero. Pipeline licensees tend to use a more quantitative approach to risk, including factors such as probability of failure due to a variety of variables, including:

- pipeline material
- pipeline location and exposure to crossings, such as roads and water bodies
- quality of pipeline construction
- commodity transported
- risk of corrosion
- risk of cracking
- costs of inspection, cleanup, repair and replacement

Different stakeholders have differing views, when it comes to considering pipeline risk. The regulator and the regulated company must keep an unwavering focus on the overarching need to maintain safety and continuity of supply to satisfy the public need. The general public expects a reliable supply of affordable energy delivered by the pipeline industry in a sound environmentally responsible manner. As with all human activity, pipeline transportation has associated risk, which can be described in simple terms as:

Risk = the likelihood of an undesirable event x the consequence of that event.

Examples of undesirable events include product release, injury and environmental damage. While these can occur as a result of human error and even negligence, they may also result from natural events such as severe flooding. Either way it is imperative to identify and then mitigate risk to an acceptable level; one which seeks to balance the cost associated with a given risk reduction strategy and the corresponding benefit. Since risk

cannot be entirely eliminated from pipeline transportation, the challenge is to reduce it to as low as is reasonably practicable – a measure known as ALARP. This is a well documented and commonly accepted legal test of striking a balance between multiple stakeholder interests. It is an intrinsic component in the development of pipeline integrity management programs and their subsequent regulatory validation.

3.4. Project Definition and Objectives

Alberta had almost 400 000 kilometers of provincially regulated pipeline at the end of 2010 (Appendix C, Ref 60). The ERCB regulatory approach uses informed risk assessment and management to guide its regulatory and technical pipeline application requirements, approval processes and inspection programs.

Provincial legislation and regulation governing pipeline safety in Alberta incorporate specific requirements covering all aspects of pipeline design, application requirements, construction, operations, maintenance, incident response, discontinuance and abandonment.

The ERCB ensures that stakeholders comply with the requirements of the Pipeline Act, Pipeline Regulation and applicable Canadian Standards Association (CSA) standards through ongoing surveillance, including operational inspections.

The ERCB requires licensees to report all pipeline incidents, not just spills. This includes even minor contact that does not result in pipeline damage or a release. In recent years the number of pipeline incidents per kilometer of installed pipe (see Appendix C, Ref 60) has been steadily declining. When an incident does occur, the ERCB holds licensees responsible for prompt, effective, and efficient response. *ERCB Directive 071: Emergency Preparedness and Response Requirements for the Petroleum Industry* outlines emergency planning and response requirements.

The Government of Alberta asked the ERCB to engage an independent third party to perform an assessment of the ERCBs current regulatory requirements and framework and industry best practices for **existing** ERCB-regulated pipelines related to:

- public safety and response to pipeline incidents
- pipeline integrity management
- safety of pipelines near water bodies

The purpose of the assessment is to determine if the ERCBs current regulatory requirements and industry best practices remain relevant and accurately reflect the risk profile of ERCB-regulated pipelines, and to identify areas for improvement. It will also include an assessment of how the ERCBs pipeline regulatory requirements and framework plus industry best practices for existing pipelines compare to other comparable jurisdictions (including other Canadian pipeline regulators).

4. Analysis of Results

The report was prepared addressing the three subject areas, and when regulations are referred to in general terms, it is typically with reference to pipeline integrity management.

4.1. Regulator General Comparison Information

Statements made in the following summary are based on information gained through interviews and internet searches. The collected information was used to gain an understanding of the size, complexity and number of pipeline licensees; as well as the total length of pipelines within each regulatory jurisdiction.

It is difficult to make a strict comparison of the effectiveness of various regulatory jurisdictions across Canada, North America and even the world since it was immediately apparent that no two are directly comparable in terms of the type of pipelines they regulate. Operational environments, pipe sizes and diversity of product carried vary between jurisdictions making direct comparisons difficult. Despite these factors, one thing in common is the desire for increased, and continuously improving pipeline safety. Comparing performance effectiveness of regulators on the basis of statistics can be misleading as reporting requirements are often different, incomplete or occur over differing time periods. Even normalized data can be difficult to compare, as there can be differences in the definitions used in incident causation classification.

The most recent version of the *Canadian Standard CSA Z662-11*, is adopted by all jurisdictions in Canada as the minimum standard required for pipelines. *CSA Z662* gives a more detailed description of what the provincial act and regulation expect, but are not limited to, thus allowing for additional information to be added via directives and guides specific to each province or jurisdiction where it deems relevant to increased pipeline safety. As stated previously, *CSA Z662* is considered a harmonizing standard for the design and operation of pipelines.

Within Alberta *all* pipeline failures must be reported, making this a unique database since there are no defined criteria relating to size of the spill, area affected or type of fluid released. Rather, if a failure occurs on any portion of a licensed pipeline, that failure is reportable and made mandatory through the Act (*Pipeline Act Part 6 Section 35*). In other countries or regions, such as Europe, the notification of a failure may be voluntary (Appendix C, Ref 205) or it may be specified through regulation, as is the case with the U.S. Federal Pipeline regulator PHMSA (*Title 49 of the Code of Federal Regulations (CFR), Parts 191,194 &195*).

Pipeline leak statistics, although unique to each jurisdictional area, still provide valuable information for trending purposes. The information can still be used as an internal benchmark as well as helping to set goals and establish performance indicators essential to the goal of continuous improvement.

Alberta Energy Resources Conservation Board (ERCB):

The ERCB currently regulates 886 licensees operating approximately 400 000 km of pipelines within the province of Alberta. These pipelines carry various fluids and vary in length and size. Total lengths of pipeline and general product composition are tabulated below. All pipelines are licensed with spatial data (mapped locations) that are maintained for identification and record purposes. The ERCB follows a commonly adopted regulatory hierarchical system in that there is an act, regulation and directives governing the proper operation of a pipeline. These governing documents not only direct and guide the licensee toward compliance with the regulation, but also allow the regulator the basis for enforcing compliance. Such enforcement can be done through general field inspection,

partial system audits or following failure investigations. The licensee is held accountable for the safe design, operation, maintenance and abandonment of their pipelines.

The latest version of the *Canadian Standard Z662* is regularly referenced in the Alberta regulation as a minimum requirement. In addition the provincial directives and guides give provisions where necessary for increased pipeline safety. The following data was provided by the ERCB:

Product	Pipeline Length (km)
Oil Effluent	59 326
Crude Oil	19 698
Salt Water	23 793
Natural Gas	235 996
Sour Gas	22 098
Other	34 605
Total	395 516

British Columbia Oil and Gas Commission (B.C. OGC):

The B.C. OGC currently regulates 120 licensees operating approximately 39 000 km of pipeline within the province of British Columbia. Similar to Alberta these are composed of multiple flow lines, gathering lines, and sales or transmission lines conveying various products. All regulated pipelines are contained within Provincial boundaries. Listed below is the approximate length of pipelines in British Columbia. The following data was provided by the B.C. OGC:

Product	Pipeline Length (km)
Crude Oil	2 412
Salt Water	2 977
Natural Gas	19 159
Sour Gas	11 910
Other	2 565
Total	39 023

Saskatchewan Ministry of the Economy (formerly Ministry of Energy and Resources (MER)):

The Saskatchewan Ministry of the Economy currently regulates 25 licensees operating approximately 23 000 km of pipelines consisting of mainly sales or transmission pipelines within the province of Saskatchewan. They estimate approximately 68 000 pipelines are unlicensed flow lines that are not currently regulated. Similar to Alberta, the minimum standard for design, operation and maintenance follows the most recent version of CSA Z662. The 2011 Provincial Auditor of Saskatchewan Report Chapter 5 “Regulating Pipelines” (Appendix C, Ref 94) identified areas of improvement for which actions have since been taken. The following data was provided by the Ministry of the Economy:

Product	Pipeline Length (km)
Crude Oil	4 168
Salt Water	143
Natural Gas	16 907
Sour Gas	704
Other	1 124
Total	23 046

National Energy Board of Canada (NEB):

The National Energy Board currently regulates 99 licensees operating large diameter pipelines of approximately 70 000 km across Canada. Typically they are transmission pipelines (large diameter) crossing provincial or national boundaries. The following data was provided by the NEB:

Product	Pipeline Length (km)
Crude Oil	15 218
Salt Water	21
Natural Gas	51 260
Sour Gas	2 334
Other	1 381
Total	70 214

U.S. Department of Transportation Pipeline and Hazardous Materials Safety Administration (PHMSA):

The U.S. Department of Transportation Pipeline and Hazardous Materials Safety Administration regulates approximately 3000 companies. Not all companies are upstream oil and gas producers; some are related to distribution utilities, falling under the PHMSA regulation. Approximately 798 000 km of onshore and offshore hazardous liquid, gas transmission and gathering pipelines are regulated under PHMSA's authority. (<http://primis.phmsa.dot.gov/comm/PipelineBasics.htm>)

Product	Pipeline Length (km)
Hazardous Liquid	281 575
Gas Gathering & Transmission	516 489
Total	798 064

Alaska Office of Pipeline Safety (OPS):

Onshore and offshore hazardous liquid, gas transmission and gathering pipelines are all regulated through the OPS. The lengths of pipelines regulated are listed below. (http://primis.phmsa.dot.gov/comm/reports/safety/AK_detail1.html)

Product	Pipeline Length (km)
Hazardous Liquid	1 820
Gas Transmission	1 025
Gas Gathering	105
Total	2 940

Texas Office of Pipeline Safety (OPS) interstate pipelines (through certification/delegation by PHMSA The Texas Railroad Commission (RRC) also regulates intrastate pipelines):

To give an understanding of the Texas regulatory regime, two tables are attached. The first relates to the type and length of licensed pipelines and the second to the jurisdictional responsibility. (http://primis.phmsa.dot.gov/comm/reports/safety/TX_detail1.html).

Product	Pipeline Length (km)
Hazardous Liquid	88 529
Gas Transmission	102 429
Gas Gathering	11 181
Total	202 139

Regulatory Jurisdiction of Facilities Under the Pipeline Safety Act (Federal and State Jurisdiction)

The table below (Appendix C, Ref 146) shows the United States (DOT, RRC) breakdown of regulatory jurisdiction between the federal Department of Transportation (DOT/PHMSA) and the Texas Rail Road Commission (RCC). When comparing the Interstate grouping of the DOT responsibilities in the U.S. to that of the NEB of Canada, all gathering lines, whether rural or urban, are regulated in Canada if they cross a provincial border.

When comparing the RRC of Texas to that of the ERCB in Alberta it should be noted that sour pipelines in Texas are identified as containing 100ppm or higher. Offshore and natural gas distribution pipelines are regulated by the Texas RRC, where rural gathering lines are not. In Alberta, all pipelines within the borders of Alberta are regulated, either provincially by the ERCB or federally by the NEB (excluding utility pipelines).

	Natural Gas	Hazardous Liquids	Crude Oil	Sour Gas
Interstate				
Transmission	DOT	DOT	DOT	Not Regulated
Urban Gathering	DOT	DOT	DOT	Not Regulated
Rural Gathering	Not Regulated	N/A	Not Regulated	Not Regulated
Offshore(OCS)	DOT/BOEM	DOT/BOEM	DOT/BOEM	Not Regulated
Intrastate				
Transmission	RRC	RRC	RRC	RRC
State Offshore	RRC	RRC	RRC	RRC
Urban Gathering	RRC	RRC	RRC	RRC
Rural Gathering	Not Regulated	Not Regulated	Not Regulated	Not Regulated
Lease/Flow Lines (bay & offshore)	RRC	RRC	RRC	RRC
Distribution	RRC	N/A	N/A	N/A
Master Meter System	RRC	N/A	N/A	N/A

(DOT – Department of Transportation, BOEM – Bureau of Ocean Energy Management, RRC – Railroad Commission of Texas , N/A – Not applicable)

4.2. Public Safety and Response to Pipeline Incidents

The following summary outlines how Alberta manages emergency preparedness and response, specifically with respect to ERCB regulated pipelines. Summaries are also provided for British Columbia, Saskatchewan and for federally regulated pipelines.

The comparison is based on interpretations of the pertinent acts, regulations, directives, plans, standards, requirements, frameworks, programs, protocols and strategies.

Emergency preparedness and response is a shared effort between the federal government, provincial/territorial governments, local authorities, non-government organizations and the private sector.

This consistent formula of governance and interaction, pertaining to public safety and response to pipeline incidents in Canada, allows the appropriate provincial authority to enact measures, either by assisting or leading in an emergency, or escalating it to a federal level whenever it is necessary to protect public safety or the environment. This is accomplished by engaging departments/agencies, and ensuring expertise and other resources are available to communicate, control and contain any level of emergency that arises.

Across Canada there appears to be a consistent and comprehensive approach when it comes to public safety and response to pipeline incidents. In addition, the widespread adoption of the Incident Command System ((ICS) Appendix C, Ref 173) has proven valuable not only across Canada, but also throughout North America and other areas worldwide (ICS was initially developed by the US Coast Guard). The ICS system implements uniformly, a set of personnel, policies, procedures, facilities and equipment requirements that have been integrated into a common organizational structure designed to improve emergency response operations of all types and complexities.

With the adoption of the ICS into overall emergency management systems, the identification of hazards and the preparedness and maintenance of emergency response plans (ERPs) with respect to those specific identified hazards, are tied together. A comparison of public safety and response to pipeline incidents may be found in tabular form in Appendix B1 of this report.

It will be apparent that there are a number of similar requirements among the various jurisdictions.

4.3. Pipeline Integrity Management

The following summarizes how pipeline integrity is managed, specifically with respect to ERCB regulated pipelines.

Pipeline integrity is the primary responsibility of a licensee or pipeline licensee and requires them to take a system-wide integrated approach to keeping their pipeline in a sound operating condition. By using risk mitigation activities, a licensee can ensure system operability and safety is achieved for the life of the pipeline.

The *Canadian Standard CSA Z662* contains provisions for addressing system integrity, with the 2003 S1-05 edition introducing *Annex N*: “Guidelines for pipeline system integrity management programs”. This non-mandatory annex is enforced as mandatory in the ERCB *Directive 077* in Alberta. Similarly, BC has enforced it as mandatory, but it has not been adopted by the NEB, while the Saskatchewan regulations are silent on the matter.

The comparisons of the jurisdictions did not highlight any obvious deficiencies in Alberta on the subject of pipeline integrity; however, the regulator and licensee interviews did identify areas that have improvement opportunities.

4.4. Safety of Pipelines Near Water Bodies

The ERCB regulates activities at, or close to water bodies with some general, but few specific requirements on how the interaction of pipelines with water bodies are to be managed by the pipeline licensees. Pipelines with a major potential for failure at, or near a water body warrant special consideration as part of the company’s risk assessment process (identified as high risk). However, the criteria for implementing mitigation inspection or monitoring activities to manage the risk is not clearly defined by the ERCB, rather it is determined largely by the pipeline licensees in their pipeline integrity management program. The following paragraphs outline the gaps found in the Alberta regulation, as well as those observed when comparing these to other regulations.

With respect to water bodies, there are areas in the Alberta pipeline regulation that are well defined as well as those that lack clarity or definition. The following paragraphs will outline both at a high level.

In the area of pipeline inspection, the Alberta regulation does not require specific integrity inspection practices to take place at water bodies. As part of the risk assessment process, the pipeline licensee determines the type and frequency of the physical condition (integrity) assessments of the pipeline.

ERCB *Directive 066* clearly states that a pipeline spill into water, if not immediately contained, is subject to high-risk enforcement.

Alberta and B.C. have very similar requirements for pipelines at or near water bodies. Because both jurisdictions have adopted CSA Z662, both adhere to the requirements of this standard and are therefore closely aligned. The Alberta regulation has more prescriptive requirements with respect to minimums of at least an annual inspection of the right-of-way where a pipeline crosses water (more frequently in certain cases depending on product in the pipeline and location).

Overall, the National Energy Board's regulatory requirements are similar to the regulation set out by the province of Alberta.

The federal Navigable Water Protection Act allows the Minister to impose any terms and conditions on the construction, maintenance, operation, safety and removal of the pipeline at a water body. This level of authority is not established in the Alberta regulation.

One key difference between the Alberta regulation and that found in the PHMSA regulation in the U.S. is that water bodies are clearly defined as high consequence areas by PHMSA. This includes navigable waterways, drainage systems or small streams that could flow to a high consequence area, farm tile fields, and roadway ditches that could carry spillage into a waterway. The Alberta regulation does not go as far as to define streams, ditches, etc. that may flow into another water body as being high consequence. In all other comparable areas, the Alberta and federal U.S. requirements are equivalent.

Australia has a more clearly defined regulation than the province of Alberta for pipelines at water bodies. The Australian regulation stipulates that pipeline owners must carry out inspections to identify actual or potential problems at water bodies. The Alberta regulation is more risk based and other than the prescribed right-of-way surface inspections, additional inspections may occur at a water body if the licensee deems this necessary. Additionally, the Australian regulation stipulates that if inspections at underwater crossings reveal a threat to the integrity of the pipeline, immediate action must be taken. The Alberta regulation does not contain such a statement.

The UK has very little specific regulation with respect to pipelines at water bodies, as they are typically managed through risk profiling. Where they do exist, they are found to be equivalent to Alberta.

To summarize, the Province of Alberta has in place strong regulation for pipelines and overall is well advanced when compared to other jurisdictions in the area of safety near water bodies. There are a few key areas where other jurisdictions are more prescriptive or provide more clarity than Alberta as outlined above. The Australian regulation was found to provide the most relevant comparison to Alberta, and it has developed a simple, but well-defined regulation that clearly outlines the expectation of pipeline operators and their approach to pipeline integrity management at water bodies. Alberta's risk assessment approach gives pipeline licensees the ability to determine their own level of risk tolerance as determined by their corporate risk profile. However, there could be benefit in enhancing the regulation to incorporate more clarity and definition with regard to expectations for design, inspection, mitigation and monitoring at water bodies in Alberta.

4.5. Effectiveness Evaluations of Pipeline Regulatory Documents

The pipeline safety review was not performed with the intention of declaring whether one regulatory environment is better than, equivalent to, or worse than any other selected regulatory environments for the three specified topics. The task was to compare (clause by clause) acts, regulations, best practices, etc., across jurisdictions and to summarize the differences. These comparisons ultimately led to an assessment of “effectiveness” in accordance with the criteria outlined in Figure 2.

The process followed is described in Section 5 Methodology. The information recorded in Appendix B was reviewed, compared and summarized up to the information presented in Table 1; which presents a very high level visual guide of comparative effectiveness of the assessed regulatory jurisdictions. As Table 1 is based on Appendix B, it has not taken account of any information gathered in any of the regulator or licensee interviews. The U.S. DOT comparison results suggest that the DOT regulatory provisions are more comprehensive than those of Alberta. The DOT regulatory provisions are assessed as more prescriptive than the Alberta regulatory provisions (and other Canadian jurisdictions). As stated in Table 1, Note 1, the Alberta regulatory provisions, as summarized, do not include the adopted requirements of CSA Z662, which has allowed the DOT regulatory provisions to appear as having more provisions.

The results of the comparisons are presented Table 1.

Figure 2: Criteria Affecting Regulation Effectiveness

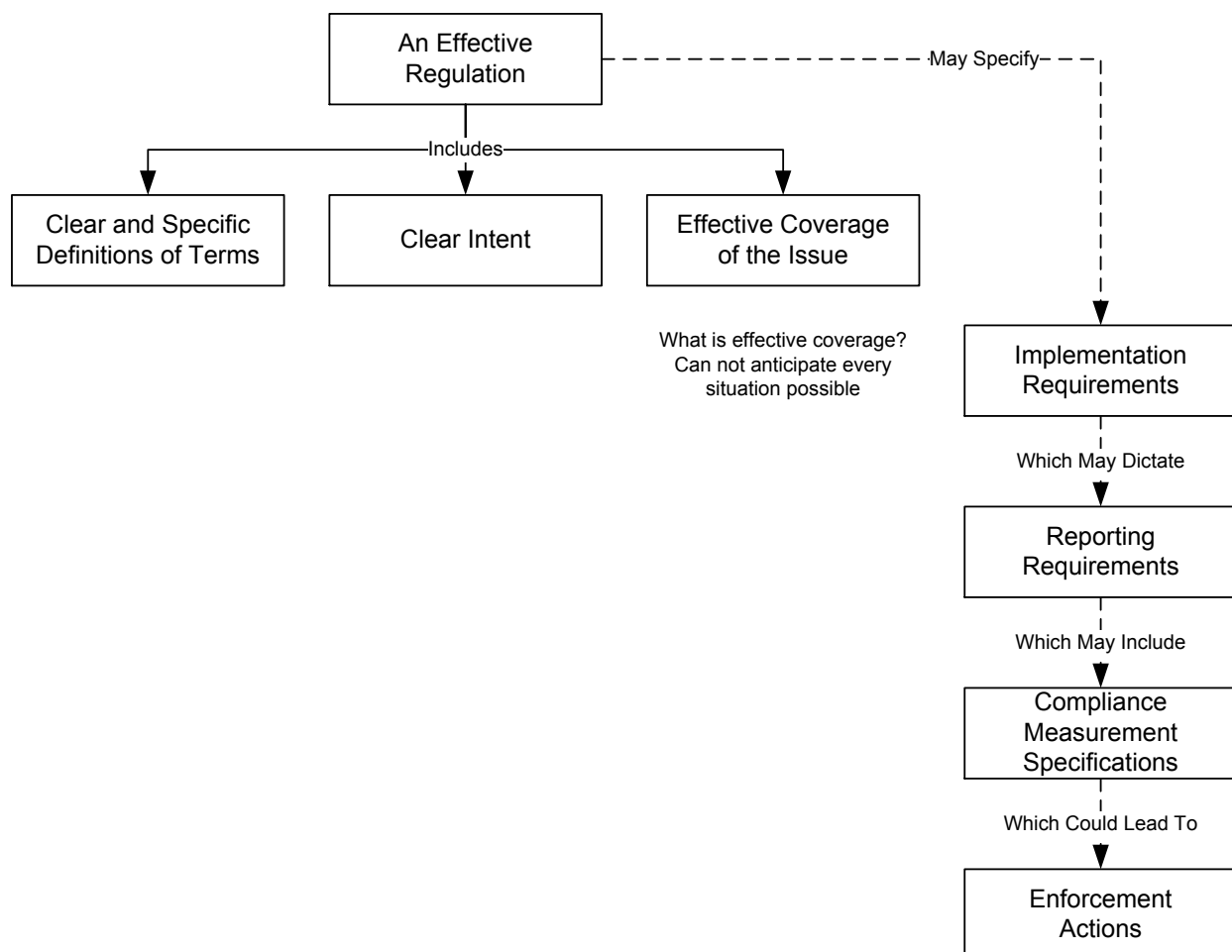


Table 1: Assessment and Comparison of Regulatory Provisions

Category	Subcategory	Ranking					
		Alberta	British Columbia	Saskatchewan	Canada (NEB)	Other	
						US (DOT)	Australia
Pipeline Integrity Management¹	Legal / Technical Requirements	++	++	+	++	++	
	PIM Program Management	++	+	+	++	++	
	Damage Management	++	+	+	++	+++	
	Abandonment	+++	+	+	++	++	
Public Safety and Response to Pipeline Incidents	Program Requirements	++	++	+	+++		
	Compliance / Assurance	++	++	++	+++		
	Enforcement ²	+	++	+	+++ ³	+++	
Safety of Pipelines Near Water Bodies	Definition	+++	++	0	++	++	0
	Inspection / Operation	++	+	0	0	+++	+++
	Risk	++	0	0	+	+++	++

Symbol	Description
0	No provision in place
+	Basic Provision
++	Several Provisions
+++	Many Provisions

1. As all jurisdictions require CSA Z662 to be followed for pipeline operation, provisions made in that document are not included in the ranking of this table. Rather, ranking is based on the provisions in the documents provided by the individual jurisdictions.
2. Enforcement rating is based on the level of fines imposed at regulatory jurisdiction for oil and gas, other government divisions may also enforce but those are not being compared. It is noted that the ERCB does not fine licensees. Enforcement is applied by shutting in facilities until the reason for enforcement is corrected (this effectively applies a time based punitive measure).
3. NEB of Canada recently revised their enforcement penalty

4.6. Industry Interviews

To enhance the value of the Pipeline Safety Review it was decided to interview a number of pipeline licensees; using a prepared script so feedback could be compared and practically summarized. The intent of the interviews was not to measure compliance, but rather to assess the practical ability to comply with the regulation and also determine where there may be instances or related opportunities for continuous improvement in the areas of: emergency response, pipeline integrity management and safety of pipelines near water bodies.

Given the number of companies that are pipeline licensees in Alberta, a representative sample was selected for interviews. The basis for selection was to have a mix of upstream, midstream and downstream (transmission); a mix of gas vs. liquids transporters and a blend of multi-jurisdictional and multi-national pipeline licensees. Within these criteria, interviewees included juniors through major multi-nationals.

Interview questions and summarized responses are presented in Table 2. The willingness of pipeline licensees to participate in interviews was excellent, and all licensees interviewed strongly support the need for continuous improvement in all aspects of pipeline safety.

Key points noted from the interviews are summarized as follows:

Emergency Response

- Emergency response programs (ERP) are typically universal and on the whole, meet the requirements of both the ERCB Directive 71 and the Incident Command System (ICS).
- Companies have a corporate ERP, typically supported by area and/or product specific ERPs.
- Companies that transport hydrocarbon liquids are typically more aware of the environmental consequences of a leak (compared to a gas leak) and have a higher awareness of how to react to pipeline leaks. This includes increased training for staff and (for the larger companies) having their own spill response equipment in addition to that available through their Western Canadian Spill Services (WCSS) co-op membership.
- Smaller companies are more likely to have relationships with environmental consultants/contractors to assist them in the event of a spill.
- All companies are aware of the regulatory requirements for leak detection, but the hydrocarbon liquids transporter have superior knowledge and capabilities with regard to leak detection methodologies (they will use computational pipeline monitoring, mass balance and supervisory control and data acquisition (SCADA), as well as surveillance); whereas gas transporters are more likely to be dependent on surveillance only (the other methods are typically less suited to gas operations).

Pipeline Integrity Management

- All the interviewed licensees have integrity management programs along with emergency response plans and understand the management systems approach.
- The size of the company plays an obvious part in the ability to have internal resources for the three subject areas. Smaller companies depend more on consultants; whereas, larger companies tend to have better in-house knowledge and best practices, though often support the process with the use of consultants.
- The tendency is to have one integrity management program, based on the dominant regulation (typically ERCB), occasionally supplemented by requirements from the NEB and/or Pipeline Hazardous Materials Safety Administration (PHMSA). In some instances companies with multiple regulators will maintain a single program with a default to the most demanding of the jurisdictional requirements.

- In isolated cases a company may still have integrity management programs, which are jurisdiction specific (including the U.S.).
- The ERCB appears to perform fewer audits than the NEB and B.C. OGC; but, seems to do more field inspections.
- The acts and regulations along with CSA Z662, Oil and Gas Pipeline Systems are typically the basis for the integrity management programs.
- The smaller companies more prevalently use industry best practices; whereas the larger companies tend to have their own internal best practices and/or expertise.
- Pipelines are typically abandoned in place, cleaned and made safe as per regulatory requirements.
- The ERCB requires notification of discontinuation or abandonment; whereas the NEB requires an application to discontinue or abandon a pipeline, confirming some inconsistency across regulators on the issue of abandonment.
- With respect to pipeline records (design, construction, operating, integrity and location), deficiencies are most prevalent with upstream companies, and definitely related to the age of the pipeline (older pipelines (pre 1990) have few or no records). A contributing factor to the reduction of available records is associated with historical ownership transfer.
- The majority of Alberta's pipelines being under one jurisdiction was stated as beneficial.
- Records in Alberta are typically more complete than in other jurisdictions.

Water Bodies

- There is no clear regulatory definition on water bodies and river/creek crossings.
- There is no regulator who clearly directs the identification of water bodies and river crossings.
- The minimum requirement is typically stated to be determination of water bodies/crossings off a 1:1 000 000 map.
- Industry uses 1:1 000 000, 1:250 000, and 1:50 000 maps, and in many cases supplement the map identification approach with ground patrol verification.
- Liquids transporters typically have more comprehensive water body/crossing identification criteria when compared to gas transporters.
- Pipeline integrity at river crossings is typically managed as an identified hazard during the risk assessment process.
- The number of pipeline water body inspections that identify concerns cannot be accurately stated; but, the predominant deficiencies are exposure or reduced soil cover due to surface ground erosion over time, or due to high flow events (predominantly the case for upstream and older pipelines).

Suggested Opportunities for Improvement

Based on the feedback collected from the interviews, key opportunities for improvement are summarized below:

Emergency Response:

- Consistency of ERP requirements and regulations across jurisdictions.
- Stakeholder education on the consequences of ground disturbance and ROW encroachment, as well as identifying pipeline right-of-ways, is commonly cited as an opportunity for improvement.

Clarity on which government agency (local/provincial/federal) has jurisdiction/lead in the event of an emergency, as well as co-ordination of communication from stakeholders, regulators and government to the public during an incident response.

Pipeline Integrity Management:

- Mandating records transfer.
- Harmonization of regulations and consistency to measuring compliance across jurisdictions.
- Third party ROW encroachment or pipeline interference is consistently referenced as still being a significant concern.
- The improved and prompt sharing of lessons learned is commonly cited as an opportunity for improvement (within and across jurisdictions and stakeholders).

Water Bodies

- Water body definition consistency/harmonization amongst the regulators.

A review of all the responses that were collected during the standard interviews is presented in Table 2.

Table 2: Collection of Stakeholder Interview Responses

Emergency Response	
Question	Answer
<p>1. <i>Do you have an Emergency Response Plan? Has it been reviewed for effectiveness and compliance with code and regulatory requirements, when and by whom?</i></p>	<ul style="list-style-type: none"> • All companies have ERPs. • Typically there is a corporate or global ERP manual supported by area and/or product specific ERP manuals. • Some companies have a third level booklet/guide that is very area specific and carried by staff. • Most companies use the Incident Command System (ICS) process in some format. • All companies perform exercises, both field based and table top. • Table top ERP exercises are performed at least annually, typically multiple times. The larger companies with many fields/areas are in some cases doing in excess of 50 exercises a year. • Field ERP exercises are performed less frequently, from once per year rotating through fields/areas to once per area per year. • In most cases head office (Calgary) participates in the exercises. • Regulators are invited to exercises, and there is a mixed degree of attendance. • Similarly, local first responders are typically advised of, and invited to the field exercises. Again, there is a mixed degree of attendance. • The Western Canadian Spill Services (WCSS) Co-op performs regular exercises and most member companies will participate.
<p>2. <i>What portions of the Act, regulations, directives and standards along with industry best practices were used as the</i></p>	<ul style="list-style-type: none"> • <i>Directive 071</i> is the predominantly referenced document. • ICS. • CSA Z731, Z1600 and the future Z246.2. • OPR-99, B.C. OGC Emergency Response Requirements,

Emergency Response	
Question	Answer
<i>basis for the evaluation of compliance of the Emergency Response Plans?</i>	<p>Canadian Environmental Protection Act (CEPA) documents.</p> <ul style="list-style-type: none"> • Multi nationals use DOT/PHMSA documents, U.S. Coast Guard PREP, NIMS, CFR codes. • Majors may have internal best practices.
3. <i>Are you a member of a “spill co-op”, or if not what is your corporate Emergency Response Plan?</i>	<ul style="list-style-type: none"> • All companies that transport liquids are members of a spill co-op (WCSS for Alberta). • Some companies consider themselves gas only and are not members of a spill co-op in Alberta. • The larger liquids focused transporters typically have their own spill response equipment and trained licensees (including ICS training in many cases). This may include spill response teams in some cases. • The smaller companies typically have relationships with environmental remediation contractors/consultants. • Larger companies typically have relationships with construction contractors for capital projects, and can redeploy equipment for a spill response fairly rapidly. • Formal and informal mutual aid agreements are typical throughout the industry. • There is typically a corporate environmental group involvement in the above.
4. <i>With reference to leak detection, do you have a formal approach to leak detection, and do you consider it to exceed the requirements of the Alberta regulation?</i>	<ul style="list-style-type: none"> • All companies are meeting and exceeding the regulatory (and CSA Z662) requirements in Alberta. • The predominantly liquid transporters have protocols and procedures in place for leak detection. • The predominantly liquid transporters use computational pipeline monitoring (CPM) systems, mass flow balance systems, supervisory control and data acquisition (SCADA) and visual surveillance. • The predominantly gas transporters rely extensively on right of way (ROW) surveillance. • Aerial and ground patrols are performed at least as required by the regulation, and in most cases more often. • Aerial patrols often include infrared (IR) and/or gas detection technologies. • Typically the frequency and type of leak detection surveillance is determined by risk analysis.
5. <i>Are there any obvious opportunities for the regulation to improve public safety and the response to pipeline incidents/leaks?</i>	<p>The companies were all unique in their opinions on where there may be opportunity for improvement. Their suggestions are listed below:</p> <ul style="list-style-type: none"> • Forming of a national one-call system. • Stakeholder education on ground disturbance consequences and identifying where pipelines are. • Consistency is desirable across jurisdictions with respect to ERPs. • As low as reasonably practicable (ALARP) approach is considered desirable. • Involving environmental department in pipeline risk assessments.

Emergency Response	
Question	Answer
	<ul style="list-style-type: none"> • There would be benefits to clarity on which government agency (local/provincial/federal) has jurisdiction/lead in the event of an emergency. • Co-ordination of communication from stakeholders, regulators and government to the public would be beneficial. • Setback requirements are inadequate in some cases (based on consequence). • ROW enforcement and the consequence to violators is non-existent. A caution on this is that it is preferable to have a third party strike reported rather than hidden. • Formalise the use of ICS for consistency. • Improve stakeholder understanding of the existing regulation/process with respect to emergency response (education). • Manage regulation such that budgets are not applied to low risk pipelines at the expense of reduced management and mitigation on higher risk pipelines. • Fines could be directed toward spill co-ops to improve the ability to respond effectively. • Get guidance from regulators on the minimum expectation for a response. • Ensure appropriate spill response is available to all licensees regardless of company size.

Pipeline Integrity Management	
Question	Answer
<p>1. <i>Do you have a corporate Integrity Management Program, and has it been reviewed for compliance with code and regulatory requirements, when and by whom?</i></p>	<ul style="list-style-type: none"> • The answer to the question 'Do you have an Integrity Management Program?' was consistently yes; typically with a program that is typically a corporate one supported with specific area or asset programs where necessary. • Most IMPs are written to comply with the dominant jurisdiction (most often ERCB); but, with other jurisdictions taken into account. On a single occasion, the dominant jurisdiction was the Netherlands who is presumed to have better IMP requirements/regulation. • Some companies create separate IMPs for Canada vs U.S. (or other Canadian jurisdictions); however, for the most part they are relatively similar so it simply means slight revisions for each jurisdiction. • All IMPs have typically had jurisdictional, external and internal audits and reviews performed on them. • The NEB and the B.C. OGC appear to have a more formal audit protocol; however, the ERCB appears to perform more field or area inspections. • There does not appear to be any consistent regulator audit process or pattern. • Typically, all companies interviewed have a stated internal audit/review process, and most also have an external

Pipeline Integrity Management	
Question	Answer
	audit/review process (for multinationals this could be a company based external audit team).
2. <i>What portions of the Act, regulation, directives and standards along with industry best practices were used as the basis for the evaluation of compliance for the Integrity Management Programs?</i>	<ul style="list-style-type: none"> • All companies referenced CSA Z662 and <i>Annex N</i> as the main guiding regulatory documents. • The relevant jurisdictional acts and regulations were referenced where pipelines were in the jurisdiction. • Directives, bulletins and information letters were routinely referenced. • Companies with a presence in the U.S. reference ASME and CFR codes and regulation. • Companies are all aware of industry best practices, but only around half of the companies appear to actively use them. • The majors tend to have internal best practices that predominate. • The juniors are more likely to reference and use industry best practices.
3. <i>Does the company have a philosophy for the abandonment of pipelines?</i>	<ul style="list-style-type: none"> • Typically discontinuation is favoured over abandonment. • All Companies have a decision process that is followed prior to discontinuation or abandonment. • Typically pipelines are discontinued/abandoned in place. • All companies have procedures and/or checklists that meet and/or exceed the minimum regulatory requirements. • Pipelines are generally cleaned prior to discontinuation/abandonment, and purged (generally with nitrogen). • One company leak tests the pipelines before discontinuation/abandonment. • The majors are more likely to have a group that manages discontinuation/ abandonment (of pipelines, wells and facilities) and these same companies typically have a budget for this activity. • The transmission pipeline companies tend to risk assess the decision to abandon in place or remove, and will remove if required. Often the removal of a pipeline is considered to have a more significant effect on the environment and public than leaving a line in place.
4. <i>Records are routinely stated as 'inadequate' in the pipeline industry. Please answer the following questions with one of the following responses: poor, reasonable, good, and complete.</i> a) <i>What is the status of design/construction records?</i> b) <i>What is the status of pipeline location records?</i> c) <i>What is the status of pipeline operational / integrity records?</i>	<p>The answers that follow were received from a mix of transmission, midstream and upstream companies.</p> <p>a) Half the respondents indicated 'good', while half stated 'good' for newer lines down to 'poor' for old lines.</p> <p>b) Approximately 84 per cent responded 'good' and 'complete'. The remainder had some 'good' and some 'poor', dependant on area.</p> <p>c) Approximately 75 per cent responded 'good' to 'complete', 25 per cent mixed from 'poor' (age and area driven) to 'good'.</p> <p>d) Approximately 40 per cent stated 'good' to 'complete', 15 per cent 'reasonable', 25 per cent 'poor', and the rest of the responses were mixed, dependant on age, location and size of previous owner.</p>

Pipeline Integrity Management	
Question	Answer
<p>d) <i>When pipelines are acquired, are records (as above) supplied with the pipeline?</i></p> <p>e) <i>When pipelines are sold, are records formally transferred to the new owner?</i></p>	<p>e) Approximately 75 per cent responded 'good' to 'complete'. The remainder are mixed dependant on availability of the records to transfer.</p> <p>General comments:</p> <ul style="list-style-type: none"> • Transmission and NEB regulated pipelines have better records. • Upstream companies have more challenges on records. • Upstream and midstream typically have poor records on older pipe. • The records appear to improve significantly for newer (post 2000) pipelines. • All respondents request records when acquiring pipelines and have mixed results from 'complete' records from larger companies and newer pipelines, to 'poor' records from smaller companies and older pipelines. • On occasion records are received but are incomplete. • All respondents transfer existing records with dispositions. • Comments were made that the records in Alberta are generally better compared to other jurisdictions.
<p>5. <i>Are there any obvious opportunities for the regulation to improve the integrity management of pipelines in general or specific terms?</i></p>	<ul style="list-style-type: none"> • Unauthorised ground disturbance/third party damage is still identified as a concern. It was suggested there should be penalties for these events; but, some also discouraged this, as the preference is to have people/contractors advise when these events happen rather than hide the event for fear of retribution. • The opportunity exists for clarification on Engineering Assessment (EA). There is a perception of inconsistency on the requirements in an EA within, and across regulators. • Sharing of knowledge and information between regulators and stakeholders could be improved. • Sharing of incident statistics with stakeholders could improve (with more definition and clarity, and quicker). • Setting standard key performance indicators (KPIs) for leading and lagging indicators could be beneficial. • Harmonization and consistency of regulations across jurisdictions could be beneficial. Similarly, consistency within and across jurisdictions would be beneficial with respect to measuring compliance. • Regulators could lead stakeholder improvement technical studies, as is done by the Pipeline Hazardous Materials Safety Administration (PHMSA), or promote the development of certain technologies that are beneficial to pipeline Integrity. • Regulation mandating the transfer of existing pipeline records at the time of ownership change would be beneficial. • Guidance on what is required in a Risk Assessment could be beneficial. • The current map submission requirements on application are basic, more detailed mapping (construction and survey maps) are available and would improve the quality of the ERCB records on pipeline location going forward. • The management of setbacks in developed areas could be

Pipeline Integrity Management	
Question	Answer
	<p>improved (create sterile zones on ROW's near towns and cities).</p> <ul style="list-style-type: none"> Sour service definition, per the regulation and codes, could be simplified.

Water Bodies	
Question	Answer
<p>1. <i>What definition do you use to identify water bodies from applicable regulation, directives and standards?</i></p>	<ul style="list-style-type: none"> All licensees consider ERCB <i>Directive 056</i> to be the minimum regulatory requirement guiding the identification of water body crossings in Alberta. Companies that have natural gas feel the 1:1 000 000 Map criteria to identify river crossings is adequate (a gas leak is typically of lower consequence). Companies with liquid pipelines typically use 1:250 000 or 1:50 000 maps to identify water bodies, and typically add ground based surveys to identify additional drainage risks. Most companies have internal environmental departments and they typically have maps with higher than 1:1 000 000 resolution. ERP maps are typically higher than 1:1 000 000 resolution. Some companies have river crossings identified and monitored by their Geotechnical departments. Some companies define their crossings and water bodies to Alberta Environment (AENV) and Environment and Sustainable Resource Development (ESRD) requirements (Appendix C, Ref 35 & 36). On new pipelines, some companies identify crossings and water bodies off the construction alignment and survey maps.
<p>2. <i>What portions of the Act, regulation, directives and standards along with industry best practices were used as the basis for identifying and establishing the number of pipelines crossing water bodies?</i></p>	<ul style="list-style-type: none"> Alberta Pipeline Act, Regulation, <i>Directive 056</i>, <i>Directive 066</i>, CSA Z662, Alberta Environment and Sustainable Resources Act/Regulations//Codes of Practice. There is no one clear document (regulatory or best practice) that directs pipeline licensees on how to identify water bodies. A pipeline licensee will run risk assessments to identify water body crossings per company best practices.
<p>3. <i>What is considered required by the regulation regarding the inspection' of river crossings?</i></p>	<ul style="list-style-type: none"> The <i>Alberta Pipeline Regulation (43(1))</i> sets an annual requirement for the surface inspection of a pipeline that crosses water. Companies typically extend the requirements to include depth of cover on pipelines. Companies will typically inspect (in addition to the annual requirement) following high flow events. Some companies consider the pipeline regulation requirements to be specifically for a surface inspection, and monitor pipeline integrity based on the risk assessment of the pipeline at the water crossing.

Water Bodies	
Question	Answer
	<ul style="list-style-type: none"> • Some companies perform integrity assessments as part of the annual water crossing inspection. • Some companies perform underwater inspections. • The minimum requirement to perform ROW surveillance and water crossing inspections was stated as always achieved, and in most cases exceeded. ROW surveillance flights in some cases are performed up to weekly.
<p>4. <i>What percentage of Identified crossings, have been evaluated for compliance of patrol and annual inspection as required by the Act, regulation, directives and standards?</i></p>	<ul style="list-style-type: none"> • Consistently stated that all identified crossings have been evaluated for compliance.
<p>5. <i>What percent of water body crossing inspections find concerns, and which are the most prevalent issues.</i></p>	<ul style="list-style-type: none"> • The per cent of water crossings that find concerns varies tremendously depending on the companies. From none to few and in one case potentially up to 10 per cent. • The predominant concern is reduced depth of cover (typically older pipelines). • Exposed pipelines, riverbank movement, missing signage were also noted as concerns.
<p>6. <i>Are there any obvious opportunities for the regulation to improve the safety of pipelines at water bodies and crossings?</i></p>	<ul style="list-style-type: none"> • Clarity on the regulation and definition on what inspections are required and at what frequency would be beneficial. • Clarity on the regulation and inspection requirements for non-metallic pipelines would be beneficial. • Water body definition consistency/harmonization amongst the regulators (and stakeholders). • Pipeline licensees should have an inventory of water crossings, including location, pipeline, production details and incident response guidance. • Increase risk based inspection approach at crossings.

4.7. Regulator Interviews:

Interviews were conducted with members of the ERCB, B.C. OGC and the Saskatchewan Ministry of the Economy (Engineering Services Branch). The NEB provided their feedback through a written response to a prepared set of questions. The information gleaned from these interviews was typically consistent within and across the regulators and has been summarized below.

The following table reveals the number of licensees managed by each regulator (supplied by respective regulators, November, 2012).

Regulatory Jurisdiction	Number of Licensees
Alberta (ERCB)	886
British Columbia (OGC)	120
Saskatchewan (MER)	25
Canada (NEB)	99

Public Safety and Response to Pipeline Incidents

All of the regulators responded that they felt the systems and procedures in place for reacting to pipeline incidents are well established and adequate. There are currently revisions to the existing directives being prepared in both Alberta and BC, where improvements from past reviews, exercises and incidents were noted. The regulators commented that the addition of a requirement to follow the Incident Command System (ICS) in the pending revisions will contribute to improving current requirements and enhance public safety. Spill Co-ops have been set up across Alberta, BC and Saskatchewan; which provide a consistent and available resource of trained personnel and equipment for oil and gas industry emergency support.

All licensees transporting liquids are members of a spill co-op, all of whom require mandatory involvement in exercises. All required ERCB staff are trained to ICS requirements, and at least one person at all nine ERCB field offices, plus personnel within the central Calgary office, are trained responders (per formal advanced training provided by the Alberta Emergency Management Agency). This ensures that the ERCB is able to assist industry and synchronize with other government regulatory bodies to make sure emergencies are managed and that effective communications are maintained.

Pipeline Integrity Management

On the topic of pipeline integrity management it was noted that a *one size fits all* approach to regulation is not the best approach as industry has different needs and capabilities based on the licensee's competency and maturity level. It was noted that from the ERCB field inspectors' perspective, there is a necessity for simple prescriptive regulation in some cases; whereas the ERCB staff in Calgary were more supportive of a goal based approach. The NEB has had more experience of administering a performance-based approach than other regulators. Across all Canadian regulatory jurisdictions it is a common consensus that pipeline integrity management regulation is adequate, and that the onus is on the licensee to ensure their pipelines comply with existing regulation and are operated safely.

A next step, which has been identified by regulator staff, to improve overall pipeline integrity is checking the adequacy and effectiveness of a licensee's mandated integrity management program (IMP). Inspections, audits and maintaining records of the history of pipeline incidents is seen as areas for improvement in the application of integrity management programs and possible benchmarks for improvement.

Pipeline records transfer was also highlighted as an area for improvement. While there have been improvements in record keeping in recent years by licensees constructing new pipelines, there is a general understanding that records retention and transfer during the processes of acquisition and divestiture could be improved, thus allowing for more thorough integrity management.

In discussions with ERCB personnel, the issue of future resourcing to keep up with the expanding industry and changing technologies was a common concern. This is with reference both to technical competency, as well as number of resources available to perform regulatory oversight (this applies to all three subject areas of the review).

Safety of Pipelines near Water Bodies

The key point raised by interviewed regulators on the safety of pipelines near water bodies is a lack of consistency for the actual definition of a water body by a licensee. The definitions of water bodies, and the interpretation of the inspection requirements, varies dependent on the competency and maturity of the licensee. How licensees manage the safety of pipelines near water bodies will differ upon their understanding or interpretation of available definitions.

Risk

The interviews confirmed that all regulators understand that risk management is an integral part of their function; whether it is applied to design, inspection, audits, changes to regulation or emergency response and crisis management. The public, licensees and regulators experience exposure to risk every day; however, each has a different risk appetite and risk tolerance. The creation of a consistent framework that sets out requirements for risk definition and management will assist in building alignment amongst all parties on *acceptable* risk. If this risk framework is prepared collaboratively between regulators and government bodies (e.g. the ERCB and Alberta Environment), and possibly industry and the public through appropriate representation, the opportunity for an early consensus will improve. The ERCB has identified the need for the development of a corporate (ERCB) wide risk management system as a strategic objective, and have set a goal to achieve this.

5. Methodology

5.1. Method of Approach

5.1.1. Phase 1: Information Gathering and High-level Review

The pipeline safety review project was performed by a team of subject matter experts with diverse backgrounds, including engineers, academia, retired regulators and industry pipeline specialists; as well as technical staff still intimately involved with the pipeline integrity industry in Alberta and further afield.

The project leadership team and subject matter experts first defined the sources of document reference material and then the tasks required to procure the relevant materials for more detailed review. Ultimately, **twelve** jurisdictions were assessed and compared to an appropriate degree in the review (see Table 3).

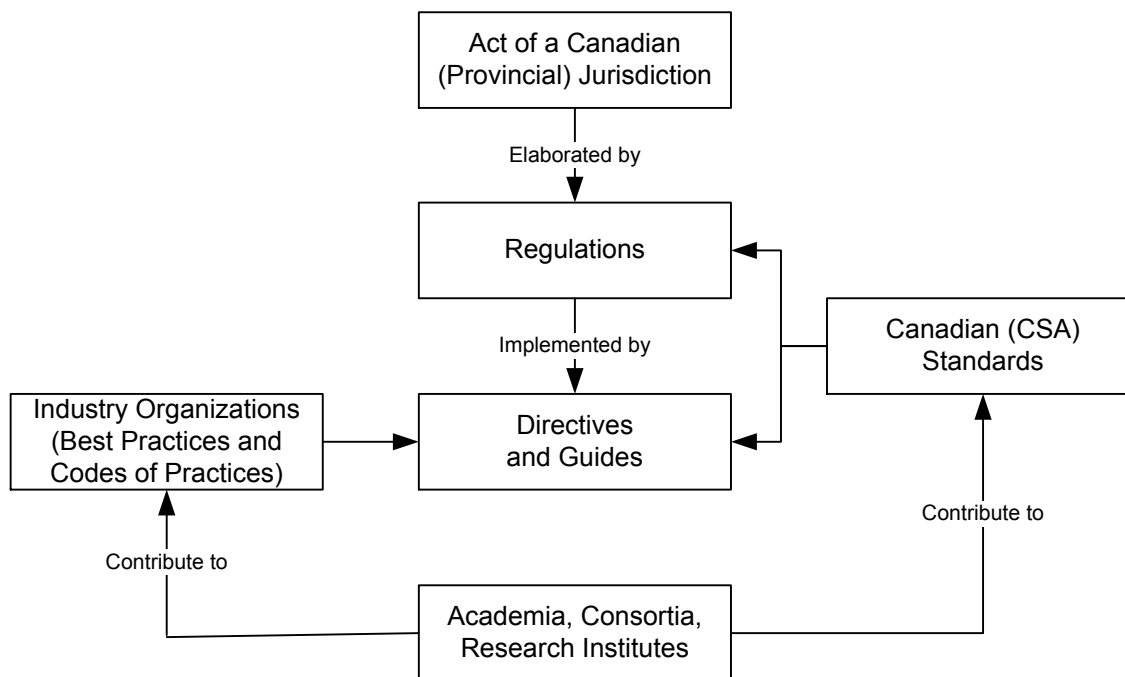
For U.S. jurisdictions, the federal regulator (DOT/PHMSA) and two representative states were included, reflecting the spectrum of U.S. regulation. A limited analysis of international jurisdictions — primarily UK/Europe and Australia — was included only at a high level. While not included as separate jurisdictions, pipeline and energy industry organizations were included to the extent that their best practices influence the Canadian regulatory environment for pipelines.

Table 3: Jurisdictions and other Information Sources Included in Review

Jurisdiction (Count)	Review Encompassed
Alberta (1)	Acts, Regulations, Directives, Guides
	Directly-referenced Canadian Standards Association (CSA) Codes
Canadian Provincial (2)	B.C., Saskatchewan, (offshore pipelines were not included because Alberta has none)
Canadian Federal (1)	NEB-Pipelines that cross a provincial or international boundary
U.S. Sample of States (2)	Texas: pipelines in operation the longest time
	Alaska: pipelines most stringently-regulated U.S. state
International (6)	United Kingdom, Netherlands, France, Norway, Brazil and Australia. High-level review only
Industry Organizations (6)	Reviewed principally for best practices; for example, CEPA, CAPP, INGAA, NOPSEMA, CONCAWE, UKOPA

A top-down approach to organize documents for inclusion; see Figure 3 for an idealized Canadian document organization.

Figure 3: Hierarchical Approach to Document Inclusion in Review



As relevant documents were gathered, they were further grouped into the three key subject areas listed in Section 3.4 specified by the ERCB as the focus of the analysis, noting any pertinent relationships between the areas.

The ERCB reference material was categorized, summarized and tabulated first, and was then cross-referenced to the remaining reference materials from other jurisdictions and stakeholders.

Information was also collected via interviews conducted with selected stakeholder representatives. Personnel interviewed included representatives of:

- the ERCB
- representatives of other regulators and jurisdictions (Canadian, North American and international)
- industry organizations
- pipeline licensees

Where possible, standardized interview scripts for the respective parties to be interviewed were prepared, to guide the interview process and provide consistency to the data collected. Each script was intended to assess an organization's understanding of the existing local regulation (and others if they are multi-jurisdictional) and best practices, and to determine if there are any obvious opportunities for improvement.

6. Appendices

Appendix A: Abbreviations Used

ACRONYM	DESCRIPTION
ABSA	Alberta Boilers Safety Association
ACoP	Approved Code of Practice
AEMA	Alberta Emergency Management Agency
AENV	Alberta Environment
AEW	Alberta Environment and Water
AGA	American Gas Association
AHS	Alberta Health Services
AHW	Alberta Health and Wellness
ALARP	As Low As Reasonably Practicable
APC	Alaska Pipeline Commission
API	American Petroleum Institute
APUC	Alaska Public Utilities Commission
ARD	Agriculture and Rural Development
AS	Australian Standard
ASERT	Alberta Environment Support Emergency Response Team (with AEW)
ASME	American Society of Mechanical Engineers
ASSIST	Alberta Security and Strategic Intelligence Support Team
AT	Alberta Transportation
B.C. OGC	British Columbia Oil and Gas Commission
BOEM	Bureau of Ocean Energy Management
BSi	British Standards
C-FER	Technologies – Centre for Frontier Engineering Research
CAPP	Canadian Association of Petroleum Producers
CAR	Community and Aboriginal Relation Group (ERCB)
CDJ	Canada Department of Justice
CEPA	Canadian Energy Pipeline Association
	Canadian Environmental Protection Act
CEAA	Canadian Environmental Assessment Act
CFR	Code of Federal Regulations (United States)
CGA	Canadian Gas Association
CI	Critical Infrastructure
CIC	Alberta Transportation Coordination and Information Centre

ACRONYM	DESCRIPTION
CMO	Consequence Management Officer
COGOA	Canada Oil and Gas Operations Act
COMAH	Control of Major Accident Hazards Regulations
CONCAWE	Conservation of Clean Air and Water in Europe
COPR	Common Operating Picture Report (for ministers)
CPEC	Canadian Pipeline Environment Committee
CPUC	California Public Utilities Commission
CSA	Canadian Standards Association
DFO	Department of Fisheries and Oceans Canada
DOT	Department of Transportation (United States)
DRP	Disaster Recovery Program
EC	Environment Canada
ECO	Emergency Operations Centre
EI	Employment and Immigration
EOC	Emergency Operations Centre
EPA	Environmental Protection Agency (United States)
EPWG	Emergency Planning Working Group
ERCB	Energy Resources Conservation Board
ERG	Emergency Response Group (with ERCB)
ERP	Emergency Response Plan
ESRD	Ministry of Environment and Sustainable Resources Development
EU	European Union
EUB	Energy Utilities Board
FNHIB-HC	First Nations and Inuit Health Branch - Health Canada
GoA	Government of Alberta
H ₂ S	Hydrogen Sulphide
HADD	Harmful Alteration, Disruption or Destruction
HSE	Health Safety and Executive (United Kingdom)
IB	Information Bulletin
ICS	Incident Command System
ID	Interim Directive
IG-26	ERCB Internal Guide 26 - Incident Response and Reporting Protocol
INGAA	Interstate Natural Gas Association of America
IRR	Incident Response Report

ACRONYM	DESCRIPTION
KPI	Key Performance Indicators
MA	Municipal Affairs
MBCA	Migratory Birds Convention Act
MEP	Municipal Emergency Plan
MERSK	Ministry of energy Resources of Saskatchewan
MOEON	Ministry of Energy Ontario
MOU	Memorandum of Understanding
NACE	National Association of Corrosion Engineers
NEB	National Energy Board
NEBA	National Energy Board Act
NOPSEMA	National Offshore Petroleum Safety and Environmental Management Authority (Australia)
NTA	Netherlands Technical Agreement
NWPA	Navigable Waters Protection Act
OC	Oil Commission
OEB	Ontario Energy Board
OECD	Organization for Economic Co-operation and Development
OH&S	Occupational Health & Safety
OSFM	Office of the State Fire Marshal
OSHA	Occupational Safety and Health Administration
PAB	Public Affairs Bureau
PAPA	Pipeline Association for Public Awareness
PAS	Publicly Available Specification
PHMSA	Pipeline and Hazardous Materials Safety Administration
PIA	Post Incident Assessment
PIISP	Petroleum Industry Incident Support Plan
POC	Provincial Operations Centre (formerly known as the GEOC)
PoE	Pathways of Effects
PPSA	Pigging Products and Services Association
PRCI	Pipeline Research Council International
PSC	Public Safety Canada
REOC	Regional Emergency Operations Centre
RRC	Railroad Commission of Texas
RSA	Revised Statutes of Alberta
RSBC	Revised Statutes of British Columbia

ACRONYM	DESCRIPTION
RSC	Revised Statutes of Canada
RSS	Revised Statutes of Saskatchewan
RSO	Revised Statutes of Ontario
SA	Service Alberta
SARA	Species at Risk Act
SBC	Statutes of British Columbia
SC	Statutes of Canada
SIESO	Society of Industrial Emergency Services Officers
SITREP	Situation Report
SME	Subject Matter Expert
SO	Statutes of Ontario
SolGPS	Alberta Solicitor General and Public Security
SOR	Statutory Orders and Regulations
SPOG	Sundre Petroleum Operations Group (mutual aid group)
SRD	Sustainable Resource Development
SS	Statutes of Saskatchewan
ST	Statistic Report
TC	Transport Canada
TSB	Transportation Safety Board of Canada
TSSA	Technical Standards and Safety Authority (Ontario)
UK	United Kingdom
UKOPA	United Kingdom Onshore Pipeline Operators' Association
U.S.	United States
USC	United States Code
USCG	United States Coast Guard
WCSS	Western Canadian Spill Services Ltd.

Appendix B: Compilation and Summary of Actual Clause Text for Acts, Regulations, and Directives and Guidelines by Jurisdiction

Appendix B for the Alberta Pipeline Safety Review is comprehensive and extensive. In order to provide easy reference for the reader, the table below is provided to guide the selection of information for comparison. By lining up the jurisdiction of choice next to Alberta, all rows will line up for comparison. If a table shows a shaded cell it means that there is no comparable act, regulation, directive, etc.

For the Canadian jurisdictions, comparisons were made of the information in Appendix B. For the U.S. and international regulatory bodies, the review was at a higher-level and comparisons were only made where obvious and relevant.

It is important to note that all comparisons in this review are made with Alberta as the constant. *It is recommended that the Alberta tab is opened first, and that the other jurisdiction tabs are opened in comparison to Alberta. Comparing non-Alberta jurisdictions to each other in this appendix may in some cases provide inadequate information.*

Public Safety & Response to Pipeline Incidents				
	Alberta	BC	Sask	NEB
	1ERP 1AB	1ERP 2BC	1ERP 3SK	1ERP 4NEB

Pipeline Integrity Management								
	Alberta	BC	Sask	CSA	NEB	U.S. DOT	Alaska	Australia
<i>Abandonment</i>	2-1PIM 1AB	2-1PIM 2BC	2-1PIM 3SK	2-1PIM 4CSA	2-1PIM 5NEB	2-1PIM 6DOT	2-1PIM 7ALASKA	2-1PIM 8AUS
<i>Board Inspection and Legal</i>	2-2PIM 1AB	2-2PIM 2BC	2-2PIM 3SK	2-2PIM 4CSA	2-2PIM 5NEB	2-2PIM 6DOT	2-2PIM 7ALASKA	2-2PIM 8AUS
<i>Leaks, Damage, Records</i>	2-3PIM 1AB	2-3PIM 2BC	2-3PIM 3SK	2-3PIM 4CSA	2-3PIM 5NEB	2-3PIM 6DOT	2-3PIM 7ALASKA	2-3PIM 8AUS
<i>Ground Disturbance</i>	2-4PIM 1AB	2-4PIM 2BC	2-4PIM 3SK	2-4PIM 4CSA	2-4PIM 5NEB	2-4PIM 6DOT	2-4PIM 7ALASKA	2-4PIM 8AUS
<i>Operation-Change-Monitor</i>	2-5PIM 1AB	2-5PIM 2BC	2-5PIM 3SK	2-5PIM 4CSA	2-5PIM 5NEB	2-5PIM 6DOT	2-5PIM 7ALASKA	2-5PIM 8AUS
<i>PIM and Corrosion</i>	2-6PIM 1AB	2-6PIM 2BC	2-6PIM 3SK	2-6PIM 4CSA	2-6PIM 5NEB	2-6PIM 6DOT	2-6PIM 7ALASKA	2-6PIM 8AUS

Safety of Pipelines near Water Bodies							
	Alberta	BC	Standards	CSA	U.S. DOT	Australia	UK
	3All Water 1AB	3All Water 2BC	3All Water 3Standards	3All Water 4Cda	3All Water 5US	3All Water 6Aus	3All Water 7UK

Appendix B1: Public Safety and Response to Pipeline Incidents

Refer to attached document: ApdxB1-Public Safety and Response to Pipeline Incidents.pdf

Appendix B2: Pipeline Integrity Management

Refer to attached document: ApdxB2-PIM Comparison Table.pdf

Appendix B3: Safety of Pipelines near Water Bodies

Refer to attached document: ApdxB3-All Water Comparison Table.pdf

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¹⁶ EOC – Emergency Operations Centre
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³¹ COMAH – Control of Major Accident Hazards Regulations