RISK ANALYSIS

of
Emers Brunswick Pipeline Company Ltd.'s preferred natural gas pipeline corridor through The City of Saint John

Prepared by: Saint John Fire Department
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Submitted to: Common Council
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I. **Executive Summary**

A. Introduction

At its meeting of July 18th Common Council instructed the Fire Chief to undertake a Risk Analysis of the Emera Brunswick Pipeline Company Ltd.’s high pressure natural gas pipeline project, through the identified preferred land route. The primary purpose for the Risk Analysis is to provide a briefing to Common Council with regard to public safety issues.

Previously, following a vote of Council, the City Manager had drafted a policy document stating that a second option, a marine route, is preferred from the standpoint of the City of Saint John. Utilization of a marine route would traverse from the LNG/Canaport facility, across the outer harbour, to the area of Saint’s Rest Beach and would in effect eliminate many public issues around land use encroachment.

The Saint John Fire Department completed the Risk Analysis as a document mutually exclusive from the City’s adopted policy on its preferred corridor. The analysis conducted by the Saint John Fire Department was completed based upon factual information gained through objective research, with a view toward representing public safety issues and concerns.

The document illustrates the concerns of the Saint John Fire Department as well as input presented by key individuals and organizations. Although the concerns referenced herein are based upon the preferred corridor, as identified by Emera, the identified concerns would be similar should the proponent change its proposal to other possible urbanized/industrialized corridors.

B. General Description of Risk Analysis – Scope

The scope of this document is a public safety risk analysis that follows the linear corridor of the proposed Emera natural gas transmission pipeline, starting at the Canaport LNG facility in Red Head and concluding at the south western limits of the City, along Route 1.

To gain a thorough understanding of the project and the possible consequences to the “community” in which the pipeline would traverse, the following areas of research and analysis were covered:

- Emera Brunswick Pipeline Corridor Proposal Documents
- Project Specifications
- Product Characteristics
- Safety Systems, Procedures and Maintenance
- Applicable Governing Regulations, Standards and Standards Setting Bodies
- Industry Standards
- Historical Analysis
- Security Issues (to a limited extent)
- Probabilities and Possibilities: Types of Events
- Scenario Analysis of two possible incidents (specific locations)
- Hazard Consequence Distances/Area
- Impact/Consequence Worst Case Scenario Assessment
- Mapping of Worst Case Scenario (Hot Zones)
- Response and Consequence Analysis
- Identification of proximity to Critical Infrastructure
- Review of Project Risk Analysis Document (Bercha) from the Emera proposal
- Consultation with concerned members of the public
- Consultation with Maritimes and Northeast Pipelines
- Tour of the Proposed Corridor (SJFD, M&NP, SJEMO, NFPA)
- Survey of other Municipalities
- Request for input from Water and Electricity Utilities
- Request for input from co-responders within SJEMO Group
- Request for input from National Fire Protection Association (NFPA)
- Request for input from New Brunswick Securities Directorate

This Risk Analysis was conducted on the assumption of the credible worst case pipeline failure and the related worst case probability impacts and consequences. A key consideration in this analysis is the definition of the affected area in relation to a pipeline failure, in the worst case event. (Stephens, Smith & Merritt)

It is recognized that to conduct a proper Risk Analysis, the magnitude of a worst case event must be researched. The worst case event was then applied to sites along the pipeline corridor to assess the impact, consequences and emergency response needs. Consideration was then given to measures that would have lessened the impact of a pipeline failure, or helped mitigate the emergency response.

This Risk Analysis is a fact-based study of the possible contingencies/consequences of the proposed transmission pipeline routing and associated response complexities. This Risk Analysis is not written to refute technical information provided by the proponent, or to reinforce existing public policy, or respond to politically controversial matters with regard to the specific corridor. It is an examination of the public safety issues associated with Emera Brunswick Pipeline’s preferred corridor. For the purposes of this Risk Analysis, it must be noted that:

1) There are at present no natural gas transmission lines of this size and pressure passing through urbanized areas of Saint John.

2) There are tremendously complex issues associated with the magnitude of possible events associated with this project; given the interrelated and congested residential and critical infrastructure along the proposed corridor (in Saint John).

3) The staff of the Saint John Fire Department do not have subject matter expertise in the field of natural gas pipeline engineering; however, in the examination of consequences of a possible event, the Fire Department must be considered the subject matter experts regarding the fire response needs of the community, including public safety and protection of critical infrastructure.
C. Considerations *not* included in the Risk Analysis

The Liquefied Natural Gas (LNG) Terminal currently under construction at Canaport was *not* in the scope of this document.

Intentional acts causing pipeline failures was touched upon in this analysis; however a thorough examination of such risks should be undertaken by the proponent with the appropriate security agencies having jurisdiction over such matters. In that regard, security measures should be put in place that corresponds with the levels of threat associated with this proposed project.

D. Calculation of Hazard Consequence Area (HCA)/Hot Zone

It is imperative for the purposes of this Risk Analysis that the Hazard Consequence Area (HCA) be firmly defined. For the purposes of this report, the HCA is defined as a 300 meter or 1000 feet + Hot Zone along both sides of the proponent’s preferred pipeline corridor. The following sourced comments and empirical evidence provides support to the Fire Department’s representation of a 300m Hot Zone, more specifically:

- As part of its application to the N.E.B., Emera Brunswick provided a “Quantitative Risk Analysis of the Proposed Brunswick Natural Gas Pipeline, Final Report” (*also known as the Bercha document*) as appendix 5 of the larger document.

- The Bercha document provides (*page 4.12/Table 4.3*) that the high intensity 170 kw/m² isopleth under unstable conditions (meteorological) extends 298 meters.

- The Bercha document consequence model (Table 4.3) provides a number of isopleth distance calculations with respect to full double rupture, across each of the fire and explosion consequences. In fact twenty-two of twenty-seven of the model distances (for ruptures) produced a Hot Zone that was at least 300 m.

- Page 4.3 of the Bercha document provides comments with respect to the effects of thermal radiation and explains that a thermal radiation level of 37.5 kw/m² is sufficient to cause 100% fatality within 60 seconds. By a cross assessment with the information provided in Table 4.3 it can be concluded that at 298 meters, the thermal radiation associated with a flash fire is over four times sufficient (more likely) to cause 100% fatality in 60 seconds.

*Explosion Overpressure (Concussion)*

- The Bercha document (*p. 4.3*) references the direct and indirect explosion effects on people caught in an exposure to overpressures. Buildings will be damaged if exposed to 20 kPa overpressures and anyone inside such buildings could die as a result of structural collapse.
Page 4.12 of the Bercha document states that “under urban conditions, if an explosion does occur, the 35kpa isopleth will extend 411 meters”; being well beyond the 300 meters hot zone referenced herein.

**Supporting Documentation for 300 meter Hot Zone**

- In the Mark J. Stephens’ report, “A Model for Sizing High Consequence Areas Associated with Natural Gas Pipelines”, a number of National Transportation and Safety Board (NTSB) reports provide further support for the position of 300 m as being a conservative representation of the Hot Zone.
  - **NTSB-PAR-87-1**: A 30” pipeline, 987 psi burned an area of 900 feet by 1000 feet (300 meters); 2 houses, 1 house trailer and numerous other structures and equipment destroyed. 3 people burned running from house 280 feet away from rupture (requiring hospitalization), 5 others received minor burn injuries running from dwellings between 200 and 525 feet from rupture. (250 foot offset).
  - **NTSB-PAR-86-1**: A 30 inch pipeline, 1,016 psi burned an area of 1,450 feet long by 360 feet wide (furthest fire extent 950 feet), 5 fatalities (within 65 feet, 0 foot offset), and 23 injuries (within 800 feet, 180 foot offset).

- Sean Tracey, Canadian Regional Manager of the National Fire Protection Association, states in his project assessment document, “that the hazard assessment zones identified by the City of Saint John at 300 meters is a more than reasonable assessment. The assessments have been based on historical losses including a number of similar 30 inch pipeline failures.”

**The Saint John Fire Department is confident that 300 meters is a conservative representation of the Hot Zone.**

**Warm and Cold Zones - Consequences beyond 300 meters**

- Beyond the distance of 300 meters there can be injuries to people and property damage for a distance of 800 meters in all directions as well as the possibility of serious injuries and property damage from flying debris. The zone between 300 meters to 800 meters is referred to as the warm zone. Everything beyond 800 meters is considered the cold zone (no injuries or property damage anticipated). The three zones are reflected in the following Table: I-1
<table>
<thead>
<tr>
<th>Operational Zones</th>
<th>Distance</th>
<th>References</th>
<th>Consequences</th>
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<tbody>
<tr>
<td>Hot</td>
<td>300 M</td>
<td>Table 4.3 - Quantitative Risk Analysis of the Proposed Brunswick Natural Gas Pipeline, Final Report, Bercha Group, February 14, 2006., N.T.S.B. &amp; Stephens</td>
<td>In all directions from the rupture: extremely high chance of death and/or property destruction within Hot Zone. Degree of impact lessens as you move away from the rupture site.</td>
</tr>
<tr>
<td>Warm</td>
<td>800 M</td>
<td>Figure 5.9 - Quantitative Risk Analysis of the Proposed Brunswick Natural Gas Pipeline, Final Report, Bercha Group, February 14, 2006.</td>
<td>In all directions from the rupture: fair chance of injury and property damage (of decreasing intensity) over the Warm Zone. The topography of the surrounding area will determine the nature and scope of injury and damage within this Zone. Due to the size of a blast from a full double rupture, there could be the potential of falling debris. Second degree burns and blistering of skin are likely to persons in this area.</td>
</tr>
<tr>
<td>Cold</td>
<td>Beyond 800 M</td>
<td>Saint John Fire Department</td>
<td>A Full Double Rupture with explosion may cause little to no injury or damage beyond 800 meters. A vapour cloud or smoke from a fire(s) might be noticeable. The major concern within this zone will be the Fire Department's ability to respond to calls while mitigating fire and rescue incidents in the Hot and Warm Zones. The Saint John Fire Department experienced 2,451 simultaneous calls during 2005. With most of the Department's resources responding to a Full Double Rupture; there could be delays in responding to simultaneous calls originating in the Cold Zone.</td>
</tr>
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Diagram I-1
Hazard Consequence Distances

Representation of the impact zones
E. Emera’s Preferred Corridor and Engineering Parameters

The map and table presented below provides an illustration of Emera Brunswick Pipeline Company’s preferred corridor through Saint John and the basic details (Table) of Emera Brunswick Pipeline’s proposed engineering parameters. The Saint John Fire Department has broken this proposed corridor into 8 linear zones for the purpose of analysis. These zones are illustrated in detail in the body of the Risk Analysis. The corresponding City of Saint John map illustrates (through red highlighting) the 300 meter Hot Zone around the proposed corridor.
Emera Brunswick’s Proposed Pipeline Engineering Parameters

<table>
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<th>BASIC DETAILS</th>
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<tr>
<td><strong>Application:</strong> Sweet natural gas, CSA Z662 Class 1, 2, 3 as required</td>
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<tr>
<td><strong>Diameter:</strong> 762 mm (NPS 30)</td>
</tr>
<tr>
<td><strong>Wall Thickness:</strong> 9.8 mm (0.4 inch) minimum depending on grade selected and class location</td>
</tr>
<tr>
<td><strong>Grade:</strong> Grade 483</td>
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<tr>
<td><strong>Licensed MOP:</strong> 9930 kPa (1,440 psig)</td>
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<tr>
<td><strong>Max Operating Temp.:</strong> 50°C (120°F)</td>
</tr>
<tr>
<td><strong>Flow:</strong> 750,000 Decatherms per day, 1 Billion cu/ft per day</td>
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<tr>
<td><strong>Depth of Cover:</strong> CSA Z662 code requirements as a minimum 1.2 m under road and recommended 1 m minimum elsewhere</td>
</tr>
<tr>
<td><strong>Length:</strong> 145 km, 41 km approximately in Saint John City limits</td>
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<tr>
<td><strong>Coatings:</strong> Proposed FBE as minimum + added epoxy or urethane for drilled and bored sections</td>
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<tr>
<td><strong>Isolation Valves:</strong> 6 Line Block Valves (LBV) plus one at each end</td>
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<tr>
<td><strong>Integrity Verification:</strong> Diagnostic pigging at time intervals to be determined by results</td>
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<tr>
<td><strong>Right-of-Way (RoW):</strong> 30 m wide. Posted with warning signs at strategic locations</td>
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F. Risk Considerations Relative to the Proposed Pipeline Corridor

The depth of concern with regard to risk is proportional to the amount of critical infrastructure which falls in or adjacent to the hot zone. For the purpose of this Risk Analysis, critical infrastructure is defined as: the framework of electrical, water, sewerage, telecommunication, or transportation networks and systems supporting industries, institutions, and residential areas. The Risk Analysis identified significant risks to critical infrastructure within the Warm Zone along the perimeter of the proposed pipeline corridor. Examples of key assets that might be impacted in the event of a pipeline rupture are as follows (working in linear fashion from the beginning of the pipeline):

- McAllister Industrial Park
- Regional Correctional Centre
- Grandview Industrial Park
- Grandview Avenue Water Main
- Irving Oil Refinery
- Champlain Heights Residential Area
- Champlain Heights Elementary School
- Loch Lomond Road and Water Main
- High Voltage Electric Transmission Lines
- Silver Falls Residential Area
- Ellerdale Residential Area
- Westmorland Road Water Main
- Rothesay Avenue Transportation Corridor
- Canadian Blood Services
- Millidgeville Residential Area
- Saint John Regional Hospital
- Millidge Avenue Transportation Corridor
- Millidge Avenue Water Main
- Millidge Avenue Electrical Sub Station
- North End Residential Area
- Milford Residential Areas
- Access and Egress to Milford
- Greenhead Road Water Main
- N.B. Southern Rail Yard
- Ridgewood/Centracare Facility
- West Gate Residential Areas
In relation to the proposed corridor, there is also concerns that there could be response complexities created by a loss of critical infrastructure caused by a pipeline rupture (i.e. loss of fire water, trunk radio network, cell towers, or electricity).

**G. Risk Assessment – Relative to Emergency Planning and Response**

This Risk Analysis revealed a number of concerns relating to emergency planning and response. Notwithstanding the fact that these concerns will need to be addressed in Emera’s Emergency Response Plan (ERP) (as a condition of project approval); they are listed in this analysis so as to provide Common Council with an understanding of the scope and nature of the emerging issues that are inherent to this project.

**It is clear that the other agencies consulted, share the concerns of the Saint John Fire Department.**

Should the Emera pipeline project proceed as proposed, Common Council must be aware that sufficient resources do not currently exist (within the Fire Department or SJEMO) to conduct comprehensive training, response mitigation, and recovery plans. This state of insufficient resources can be attributed to the cumulative affect of the concentration of industry within our community and critical infrastructure along the proposed pipeline corridor. More specifically, the pipeline is not like a fixed hazard (i.e. power plant, refinery, pulp mill); instead it traverses the City, creating variable hazard levels along the length of the pipeline. The Fire Department and SJEMO are currently challenged to conduct the aforesaid functions relative to the scale of the hazards that would be created by the pipeline project.

In addition, there is a need to ensure that the response requirements for a pipeline emergency never exceed the response capabilities of the Saint John Fire Department; therefore a number of considerations need to be addressed. Specifically, the Fire Department must: maintain an adequate number of reserve fire apparatus to accommodate 3rd and 4th alarms; and maintain formalized mutual aid agreements with neighbouring communities. Natural gas specific training aids and curriculum must be made available to the Fire Department so as to ensure first responders possess the requisite skills and knowledge to effectively mitigate natural gas emergencies.

*It must be noted that even with extensive response preparation, the probability of a worst case pipeline failure event still exists. Emergency response preparation would only ensure that emergency responders are as prepared and equipped as possible to achieve successful and timely incident mitigation.*
H. Finding / Concerns

Findings

The preferred pipeline corridor presents a number of challenges to the Saint John Fire Department and member agencies of SJEMO; more specifically, of paramount concern is the proximity of the corridor to:

- Critical infrastructure;
- Key community facilities (i.e. Correctional Centre, Centracare);
- Fuel storage areas / transmission systems;
- Transportation corridors;
- Residential dwellings;
- Neighbourhoods with one means of access and egress (i.e. Milford, Lorneville);
- Conflicting land uses (i.e. ongoing blasting at Bald Hill);

It is acknowledged that the occurrence of a high consequence - worst case failure event involving the proposed natural gas pipeline, is of low statistical probability. However, from a due diligence perspective, it is incumbent upon the Saint John Fire Department to conduct a Risk Analysis in relation to the consequences of such an event. Evidence indicates that:

1) There are a number of transmission line failures in North America each year;
2) When there is a failure of a transmission line, it is often catastrophic;
3) Given that the vast majority of transmission pipeline infrastructure is located in rural areas in most communities, failures to date have occurred in these areas; the consequences of these failures are not comparable to what could happen in an urban setting; and
4) Given the physical footprint of a 30 inch natural gas transmission pipeline failure in relation to adjacent industrial/residential properties, the operational challenges associated with incident mitigation are significantly greater than in a rural setting.

Knowing the consequences associated with a natural gas pipeline failure, it is incumbent upon emergency responders to be prepared. Response preparation must first be completed in the form of a draft plan (prior to pipeline operating). The proponent’s Bercha risk analysis document states: “The most important risk mitigation measure for this project is the emergency response capability.” (Bercha, p 7.4) The Saint John Fire Department concurs with this statement.

Concerns

The Saint John Fire Department Risk Analysis identified the following emergency response concerns with respect to preparing for and mitigating a pipeline failure in an urbanized or industrialized corridor.
a) Citizens could be killed, injured or affected by a pipeline failure.

b) Critical Infrastructure and property could be destroyed or affected by the event.

c) Should key critical infrastructure (i.e. water mains, radio systems, cell coverage, electric utility infrastructure) be destroyed, response to the incident will become more complex.

d) Given our City’s industrial density: simultaneous Hazardous Materials Incidents could be triggered by a pipeline failure.

e) A pipeline failure would challenge the Saint John Fire Department to respond effectively in the areas of strategic and tactical response.

f) SJEMO co-responders would be challenged by a pipeline failure (See SJEMO references in “Input from other Sources”, pg 58) as each member could be responding to its own related emergency incidents.

g) A review by the Canadian Director of N.F.P.A. also states similar concerns to those of SJEMO and the Saint John Fire Department (see Sean Tracey’s report in Appendix 1)

I. Recommendations

In the event that the National Energy Board fails to support the City’s position to utilize a marine route as the preferred option, then consideration must be given to satisfying the various public safety concerns that have emerged from the analysis of the proponent’s preferred land based route. More specifically, based upon a low probability high consequence event (that could occur anywhere along the pipeline corridor), the Saint John Fire Department present the following recommendations:

**Recommendations (Emera)**

It is recommended that:

1. SJFD and officials with SJEMO continue to meet with Emera Brunswick’s representatives with the objective of resolving the concerns identified in this Risk Analysis. Should the parties fail to come to an agreement on resolutions to the concerns, Common Council direct the City Manager and appropriate staff to present the remaining concerns to the NEB for final disposition;

2. The proponent (Emera Brunswick Pipeline Company Ltd.) provide hands-on tactical training for natural gas transmission pipeline emergency response to all Saint John Fire Department personnel (such courses to be funded by the proponent on an ongoing basis);

3. The proponent provide and pay for Command Staff-incident Command Training for natural gas emergencies;

4. In recognition that the Bercha risk analysis document outlines structural collapse as a likely event (*Bercha, p.4.3*), the proponent provide SJFD with funding to acquire full capabilities in NFPA 1670 competencies for structural collapse and technical rescue;
This is to include all applicable structural collapse rescue equipment. (SJFD currently does not have such emergency response equipment);

5. Should the NEB grant an operating permit for the proposed pipeline, then as a condition of operation (and in compliance with the Onshore Pipeline Regulation, 1999), the proponent be required to obtain the concurrence of the City of Saint John with respect to the development and implementation of the Emergency Response Plan (ERP) and related public safety requirements, to include public notification capabilities. The scope and nature of the ERP and related public safety requirements must fully comply with all aspects of NFPA 1600 - Disaster & Emergency Management and Business Continuity Programs. The costs associated with the development of the ERP shall borne by the proponent;

6. The proponent provide or fund fixed site pipeline training props, to be situated at the Saint John Fire Department Training Academy. This is to include access to a defined supply of natural gas for training scenario purposes;

7. Consideration be given to adding Mercaptan to the natural gas entering the pipeline so as to provide citizens with an olfactory warning of a leak or line breach; and

8. Consideration be given to adding additional line blocking valves so as to minimize exposure to thermal energy should a ruptured line ignite (in the urban corridor).

**Recommendations (Common Council)**

It is recommended that:

9. Common Council give consideration to reinstating a Training Officer’s position in the Fire Department’s Training Division.

   During previous presentations to Common Council, the Fire Chief expressed concerns with respect to the availability of adequate training resources. Given the additional training and response requirements associated with the proposed natural gas transmission pipeline project, coupled with current demands; the Saint John Fire Department’s ability to ensure that every firefighter possesses the requisite skills and training, is further challenged.

10. Common Council give consideration to establishing the position of “Emergency Planner” within SJEMO.

   The SJEMO is currently resourced with one full time position. It has been identified that the demands associated with SJEMO are well beyond existing capacity. The additional complexities arising from the proposed pipeline project, coupled with the evolving community preparedness needs, will require additional human resources to meet emergency preparedness requirements.
II. Definitions

**Apparatus:** Any vehicle that serves a specific function other than just transportation of people. Engines, Ladders, and Rescue Units are examples of apparatus. A chief’s vehicle is generally NOT considered apparatus.

**Authority Having Jurisdiction (AHJ):** An organization, office, or individual responsible for enforcing the requirements of a code or standard, or for approving equipment, materials, an installation, or a procedure.

**Bcf - Billion Cubic Feet:** A unit of gas measurement approximately equal to one trillion (1,000,000,000,000) Btu's.

**Btu - British thermal unit:** The Btu is the standard unit of measurement for heat. A Btu is defined as the amount of energy needed to raise the temperature of one pound of water one degree Fahrenheit from 58.5 to 59.5 degrees under standard pressure of 30 inches of mercury.

**Cold Zone:** The zone at an emergency incident that contains the Command Post and such other support functions as are deemed necessary to control the incident. This zone is also referred to as the “Support Zone”.

**Command and Control System:** The arrangement of personnel, information management, procedures, and equipment and facilities essential to the Fire Department Incident Command to conduct operations.

**Compression:** Natural gas is compressed during transportation and storage. The standard pressure that gas volumes are measured at is 14.7 pounds per square inch (psi). When being transported through pipelines, and when being stored, gas is compressed to save space.

**Compression, gas:** The process of increasing the pressure on gas to reduce its volume or cause it to flow. Natural gas is usually compressed for pipeline transportation.

**Compressor station:** A facility containing equipment that is used to increase pressure to compress natural gas for transportation.

**Control Zones:** The areas or zones at an emergency incident that are designated based upon safety and the degree of hazard.

**Corridor:** A tract of land forming a passageway.

**Critical Infrastructure and Key Resources:** The framework of interdependent networks and systems comprising identifiable industries, institutions (including people and procedures), and distribution capabilities, that provide a reliable flow of products and services. The smooth functioning of government at all levels, and society as a whole.

**Cf - Cubic Foot:** A unit of measurement for volume. It represents an area one foot long, by one foot wide, by one foot deep. Natural gas is measured in cubic feet, but the measurements are usually expressed in terms of Mcf, Bcf, Tcf, or Quads.
CSA: The Canadian Standards Association is a not-for-profit membership-based association serving business, industry, government and consumers in Canada and the global marketplace. As a solutions-oriented organization, CSA works in Canada and around the world to develop standards that address real needs, such as enhancing public safety and health, advancing the quality of life and helping to preserve the environment.

**Deliverability Rate:** A measure of the amount of gas that can be delivered (withdrawn) from a storage facility on a daily basis, typically expressed in terms of millions of cubic feet per day (MMcf/day).

**Double ended release:** A rupture in the natural gas line characterized by a total cut of the pipe from top to bottom (i.e. excavation – resulting in gas feeding from both directions).

**Explosion:** A release of mechanical, chemical, or nuclear energy in a sudden and often violent manner with the generation of high temperature and usually with the release of gases. A violent bursting as a result of internal pressure.

**FERC - Federal Energy Regulatory Commission:** The US federal agency that regulates interstate gas pipelines and interstate gas sales under the Natural Gas Act. The FERC is considered an independent regulatory agency responsible primarily to Congress, but it is housed in the US Department of Energy.

**Hazard:** An unknown and unpredictable phenomenon that causes an event to result one way rather than another.

**Hazardous material:** Any material that presents a potential for unwanted consequences to people, property and the environment.

**Hot Zone:** The control zone immediately surrounding an emergency incident involving fire or hazardous materials release. It extends far enough to where adverse effects from the thermal radiation or the hazardous material release will not be expected. It is also referred to as the exclusion zone or the restricted zone.

**Hydrocarbon:** An organic compound containing only carbon and hydrogen. Hydrocarbons often occur in petroleum products, natural gas, and coals.

**Incident:** A specific unplanned event or sequence of events that has an unwanted and unintended effect on people’s safety or health, on property or the environment, or on regulatory compliance.

**Incident Management System:** In disaster/emergency management applications, the combination of facilities, equipment, personnel, procedures, and communications operating within a common organizational structure with responsibility for the management of assigned resources to effectively accomplish stated objectives pertaining to an incident.

**Infrastructure:** The basic facilities, services, and installations needed for the functioning of a community or society, such as transportation and communications systems, water and power lines, and public institutions including schools, post offices, and prisons.

**Isopleth:** A line drawn on a map connecting points having the same numerical value of some variables.

**Isolation (Line Block) Valves:** Valves placed in pipes designed to stop the flow of product.
**Jet Fire**: A sustained vertical high thermal radiation fire emanating from a natural gas pipeline rupture including product under pressure.

**Liquefied Natural Gas (LNG)**: Natural gas that has been cooled to -259 degrees Fahrenheit (-161 degrees Celsius) and at which point it is condensed into a liquid which is colourless, odourless, non-corrosive and non-toxic. Characterized as a cryogenic liquid.

**Methane**: Methane ($\text{CH}_4$) is commonly known as natural gas. It is colourless and burns efficiently without many byproducts. Natural gas has odour added as a safety measure since it is naturally odourless.

**Mitigation**: Activities taken to eliminate or reduce the probability of the event, or reduce its severity or consequences, either prior to or following a disaster/emergency.

**Mutual Aid Agreement**: A pre-arranged agreement developed between two or more entities to render assistance to the parties of the agreement.

**National Energy Board (NEB)**: An independent federal agency that regulates several aspects of Canada's energy industry. Its purpose is to promote safety and security, environmental protection and efficient energy infrastructure and markets in the Canadian public interest within the mandate set by Parliament in the regulation of pipelines, energy development and trade.

**Natural Gas**: A hydrocarbon gas that is usually obtained from underground sources, often in association with petroleum and coal deposits. Natural gas generally contains a high percentage of methane and inert gases.

**NFPA**: National Fire Protection Association. The mission of the international non-profit NFPA is to reduce the worldwide burden of fire and other hazards on the quality of life by providing and advocating scientifically-based consensus codes and standards, research, training, and education.

**Overpressure**: A transient air pressure, such as the shock wave from an explosion, that is greater than the surrounding atmospheric pressure.

**Preparedness**: Activities, programs, and systems developed and implemented prior to a disaster/emergency that are used to support and enhance mitigation of, response to, and recovery from disasters/emergencies.

**Pounds per Square Inch (psi)**: Pressure measured with respect to atmospheric pressure. This is a pressure gauge reading in which the gauge is adjusted to read zero at the surrounding atmospheric pressure.

**Probability of Impact/Consequence**: Mathematical calculation of the likelihood of an event occurring. Consequence, for the purpose of this report, consequence and impact are utilized interchangeably.

**Proponent**: A person (or entity) who pleads for a cause or propounds an idea. In this case, the proponent is Emera Brunswick Pipeline Company Ltd.

**Response**: In disaster/emergency management applications, activities designed to address the immediate and short-term effects of the disaster/emergency.
Resources: All responders and major items of equipment which are available, or potentially available, for assignments to incident tasks on which status is maintained.

Right-of-way: The right of passage or of crossing over someone else's land. Also, an easement in lands belonging to others that is obtained by agreement or lawful appropriation for public or private use.

Risk: A measure of the probability and severity of adverse effects that result from an exposure to a hazard.

Risk Analysis: A procedure to identify threats and vulnerabilities, analyze them to ascertain the exposures, and highlight how the impact can be eliminated or reduced. A process to determine what security is appropriate for a system or environment.

Risk Assessment: A report that shows assets, vulnerabilities, likelihood of damage, estimates of the costs of recovery, summaries of possible defensive measures and their costs and estimated probable savings from better protection. A "risk analysis" is the process of arriving at a risk assessment, which is also called a "threat and risk assessment".

Saint John Emergency Management Organization (SJEMO): On behalf of Saint John Common Council, administers the Saint John Emergency Plan and associated contingency plans, together with provisions to set in motion and fulfill such plans. SJEMO works cooperatively with a wide range of partner agencies and organizations, both within the community and outside, to establish an active partnership, trained and qualified to effectively manage emergencies that may occur in the community.

Through the Saint John Emergency Management Organization, the City of Saint John meets the mandate set out in the Emergency Measures Act of the Province of New Brunswick whereby municipalities are required to establish and maintain an emergency measures organization. SJEMO provides prompt and coordinated response to emergencies that are beyond normal incident response capabilities and provides additional support and coordination assistance from a larger base. The aim of emergency management is to protect life, property and the environment and to restore order as quickly as possible after an event.

Stakeholders: Individuals, groups or organizations that are affected by and/or have an interest in a particular issue. Individuals with a vested interest in a project’s outcome.

Steady State Fire: Preceded by ignition and/or an explosion, a fire which continues unabated until supply is cut off and the product feeding it has burned out.

Thermal Radiation: A general statement equating emission and absorption in heated objects.

Transmission Pipeline: A system of pipelines, compressor stations and other related facilities that transport natural gas from the gathering system to the southern terminus.

Trench Fire: A jet fire in which the discharging gas jet impinges upon an opposing jet and/or the side of the crater formed in the ground. Impinging dissipates some of the momentum of the escaping gas and redirects the jet upward, thereby producing a fire with a horizontal profile that is generally wider, shorter and more vertical in orientation than would be the case for a randomly directed and unobstructed jet. (Stephens)
Unified Command: Within the Saint John Fire Department’s Incident Command System, Unified Command is a unified team effort which allows all agencies with responsibility for the incident, either geographical or functional, to manage an incident by establishing a common set of incident objectives and strategies. This is accomplished without losing or abdicating agency authority, responsibility, or accountability. A method whereby agencies or individuals who have either geographic or functional jurisdiction at an incident can jointly determine overall objectives, select a strategy and establish common organizational objectives. This may be implemented in a variety of ways and does not compromise the principle of having only one incident commander.

Vapour Cloud (Natural Gas): An un-ignited cloud of natural gas mixed in air, which may be at, below, or above its Lower Explosive Limit or Upper Explosive Limit at any given area of the cloud.

Warm Zone: The control zone at a fire or hazardous materials release where personnel and equipment decontamination and Hot Zone support takes place. It includes control points for the access corridor, helping to reduce the spread of contamination or exposure to people. This zone is also referred to as the “Limited Access Zone”

III. Product Characteristics

A. Natural Gas

Natural gas is a combustible, gaseous mixture of simple hydrocarbon compounds found in deep underground reservoirs formed by porous rock. It is composed almost entirely of methane but does contain small amounts of other gases, including propane, butane, and pentane. Once brought from underground, the natural gas is refined to remove impurities like water, other gases, sand, and other compounds. Some hydrocarbons are removed and sold separately, including propane and butane. Other impurities are also removed, like hydrogen sulfide (the refining of which can produce sulfur, which is then also sold separately). After refining, the clean natural gas is transmitted through a network of pipelines, thousands of miles of which exist in Canada and the United States. From these pipelines, natural gas is delivered through distribution pipelines to its point of use. (Office of Pipeline Safety, Department of Transportation, USA)

The proponent cites the composition of its natural gas product as: Methane (CH₄) 96.5%, Ethane (C₂H₆) 3.0%, Propane (C₃H₈) 0.50%. The proponent states that there will be no moisture present in the product. The following properties are considered with regard to emergency response: Vapour Density: 0.5, Specific Gravity: 0.74, Percent Volatile: vol.100%, Evaporation rate (nButAc=1): >1, Explosive Limits: LEL%: 5.3/UEL% 14.0 (the upper and lower limits of percentage composition of a combustible gas mixed with other gases or air within which the mixture explodes when ignited), Auto-ignition Temperature: 537°C (999°F) The Auto-ignition temperature of a chemical is the lowest temperature at which a material will ignite without an external source of ignition.
B. Measuring Natural Gas

Natural gas can be measured in a number of different ways. As a gas, it can be measured by the volume it takes up at normal temperatures and pressures, commonly expressed in cubic feet. Production and distribution companies commonly measure natural gas in thousands of cubic feet (Tcf), millions of cubic feet (Mcf), or billions of cubic feet (Bcf). While measuring by volume is useful, natural gas can also be measured as a source of energy. Like other forms of energy, natural gas is commonly measured and expressed in British thermal units (Btu). One Btu is the amount of natural gas that will produce enough energy to heat one pound of water by one degree at normal pressure. To give an idea, one cubic foot of natural gas contains about 1,027 Btu’s. When natural gas is delivered to a residence, it is measured by the gas utility in 'therms' for billing purposes. A therm is equivalent to 100,000 Btu's, or just over 97 cubic feet, of natural gas. (Office of Pipeline Safety, Department of Transportation USA)

C. Transporting Natural Gas

The transportation system for natural gas consists of a complex network of pipelines, designed to transport natural gas from its origin, to areas of high natural gas demand. There are essentially three major types of pipelines along the transportation route: the gathering system, the transmission pipeline, and the distribution system.

The gathering system consists of low pressure, low diameter pipelines that transport raw natural gas from the wellhead to the processing plant. Transmission pipelines are the “highways” of natural gas transmission. Natural gas that is transported through transmission pipelines travels at high pressure in the pipeline, at pressures anywhere from 200 to 1500 pounds per square inch (psi). When natural gas reaches its general destination, pressure is reduced and the natural gas is transported on small diameter low pressure lines to the end user. (Office of Pipeline Safety, Department of Transportation USA)

D. Use of the odourant - Mercaptan

Natural gas in its native state is colourless and odourless. Mercaptan is the additive that makes it easier to detect a leak in a natural gas line. It takes only a few parts per million of Mercaptan to give natural gas a smell. Simply put, if Mercaptan was not added to natural gas, it would be hard to detect unlit gas coming from a stove (after a valve is turned on) and leaks from furnaces and hot water heaters would be nearly impossible to detect without expensive equipment. In other words, Mercaptan's smell is a very valuable safety feature.

The proposed natural gas transmission line does not include the use of Mercaptan as an odourant.
E. Pipeline Components

The proposed transmission pipeline consists of a number of components which ensure the efficiency and reliability that is needed from a system that delivers product year round, twenty four hours a day, and consists of a number of different components.

Transmission pipelines can measure anywhere from 6 to 48 inches in diameter. The pipeline in the Saint John application will be 30 inches in diameter. The actual pipeline itself, commonly called “line pipe”, consists of a strong carbon steel material. Pipelines are produced in steel mills, which are sometimes specialized to produce only line pipe. Transmission line pipe is covered with a specialized coating to protect the pipe from moisture so that it does not corrode once placed in the ground.

F. Line Blocking Valves (LBV)

Transmission pipelines include a great number of valves (line blocking valves) along their entire length. These valves work like gateways; they are usually open and allow natural gas to flow freely, or they can be used to stop gas flow along a certain section of pipe. There are many reasons why a pipeline may need to restrict gas flow in certain areas. For example, if a section of pipe requires replacement or maintenance, valves on either end of that section of pipe can be closed to allow engineers and work crews safe access. These large valves can be placed every 5 to 20 miles along the pipeline, and are subject to regulation by safety codes. There will be three such valves installed between the LNG facility at Canaport and the Saint John City limits.

G. Control Stations and SCADA Systems

Natural gas pipeline companies have customers on both ends of the pipeline: 1) the producers and processors that input gas into the pipeline; and 2) the consumers and local distribution companies that take gas out of the pipeline. In order to manage the natural gas that enters the pipeline, and to ensure that all customers receive timely delivery of their portion of this gas, sophisticated control systems are required to monitor the gas as it travels through all sections of what could be a very lengthy pipeline network. To accomplish this task of monitoring and controlling the natural gas that is traveling through the pipeline, centralized control stations collect, assimilate, and manage data received from monitoring and compressor stations all along the pipe.

Most of the data that is received by a control station is provided by Supervisory Control and Data Acquisition (SCADA) systems. These systems are essentially sophisticated communications systems that take measurements and collect data along the pipeline (usually in metering or compressor stations and valves) and transmit them to the centralized control station. Flow rate through the pipeline, operational status, pressure, and temperature readings may all be used to assess the status of the pipeline at any one time. These systems also work in real-time, meaning that there is little lag time between the measurements taken along the pipeline and their transmission to the control station.
This information, relayed to a centralized control station, enables pipeline engineers to know exactly what is happening along the pipeline at all times. This allows reactions to equipment malfunctions, leaks, or any other unusual activity along the pipeline. Where necessary, SCADA systems also incorporate the ability to remotely operate certain equipment along the pipeline, including compressor stations, allowing engineers in a centralized control center in this case Houston, Texas to immediately and easily adjust flow rates in the pipeline.  

(Office of Pipeline Safety, Department of Transportation, USA)

H. Pipeline Inspection and Safety

In order to ensure the efficient and safe operation of the extensive network of natural gas pipelines, pipeline companies routinely inspect their pipelines for corrosion and defects. This is done through the use of sophisticated pieces of equipment known as pigs. Pigs are intelligent robotic devices that are propelled down pipelines to evaluate the interior of the pipe. Pigs can test pipe thickness, and roundness, check for signs of corrosion, detect minute leaks, and any other defect along the interior of the pipeline that may either impede the flow of gas, or pose a potential safety risk for the operation of the pipeline. Sending a pig down a pipeline is fittingly known as 'pigging' the pipeline.

A few of the safety precautions associated with natural gas pipelines include:

1. **Aerial Patrols** - Planes and helicopters are used to ensure no construction activities are taking place too close to the route of the pipeline, particularly in residential areas.

2. **Leak Detection** - Natural gas detecting equipment is periodically used by pipeline personnel on the surface to check for leaks. This is especially important in areas where the natural gas is not odourized.

3. **Pipeline Markers** - Signs on the surface above natural gas pipelines indicate the presence of underground pipelines to the public, to reduce the chance of any interference with the pipeline.

4. **Gas Sampling** - Routine sampling of the natural gas in pipelines ensures its quality, and may also indicate corrosion of the interior of the pipeline, or the influx of contaminants.

5. **Preventative Maintenance** - This involves the testing of valves and the removal of surface impediments to pipeline inspection.

6. **Emergency Response** - Pipeline companies have emergency response teams that train for the possibility of a wide range of potential accidents and emergencies. The M&NP response teams vary from 1 person upwards and respond with the goal of ensuring shutdown of the gas. This response team does not provide tactical mitigation measures to the general public.

7. **The One Call Program** – The City of Saint John has instituted what is known as a 'one call' program, which provides excavators, construction crews, and anyone interested in digging into the ground around a pipeline with a single phone number that may be
called when any excavation activity is planned. This call alerts the City of Saint John and the pipeline company, which may flag the area, or even send representatives to monitor the digging. (Office of Pipeline Safety, Department of Transportation, USA)

I. Failures

Failure of a natural gas pipeline can occur due to a number of different causes such as external interference, corrosion, fatigue, ground movement, material or construction defects. The failure modes that can occur are leaks (punctures) or breaks (ruptures). The failure mode is determined by the length, depth and type of defect, and is dependent on the pipe diameter, wall thickness, material properties and the operating pressure.

J. Gas Outflow

Due to the pressure at which transmission pipelines are operated, a failure of a pipeline leads to a turbulent and complex gas release. Following a rupture or large puncture of a pipeline, there will be a rapid depressurization of the pipeline in the vicinity of the failure. For buried pipelines, the overlying soil will be ejected with the formation of a crater of a size and shape which influences the behavior of the released gas.

Depending on the alignment of the pipe-ends in the case of a rupture, the gas will escape to the atmosphere in the form of a jet, or jets. At the start of the release, a highly turbulent mushroom shaped cap is formed which increases in height above the release point due to the source momentum and buoyancy, and is fed by the gas jet and entrained air from the plume which follows. In addition to entrained air the release can also result in entrainment of ejected soil into the cap and plume. Eventually, the cap will disperse due to progressive entrainment and a quasi-steady plume will remain.

Immediately following a rupture the flow from each side of the rupture will be balanced. However, at later stages the flow through each limb will be determined by the behaviour of the pipeline system. This is affected by features such as compressor stations or feeds from, or to, other pipelines which may be at large distances from the failure point. These boundary conditions determine whether the flow through the pipeline at the rupture will decrease to zero or to a steady-state flow. (Office of Pipeline Safety, Department of Transportation, USA)

K. Ignition

Ignition can occur at any time during the release of natural gas. If ignition occurs immediately on, or shortly after a rupture, a transient fireball will occur. The fireball which is the result of combustion of the mushroom-shaped cap lasts, typically, for up to thirty seconds and then burns out leaving a quasi-steady state fire. If ignition occurs after the initial highly transient phase, the transient involved in establishing a quasi-steady fire is much less pronounced. (Office of Pipeline Safety, Department of Transportation, USA)
L. Thermal Radiation and its Effects

The levels of thermal radiation on the area surrounding the ignited release vary with time after rupture and with distance from the release point and are dependent on the shape, nature, and extent of the fire (determined by the source and atmospheric conditions), and the atmospheric transmissivity between the fire and the receiver (determined by the humidity). (Office of Pipeline Safety, Department of Transportation (US))

Both people and property in the vicinity of an ignited pipeline release can be affected by the levels of incident thermal radiation. People can die as a result of receiving large thermal radiation doses (suffer burns) and buildings can be ignited by thermal radiation directly from the fire, or from secondary fires (e.g. from burning vegetation). The release following a pipeline rupture is transient, with the outflow decaying significantly over the time period for which the thermal radiation effects are quantified. The structures exposed to the initial or transient phase of the fire will continue to burn out of control even though the pipeline fire extinguishes itself due to lack of fuel.

(Stephens)
IV. **Analysis of Applicable Standards**

The resolution of Common Council required a comprehensive analysis of all safety regulations and standards that apply to the proposed project. The first part of this process is a review of Emera Brunswick Pipeline Company’s application to the National Energy Board to identify the standards and regulations with which the proponent agreed to comply. Next is a review of accepted industry standards and regulations for the construction and operation of a natural gas pipeline. Finally this section of the analysis verifies that the safety standards and regulations being specified by Emera Brunswick Pipeline Company (in their application to the National Energy Board) are, in fact, the highest acceptable standard or regulation for natural gas pipeline installation and operation.

A. **Emera Brunswick Pipeline’s Application to the NEB**

Emera Brunswick Pipeline’s application to the National Energy Board states that the engineering design philosophy for the project is as follows:

*The Brunswick Pipeline will be designed, constructed and tested in accordance with CSA Z662-03, the provisions of the NEB Act and other applicable governing codes. Emera Brunswick Pipeline Company will comply with the requirements of the Onshore Pipeline Regulations, 1999 for the construction, operation and maintenance of the pipeline. The service fluid is sweet natural gas and the design pressure for the components and piping is 9,930 kPa. There will be 100% non-destructive examination of all welds for the Project. Welding and testing will follow the requirements as per CSA Z662-03. The facility will be tested in accordance with DEGT Procedure TP-CT1.0 dated May 5, 2004, Pressure Testing of Gas Transmission Facilities, which complies with the requirements of:

- CSA Z662-03 Oil and Gas Pipeline Systems; and
- The Onshore Pipeline Regulations, 1999.

* (Emera Brunswick Pipeline Company Ltd., Application to the National Energy Board, May 2006, Page 48)

The Proponent states numerous times in its NEB submission that it will also comply with the below list of industry standards:

- CSA Z662-2003 – Oil and Gas Pipeline Systems
- CSA Z245.1-2002 – Steel Line Pipe
- CSA Z245.11-2005 – Steel Fittings
- CSA Z245.12-2005 – Steel Flanges
- CSA Z245.15-2005 – Steel Valves
- CSA Z245.20-2002 – External Fusion Bond Epoxy Coated Steel Pipe
- CSA Z245.21-2002 – External Polyethylene Coating for Pipe
- CSA C22.1-2006 – Canadian Electrical Code, Part I
- NRC National Building Code of Canada 2005
- 5.2.3 Quality Assurance and Quality Control
B. Review of Industry Standards for Natural Gas Pipeline Installation and Operations

This Risk Analysis does not address the numerous worker health and safety regulations required to be followed as part of the construction; it only focuses on natural gas pipeline standards that impact the general public.

The National Energy Board (NEB) is the primary authority having jurisdiction over inter-provincial or international natural gas pipeline projects. The NEB Act itself does not make specific reference to CSA or other safety standards. All applicable references to safety standards can be found in the Onshore Pipeline Regulations of the NEB Act. It is this regulation that governs the design, construction, operation and abandonment of pipelines. More specifically the Onshore Pipeline Regulations, 1999 of the NEB Act, make reference to three Canadian Standard Association safety standards; being CSA Z662 (oil and gas pipeline systems); CSA Z276 (LNG production and Storage); and CSA Z341 (storage of underground hydrocarbons).

Similarly, the Canadian Standards Association makes reference to four standards related to the design, construction and operation of natural gas pipelines. These safety standards are: CSA Z245 (steel pipe, fitting and flanges); CSA Z276 (LNG production and storage); CSA Z341 (Storage of hydrocarbons underground); and CSA Z662 (oil and gas pipeline systems).

The CSA standards applicable to the Emera Brunswick Pipeline Project are Z245 and Z662. Standards Z276 and Z341 are not applicable to this component of the project. Of the two applicable standards, Z662 is the most applicable to the Risk Analysis. CSA Standard Z662 covers the design, construction, operation, and maintenance of oil and gas industry pipeline systems that convey: a) liquid hydrocarbons, including crude oil, multiphase fluids, condensate, liquid petroleum products, natural gas liquids, and liquefied petroleum gas; b) oilfield water; c) oilfield steam; d) carbon dioxide used in oilfield enhanced recovery schemes; or e) gas.

The scope of this standard includes: a) oil industry fluids, piping and equipment in offshore pipelines, onshore pipelines, tank farms, pump stations, pressure-regulating stations, and measuring stations; b) oil pump stations, pipeline tank farms, and pipeline terminals; c) carbon dioxide pipeline systems, piping and equipment in onshore pipelines, pressure-regulating stations, and measuring stations; d) gas industry fluids, piping and equipment in offshore pipelines, onshore pipelines, compressor stations, measuring stations, and pressure-regulating stations; e) gas compressor stations; and f) gas storage lines and pipe-type and bottle-type gas storage vessels.

The CSA Standard Z662 is intended to establish essential requirements and minimum standards for the design, construction, and operation of oil and gas industry pipeline systems.
C. Applicability of standards put forth by the Proponent

The project proponent clearly states that it intends to adhere to CSA Z245 and CSA Z662; the two key standards regulating the construction and operation of a natural gas pipeline.

The proponent also states it will adhere to the Onshore Pipeline Regulations. As noted above, this regulation covers a wide range of safety issues with respect to the planning, construction and maintenance of gas pipelines. For the purpose of this Risk Analysis, the most applicable section of the Onshore Pipeline Regulation is Part 6. This part of the regulation deals with operations and maintenance. More specifically this section requires the proponent to:

- **Create an Emergency Procedures Manual**
  “A company shall develop, regularly review and update as required, an emergency procedures manual. As part of this process, the Company shall establish and maintain liaison with the agencies that may be involved in the emergency response on the pipeline and shall consult with them in development and updating the emergency procedures manual. The Proponent shall take all reasonable steps to inform all persons who may be associated with an emergency response activity on the pipeline of the practices and procedures to be followed and make available to them the relevant information that is consistent with that which is specified in the emergency procedures manual.”

- **Continuing Education Program**
  “The Proponent shall develop a continuing education program for the police, fire departments, medical facilities, other appropriate organizations and agencies and the public residing adjacent to the pipeline to inform them of the location of the pipeline, potential emergency situations involving the pipeline and the safety procedures to be followed in the case of an emergency.”

In summary, the Proponent is agreeing to abide by all applicable safety regulations as required by the governing authority. In fact, the Proponent is agreeing to incident mitigation planning. It is up to the City of Saint John to ensure that the Proponent addresses the above two referenced portions of Part 6 of the Onshore Pipeline Regulations in accordance with community needs.

D. Stakeholders

Some of the stakeholders that Emera Brunswick Pipeline Company Ltd. should consult and include in its Emergency Procedures Manual and Continuing Education Program, as required under the Onshore Pipeline Regulation include but are not limited to the following:

**Community / Institutional / Utility**
- Department of Public Safety - Saint John Regional Correction Centre
- AHSC - Centracare / Ridgewood Veterans / Ridgewood Addiction
- School District 8 - Champlain Heights School
V. **Event Causation**

The Bercha Group prepared the risk analysis portion of Emera Brunswick Pipeline’s submission to the N.E.B. The following tables illustrate the type of causes that have (in the past) led to a leak or rupture in transmission pipelines.

**Historical Gas Pipeline Leak Causal Distribution (1995-2003)**

<table>
<thead>
<tr>
<th>NEB Leak Cause Classification</th>
<th>Historical Dist. (%)</th>
<th>Historical Failure Rate (per km-yr)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>CORROSION</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>• Internal</td>
<td>6.1</td>
<td>2.45E-05</td>
</tr>
<tr>
<td>• External</td>
<td>26.3</td>
<td>1.05E-04</td>
</tr>
<tr>
<td>• Stress Corrosion Cracking</td>
<td>20.0</td>
<td>8.02E-05</td>
</tr>
<tr>
<td><strong>EXTERNAL IMPACT</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>• Third Party Damage</td>
<td>9.0</td>
<td>3.61E-05</td>
</tr>
<tr>
<td>• Natural Forces</td>
<td>1.2</td>
<td>4.81E-06</td>
</tr>
<tr>
<td><strong>OPERATIONAL</strong></td>
<td>27.5</td>
<td>1.10E-04</td>
</tr>
<tr>
<td><strong>MATERIAL FAILURE</strong></td>
<td>7.1</td>
<td>2.85E-05</td>
</tr>
<tr>
<td>• Defect</td>
<td>5.1</td>
<td>2.05E-05</td>
</tr>
<tr>
<td>• Fatigue</td>
<td>2.0</td>
<td>8.02E-06</td>
</tr>
<tr>
<td><strong>OTHER</strong></td>
<td>2.8</td>
<td>1.12E-05</td>
</tr>
<tr>
<td><strong>TOTALS</strong></td>
<td>100.0</td>
<td>4.01E-04</td>
</tr>
</tbody>
</table>

**TABLE VI-2**

<table>
<thead>
<tr>
<th>NEB LEAK CAUSE CLASSIFICATION</th>
<th>HISTORICAL DISTRIBUTION (%)</th>
<th>HISTORICAL FAILURE RATE (per km-yr)</th>
</tr>
</thead>
<tbody>
<tr>
<td>CORROSION</td>
<td>50.0</td>
<td>2.45E-05</td>
</tr>
<tr>
<td>• Internal</td>
<td>6.7</td>
<td>3.28E-06</td>
</tr>
<tr>
<td>• External</td>
<td>28.3</td>
<td>1.39E-05</td>
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<tr>
<td>• Stress Corrosion Cracking</td>
<td>15.0</td>
<td>7.35E-06</td>
</tr>
<tr>
<td>EXTERNAL IMPACT</td>
<td>26.1</td>
<td>1.28E-05</td>
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<tr>
<td>• Third Party Damage</td>
<td>17.4</td>
<td>8.53E-06</td>
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<tr>
<td>• Natural Forces</td>
<td>8.7</td>
<td>4.26E-06</td>
</tr>
<tr>
<td>OPERATIONAL</td>
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<td>3.19E-06</td>
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<td>MATERIAL FAILURE</td>
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<td>4.26E-06</td>
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<tr>
<td>• Defect</td>
<td>4.4</td>
<td>2.13E-06</td>
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<tr>
<td>• Fatigue</td>
<td>4.4</td>
<td>2.13E-06</td>
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<tr>
<td>OTHER</td>
<td>8.7</td>
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</tr>
<tr>
<td>TOTALS</td>
<td>100.0</td>
<td>4.90E-05</td>
</tr>
</tbody>
</table>

**Intentional Acts**

On an increasing basis, security agencies are becoming concerned with individuals and groups who pose a threat to natural gas infrastructure. The New Brunswick Securities and Emergencies Directorate has stated that “this proposal is noteworthy because it links a new LNG import terminal to an international market as its primary intent…. There is information that suggests that such installations are of interest to groups who may wish to disrupt pipeline operations… In relation to this specific proposal, there are two notable elements: the corridor proximity to major urban infrastructure and population concentrations and the size and pressurization of the proposed line”. See attached letter from the New Brunswick Security and Emergencies Directorate 9 September 2006

As well, the following is taken from The Integrated Threat Assessment Centre (ITAC), Intelligence Assessment 2006 03 24, Unclassified.

- “Terrorist organizations have attacked natural gas pipelines and facilities world wide in the past…”
- (p 4) “The continued threat to the world’s energy infrastructure by terrorist groups poses a serious threat to the LNG Industry”.

Groups listed as posing a threat, planning attacks or carrying out pipeline or other Natural Gas infrastructure terrorism include:
• The Covenant, The Sword and The Arm of the Lord (CSA);
• Hezbollah
• Basque Fatherland and Freedom Separatist Group
• Al Qaeda – “The most affective way for terrorists to disrupt the global economy is to attack the oil supply which is the provision line feeding artery of the life of the crusader nation.” (*ITAC, CSIS*)

On security issues around the pipeline, the Saint John Fire Department looks to the Saint John Police Force as the authority having jurisdiction.

VI. **Probabilities and Possibilities - Types and Events**

A. Leaks

Through research it has been shown that there is a very low probability of a leak given the pressure in the line (1,440 psi). Conversely, the highest probability in the event of a leak is that the leak will become a rupture very quickly. At 1,440 psi and with 1 billion cu/ft of product to travel daily through the proposed 30 inch diameter pipeline, the product will self excavate very quickly.

B. Leak/Vapour Cloud (Non ignited Gas Dispersion)

If a leak occurs due to corrosion (the highest probability), a natural gas vapour cloud will spread in the vicinity of the leak, and if unignited, it will dissipate to atmosphere quickly (*Bercha, Stephens*). The immediate concern for emergency responders is to eliminate downwind ignition sources and close the LBVs. Evacuation may be necessary. To accomplish this, clear Command, Control and Communications between responders is imperative. This is best achieved through Unified Command, the Fire Department’s command post as utilized during the Enbridge leak (Crown Street, 2005), and SJEMO Mobile Command Unit linked to the SJEMO Emergency Operation Centre. Should this leak event occur, in the context of the proponent’s application, there would be the added safety and response complexity as the proponent is not adding the odourant Mercaptan.

C. Probabilities and Possibilities

The Bercha Group risk analysis of the proposed natural gas pipeline provides a historical and proposed representation of natural gas leaks and ruptures. The table as presented below is an illustration of the calculations as proposed by the Bercha Group.

**Probabilities:**

<table>
<thead>
<tr>
<th>LEAK</th>
<th>HOLE / RUPTURE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Historical</td>
<td>Proposed</td>
</tr>
<tr>
<td>4.01 / 10,000 km</td>
<td>1.61 / 10,000 km</td>
</tr>
<tr>
<td></td>
<td>Historical</td>
</tr>
<tr>
<td>.49/ 10,000 km</td>
<td>.19 /10,000 km</td>
</tr>
</tbody>
</table>
The probability tree diagram shown below provides a representation of a natural gas incident event sequence, as well as the ratio and types of possible occurrences (jet fire, flash fire, explosion, and dispersion). Moving from left to right on the tree diagram the data provides that a gas leak (L) will ignite 10 percent of the time and that this ignition will be immediate 10 percent of the time, and that this immediate ignition will always result in a jet fire at an overall rate of 1 percent (.10 x .10) of the time, that there is a natural gas leak.

![Probability Tree Diagram](image)

Integrating the calculations from both tables illustrates that a natural gas leak happening at a rate of 4.01 occurrences per 10,000 kilometers/year will result in an immediate jet fire 0.04 times a year (4.01 x .10 x .10) or (4.01 x .01). In other words, the probability of a rupture that ignites is low, but the reality is that some day a pipeline failure will occur along some portion of the pipeline. *(Tracey)* *(This line was revised from the original report, see page 92.)*
Documented Natural Gas Pipeline Incidents

The below table lists historical ruptures and leaks that were reviewed as part of the Risk Analysis.

<table>
<thead>
<tr>
<th>Date</th>
<th>Report</th>
<th>Location</th>
<th>Incident</th>
<th>Damage</th>
<th>Maximum Burn Distance</th>
<th>Dia. (in)</th>
<th>Press. (psi)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1974</td>
<td>NTSB-PAR-75-3</td>
<td>Farmington, New Mexico</td>
<td>Rupture at 3:45 a.m. on March 15th, ignition soon after failure</td>
<td>Earth charred within a 300 ft diameter circle, 3 fatalities</td>
<td>12.75</td>
<td>497</td>
<td></td>
</tr>
<tr>
<td>1976</td>
<td>NTSB-PAR-77-1</td>
<td>Cartwright, Louisiana</td>
<td>Rupture at 1:05 p.m. on August 9th, ignited within seconds.</td>
<td>Burn area 3 acres (implies a 200 ft radius circle), 6</td>
<td>20</td>
<td>770</td>
<td></td>
</tr>
<tr>
<td>1982</td>
<td>NTSB-PAR-83-2</td>
<td>Hudson, Iowa</td>
<td>5 fatalities (within 150 ft, less than 50 ft offset).</td>
<td></td>
<td>20</td>
<td>820</td>
<td></td>
</tr>
<tr>
<td>1984</td>
<td>NTSB-PAR-86-1</td>
<td>Near Jackson, Louisiana</td>
<td>Rupture at 1:00 p.m. on November 25th, ignition soon after failure.</td>
<td>Burned area 1450 ft long by 360 ft wide (furthest fire extent 950 ft), 5</td>
<td>Offset 180 ft. Distance 950 ft (289.56 Meters)</td>
<td>30</td>
<td>1016</td>
</tr>
<tr>
<td>1985</td>
<td>NTSB-PAR-87-1</td>
<td>Near Beaumont, Kentucky</td>
<td>Rupture at 9:10 p.m. on April 27th, ignition soon after failure.</td>
<td>Burned area 500 ft wide by 700 ft. long. 2 houses, 3</td>
<td>Offset 350 ft. Distance 500 ft (152.4 Meters)</td>
<td>30</td>
<td>990</td>
</tr>
<tr>
<td>1986</td>
<td>NTSB-PAR-87-1</td>
<td>Near Lancaster Kentucky</td>
<td>Rupture at 2:05 a.m. on February 21st, ignition soon after failure.</td>
<td>Burned area 900 ft. by 1000 ft. 2 houses, 1 house trailer and</td>
<td>Offset 700 ft. Distance 800 ft (243.84 Meters)</td>
<td>30</td>
<td>987</td>
</tr>
<tr>
<td>1994</td>
<td>NTSB-PAR-95-1</td>
<td>Edison, New Jersey</td>
<td>Rupture at night on March 23rd, ignition within 1 to 2 minutes after</td>
<td>Burned area 1400 ft long by 900 ft. wide. Fire damage to dwelling units up to 900 ft. from rupture, dwelling units at 500 ft. and beyond caught fire between 7 to 10 minutes after failure, no fatalities but 58 injuries.</td>
<td>Offset 720 ft. Distance 960 ft (292.61 M)</td>
<td>36</td>
<td>970</td>
</tr>
<tr>
<td>1994</td>
<td>TSB Report No. P94H0003</td>
<td>Maple Creek, Saskatchewan</td>
<td>Rupture at 7:40 p.m. on February 14th, ignition soon after failure.</td>
<td>Fire burn area 21.0 acres (8.5 hectares).</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1994</td>
<td>TSB Report No. P94H0036</td>
<td>Latchford, Ontario</td>
<td>Rupture at 7:13 a.m. on July 23rd, ignition soon after failure.</td>
<td>Fire burn area 11.8 acres (4.77 hectares), heat-affected area 18.6 acres (7.52 hectares).</td>
<td></td>
<td>36</td>
<td>1000</td>
</tr>
<tr>
<td>1995</td>
<td>TSB Report No. P95H0036</td>
<td>Rapid City, Manitoba</td>
<td>Rupture of 42 inch line at 5:42 a.m. on July 29th, ignition soon after failure leading to rupture and fire on adjacent 36 inch line at 6:34 a.m.</td>
<td>Fire burn area 48.5 acres (19.6 hectares), heat-affected area 198 acres (80 hectares).</td>
<td></td>
<td>42</td>
<td>880</td>
</tr>
<tr>
<td>1996</td>
<td>P96H0012</td>
<td>St. Norbert, Manitoba</td>
<td>Rupture, explosion and fire occurred on the 864-millimetre (34-inch) natural gas pipeline southwest of Winnipeg, near the town of St. Norbert, Manitoba.</td>
<td>Flying debris and a gyser of mud and water observed shooting up from the La Salle River, at a point where TCPL crosses the river.</td>
<td></td>
<td>34</td>
<td>725</td>
</tr>
<tr>
<td>1997</td>
<td>P97H0063</td>
<td>Cabri, Saskatchewan</td>
<td>Rupture on a 914-millimetre outside diameter line near Cabri, Saskatchewan.</td>
<td>Approximately 3,252 × 10⁷ cubic meters of natural gas was released. The gas ignited immediately, resulting in damage to the surrounding soil and vegetation.</td>
<td></td>
<td>36</td>
<td></td>
</tr>
<tr>
<td>2000</td>
<td>P00H0037</td>
<td>Hope, British Columbia</td>
<td>Rupture of a 762-millimetre outside diameter pipeline near Exit 217, Coquihalla Highway, British Columbia.</td>
<td>Several vehicles at the rest stop were damaged as a result of thrown debris from the explosion. There were no injuries. The Highway was closed for 3 ½ hours.</td>
<td></td>
<td>30</td>
<td></td>
</tr>
<tr>
<td>2000</td>
<td>NTSB Report PB 2003-916501</td>
<td>Carlsbad, TX</td>
<td>Rupture of a 30° natural gas pipeline</td>
<td>12 persons killed</td>
<td>675 ft</td>
<td>30</td>
<td>700</td>
</tr>
<tr>
<td>2002</td>
<td>P02H0017</td>
<td>Brookdale, Manitoba</td>
<td>Rupture of 36 inch line transmission pipeline, the sweet natural gas ignited and later self-extinguished.</td>
<td>No fatalities. 100 people evacuated for one day as a precaution.</td>
<td>36</td>
<td>6065 kPa</td>
<td></td>
</tr>
<tr>
<td>2002</td>
<td>NEB Report 15 May 2002</td>
<td>Fort St. John British Columbia</td>
<td>Rupture of natural gas line 15:08 MST West Coast Energy (Duke Energy)</td>
<td>Rupture resulting in evacuation; shelter in place; restrictions of air, rail and road traffic</td>
<td>N/A</td>
<td>18</td>
<td>1000</td>
</tr>
</tbody>
</table>
Natural Gas Transmission Pipeline Operators Incident Summary  
Statistics by Year Jan. 1, 1986 to July 31, 2006 (USA*)

<table>
<thead>
<tr>
<th>Year</th>
<th>No. of Incidents</th>
<th>Fatalities</th>
<th>Injuries</th>
<th>Property Damage</th>
</tr>
</thead>
<tbody>
<tr>
<td>1986</td>
<td>83</td>
<td>6</td>
<td>20</td>
<td>$11,166,262</td>
</tr>
<tr>
<td>1987</td>
<td>70</td>
<td>0</td>
<td>15</td>
<td>$4,720,466</td>
</tr>
<tr>
<td>1988</td>
<td>89</td>
<td>2</td>
<td>11</td>
<td>$9,316,078</td>
</tr>
<tr>
<td>1989</td>
<td>103</td>
<td>22</td>
<td>28</td>
<td>$20,458,939</td>
</tr>
<tr>
<td>1990</td>
<td>89</td>
<td>0</td>
<td>17</td>
<td>$11,302,316</td>
</tr>
<tr>
<td>1991</td>
<td>71</td>
<td>0</td>
<td>12</td>
<td>$11,931,238</td>
</tr>
<tr>
<td>1992</td>
<td>74</td>
<td>3</td>
<td>15</td>
<td>$24,578,165</td>
</tr>
<tr>
<td>1993</td>
<td>95</td>
<td>1</td>
<td>17</td>
<td>$23,035,268</td>
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<tr>
<td>1994</td>
<td>81</td>
<td>0</td>
<td>22</td>
<td>$45,170,293</td>
</tr>
<tr>
<td>1995</td>
<td>64</td>
<td>2</td>
<td>10</td>
<td>$9,957,750</td>
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<tr>
<td>1996</td>
<td>77</td>
<td>1</td>
<td>5</td>
<td>$13,078,474</td>
</tr>
<tr>
<td>1997</td>
<td>73</td>
<td>1</td>
<td>5</td>
<td>$12,078,117</td>
</tr>
<tr>
<td>1998</td>
<td>99</td>
<td>1</td>
<td>11</td>
<td>$44,487,310</td>
</tr>
<tr>
<td>1999</td>
<td>54</td>
<td>2</td>
<td>8</td>
<td>$17,695,937</td>
</tr>
<tr>
<td>2000</td>
<td>80</td>
<td>15</td>
<td>18</td>
<td>$17,868,261</td>
</tr>
<tr>
<td>2001</td>
<td>87</td>
<td>2</td>
<td>5</td>
<td>$23,674,225</td>
</tr>
<tr>
<td>2002</td>
<td>82</td>
<td>1</td>
<td>5</td>
<td>$26,713,069</td>
</tr>
<tr>
<td>2003</td>
<td>98</td>
<td>1</td>
<td>8</td>
<td>$49,351,490</td>
</tr>
<tr>
<td>2004</td>
<td>122</td>
<td>0</td>
<td>3</td>
<td>$67,902,001</td>
</tr>
<tr>
<td>2005</td>
<td>182</td>
<td>0</td>
<td>7</td>
<td>$252,231,427</td>
</tr>
<tr>
<td>2006</td>
<td>76</td>
<td>0</td>
<td>3</td>
<td>$34,609,006</td>
</tr>
<tr>
<td><strong>Totals</strong></td>
<td><strong>1849</strong></td>
<td><strong>60</strong></td>
<td><strong>245</strong></td>
<td><strong>$731,326,092</strong></td>
</tr>
</tbody>
</table>

From the website of the “Office of Pipeline Safety” in the United States

*Statistics on property damage not available for Canada*
VII. **Impact / Consequence of a Worst Case Failure Event – Saint John**

A guillotine cut right through the proposed pipeline with immediate ignition of the gas (i.e. worst case event) poses a significant threat to people and property in the immediate area of the event. The below impact drivers could result in a worst case impact / consequence, being a fireball followed by a sustained jet/trench fire.

The impact drivers are:

1) immediate ignition
2) unobstructed release
3) delayed local ignition
4) delayed remote ignition (*Bilo & Kinsman*)
5) hazard potential of over pressure and flying debris (*Stephens*)

The worst case impact / consequence to the general public is thermal radiation from a sustained trench or jet fire which may be preceded by a short lived fireball. The impact / consequence will be a function of: the size of the “failure”; the operating pressure; ignition; time of ignition delay; thermal radiation; time it takes to close the LBV; and flying debris. Conversely, the sustained fire intensity and corresponding size of the affected area will depend directly upon the rate at which fuel feeds the fire.

As stated in Stephens (*Model for sizing high consequence areas...*): “In the event of a pipeline rupture, a mushroom-shaped gas cloud will form; grow in size; and rise due to discharge momentum and buoyancy. This cloud will disperse rapidly and a quasi-steady gas jet or plume will establish itself. If ignition occurs before the initial cloud disperses, the flammable vapour will burn as a rising and expanding fireball before it evolves into a sustained jet or trench fire. If ignition is slightly delayed only a jet or trench fire will develop. Note that the added effect on people and property of our initial transient fireball can be accounted for by overestimating the intensity of the sustained jet or trench fire that remains following the dissipation of the fireball.” (*Stephens*)

**A. Hot Zone, Warm Zone and Cold Zone**

It is imperative for the purposes of risk analysis that the Hazard Consequence Area (HCA) be firmly defined utilizing the above worst case event. For the purposes of this report, the HCA is defined at 300 meters each direction from the perimeter of the proponent’s preferred corridor and (given the worst case event), anyone that is within 300 meters will receive serious or fatal injuries. Property damage within this distance is expected to be significant. For the purpose of this Risk Analysis, the first 300 meters from either side of the perimeter of the proposed pipeline corridor is termed the “Hot Zone.”

Beyond 300 meters, there can be moderate injuries and property damage to a distance of 800 meters each direction. The possibility of serious injuries including second degree burns and property damage due to fire still exists. The 300 meter to 800 meter area is termed the “Warm Zone.”
The area beyond 800 meters along both sides of the perimeter of the pipeline corridor is considered the “Cold Zone”. Injury and property damage from a pipeline rupture are not likely to occur in this zone.

Probabilities and Possibilities - Scenarios

As part of his assessment comments on the pipeline project, Sean Tracey, the Canadian Regional Manager of the National Fire Protection Association, stated that a number of potential scenarios could be envisaged and should therefore be addressed by the proponents. Emergency response plans for the City must be coordinated with the facility proponents at the earliest possible stage and should address the following scenarios:

- Rupture in the natural gas pipeline; and
- Rupture and ignition of the natural gas pipeline.

With respect to the concerns raised in Mr. Tracey’s comments, the Saint John Fire Department prepared two worst case pipeline rupture scenarios which are as follows:

B. Scenario 1 – Pipeline Rupture near Creighton Avenue

**Scenario Analysis 1**

<table>
<thead>
<tr>
<th>Date of Incident:</th>
<th>-</th>
<th>12 September, 2006</th>
</tr>
</thead>
<tbody>
<tr>
<td>Time of Incident:</td>
<td>-</td>
<td>1300 hrs.</td>
</tr>
<tr>
<td>Location of Incident:</td>
<td>-</td>
<td>Behind Creighton Avenue at Champlain Drive</td>
</tr>
<tr>
<td>Dispatch Information:</td>
<td>-</td>
<td>Rupture Pipeline – Huge Fire</td>
</tr>
<tr>
<td>Apparatus Responding:</td>
<td>-</td>
<td>E-2, E-4, L-1 R-5, F-3 (1st alarm) E-1, Q-5 (2nd Alarm)</td>
</tr>
<tr>
<td>Wind Direction:</td>
<td>-</td>
<td>20 to the East</td>
</tr>
<tr>
<td>Weather/Temperature:</td>
<td>-</td>
<td>12º Clear</td>
</tr>
<tr>
<td>OTHER:</td>
<td>-</td>
<td>Report of Catastrophic Gas Line Failure</td>
</tr>
</tbody>
</table>
Information on Dispatch:

- Break in 30 inch natural gas transmission line behind Creighton Avenue
- Report of huge explosion and fire

Information while apparatus is enroute:

- Maritime & Northeast Pipeline has been notified
- Irving tank field is exposed to the nature pipeline fire
- Numerous houses on Creighton Avenue are engulfed in flames
- Wooded and grassland area behind Champlain Drive and leading towards Grandview Avenue are on fire

Information on Arrival:

- Engine 2’s closest approach is from Knox Court
- Engine 4’s closest approach is from Swanton Street and Champlain Drive
• Champlain Heights School is within the Warm Zone (800m) and may not be accessible by responding apparatus. 300 students attend the school.
• Power and communication lines have been knocked out of service in the Champlain Heights area
• SJEMO EOC activated – Mobile Command Post called to the site.

Response Challenges:

• Management of self evacuating residents – multiple casualties and injuries
• Communications and access to 300 students
• Communications and access to residents and traveling public
• Access to incident site
• Size of the incident site
• Possible fires on the Irving Oil property
• Water Supply for fire suppression operations may be affected by explosion
• Maintaining emergency response capabilities within the cold zone (rest of city)
• General alarm of fire fighting personnel called to staff the 4 spare pieces of fire fighting apparatus. Overtime costs being incurred.
• After 3rd alarm of an Engine and Ladder called, only 3 Engines (1 Front Line 2 Spares) & 1 Engine Reserve remain to protect the entire city.
• Incident Command challenges
  o Coordination and accessibility of Unified Command personnel
  o Numerous command staff required to cover operations field
• Numerous fire fronts
• Tactical (foam) supplies to fight tank fires
• Mitigate threat to the rest of the refinery site

C. Possible Scenario 2 – Pipeline Rupture at Millidge Avenue Crossing

Scenario Analysis #2

<table>
<thead>
<tr>
<th>Date of Incident:</th>
<th>12 September, 2006</th>
</tr>
</thead>
<tbody>
<tr>
<td>Time of Incident:</td>
<td>0700 hrs.</td>
</tr>
<tr>
<td>Location of Incident:</td>
<td>Millidge Avenue at Subway Mall</td>
</tr>
<tr>
<td>Dispatch Information:</td>
<td>Rupture Pipeline – Fire / Explosion</td>
</tr>
<tr>
<td>Apparatus Responding:</td>
<td>E-8, Q-5, E-6 R-5, F -3 (1st alarm) E-1,L1-1 (2nd alarm)</td>
</tr>
<tr>
<td>Wind Direction:</td>
<td>10 K to the North</td>
</tr>
<tr>
<td>Weather/Temperature:</td>
<td>12°C Clear</td>
</tr>
<tr>
<td>Possible Cause:</td>
<td>Excavation: performing maintenance/expansion on utility infrastructure</td>
</tr>
</tbody>
</table>
Information on Dispatch:

- Break in 30 inch natural gas transmission line at Millidge Avenue crossing
- Report of explosion and fire.

Information while apparatus is enroute:

- Maritime & Northeast Pipelines has been notified
- High tension power lines have been knocked down
- Electricity to the Millidgeville area has been knocked out
- Electrical Substation on fire
- Millidge Avenue impassible – emergency access delayed
- 16 inch water main supply knocked out
Information on Arrival:

- Fire Ball has engulfed the strip mall as well as the nearby dental clinic
- Fire Ball has impinged upon the Esso Station at Somerset and Millidge Avenue
- Wooded and grassland area within the existing utility line on fire

Response Challenges:

- Gain access to site to mitigate rescue
- Engine 8 only unit immediately on the north side of the incident.
- Additional alarm required to address other fire front – Following 3rd Alarm: 1 (Engine & 1 Ladder) only 2 Engines (1 Spare 1 Front Line) and 1 Engine Reserve are available to protect the City Water supply for fire suppression activities – SJFD has only 2 staffed water Tankers.
- Numerous fire fronts
- Access and egress to Millidgeville area limited to Kennebecasis Drive
- Maintaining suppression capabilities within the cold zone (rest of city)
  - General alarm of firefighting personnel called to staff 4 spare pieces of equipment, over time cost incurred
- Command and Control Challenges
  - Coordination and accessibility of Unified Command personnel
  - Numerous command staff required to cover operations field
  - Lack of coordination will lead to chaos
- Initiating brush & forest fire operations to control spread of forest fire in and beyond the utility lines and toward University Avenue.

D. Emergency Response – Strategy and Tactics

A natural gas transmission line failure has the potential to be a catastrophic event within the municipality. The Saint John Fire Department’s emergency response plan has linked the worst case scenario analysis with a strategic and tactical response plan integrated across each of the transmission zones within our municipality. The Saint John Fire Department will respond to this complex incident relative to its response capabilities with respect to manpower, training and the equipment that is provided by Council and the Proponent.

Research provides that the consequences will include a blast/fire area in the vicinity of 300 meters to 800 meters in all directions. (Bercha, Stephens, National Transportation Safety Board Incident Reports). Given the various residential, commercial, and industrial areas within the City, the Saint John Fire Department (SJFD) divided the proposed pipeline corridor into eight “emergency response” zones. The Risk Analysis then examines the physical characteristics, risk characteristics and response complexities of each of the zones. The SJFD emergency response plan for each zone is based upon an “all hazards” approach with Command and Control provided through the Unified Command System.
**Strategy**

The emergency response strategy incorporates the need to develop a comprehensive (multi-agency) response to a natural gas line incident while sustaining the municipality’s capability to meet regular emergency response demands. The strategic response will include a first and second alarm (7 apparatus with 4 Fire Fighters on each apparatus), the activation of the Emergency Operations Centre (EOC), both Unified and Mobile Command Post placed in the field; the deployment of an emergency site manager as well as fire, EMS and police control officers. Our strategic preparation includes an assessment with respect to the hazards within the particular transmission zone and the necessary hot, warm and cold zones around the incident. Rescue of civilians, as well as the isolation and/or evacuation areas outside of the incident, and the fire suppression efforts necessary to extinguish the fire area and protect the unaffected exposures.

**Tactics**

The emergency response tactics include the actual efforts that are employed to follow through with the identified strategy. For evacuation and perimeter demands, the Saint John Police Force will take the necessary steps to ensure that evacuation and isolation is achieved. For rescue, fire extinguishment and fire exposure hazards, the first and second alarm responding fire companies will utilize large volume nozzles (master streams) both manned and unmanned, to contain the fire (to the involved area); traditional fire fighting tactics will be employed in those areas where it is appropriate. The Fire Suppression tactics will be prioritized to assist in rescue of civilians and the isolation of the Jet or Trench Fires. The pipeline fire itself will not be attacked tactically as it must be burned off following the closure of the LBVs (minimum 15 minutes, Bercha). It is likely that given the areas of the proposed pipeline rupture; there may be simultaneously Hazardous Materials Incidents involving fixed facilities or transportation (Rail, Truck). Such incidents will require strategic and tactical responses beyond that previously noted.

**Summary Emergency Response**

Preparation of our emergency response plans includes the need for enhancements to emergency response infrastructure such as communication and tactical response equipment. This is in addition to training for: emergency operations personnel; and Incident Command and tactical operations. Coordination of “strategies and tactics” to match the particular transmission / “emergency response” zone, combined with increased resources and training, will help ensure that SJFD’s emergency response plans will meet the challenges presented by a natural gas transmission line failure.

Responses to such incidents require a high level of multi-agency coordination and clear communication. A lack of communication can result in inefficient strategic and tactical responses. This was particularly evident amongst the pipeline operators, emergency responders and the municipal responders involved with the Fort St. John incident (*West Coast Energy Inc. (Duke), Fort St. John British Columbia, N.E.B. Pipeline Incident Report 15 May 2002*). In summary, enhances coordination / communication linkages between the incident site and the
Emergency Operations Centre were required to best facilitate public notification, site support, reception centre, as well as the continued emergency management of areas of the city not affected by the incident.

VIII. Response and Consequence Analysis – Saint John

For the purposes of this Risk Analysis, the Saint John Fire Department has broken the linear corridor of the proposed pipeline into 8 Zones. These zones do not correspond to, or represent SJFD’s Fire Demand Zones. The Zones are as follows:

- **ZONE #1** CANAPORT to GRANDVIEW AVENUE SOUTH
- **ZONE #2** GRANDVIEW AVENUE NORTH to LOCH LOMOND ROAD
- **ZONE #3** LOCH LOMOND ROAD, ROTHESAY AVENUE, HIGHWAY # 1
- **ZONE #4** HIGHWAY #1 to SANDY POINT ROAD
- **ZONE #5** SANDY POINT ROAD to INDIAN TOWN
- **ZONE #6** WATER CROSSING – ST. JOHN RIVER
- **ZONE #7** PLEASANT PARK MILFORD to RIDGEWOOD/CENTRACARE, WESTFIELD ROAD
- **ZONE #8** WESTFIELD ROAD to CITY LIMITS

It is apparent from this analysis that the SJFD will be highly challenged to effectively respond to incidents in these Zones during a worst case pipeline incident (given the “response complexities”, scope of the incident, and available resources).
A. ZONE #1 – Canaport Property to Grandview Avenue South

Fire Demand Zone 2:

First in Alarm: Engine 2, Engine 4, Ladder 1, Rescue 5, Fire Command 3
Second Alarm: Engine 1, Quint 5; Deputy Fire Chief (F-2), Fire Chief (F-1), District Chief (F-4)

Remaining Staffed Apparatus - Engine 7, Engine 6, and Engine 8

First In Engine Response Time (Approx): 4 to 11 minutes

Linear Pipeline Distance: \(9 \text{ Km} +\)
Dwelling Units in HCA: 79
Population in HCA: 174 (Statistics Canada, 2001 Census)
Property Value in HCA: $158 Million

Existing Critical Infrastructure / Proximity Concerns:

1. Grandview Industrial Park (PCL, IPEX - Plastics Resins and Products)
2. McAllister Industrial Park (Upinor - Plastic Resins and Plastics)
3. Water Line Interface at Grandview Avenue
4. Saint John Regional Correctional Centre

Response Complexities:

1. Response Times
2. Water Supply 3 - 24” water mains crossed by pipeline
3. Access considerations
4. Wildland Interface Consequence Fires
5. Possible loss of water supply for fire fighting at refinery – (Grandview main)
6. Loss of electrical towers resulting in near City-wide power outage.
7. Registered PCB storage site (Grandview Avenue Electrical Substation)
8. Possible simultaneous hazardous materials incidents at plastics manufacturers
ZONE #1 – Canaport to Grandview Avenue South

B. ZONE #2 – Grandview Avenue North to Loch Lomond Road

Fire Demand Zone 2

First In Alarm: Engine 2, Engine 4, Ladder 1, Rescue 5, Fire Command 3
Second Alarm: Engine 1, Quint 5, Deputy Fire Chief (F-2), Fire Chief (F-1), District Chief (F-4)

Remaining Staffed Apparatus – Engine 6, Engine 8, and Engine 7

First In Engine Response Time (Approx): 2 - 4 minutes

Linear Pipeline Distance: \(2.6 \text{ Km}\)
Dwellings Units in HCA: 319
Population in HCA: 701 \((\text{Statistics Canada, 2001 Census})\)
Property Value in HCA: $122 Million

Existing Critical Infrastructure / Proximity Concerns:

1. Irving Oil Refinery
2. Grandview Avenue – Access if destroyed
3. Proximity to public in Champlain Heights
4. Elementary School in Champlain Heights

**Response Complexities:**

1. Possible simultaneously triggered incident Irving Oil Refinery
2. Volume of casualties Champlain Heights
3. Evacuation concerns Champlain Heights
4. Public Notification to efficiently evacuate (or shelter in place) allowing effective fire fighting operations

**ZONE #2 – Grandview Avenue North to Loch Lomond Road**
C. ZONE #3 – Loch Lomond Road (North), Rothesay Avenue to Highway #1

Fire Demand Zones 2 and 4

First In Alarm: Engine 2, Engine 4, Ladder 1, Rescue 5, Fire Command 3
Second Alarm: Engine 1, Quint 5, Deputy Fire Chief (F-2), Fire Chief (F-1), District Chief (F-4)

Remaining Staffed Apparatus – Engine 6, Engine 8, and Engine 7

First In Response Time (Approx): 2 minutes at road crossings. Undetermined in wooded areas should there be no access road.

Linear Pipeline Distance: 1.7 km ±
Dwelling Units in HCA: 779
Population in HCA: 1,713 (Statistics Canada, 2001 Census)
Property Value in HCA: $149 Million

Existing Critical Infrastructure / Proximity Concerns:

1. Hydro Lines
2. Water lines at Loch Lomond, Westmorland and Rothesay Avenue
3. Proximity to residential properties Westmorland Heights, Silver Falls Park
4. Access through Westmorland Road and Rothesay Avenue
5. NB Southern Rail Yard
6. Loss of Thruway

Response Complexities:

1. Possible simultaneously triggered Hazardous Materials Incident N.B. Southern Railroad (i.e. Butane Cars etc.)
2. Loss of water or power due to event
3. Possible simultaneously triggered Hazardous Materials Incident Thruway
D. ZONE #4 – Highway # 1 to Sandy Point Road

Fire Demand Zone 8

First In Alarm: Engine 8, Engine 1, Quint 5, Rescue 5, Fire Command 3
Second Alarm: Engine 6, Ladder 1, Deputy Fire Chief (F-2), Fire Chief (F-1), District Chief (F-4)

Remaining Staffed Apparatus – Engine 2, Engine 4, and Engine 7

First In Engine Response Time (Approx): 3 minutes minimum.

Linear Pipeline Distance: 3.2 KM ±
Dwelling Units in HCA: 35
Population is HCA: 77 (Statistics Canada, 2001 Census)
Property Value in HCA: $27 Million

Existing Critical Infrastructure / Proximity Concerns:

1. Possible Wildland Fire Rockwood Park
2. Loss of transportation corridor
3. Loss of electricity and cell phone service in and around Saint John

**Response Complexities:**

1. Possible Hazardous Materials Incident (Thruway, transportation corridor)
2. Limited water supply in some areas
3. Wildland Interface Fire
4. High voltage wires down

**ZONE #4 – Highway # 1 to Sandy Point Road**
E. ZONE #5– Sandy Point Road to Indian Town

Fire Demand Zone 8

First In Alarm: Engine 8, Engine 1, Quint 5, Rescue 5, Fire Command 3
Second Alarm: Engine 6, Ladder 1, Deputy Fire Chief (F-2), Fire Chief (F-1), District Chief (F-4)

Remaining Staffed Apparatus – Engine 2, Engine 4, and Engine 7
First In Engine Response Time (Approx): 2 – 4 Minutes

Linear Pipeline Distance: 3.7 Km
Dwelling Units in HCA: 1,691
Population in HCA: 3,719 (Statistics Canada, 2001 Census)
Property Value in HCA: $100 Million

Existing Critical Infrastructure / Proximity Concerns:

1. Saint John Regional Hospital will require enhanced joint responder emergency preparedness and response plans given proximity of the facility and access routes, to the proposed corridor.
2. Saint John St. Stephen Nursing Home, Kennebec Manor
3. University Avenue access/egress
4. Water Pumping Station, Varsity Avenue, water main on Millidgeville Ave.
5. Charlton Place
7. Millidgeville substation – largest feed in Saint John, loss of power to most of northern city including the Saint John Regional Hospital
8. Canadian Blood Services

Response Complexities:

1. Access to water in some areas
2. Population density is high
3. Evacuation
4. Possible loss of radio communications
5. Possible loss of firefighting water to Millidgeville
6. Response to the Saint John Regional Hospital given possible loss of other infrastructure (i.e. Water, Power, Radio etc.)
7. Public Notification – large scale evacuation or protect in place
**F. ZONE #6– Water Crossing – St. John River**

**Fire Demand Zone 8**

First In Alarm: Engine 8, Engine 1, Quint 5, Rescue 5, Fire Command 3 (Anticipated Vapour Cloud)

Second Alarm: Engine 6, Ladder 1, Deputy Fire Chief (F-2), Fire Chief (F-1), District Chief (F-4)

Remaining Staffed Apparatus – Engine 2, Engine 4, and Engine 7

First In Engine Response Time (Approx): 2 Minutes

Linear Pipeline Distance: **0.5 Km**

Dwelling Units in HCA: **264**

Population in HCA: **580** *(Statistics Canada, 2001 Census)*

Property Value in HCA: **$11 Million**

**Existing Critical Infrastructure / Proximity Concerns:**

1. High Density, Wood Frame Dwellings (100+ years)
2. Electrical Transmission Towers

**Response Complexities:**

1. Public Notification and evacuation or protect in place. Large numbers of public in this area do not have their own transportation.

**ZONE #6– Water Crossing – St. John River**

**G. ZONE #7– Pleasant Park Milford to Ridgewood/Centrica –South Bay**

**Fire Demand Zone 8**

First in Alarm: Engine 7, Engine 6, Quint 5, Rescue 5, Fire Command 3  
Second Alarm: Engine 1, Ladder 1, Deputy Fire Chief (F-2), Fire Chief (F-1), District Chief (F-4)

Remaining Staffed Apparatus – Engine 2, Engine 4, and Engine 8  
First In Engine Response Time (Approx): 4 Minutes

Linear Pipeline Distance: **4.2 Km**
Dwelling Units in HCA: **724**
Population in HCA: **1,592** *(Statistics Canada, 2001 Census)*
Property Value in HCA: $159 Million

Existing Critical Infrastructure / Proximity Concerns:

1. NB Southern Rail Line
2. Ridgewood Veterans Wing
3. Centracare (long-term mental health facility)
4. Blasting at Bald Hill (possible causation of line failure)
5. High Density Wood Frame Homes and Trailer Park

Response Complexities:

2. Evacuation and Public Notification
3. Water Supply - loss of fire fighting supply to Milford
4. Loss of electrical supply to Milford
5. Possible Hazardous Materials incident – NB Southern Rail Yard
ZONE #7– Pleasant Park Milford to Ridgewood/Centracare – South Bay

Proposed Secondary Means of Egress

Proposed Pipeline Location

L. Murphy Overpass

Proposed Secondary Means of Egress

Proposed Location of Secondary Means of Egress - Milford
H.  ZONE #8– South Bay to City Limits

Fire Demand Zone 8

First in Alarm: Engine 7, Engine 6, Quint 5, Rescue 5, Fire Command 3
Second Alarm: Engine 1, Ladder 1, Deputy Fire Chief (F-2), Fire Chief (F-1), District Chief (F-4)

Remaining Staffed Apparatus – Engine 2, Engine 4, and Engine 8
First In Engine Response Time (Approx): 4 – 6 Minutes

Linear Pipeline Distance: 13.5 Km +
Dwelling Units in HCA: 236
Population in HCA: 519
Property Value in HCA: $44 Million

Existing Critical Infrastructure / Proximity Concerns:

1. Spruce Lake Water Treatment Facility
2. Route #1 (Transportation Corridor)
3. Access to Westfield Road, homes and schools
4. Parallel 16” natural gas lines (1440 PSI MOP)
5. NB Southern Rail Line
6. 24” Crude Oil Pipeline
7. Lorneville access/egress

Response Complexities:

1. Possible simultaneous Hazardous Materials Incident (Route 1 Transportation Corridor)
2. Public notification – evacuation, (Protect in Place) would affect efficiency of fire fighting operations.
3. Access / egress to Lorneville
The 30”Emera Pipeline will cross the King William Road at the head of Spruce Lake Industrial Park. This road is the only maintained access to Lorneville. The proposed 30” line will cross the King William Road at the same location as the existing 16” natural gas pipeline and a 24” crude oil pipeline.
IX. Review of Bercha Group’s Quantitative Risk Analysis Document

The Proponent’s NEB submission for the proposed 30 inch high pressure natural gas transmission pipeline contained a number of supporting documents. One of the supporting documents is a report from the Bercha Group, titled “Quantitative Risk Analysis of the Proposed Brunswick Natural Gas Pipeline (Final Report)”. The report was commissioned by Maritimes and Northeast Pipeline as part of their supporting material. Jacques Whitford Limited was commissioned to facilitate the analysis; they in turn subcontracted the work to the Bercha Group. As part of the Saint John Fire Department Risk Analysis, staff reviewed the subject Bercha Group report and provide the following comments and concerns.

A. Statistical Probability

The Bercha document focuses on determining the statistical probability of an incident occurring. The SJFD takes no issue with these calculations; however, the SJFD considers consequence to be of primary importance given that “incidents” can happen, as revealed in our historical analysis.

Comparison of statistical probability to background risks (i.e., being struck by lightning or in a flood) is not an adequate representation from the standpoint of consequence should an incident occur. An incident would affect many citizens and infrastructure at one time.

It is recognized and agreed that “the individual risk levels to members of the public were in acceptable limits, and in the insignificant risk regions.” (Bercha, p. VII). Although statistical analysis appears to support this assertion, the SJFD recognizes by virtue of this Risk Analysis that indeed the risk to the “urbanized public” is high based upon the consequence of such an event having a high probability of being catastrophic.

With regard to the “Assessment of Proposed Brunswick Pipeline Failure Frequency” (Bercha 3.3.2) it was noted that “natural forces”, as a cause of pipeline failures, were discounted. The Fire Department is of the belief that natural forces cannot be discounted in any analysis. With respect to the proposed pipeline corridor, the Fire Department has a concern with the tremors caused by blasting at nearby Bald Hill; landslides, given the hilly terrain that must be traversed along proposed corridor; potentially caustic rock and soils conditions; and the unstable soil conditions along Rothesay Avenue. The impact these forces may have on the pipeline has not be clearly reviewed by the proponent.

B. Operations

It is noted that the odourant Mercaptan is not being added to the product (or it is not outlined in the “Natural Gas Properties” section 2.2.5 or elsewhere in the document.)

The SJFD is concerned about the presence of water in the lines as a result of condensation given our rapidly changing climate. It has been noted that many of the past failures (resulting in incidents) have been the result of corrosion.
The Saint John Fire Department is concerned that there are only 3 valve (LBV) sites chosen within Saint John, recognizing that there will be the same number of valves between the Saint John City limits and the US border (ref p. iii of document). Research has indicated that closure of LBV is a last option following, under most circumstances, a visual assessment by gas utility personnel. The SJFD is concerned that the charted “15-minute minimum delay” in deploying LBV is not acceptable and believes that in reality the delay could be much longer given the current emergency response protocols adopted by M&NP (Emera).

C. Planning

“The Emergency Response Plan (ERP) should be developed in conjunction with local emergency response agencies and public representatives to manage a possible emergency” (Bercha p IX). The SJFD agrees with this statement made in the Bercha document and contends that the ERP should recognize all contingencies and create appropriate evacuation plans for affected areas. All planning costs should be borne by the proponent.

The SJFD is concerned with 2.2.4 on p. 2.8 on the Bercha document which states “If a rapid pressure drop were detected by the control centre (in Houston), field personnel would typically be able to verify a line leak or rupture in a short period of time, after which remote closure of the valves would be initiated in time to mitigate consequences…” With respect to the position being put forth:

- At no time in this report is it outlined that the 9-1-1 will be notified (or that the SJFD will be called to respond) to a natural gas leak incident.
- Realistically, given that there is a failure or event to create the rapid pressure drop, the 15-minute minimum to close the LBVs is slow. Having M&NP (Emera) staff respond from outside the city to confirm an event is unacceptable.
- Communications may be delayed:
  1) between the pipeline and Control Centre Houston, Texas, if there is a cell, land line or satellite failure.
  2) between Houston and M&NP staff and/or SJFD should there be satellite/cell/trunk radio failure (the latter possibly caused by the explosion).

With respect to emergency training and drills, the Bercha document states that “Operating personnel to be trained and drilled in emergency procedures and use of the Emergency Response System” (Table 6.1). This supports the SJFD’s accretion with regards to training and program development for training. Recognizing that the fire service in Saint John has just under 200 firefighters, it is challenged to deliver the current standardized program of training, as well as the necessary Target Hazmat Training (i.e. Power Generating Stations, Irving Oil Refinery, Port of Saint John, Irving Pulp and Paper etc).
The Bercha Group report states “Emergency Response Plan is on file with N.E.B. and local jurisdiction”… (Table 6.1). The Saint John Fire Department has not yet seen the emergency response plan.

The Saint John Fire Department wants the proponent to take the initiative to provide: communication plans; to commit to the planning function on an on-going basis; to help design emergency response plans including appropriate evacuation analysis (with agencies); and to commit to such planning, given the complexities of the proposed corridor.

There is very little difference among the 5-minute blow down characteristics (and therefore consequences) of failures of different segments of pipeline because, until the line block valves are closed (which is 15 minutes or more), the entire pipeline is being emptied through the failure orifice.” The SJFD is concerned that:

1) the LBVs (Line Block Valves are 15 minute-plus-time to be closed)  
2) it is not specified given the operating pressure and diameter of the line, the quantity of gas that would leak given “…the entire pipeline is being emptied through the failure orifice” which may be double sided 30” cut in the case of guillotine cut. In discussions with M&NP personnel, the maximum 24-hour daily quantity is 1 Billion cu/ft.

D. General

Photos of Saint John (Bercha 2.2, 2.13, 2.14) seem to present the route through urban Saint John as being a rural and uninhabited, uncommercialized, non-industrialized area. This is not the case as shown in the SJFD Risk Analysis. In fact, the corridor seems to follow the most industrialized areas of the city. It passes right by the community’s two most complex institutions to evacuate the Saint John Regional Correctional Centre (east); and Centracare (west).

In concurrence with the Bercha report, it is the belief of the Saint John Fire Department that Emergency Response capabilities of the primary service provider (SJFD), should there be a catastrophic event, be deepened to the point where that response is sufficient and sustainable in direct proportion to the magnitude of the potential event itself.
X. Input from Other Sources

A. Sean Tracey, Canadian Director, NFPA

Sean A Tracey, Canadian Regional Manager for the National Fire Protection Association toured Saint John in early September and has provided the following comments about the Saint John LNG plant and proposed natural gas transmission pipeline projects:

- The requirement when going outside of the normal design requirements is the delivery of a project operations and maintenance manual. This document for all intents and purposes serves as the maintenance and operations manual for those on site but more importantly defines the maintenance program for the special fire and life safety systems. It is developed by the project design authority with the Authority Having Jurisdiction (AHJ), and in this case, the City’s Buildings & Technical Services and Fire Departments. The project and operations manual needs to be delivered to the City; it essentially becomes the “fire code” for the facility. It is the only means by which the Fire Department has of verifying maintenance of the specialized fire protection systems on site. The City should verify the design standards being used and ensure that a completed Operations and Maintenance Manual to be delivered, design standards to include:

  CSA Z276-01, Liquefied Natural Gas (LNG) – Production, Storage, and Handling
  CSA Z662-03 Oil and Gas Pipeline Systems; and
  NFPA 594 Standard for the Production, Storage, and Handling of Liquefied Natural Gas (LNG) 2006

- The requirements or expectations of the City for disaster or emergency management with respect to each project should follow **NFPA 1600-Standard for Disaster Management/Business Community Programs 2004 edition.** This document is intended for both public and private entities including protection of critical infrastructure. It is a good starting point for SJEMO and can be used as an expectation of the level of protection at least required by the Canaport LNG and Crude operations as well as an expectation of the support to the pipeline operations by Maritimes and Northeast Pipeline.

- There has been concern over the possibility of large flammable gas fires in populated areas. With vast quantities of gaseous fuels now being transported either in bulk or by pipeline, the likelihood of such occurrences commands attention. In the absence of a major breakthrough in the prevention or suppression of such fires, the most appropriate means of minimizing fire impact is the advanced planning, preparedness, and response of trained emergency personnel.

- The City’s emergency response capability should include the ability to act as the incident verifier and have the authority to request the shutdown of the pipeline directly with Houston. This would save considerable time in any emergency.

- The natural gas pipeline poses a greater concern for potential risk on the community. The current routing of the pipeline does not appear to address the concerns of the City and has
not been adequately addressed from a risk perspective. It would be preferable to have other alternative routes re-evaluated that consider the City’s values in protecting its citizens. Failing that, better mitigative measures should be considered which would include reviewing the emergency management protocols and granting the City’s Emergency Measures Organization a say in pipeline operations through the City.

- At this time a general preparedness program is not available in the community. Such a program could be considered. Programs are available through NFPA using the Risk Watch program but also through Public Safety Emergency Preparedness Canada. These programs are seen as needed based on the incremental risks the projects propose. Public awareness programs on the hazards and appropriate action for natural gas and LNG hazards should also be developed and funded by the respective proponents with delivery coordinated by the EMO offices.

- The proponents of both projects should consider the funding of a jointly sponsored program for public alerting. Other communities in Canada have such systems that can take the form of a reverse 911 call system, to other methods of broadcasting the proper emergency procedures to take in the event of an emergency.

**B. Saint John Energy**

Saint John Energy has identified six areas where the natural gas pipeline intersects or resides along the proposed route through the municipality of Saint John. They are:

- Grandview Avenue Substation
- Ellerdale Street
- Rothesay Avenue
- Millidgeville Substation
- Pokiok Road
- Milford Road

In general, power interruptions can be mitigated on a temporary basis within a few hours. On an individual basis full restoration could take between weeks or at most a single year.

**C. Saint John Emergency Measure Organization**

The municipal coordinator for Saint John EMO provided the following input with respect to the Risk Analysis:

*Emergency Planning*

There is clearly a lack of understanding on the part of the proponents as to the response capability in the community – there appears to be very significant assumptions in terms of capacity of emergency responders (fire, police, EMS, EMO). There is also a lack of appreciation for the nature and extent of training necessary for first responders in the event of an incident.
The pipeline proponent stated that when they conduct their impact assessment, it was restricted to the impact on lives immediately adjacent to the pipeline structure itself, and NOT the impact on other infrastructure such as water, hydro, and telephone utilities.

**Public Alerting**

While there have been some “Public Relations” efforts undertaken by the proponents, there is no evidence that the matter of notifying the public in the event of an incident has been considered to any great extent.

Any Emergency Response Plans must include a Communications Plan.

An Emergency Response Plan must also include an Exercise Plan that will ensure the Plan is tested on a regular basis and in doing so will involve all stakeholders.

**Public Education**

There is a need for the proponents to acknowledge and address the possibilities of incidents and to prepare and deliver a comprehensive public education program advising the public what to expect and what they need to do in terms of general preparedness

A Public Education Program should be funded by the proponents and developed and delivered in conjunction with the various stakeholders.

**Incident Notification**

The on-call manager must come from out-of-town (Fredericton), while the on-call technicians could be as far away as Moncton.

There is no clear (and available documentation) as to the protocol that will be followed in the event of an incident; who gets notified, how and when.

It was suggested that natural gas companies are very reluctant to shut down (turn off valves) until they are absolutely certain this must be done due to the “wear & tear” this causes to the pipes – it appears the first response to an incident would NOT be a shut-off, but rather the situation would be examined by Houston, the area manager, local technicians before such a decision would be taken.
**Day-to-Day Impact of the Proposed Pipeline on SJEMO**

There will be an increase in the number of calls to the SJEMO office from individual citizens, businesses and industry about how they will be protected in the event of an NG pipeline incident. The one staff resource does not have the information, training or technical expertise to respond to such inquiries. There is no single-point resource for information and assistance.

There is insufficient documented information on the potential risks and how these will impact people and infrastructure, and the steps that should be taken in terms of preparedness and protection. A comprehensive public awareness program needs to be developed to keep people advised of the potential dangers. SJEMO does not have the financial or human resources to carry out this responsibility.

There appears to be a general expectation on the part of the community (citizens, industry, and other agencies) that the “turn to” resource in the event of an incident is the City and/or SJEMO. There is a need to educate:

(i) individuals about their personal responsibilities in preparing for and responding to emergencies;
(ii) businesses about their responsibilities to protect their employees and their properties
(iii) industry about their responsibility to not simply meet minimum requirements/standards in terms of emergency preparedness but to share in the responsibility for protecting the community. Industry must share their emergency response plans and other pertinent information with SJEMO and its partners on an on-going basis and in a formalized manner.

SJEMO does not have the resources to undertake such a comprehensive education program to supplement existing educational efforts.

Additionally, the proponent’s expectations of SJEMO and its partner response agencies are not clear nor have they been stated. This needs to be addressed by all parties involved.

**Developing Emergency Response Plans**

Developing emergency response plans to address the many serious hazards in Saint John requires the dedication of considerable human and financial resources as well as a significant time commitment which SJEMO cannot currently meet.

**Incident Notification Protocol**

Given what is understood to be the current notification protocol by the pipeline company, there could be significant delay in notifying SJEMO. This would seriously impact a coordinated response due to the delay in activating the Emergency Operations Centre and
having responding agencies report to the EOC. This mean delays in providing the needed support to the first responders at the site(s).

**Large-scale Evacuations**

The absence of Evacuation Plans for specific neighbourhoods presents a serious concern. The development of such plans for those neighbourhoods impacted by the proposed pipeline would require significant human and financial resources; such plans would take up to a year to develop and test. To conduct large-scale evacuations without a formal Plan would prove very difficult.

**Large-Scale Public Notification**

Public Notification tools available to the community and SJEMO are currently basic in nature and fall short of what would be required in the event of a major incident. Notification through local media is the primary means of notification being used. There is no Community Notification System; there is no Reverse 911 System; the All-Channel Alert System proposed by Pelmorex is awaiting CRTC approval; a provincial EMNet system is also being pursued but is not yet available. Door-to-door notification would present a significant challenge for the Saint John Police Force.

D. Saint John Water

Mr. Peter Hanlon, Chief Water Quality Inspector for the City of Saint John conducted a thorough analysis of the proposed pipeline route. Mr. Hanlon summarized his comments within three main categories.

**The impact on future construction / development**

The natural gas pipeline once in the ground would pose a serious obstacle to any future development: it would require set backs for the protection of property and life; it would physically be in the way of underground utilities – water, sewer, drainage, telephone ducts, electrical ducts, buried cables and any other structures usually found buried in the street right of way (beyond the 30” size there would also be a substantial area below and above the pipeline that would not be accessible for future utilities); it would restrict the type of construction activity that could be undertaken regarding or even simply resurfacing the ground……

**Damage of infrastructure and impact on service to the public, resulting from a failure of the NG pipeline.**

A gas pipeline 30 inches in diameter operating at up to 1,440 pounds per square inch pressure has the real potential to do a lot of damage: initially simply the erosive action of gas escaping at such an extreme pressure; secondly, the destruction done by any resultant explosion; and finally, the damage done by the high heat from the burning gas…. 
Any time the pipeline crosses a public street, or is close to a building there is a risk posed to some portion of the public. Realistically, though, some areas have the potential for a much wider impact on the public than others: some areas have either a high concentration of utilities, residences, transportation routes or high risk businesses. Some of these areas are:

<table>
<thead>
<tr>
<th>Old Black River Road</th>
<th>Lou Murphy Overpass</th>
</tr>
</thead>
<tbody>
<tr>
<td>Irving Oil Limited Refinery, east boundary</td>
<td>Manchester Avenue</td>
</tr>
<tr>
<td>Loch Lomond Road</td>
<td>Pipeline Road West</td>
</tr>
<tr>
<td>Rothesay Road</td>
<td>Gault Road</td>
</tr>
<tr>
<td>Throughway (Highway 1)</td>
<td>Route 7</td>
</tr>
<tr>
<td>Millidge Avenue</td>
<td>King William Road</td>
</tr>
<tr>
<td>Spare Cove Road</td>
<td></td>
</tr>
</tbody>
</table>

Mr. Hanlon identified through scenario analysis, two areas of specific concern with respect to water service vulnerabilities:

- The intersection of Ellerdale and Westmorland and
- The point at which the pipeline crosses Millidge Avenue.

**Lessons learned and advice from other municipalities**

Mr. Hanlon is also working to acquire information with respect to pipeline installations across other Canadian Municipalities; as of the conclusion of this report sourced information provides that most installations are within a wide utility corridor which was originally installed in rural or remote area.
XI. **Findings and Concerns**

*Findings*

It is recognized that the occurrence of a high consequence, worst case failure event involving the proposed natural gas pipeline is of low statistical probability; however, from a due diligence perspective, it is incumbent upon the Saint John Fire Department to conduct a Risk Analysis in relation to the consequences of such an event. Evidence indicates that:

1. There are a number of transmission line failures in North America each year.
2. When there is a failure of a transmission line, it is often catastrophic.
3. Given that the vast majority of transmission pipeline infrastructure is located in rural areas, failures to date have occurred in these areas; the consequences of these failures are not comparable to what could happen in an urban setting.
4. Given the footprint of a pipeline failure and its Hazard Consequence Area (HCA), in comparison to that of an industrial/residential property, the operational challenges associated with mitigation are significantly greater.

To this end the preferred pipeline corridor (as cited by the proponent) presents a number of challenges to the SJFD and members agencies of SJEMO; specifically the proximity of the corridor to:

- Critical infrastructure;
- Key community facilities (i.e. Correctional Centre, Centracare);
- Fuel storage areas / transmission systems;
- Transportation corridors;
- Residential dwellings;
- Neighbourhoods with one means of access and egress (i.e. Milford, Lorneville);
- Conflicting land uses (i.e. ongoing blasting at Bald Hill);

Given the consequences of a pipeline failure, it is incumbent upon the emergency responders to be prepared to respond. This response preparation must be completed in the form of a draft plan prior to operating permits being granted. The proponent’s Bercha risk analysis document states: “*The most important risk mitigation measure for this project is the emergency response capability.*” *(Bercha, p 7.4)* The Saint John Fire Department concurs with this statement.

*Concerns*

The Saint John Fire Department’s Risk Analysis identified the following emergency response concerns with respect to, preparing for, and mitigating a pipeline failure in the urbanized or industrialized area of the proposed corridor:

1. A number of citizens could be killed, injured or affected by the event.
2. Critical Infrastructure and property could be destroyed or affected by the event.

3. Should key critical infrastructure be destroyed (i.e. water mains, radio systems, cell towers, electricity), response to this large scale incident would become more complex.

4. Given our city’s industrial density, simultaneous Hazardous Materials Incidents could be triggered by a pipeline failure.

5. A pipeline failure would challenge the Saint John Fire Department to respond effectively, in the areas of Strategic and Tactical Response given the:
   a. Its current level of natural gas emergency training;
   b. Existing human resource limitations; and
   c. Need to develop comprehensive, integrated pre-incident emergency response plans

6. The need to maintain existing reserve apparatus.

7. SJEMO co-responders would also be challenged by a pipeline failure given the need to:
   a. Create comprehensive contingency and evacuation plans
   b. Communicate with the public effectively during a pipeline failure

8. A review by the Canadian Director of N.F.P.A. also states similar concerns to those of SJEMO and the Saint John Fire Department.
XII. **Recommendations**

**Preamble**

The recommendations associated with the finding and concerns arising out of this Risk Analysis need to be addressed at various junctures and by various stakeholders. Specifically, the concerns that relate to the proposed pipeline corridor need to be satisfied either before or during the November NEB hearings. Issues related to resource and response capabilities and capacities of the SJFD and SJEMO need to be addressed by Common Council. Should the NEB grant permission to the proponent to build the pipeline along the proposed corridor, the remaining concerns will need to be satisfied in the proponent’s Emergency Response Plan (ERP).

**Recommendations (Emera)**

It is recommended that:

1. SJFD and officials with SJEMO continue to meet with Emera Brunswick’s representatives with the objective of resolving the concerns identified in this Risk Analysis; should the parties fail to come to an agreement on resolutions to the concerns; Common Council direct the City Manager and appropriate staff to present the remaining concerns to the NEB for final disposition;

2. The proponent (Emera Brunswick Pipeline Company Ltd.) provide hands-on tactical training for natural gas transmission pipeline emergency response to all Saint John Fire Department personnel (such courses to be funded by the proponent on an ongoing basis);

3. The proponent provide and pay for Command Staff- Incident Command Training for natural gas emergencies;

4. In recognition that the Bercha risk analysis document outlines structural collapse as a likely event (*Bercha, p.4.3*), the proponent provide SJFD with funding to acquire full capabilities in NFPA 1670 competencies for structural collapse and technical rescue; This is to include all applicable structural collapse rescue equipment. (SJFD currently does not have such emergency response equipment);

5. Should the NEB grant an operating permit for the proposed pipeline, then as a condition of operation (*and in compliance with the Onshore Pipeline Regulation, 1999*), the proponent be required to obtain the concurrence of the City of Saint John with respect to the development and implementation of the Emergency Response Plan (ERP) and related public safety requirements, to include public notification capabilities. The scope and nature of the ERP and related public safety requirements must fully comply with all aspects of NFPA 1600 - *Disaster & Emergency Management and Business Continuity Programs*. The costs associated with the development of the ERP shall borne by the proponent;
6. The proponent provide or fund fixed site pipeline training props, to be situated at the Saint John Fire Department Training Academy. This is to include access to a defined supply of natural gas for training scenarios purposes;

7. Consideration be given to adding Mercaptan to the natural gas entering the pipeline so as to provide citizens with an olfactory warning of a leak or line breach; and

8. Consideration be given to adding additional line blocking valves so as to minimize exposure to thermal energy should a ruptured line ignite (in the urban corridor).

**Recommendations (Common Council)**

It is recommended that:

9. Common Council give consideration to reinstating a Training Officer’s position in Training Division.

   During previous presentations to Common Council, the Fire Chief expressed concerns with respect to the availability of adequate training resources. Given the additional training and response requirements associated with the proposed natural gas transmission pipeline project, coupled with current demands; the Saint John Fire Department’s ability to ensure that each and every Firefighter possess the requisite skills and training is further challenged.

10. Common Council give consideration to establishing the position of “Emergency Planner” within SJEMO.

   The SJEMO is currently resourced with one full time position. It has been identified that the demands associated with SJEMO are well beyond existing capacity. The additional complexities arising from the proposed pipeline project, coupled with the evolving community preparedness needs, will require additional human resources to meet emergency preparedness requirements.
XIII. References

Bercha Group, Quantitative Risk Analysis of the proposed Brunswick Natural Gas Pipeline Final Report, 14 February 2006


C.S.I.S. Intelligence Assessment, Integrated Threat Assessment Centre, (unclassified version) “Threat to Canadian Importation of Liquefied Natural Gas (LNG)”

Emera Brunswick Pipeline Company Ltd., Application to the NEB, Brunswick Pipeline, May 2006 (p 50-52)

Jacques Whitford, Preferred Corridor & Corridor Atlantis M. P. 2006, 05, 10

Office of Pipeline Safety, Website http://ops.dot.gov/stats/TRAN_SUM.HTM

Report to Common Council, Councillor G. Tait, 7 July 2006


Stephens, M. J., A model for sizing high consequence areas associated with Natural Gas Pipelines, Gas Research Institute c-FER Report 99068

Texas A & M University Extension Service - BP Course Training Curriculum
COMMENTS REGARDING A PROPOSED LNG PLANT AND NG PIPELINE IN SAINT JOHN, N.B.

Prepared by Sean A. Tracey. MIFireE, ARM
Dated:  8 September 2006

Background

The following report has been prepared by Sean A. Tracey, the Canadian Regional Manager of NFPA, and Chair of the Canadian Centre for Emergency Preparedness. The author has a background in fire and emergency planning as noted in the attached brief biography. The author currently serves as the Canadian Regional Manager for the National Fire Protection Association (NFPA) and the Chairman of the Board of the Canadian Centre for Emergency Preparedness (CCEP). A short bio has been attached as Annex A. It has been prepared after a request by the Fire Chief for Saint John, Chief Robert Simonds. The content of this report reflects the opinion of the author and no compensation has been received for its compilation.

After discussion with Chief Simonds at the recent Maritime Fire Chiefs’ Association Annual Meeting, the Canadian Regional Manager was requested to participate in a site visit of the proposed liquefied natural gas (LNG) site and corresponding natural gas (NG) pipeline. In preparation for this report background research was conducted through the Internet, NFPA technical staff, and other NFPA resources. A site visit of Saint John was held 6-7 September 2006.

In preparing the report the comments will be broken down into two distinct projects: the review of the LNG plant; and the review of the NG pipeline. It is understood that this report or components of it will be used in support of an overall risk analysis being carried out at the request of the City Council and that it may further support a potential application to the National Energy Board. Comments will be limited to the areas or fire and life safety, risk assessment methodology, and emergency management.

LNG Plant and NG Pipeline Projects

The planned project has been split into two elements - the construction of a LNG offloading port and gasification facility and a 30 inch natural gas (NG) transmission pipeline. The plan is to send approximately 1 billion cubic feet of NG per day to markets within the US. The LNG facility as commented on at the site visit of 7 September stated they will have the potential for expansion to 2 BCF/day thus making it the largest LNG facility on the eastern seaboard. There was no stated plan to expand the pipeline route through the city, beyond the application presented to the NEB.

Regulatory Approvals & Design Standards

A regulatory framework paper was prepared for the project and was circulated. This document provided a detailed description of required approvals, the approving bodies and the deliverables for the
project. Documents to consider in addressing the Emergency Response Plan and the fire and life safety requirements are usually provincially approved standards such as the National Building Code of Canada and the National Fire Code of Canada. These two documents are absolute minimum requirements. Furthermore these documents can not envision all requirements – the LNG facility is such an example. In such cases design approvals and project deliverables are usually agreed upon with the city following what would be a performance-based design approach.

Also required when going outside of the normal design requirements is the delivery of a project Operations and Maintenance Manual. This document for all intents and purposes serves as the maintenance and operations manual for those on site but more importantly defines the maintenance program for the special fire and life safety systems. It is developed by the project design authority with the Authority Having Jurisdiction (AHJ), in this case the city building and fire departments. These documents need to be delivered to the city and is essential as they become the “fire code” for the facility. It is the only means the Fire Department has of verifying maintenance of the specialized fire protection systems on site. The city should verify the design standards being used and ensure that a completed Operations and maintenance manual be delivered. These standards include:

- CSA Z276-01, Liquefied Natural Gas (LNG) – Production, Storage, and Handling;
- CSA Z662-03 Oil and Gas Pipeline Systems; and
- NFPA 59A Standard for the Production, Storage, and Handling of Liquefied Natural Gas (LNG) 2006 Edition

The requirements or expectations of the city for disaster or emergency management with respect to each project should follow NFPA 1600 Standard for Disaster Management/Business Continuity Programs 2004 edition. This document is intended for both public and private entities including protection of critical infrastructure. It is a good starting point for the city’s EMO and can be used as an expectation of the level of protection at least required by the Canaport LNG and Crude operations as well as an expectation of the support to the pipeline operations by Maritime and Northeast Pipeline.

**Hazards of the Product**

NFPA has been protecting public interests in North America and internationally from fire and other hazards since 1896. The following excerpt from NFPA’s Fire Protection Handbook 19th edition highlights the concerns for protection of communities from natural gas leaks:

> There has been concern over the possibility of large flammable gas fires in populated areas. With vast quantities of gaseous fuels now being transported either in bulk or by pipeline, the likelihood of such occurrences commands attention. … In the absence of a major breakthrough in the prevention or suppression of such fires, the most appropriate means of minimizing fire impact is the advanced planning, preparedness, and response of trained emergency personnel.³

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2. This standard is being developed as a bi-national standard with CSA for release as CSA Z1600 in 2007.
3. NFPA Fire Protection handbook, p. 8-7
More detailed properties of LNG and NG have been attached as Annex B to this report however for the following explanation it is suffice to provide the following characteristics. The density of a gas decreases as its temperature is increased...Immediately following a spillage of liquefied natural gas (LNG, mainly methane), the vapor is heavier than air because it is at a very low temperature (the boiling point of methane is −161.5°C). As with propane at ambient temperature, LNG spills can be very dangerous because the vapor can spread over a wide area. However, the gas specific gravity of methane is only 0.55 (16/29) so that at ambient temperature the gas rises and disperses. In an enclosed area, it can create an explosion hazard very rapidly.

The concern with the respective emergency response operations at a LNG facility and a natural gas pipeline are somewhat different. With the LNG facility, the likely response for the responding emergency services personnel would be to set up a cordon area, control potential exposures, facilitate an evacuation of personnel from the potentially impacted areas, let the automatic protection features operate as planned, and if safe use hose lines to further control exposures and let the fire run its course. The LNG facility is remote from the city thus reducing some risks to the city proper; however, there are still residents potentially isolated in the area. There is further concern that the CANAPORT Crude and CANAPORT LNG operations may impact upon each other.

With NG pipeline the concern is that a leak or sudden rupture may occur along on the path of the pipeline within city limits. The rupture has the potential to leak gas which in turn may ignite. There would be a sudden fireball and a follow-on venting of burning NG that in turn would radiate heat energy. This radiant heat would in turn ignite combustible material such as homes, vegetation, or ignite other combustibles if they were within range. In the case of combustible construction the National Building Code limits building separations based upon a maximum heat of 12kW/m2 which is the heat flux required for a piloted ignition of wood and cellulosic materials. Any structure within the range of the plume exposed to this temperature regardless of the response time of the fire department would just need a fire brand to ignite thus adding to the requirements for the fire department to control the exposure. These structures would then add to the potential spread of fire and a possible conflagration.

**Probabilities and Possibilities**

A number of potential scenarios could be envisioned and should therefore be addressed by the proponents. Emergency response plans for the city must be coordinated with the facility proponents at as early a stage as possible and should address the following scenarios:

1. Gas rupture in NG Pipeline
2. Gas Rupture and Ignition in NG Pipeline
3. LNG leak - shore
4. LNG Leak and Explosion – shore
5. LNG Explosion – Ship to Shore Transfer
6. LNG Explosion – Ship

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As stated above there are a number of potential risk scenarios that need to be addressed. At present it does not appear that either proponent has given thought to the emergency response requirements for these scenarios. Early emergency response plans have not been coordinated with the city.

CANAPORT Crude and CANAPORT LNG operations, (although separate entities on paper) need to coordinate their emergency operations as their effectiveness has a direct impact on the role and expectations of the fire and EMO resources from the city. These two operations need to be brought to the table to develop their emergency response plans with the city ASAP such that any design requirements or capital purchase needs can be acted upon before the operations are brought on line. Similarly the NG pipeline operations have not been coordinated with the city. This needs to be addressed and should be a major push from the city as a condition for the NEB approval.

It is highly recommended that the city consider a number of detailed table top exercises that would evaluate the proposed emergency response plans to each of the scenarios presented above. These exercises should be facilitated by a third party who would run the scenarios, record activities, as well as provide an after action critique. Participants in the table top exercise would be representatives from all departments, and agencies, with a role in the emergency response. The city should reserve the right to require the proponents to adjust their emergency response requirements following the completion of these exercises.

**Risk Assessments**

Elements of the risk assessment for the NG pipeline prepared by the pipeline proponent as a portion of the Environmental Impact Statement were reviewed in the course of the visit. This QRA states that an expected probability of a pipeline leak would be in the order of 1.63 per 10000 km-years (much less than the historical experience as reported in the Bercha report). The proponent’s leak probability was determined through the development of fault analysis tree that consider factors such as corrosion, external impact, natural forces, material failure, and other. The author has several dissenting opinions on the qualitative assumptions made by the proponent that appears to underestimate the probability of a pipeline leak; and in fact underestates the probability presented by historical data.

For example the proponent’s report states that corrosion due to new piggable lines can be reduced by 80%. Field verification with the City of Saint John Water Department officials (not performed by the proponent,) identified areas such as Eastmount where ground conditions are categorized as very aggressive. The result has been the requirement to replace existing water lines within the city at a rate greater than expected. It is the author’s opinion that the subjective reduction of corrosion by 80% should not be considered but actually increased by 50%.

The proponent also cites that the existence of well marked utility corridors is likely to reduce the potential impact by 3rd party by at least 30%. Again the author would disagree with this observation. The preferred route chosen by the proponent again did not take into consideration the close proximity and crossing of many high traffic routes, through industrial development areas, as well as crossing or running in utility corridors serving critical infrastructure such as high voltage power lines, and primary water supply routes to the city. The requirements to maintain there utilities increase the likelihood of

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5 QRA Proposed Brunswick Pipeline, P2509 – Final Report, pp. 3.9-3.10
third party impacts. This is further supported in the M&NP published incident on the NEB website occurring on the existing 16 inch line\(^6\). It is the opinion of the author that there should be no reduction in the potential for 3rd party contacts and instead this figure should be increased by 100%.

Finally, the proponent cites that the likelihood of failure due to geotechnical forces can be decreased by 60% as much of the corridor is in stable rocky ground. This reduction is again not supported. In the area of Eastmount the ground forces are such that there has been considerable movement of the ground that has impacted existing utilities. Furthermore, within city limits there are ongoing blasting operations in support of quarrying. These quarrying operations may be within hazard areas of the proposed pipeline. It is assumed that these quarrying operations will no longer be permitted once the pipeline is in place; however, if they are not then the risk factors should increase. The figures being used for ground factors would already consider a detailed engineering analysis of ground conditions as well as extensive networks of pipelines throughout the prairies which would be assumed to be relatively stable. The arbitrary reduction of ground factors by 60% can not be supported. It should be reasonable to expect no reduction.

If one therefore accepts the above rationalization then the potential for a pipeline failure is in the order of the historical experience of 4.87 failures per 10000 km-years or approximately; 3 times the probability expressed by the proponent. If one considers approximately 40 K of pipelines through the city then the probability is 97.4% of a pipeline failure within the city within a 50 year period.

\[
\begin{align*}
4.87 \text{ Pipeline failures per 10000 km-years} \times 40 \text{ kms} \times 50 \text{ years} &= 0.9740 \\
97.4\% \text{ chance of one failure along the route in 50 years}
\end{align*}
\]

**Impact/Consequence**

Selection of the Pipeline Route – During the construction tour of 6 September it was reaffirmed that the selection route for the pipeline did not consider the same risk factors the city would consider important. In the initial selection of the route by the pipeline proponent there was no consideration given to existing rights of way (ROW). No consultation with the existing water, electric or city services was undertaken prior to the route selection. The proposed NG pipeline route in many instances crosses or follows the same corridor as many of the essential utilities for the community. In the area where the proposed pipeline crosses Loch Lomond Road it would cross two of the water feeds to the city. This also occurred in the Millidgeville area. Similar problems also occurred with the location of the pipeline within existing high power corridors, and cell and telephone trunk tower construction. In the event of pipeline rupture, emergency response would be severely hampered by the potential loss of other essential services. If the pipeline rupture were to ignite in some of the denser population centres the fire department would find itselfs attempting to control exposure fires with limited or no water supplies. The impact of a rupture and fire would be greatly increased.

It appears that the pipeline route did not consider the emergency services response. For example it became immediately apparent to the author, on his first visit to the city in 9 years that the selected

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route would cut off the community of Milford in event of a disruption near the rail and overpass. This would separate citizens from responding police and fire services personnel. Additionally, the positioning of the pipeline near properties such as the provincial jail and the Centracare facility necessitates that both these operations would need to develop relocation plans for their residents and employees. It was not apparent that either entity has a plan or the immediate capability to house their clients in alternative accommodations.

**Saint John Fire Department Assessment**

The Saint John Fire Department’s identification of a 300m Hot Zone is more than reasonable assessment given the historical experience and the fact that the proponent used an 800 meter radius in their submission to the NEB. The assessment limitations used by the utility in their submission to NEB at 800 metre radius (1600 metre total distance) in the author’s opinion may not have adequately addressed all risks, the impact of the fire on combustible structures, and the impact on other critical infrastructure elements that would exasperate emergency response.

In the risk assessment prepared by the proponent it does not appear that any pipeline risk assessment modeling was performed. There are examples for such models including Kiefner-NYGAS Risk Assessment Model\(^7\) as well as other products that can help to quantify risks and better predict the impacts and therefore develop mitigative measures. It was not clear that this had been done by the pipeline proponent with their initial NEB submission. This should be a requirement for the NEB approval. A third party consultant should be engaged to develop more refined risk models based upon predictive modeling from software.

**Assessment of the City of Saint John’s Response Capabilities**

Emergency Measures Organization (EMO) – During the tour and subsequent discussions it was the author’s opinion that the addition of two major high risk activities was going to have a great impact on the current EMO capabilities. From the discussions with personnel during the site visit it is my opinion that just leaving the emergency planning to the proponents would not result in any realistic scenarios. It is therefore necessary for the EMO and other services to press their requirements onto the proponents and to dictate the deliverables. Furthermore the ERP for the city should be developed by the city staff. This would require additional full time resources in the city. The long term benefit of the project would be to then turn these resources onto other high risk industrial operations within the city and have the emergency response plans for these operations re-evaluated.

Saint John Fire Department – In the author’s opinion the fire department is operating very effectively with very few staff at the operations and planning level. This is a credit to the professionalism and skills of these staff. Their vision statement for the department is very apt:

> To anticipate the challenges of the new millennium and, through progressive planning and leadership, provide an effective and innovative response to evolving Fire and Rescue needs of the citizens and industries of Saint John.

\(^7\) [http://www.kiefner.com/RiskModel.PDF#search=%22pipeline%20risk%20assessment%20model%22](http://www.kiefner.com/RiskModel.PDF#search=%22pipeline%20risk%20assessment%20model%22)
In the author’s experience the fire department appears to be performing at a skill level and operational tempo above that of any fire department of comparable city size in Canada. The complexity of operational expectations posed by the integration of multiple heavy industrial risks within the city, a mix of residential and other properties of various ages, is unlike any community the author has assisted in Canada. Unfortunately the added two hazards of the LNG and NG pipeline are going to place greater demands on these staff. Consideration should be given to augmenting the training and operations staff so that the necessary plans can be reviewed and the necessary coordination can be conducted that will result from these added risks.

**Proposed Emergency Management**

In preparation for the visit it was anticipated that the author would be able to review the planned emergency response programs for each portion of the project with the proponent representatives and the city while on site. It was learned that in both proponent’s cases neither had develop their concepts of emergency operations. This leaves the city representatives at a significant disadvantage in putting their cases forward to the NEB and other approval bodies. It should be noted that during the EIS portion of the LNG facility that concerns had been raised regarding the capabilities of the fire department to be able to respond. It is very difficult for the fire department to plan for the impact and necessary training without the concept of how the plan shall unfold. The following comments are therefore offered in this light.

**LNG Facility**

The facility proponents must present a detailed concept of operations that will highlight how the CANAPORT Crude and CANAPORT LNG personnel will interact to any incident and what the expectations are of the responding fire department. The city should require detailed training plans for the facility fire brigades in both locations. Due to the high risk of these operations and the requirement for plant personnel to take initial action to minimize any incident the city needs to be assured that the personnel are being trained to a reasonable standard. Appropriate initial actions in any emergency situation will have the greatest potential to reduce the severity of any incident. The city should require that the industrial fire brigade operations be assessed by a third party for their compliance with NFPA 600 Standard on Industrial Fire Brigades, 2005 Edition. Furthermore all industrial fire brigade personnel should be trained and certified to NFPA 1081 Standard for Industrial Fire Brigade Member Professional Qualifications 2001 Edition. These international standards can help ensure the appropriate response.

Another concern raised pertained to the water protection system at the LNG facility; it was to use sea water for fire fighting purposes. The proponent rep during the tour was unable to confirm details of the piping as there was concern about the depth of the buried pipe, the difficulty in replacing it and the highly corrosive nature of sea water. It is a concern that the fire protection piping would not last the expected lifespan of the facility and its replacement would be difficult. The envisioned concept is that any incident will be addressed by onsite personnel and fixed fire protection equipment. NFPA 59A also requires that enough fire flows be present to meet the automatic fire suppression requirements as well as 1000 gpm flow for hand lines. Required fire flow needs, must be coordinated with the local fire department. This should be confirmed with the LNG facility.
Natural Gas Pipeline

The proposed operation of the pipeline is such that on any major leak or incident the pipeline would be closed through the use of valves located throughout the city… The shutdown of the valves would only be affected by the pipeline control centre in Houston, Texas after field confirmation by a pipeline official. This resulting delay would result in continued venting of NG. It is recommended that the city’s emergency response includes the capability to act as this field verification and request the shutdown of the pipeline directly of Houston. This would save considerable time in any emergency.

Other Considerations

Cease of Operations – In the United States FERC has the ability to demand the cease of operations if a facility is determined to pose a risk. The City should determine who has such authority in these cases and have procedures in place to be able to require this.

Port Security - It is noted that fees in the order of $2 million a year are expected to be generated just by ships docking at the LNG facilities. Security of ships approaching and at berth at the LNG transfer facilities pose a potential security concern. In the FERC pamphlet it is noted that the US Coast Guard provides security and safety checks for every tanker entering a US port and unloading its LNG. Similar security provisions need to be considered and should be raised separately by the city with the Canadian Coast Guard and Transport Canada. These security checks include a 96 hour advance notification of ship arrival, safety inspection, manifest and crew documentation, establishing a safety zone around the ships while in route and unloading, and inspection of dock safety systems before allowing LNG to be unloaded. 8 The city needs to evaluate who is providing port security and to what level considering that $2 million a year in port fees are anticipated from the LNG operation along not considering other port operations.

Public Education – A general preparedness program is not available in the community. Such program could be considered. Programs are available through NFPA using the Risk Watch program but also through Public Safety Emergency Preparedness Canada. These programs are seen as needed based on the incremental risks the projects propose. Public awareness programs on the hazards and appropriate action for NG and LNG hazards should also be developed and funded by the respective proponents with delivery coordinated by the EMO offices.

Public Alerting – The proponents of both projects should consider the funding of a jointly sponsored program for public alerting. Other communities in Canada have such systems that can take the form of a reverse 911 call system to other methods of broadcasting the proper emergency procedures to take in the event of an emergency.

Emergency Services Training – the current fire department training grounds are located in the Millidgeville area of the city. The facilities are in the author’s opinion of inadequate size to permit the necessary industrial training evolutions and their location within a residential area would prohibit live fire training. Serious consideration should be given to relocating the training to an industrial area within the city with adequate fire flows to simulate training. This training centre could be developed in joint venture with the CANAPORT LNG, CANANAPORT Crude, and other industrial fire brigades in

8 FERC Pamphlet “A Guide to LNG: What All Citizens Should Know”
the area. The training could then be conducted without the need to certify fire service personnel out of the country. Similar operations have been taken up across Canada and have been successful means of providing training resources for the fire department as well as fostering better coordination of emergency response between fire department personnel and industrial fire brigade members.

Conclusion and Recommendations

The city has granted approval for a LNG Plant in the CANAPORT area. It is recognized that this operation will have significant potential benefits to the city in the future but it also adds increased risk to the citizens. The relative isolation of the facility helps reduce some of these concerns but the primary concern of not seeing the emergency response plans and the necessary coordination of CANAPORT emergency response with the city has still to be addressed. Port security has not been addressed but it is of great potential concern considering the increased risk in the operations, the potential impact on other port operations, and the lack of a marine security presence.

The NG pipeline poses a greater concern for potential risk on the community. The current routing of the pipeline does not appear to address the concerns of the city and has not been adequately addressed from a risk perspective. It would be preferable to have other alternative routes re-evaluated that consider the city’s values in protecting its citizens. Failing that, better mitigative measures should be considered which would include reviewing the emergency management protocols and granting the city emergency measures organization a say in pipeline operations through the city.

The city EMO and fire service are dedicated competent individuals sincerely concerned with the protection of the community. Their concerns need to be highlighted in the various approval processes. The concerns they have raised appear valid and a number of recommended actions should be undertaken to reduce the risk on the community.

Recommendations:

- Require both proponents to present their concepts of emergency response to the city as a condition of further support before granting further approvals
- Have city emergency management officials review and refine these plans with the proponents. From these reviews additional resources may be needed for these departments. These added resources should be funded by the proponents.
- Require the CANAPORT LNG proponent to produce a coordinated emergency response plan with the city that includes the crude operations. The Emergency Response Plan should include the Operations and Maintenance manuals to be able to verify systems effectiveness by the local fire inspection element of Saint John Fire Department.
- Investigate the requirements for port security as these operations are critical to how Saint John will be protected …considering the port fees generated.
- Contract a third party to facilitate a number of major table top exercises of each of the proposed emergency response scenarios. Require a complete follow-up of the after action report comments.
• Require a third party review of the pipeline route and the risk assessment using a risk assessment model. If the results of the model result in unfavourable review of the risk, the city should consider the requirement to relocate the pipeline.

• Require CANAPORT operations (Crude and LNG) to have their fire department operations certified to meet NFPA 600 Industrial Fire Brigade requirements and their response personnel meet NFPA 1081.

• Consider the construction of a new fire department training ground that could also be used to facilitate the training and recertification of industrial fire brigade personnel in the region.

• Require the development of public awareness campaigns on the hazards of NG and LNG.

• Establish a public alerting network similar to other communities across Canada.

Sean A. Tracey  
Canadian Regional manager  
NFPA  
8 September 2006
BIOGRAPHY

Sean A. Tracey, P.Eng., MIFireE, ARM

After successfully completing a twenty-year career in the Canadian Forces, in 2000, Sean Tracey became the first Regional Manager in Canada for the National Fire Protection Association. Established in 1896, NFPA’s mission is to reduce the worldwide burden of fire and other hazards on the quality of life by providing and advocating scientifically-based consensus codes and standards, research, training, and education.

A Military Engineer by trade he has completed twenty years in the field of facilities engineering holding numerous positions as a facility engineer throughout Canada and in support of UN operations. He retired in 2000 at the rank of Lieutenant Colonel and his last posting was as the Canadian Forces Fire Marshal. In this role he was responsible for directing the Department of National Defense’s Fire Service. Sean has extensive experience in the fields of facility engineering, general safety, and risk management and is a regular contributor to fire, health care engineering, and construction journals. He is a past Director of the Canadian Council of Fire Marshals and Fire Commissioners. In November of 2005 he was appointed as the Chair of the Canadian Centre for Emergency Preparedness (www.ccep.ca). CCEP annually hosts the World Conference on Disaster Management in Toronto.

Sean is a graduate of the Royal Military College of Kingston with a Civil Engineering Degree, and a graduate of the Canadian Forces Command College. He is certified as an Associate in Risk Management and is a certified Professional Engineer in the province of Ontario.
Liquid Natural Gas

Classifications: Liquefied natural gas is classified as flammable, cryogenic, and fuel.

Chemical Properties: LNG is a mixture of materials all comprising carbon and hydrogen. The principal component is methane, with lesser amounts of ethane, propane, and butane. The composition will vary, depending principally on whether the source of the natural gas (which has been liquefied) is a transmission pipeline or gas wells. In the former instance, more of the propane and butane is removed prior to introduction into the pipeline (Table 8.7.4). LNG is nontoxic but is a simple asphyxiant.

Hazards When Released from Containment: LNG presents both combustion explosion and fire hazards when released from containment. At the present time, LNG is seldom used indoors and when so used the structure is designed for a combustion explosion hazard in accordance with national standards and regulations.

Emergency Control: Escaping LNG presents both “no fire” and “fire” emergency situations. LNG gas vaporizing from the cryogenic liquid near its normal boiling point is about 1½ times heavier than air is at 70°F (21°C) and will spread along the ground accompanied by the visible fog created by condensed water vapor. This distance will depend upon the leak size and meteorological conditions and upon the geometry of the required liquid-impounding area provided. Ignitable areas are roughly defined by the visible cloud, but can extend beyond the visible area. Such escape can be controlled by water spray. Contact between water and pooled LNG should be avoided to prevent increased vaporization, unless the vapor can be controlled. Water should be applied to fire-exposed containers and the flow of gas stopped, if possible.

Natural Gas

Chemical Properties: The term utility gas applies to any flammable gas distributed by gas utilities as a fuel gas. Natural gas dominates this field today. Some LP-Gas is distributed by gas utilities. Most utilities use LP-Gas to augment natural gas supplies during short periods of peak demand which occur in unusually cold weather.

The creation of natural gas is the result of decomposition of organic material by heat, pressure, and bacteriological action in the absence of air, usually below ground. As it is evolved underground, natural gas consists of both flammable and nonflammable gases. The flammable gases are composed of carbon and hydrogen and are principally methane and ethane, with some propane, butane, and pentane. The nonflammable gases are principally nitrogen and carbon dioxide. In commerce, most of the nonflammable gases are removed prior to distribution so that the natural gas consists of about 70 to 90 percent methane, with the remainder mostly ethane (see Table 8.7.3).
Natural gas is nontoxic but is an asphyxiant. This is in marked contrast to the manufactured gas formerly widely distributed as utility gas and which contained quantities of poisonous carbon monoxide. Utility natural gas has no odour of its own and is generally odorized as distributed.

**Physical Properties:** With the exception of liquefied natural gas (LNG), utility natural gas is distributed in piping as a compressed gas at pressures ranging from approximately 0.25 to 1000 psi (1.72 to 6895 kPa) and in cylinders at pressures up to 3600 psi (24.8 MPa). The gas has a density of about 2/3 that of air.

**Usage:** Utility natural gas supplies about one-fifth to one-fourth of the total fuel energy of the United States for domestic, commercial, and industrial heating and power. It is also being used as a motor fuel and is known as “compressed natural gas (CNG).” Natural gas (usually supplied from a gas utility distribution piping system) is compressed to 2400 to 3600 psi (16.5 to 24.8 MPa), stored in a fueling station, and dispensed into vehicle containers at the same pressure.

**Hazards Inside Containers:** Utility natural gas is distributed nearly exclusively by a network of more than 1 million miles (1 million miles equals 1.6 million km) of underground pipeline in the United States and Canada. It is transported from gas wells in producing areas in large-diameter transmission pipelines at pressures up to approximately 1000 psi (6,895 kPa). These pipelines are tapped by utility gas companies, and pressures are reduced for distribution—generally to around 0.25 to 60 psi (1.72 to 414 kPa). Regulators and safety relief devices are used to control pressures. Steel and cast-iron pipe are used extensively. In recent years, thermoplastic and thermosetting plastic piping have been used extensively in distribution piping at pressures up to approximately 100 psi (689.5 kPa).

**Fire Hazards of Liquefied Natural Gas:** LNG is stored at an approximate temperature of –260°F (–162°C). Studies show that at temperatures less than –180°F (–118°C), LNG is more dense than air at 60°F (16°C). Because LNG is a flammable cryogen, the integrity of the container and piping is of primary concern; a container or piping failure can result in a cryogen liquid spill. However, loss of liquid from a container requires that the outer steel shell, insulation, and inner vessel all fail. All three components are less likely to fail than are single-wall, atmospheric storage tanks found on conventional gasoline- or diesel fueled vehicles. Nonetheless, the probability of a spill is still a consideration. The liquid from an LNG spill begins to vaporize rapidly and forms a white cloud as cold vapors condense in air. Initially, the vapor is negatively buoyant and sinks to the ground until it warms to approximately –180°F (–118°C). At this temperature, the vapor becomes positively buoyant and begins to rise. The vaporization rate and distance the gas cloud travels and disperses depends on four factors:

1. **Wind Speed:** Wind speed is influential because as velocity increases, the LNG evaporation rate tends to increase. Increased wind velocity helps to induce mixing of methane vapors with air, causing the vapor cloud to disperse into smaller clouds, or puffs. This reduces the flammable atmosphere’s area.

2. **Surface Area of the Spill:** The larger the spill area, the greater its vaporization rate. This can result in larger vapor clouds, increasing the boundary of the flammable atmosphere.
3. **Surface Type**: The surface where the LNG spills influences its vaporization rate. Vaporization rates are high on wet surfaces, such as muddy soil, because water acts as a heat sink. Asphalt promotes vaporization because its dark color acts as a heat radiator. If LNG spills onto a good heat-insulating surface, boiling may eventually slow down, but the remaining liquid pool continues to evaporate rapidly. Evaporation maintains the remaining liquid near its boiling point as it absorbs heat from its surroundings.

4. **Time of the Incident**: At night, lack of atmospheric heating by the sun and ground reduces the evaporation rate of LNG. While this influences the vaporization rate, it also influences the distance from the source spill in which the vapor puff remains in its flammable range. At night, the distance is greater because the time needed to heat the vapor until it is lighter than air increases. Firefighters should remember that LNG vapor formed during the phase change is colorless and odourless at normal temperature indicators to establish safe boundaries. Only gas detection equipment designed to detect methane can establish safe exclusion and operating zones when dealing with LNG releases.
XV. Appendix 2

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA) - STANDARD 1600:

Sean Tracey Canadian Regional Manager NFPA provides “that the requirements or expectations of the city disaster or emergency management with respect to each project should follow NFPA 1600 Standard for Disaster Management/Business Continuity Programs 2004 edition. This document is intended for both public and private entities including protection of critical infrastructure. It is a good starting point for the City’s EMO and can be used as an expectation of the level of protection at least required by the Canaport LNG and Crude operations as well as an expectation of the support to the pipeline operations by Maritime and Northeast Pipeline.”

The following excerpts from NFPA 1600 are relevant direction with respect to the installation of the natural gas pipeline throughout Saint John.

1.1 Scope:
This standard establishes a common set of criteria for disaster management, emergency management, and business continuity programs hereinafter referred to as the program.

1.2 Purpose:
This standard shall provide those with the responsibility for disaster and emergency management and business continuity programs the criteria to assess current programs or to develop, implement, and maintain a program to mitigate, prepare for, and recover from disasters and emergencies.

1.3 Application:
This document shall apply to both public and private programs

DEFINITIONS:

3.3.1 Business Continuity Program - An ongoing process supported by senior management and funded to ensure that the necessary steps are taken to identify the impact of potential losses, maintain viable recovery strategies and recovery plans, and ensure continuity of services through personnel training, plan testing, and maintenance.

3.3.2 Damage Assessment - An appraisal or determination of the effects of the disaster on human, physical, economic, and natural resources.

3.3.3. Disaster / Emergency Management Program - A program that implements the mission, vision, and strategic goals and objective as well as the management framework of the program and organization.

3.3.4 Entity - A government entity or jurisdiction, private or public company, partnership, non-profit organization, or other organization that has disaster/emergency management and continuity of operations responsibilities.
3.3.5 Impact Analysis (Business Impact Analysis, BIA) - The management level analysis that identifies the impacts of losing the entity’s resources. The analysis measures the effect of resources loss escalating losses over time in order to provide the entity with reliable data upon which to base decisions concerning hazard mitigation, recovery strategies, and continuity planning.

5.1* - General

5.1.1 The program shall include the elements given in Section 5.2 through Section 5.15, the scope of which shall be determined by the impact of the hazards affecting the entity.

5.1.2* These elements shall be applicable to the four phases of disaster/emergency management: mitigation, preparedness, response, and recovery.

5.2 - Laws and Authorities

5.2.1 The disaster/emergency management program shall comply with applicable legislation, regulations, directives, policies, and industry codes of practice.

5.2.2* The entity shall implement a strategy for addressing needs for legislative and regulatory revisions that evolve over time.

5.3* - Hazard Identification, Risk Assessment, and Impact Analysis

5.3.1* The entity shall identify hazards, the likelihood of their occurrence, and the vulnerability of people, property, the environment, and the entity itself to those hazards.

5.3.2* Hazards to be considered at a minimum shall include, but shall not be limited to, the following:
   1) Natural hazards (geological, meteorological, and biological)
   2) Human-caused events (accidental and intentional)

5.3.3* The entity shall conduct an impact analysis to determine the potential for detrimental impacts of the hazards on conditions including, but not limited to, the following:
   1) Health and safety of persons in the affected area at the time of the incident (injury and death)
   2) Health and safety of personnel responding to the incident
   3) * Continuity of operations
   4) Property, facilities, and infrastructure
   5) Delivery of services
   6) The environment
   7) * Economic and financial condition
   8) Regulatory and contractual obligations
   9) Reputation of or confidence in the entity
5.4 - Hazard Mitigation

5.4.1 The entity shall develop and implement a strategy to eliminate hazards or mitigate the effects of hazards that cannot be eliminated.

5.4.2* The mitigation strategy shall be based on the results of hazard identification and risk assessment, impact analysis, program assessment, operational experience, and cost-benefit analysis.

5.4.3 The mitigation strategy shall consider, but not be limited to, the following:

1) The use of applicable building construction standards
2) Hazard avoidance through appropriate land-use practices
3) Relocation, retrofitting, or removal of structures at risk
4) Removal or elimination of the hazard
5) Reduction or limitation of the amount or size of the hazard
6) Segregation of the hazard from that which is to be protected
7) Modification of the basic characteristics of the hazard
8) Control of the rate of release of the hazard
9) Provision of protective systems or equipment for both cyber or physical risks
10) Establishment of hazard warning and communication procedures
11) Redundancy or duplication of essential personnel, critical systems, equipment, information, operations, or materials

5.5* - Resource Management

5.5.1 The entity shall establish resource management objectives consistent with the overall program goals and objectives as identified in Section 4.1 for the hazards as identified in Section 5.5.2 The resource management objectives established shall consider, but not be limited to, the following:

1) Personnel, equipment, training, facilities, funding, expert knowledge, materials, and the time frames within which they will be needed.
2) Quantity, response time, capability, limitations, cost, and liability connected with using the involved resources.

5.5.3 An assessment shall be conducted to identify the resource capability shortfalls and the steps necessary to overcome any shortfalls.

5.5.4 A current inventory of internal and external resources shall be maintained.

5.5.5 Voluntary donations, solicited and unsolicited, and the management thereof, shall be addressed.
5.6* - Mutual Aid

5.6.1 The need for mutual aid shall be determined and agreements established.

5.6.2 Mutual aid agreements shall be referenced in the applicable program plan.

5.7 - Planning

5.7.1* The program shall include, but shall not be limited to, a strategic plan, an emergency operations/response plan, a mitigation plan, a recovery plan, and a continuity plan.

5.7.2* Plans

5.7.2.1* The strategic plan shall define the vision, mission, goals, and objectives of the program as it relates to the policy of the entity that is required in Section 4.1.

5.7.2.2 The emergency operations/response plan shall assign responsibilities to organizations and individuals for carrying out specific actions at projected times and places in an emergency or disaster.

5.7.2.3 The mitigation plan shall establish interim and long-term actions to eliminate hazards that impact the entity or to reduce the impact of those hazards that cannot be eliminated.

5.7.2.4* The recovery plan shall be developed using strategies based on the short-term and long-term priorities, processes, vital resources, and acceptable time frames for restoration of services, facilities, programs, and infrastructure.

5.7.2.5* A continuity plan shall identify the critical and time-sensitive applications, vital records, processes, and functions that shall be maintained, as well as the personnel and procedures necessary to do so, while the damaged entity is being recovered.

5.7.3 Common Plan Elements

5.7.3.1 The functional roles and responsibilities of internal and external agencies, organizations, departments, and individuals shall be identified.

5.7.3.2 Lines of authority for those agencies, organizations, departments, and individuals shall be established or identified.

5.8 - Direction, Control, and Coordination.

5.8.1 The entity shall develop the capability to direct, control, and coordinate response and recovery operations.

5.8.2* The capabilities shall include, but shall not be limited to, the following:
1) An incident management system.
2) *The specific organizational roles, titles, and responsibilities for each incident management function specified in the emergency operations/response plan.

5.8.3 The incident management system utilized shall be communicated to and coordinated with appropriate authorizations and resources identified in Section 5.5.

5.8.4 The entity shall establish applicable procedures and policies for coordinating response, continuity, and recovery activities with appropriate authorities and resources while ensuring compliance with applicable statutes or regulations.

5.9 - Communications and Warning

5.9.1 Communications systems and procedures shall be established and regularly tested to support the program.

5.9.2 The entity shall develop and maintain a reliable capability to notify officials and alert emergency response personnel.

5.9.3 Emergency communications and warning protocols, processes, and procedures shall be developed, periodically tested, and used to alert people potentially impacted by an actual or impending emergency.

5.9.4 The program shall address communications including, but not limited to, the following:
   1) Communication needs and capabilities to execute all components of the response and recovery plans.
   2) The inter-operability of multiple responding organizations and personnel.

5.10* - Operations and Procedures

5.10.1 The entity shall develop, coordinate, and implement operational procedures to support the program.

5.10.2 The safety, health, and welfare of people and the protection of property and the environment under the jurisdiction of the entity shall be addressed in the procedures.

5.10.3* Procedures, including life safety, incident stabilization, and property conservation, shall be established and implemented for response to, and recovery from, the consequences of those hazards identified in Section 5.3.

5.10.4 A situation analysis that includes a damage assessment and the identification of resources needed to support response and recovery operations shall be conducted.
5.10.5 Procedures shall be established to allow for initiating recovery and mitigation activities during the emergency response.

5.10.6 Procedures shall be established for succession of management/government as required in

5.11 - Logistics and Facilities

5.11.1 The entity shall establish logistical capability and procedures to locate, acquire, store, distribute, maintain, test, and account for services, personnel, resources, materials, and facilities procured or donated to support the program.

5.11.2* A primary and alternate facility capable of supporting continuity, response, and recovery operations shall be established, equipped, periodically tested, and maintained.

5.12 - Training

5.12.1 The entity shall assess training needs and shall develop and implement a training/educational curriculum to support the program. The training and education curriculum shall comply with all applicable regulatory requirements.

5.12.2 The objective of the training shall be to create awareness and enhance the skills required to develop, implement, maintain, and execute the program.

5.12.3 Frequency and scope of training shall be identified.

5.12.4 Personnel shall be trained in the entity's incident management system.

5.12.5 Training records shall be maintained.

5.13 - Exercises, Evaluations, and Corrective Actions

5.13.1 The entity shall evaluate program plans, procedures, and capabilities through periodic reviews, testing, post-incident reports, lessons learned, performance evaluations, and exercises.

5.13.2* Exercises shall be designed to test individual essential elements, interrelated elements, or the entire plan(s).

5.13.3* Procedures shall be established to ensure that corrective action is taken on any deficiency identified in the evaluation process and to revise the relevant program plan.

5.14 - Crisis Communication and Public Information
5.14.1* The entity shall develop procedures to disseminate and respond to requests for pre-disaster, disaster, and post-disaster information, including procedures to provide information to internal and external audiences, including the media, and deal with their inquiries.

5.14.2 The entity shall establish and maintain a disaster/emergency public information capability that includes, but is not limited to, the following:

1) A central contact facility for the media
2) A disaster/emergency information handling system
3) Pre-scripted information bulletins
4) A method to coordinate and clear information for release
5) The capability of communicating with special needs populations
6) Protective action guidelines/recommendations (e.g., shelter-in-place or evacuation)

5.14.3 Where the public is potentially impacted by a hazard, a public awareness program shall be implemented.

5.15* - Finance and Administration

5.15.1* The entity shall develop financial and administrative procedures to support the program before, during, and after an emergency or a disaster.

5.15.2 Procedures shall be established to ensure that fiscal decisions can be expedited and shall be in accordance with established authority levels and accounting principles. The procedures shall include, but not be limited to, the following:

1) Establishing and defining responsibilities for the program finance authority, including its reporting relationships to the program coordinator.
2) Program procurement procedures.
3) Payroll.
4) Accounting systems to track and document costs.
LETTER FROM ANDREW EASTON TO MARK GILLAN

September 9, 2006

Deputy Chief Mark Gillan
Saint John Fire Department
45 Leinster Street
Saint John, NB
E2J 1H9

Dear Deputy Chief Gillan:

This is in response to your email of September 1st, 2006 in relation to the proposed EMERA Natural Gas (NG) Pipeline.

In your email, you requested that the Security and Emergencies Directorate provide information in relation to the probability of worst case event occurring, or assist in calculations of consequence mitigation measures.

In response, I am providing comments in five areas: energy security environment, security threats and effects on risk, critical infrastructure, critical infrastructure interdependencies, and parallels between pipeline and LNG consequence assessment. These comments will be general rather than specific in nature, as much more effort is required to analyse these considerations in detail.

Energy Security Environment

This proposal is noteworthy because it links a new LNG import terminal to an international market as its primary intent. From various open information sources, domestic United States natural gas sources and their current international supply will not be able to meet projected continental US demand within the next few years. More than 90% of Canada’s domestic natural gas production is currently exported to the US. Increasing US dependence on new international NG sources will increase the criticality of international US-Canada pipelines and their supply sources.

Security Threats and Effects on Risk

Assessments shared by Canada’s Integrated Threat Assessment Centre on Canada’s energy sector consider NG issues. While these assessments make it clear that Canada and Canadian interests overseas are under significant threat from Islamist extremism, there is no information suggesting there is an imminent risk to NG infrastructure, including pipelines. There is information that suggests that such installations are of interest to various groups who may wish to disrupt pipeline operations, cause concern with the public, or inflict damage and casualties on an area. Some groups have expertise to select strategic locations and methods to achieve maximum effect, whether disruption, concern or damage. This could result in exploitation of vulnerabilities or critical infrastructure interdependencies. There are mitigation measures taken for security risks for pipeline systems and the line itself; these are established by the National Energy Board.

In relation to this specific proposal, there are two notable elements: the corridor proximity to major urban infrastructure and population concentrations and the size and pressurization of the proposed line. These influence any security analysis. More work is needed before any assessment could be rendered.
**Critical Infrastructure of Interest**
We note several services, systems or facilities from your draft documentation that are critical infrastructure of potential provincial importance. The Irving Oil Refinery, the Saint John Regional Hospital, the Canadian Blood Services facility, certain power generation/transmission facilities, and the international short-haul rail line are of particular note. We do note that your analysis focuses on physical critical infrastructure.

We recommend further assessment considering each of the 10 sectors set by Public Safety Canada, which NB has endorsed (appended herein). This approach ensures consideration of key systems and services that may not be immediately evident. NB can also provide methodology to measure the criticality of identified infrastructure of interest, suggesting priorities for mitigation, and participate in the work, should this be helpful. A joint approach involving owners/operators, local and provincial safety and security officials and the proponent may be helpful. External experts, such as the NFPA, could augment such a process.

**Critical Infrastructure Interdependencies**
Impact analysis considering how each of the impacted sectors influences others is warranted. For example, you cite a potential consequence of loss of power grid integrity in parts of the city. There may be key critical infrastructure that may be outside the primary damage zone, but will be impacted by an event due to such interdependencies. Key components of telecommunications, public safety, finance, and transportation infrastructure exist within City boundaries, but not necessarily within the primary damage zone. There may be impacts well outside the City as well. Again, more work is needed before offering an assessment.

**Parallels Between Pipeline and LNG Consequence Assessment**
Your analysis document could benefit by more clearly outlining the contingency (e.g. catastrophic deliberate or accidental breach of the pipeline, formation of vapour cloud, delayed cloud ignition, under certain meteorological conditions, with resultant blast and thermal effects), the methodology used to establishment a 300m planning zone, rather than the 800m zone with thermal radiation impacts, and notable features of the proposal.

We are more familiar at this time with LNG transhipment and regasification plants. In these, high, medium and low consequence zones are established. The size and shape of each zone may differ depending on the planning contingency. A sustained fire with extensive thermal radiation may impact populations and critical infrastructure outside of the 300m immediate damage zone.

I trust this limited analysis is in some small way helpful. As you move forward with this matter, we are prepared to work with the City on further security and critical infrastructure analysis should it seem appropriate.

Sincerely,

Andrew Easton
Director
SED
XVII. **Appendix 4**

**Canada’s Critical Infrastructure Sectors:**

1. **Energy and utilities** (e.g. electrical power, natural gas, oil production and transmission systems).
2. **Communications and information technology** (e.g. telecommunications, broadcasting systems, software, hardware and networks including the Internet).
3. **Finance** (e.g. banking, securities and investment).
4. **Health care** (e.g. hospitals, health care and blood supply facilities, laboratories and pharmaceuticals).
5. **Food** (e.g. safety, distribution, agriculture and food industry).
6. **Water** (e.g. drinking water and wastewater management).
7. **Transportation** (e.g. air, rail, marine and surface).
8. **Safety** (e.g. chemical, biological, radiological and nuclear safety, hazardous materials, search and rescue, emergency services and dams).
9. **Government** (e.g. services, facilities, information networks, assets and key national sites and monuments).
10. **Manufacturing** (e.g. defense industrial base, chemical industry).

**Source:** Public Safety and Emergency Preparedness Canada 2006
**Revision Summary**

**September 26, 2006**

**Page 26**

Original: It is up to the City of Saint John to ensure that the Proponent addresses the above two referenced portions of Part 6 of the Onshore Pipeline Regulations.

Revision: It is up to the City of Saint John to ensure that the Proponent addresses the above two referenced portions of Part 6 of the Onshore Pipeline Regulations in accordance with community needs.

Rationale: Clarity

**Page 30**

Original: In other works, the probability of a rupture that ignites is low, but the reality is that some day a rupture that ignites will occur along some portion of the pipeline.

Revision: In other words, the probability of a rupture that ignites is low, but the reality is that some day pipeline failure will occur along some portion of the pipeline. *(Tracey)*

Rationale: Editing error.