Public Safety Issues at the Proposed Beaumont LNG Terminal

Dr. James A. Fay

77 Massachusetts Avenue, Rm. 3-258

Cambridge, MA 02139

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1 Introduction

Gaz Metro Limited Partnership, Gaz de France, and Enbridge Inc. have jointly proposed to construct and operate a liquefied natural gas (LNG) import terminal, denoted as the Rabaska Project (Rabaska), in the Ville Guay/Beaumont area, located at the limits of the City of Levis and the Municipality of Beaumont. To reach this terminal, ocean-going LNG tankers must move through the Chenal des Grands Voiliers of the St. Lawrence River. Both the terminal site and the tanker route are potential sources of LNG spills and their attendant hazards to human health.

Natural gas, a hydrocarbon fuel, is usually piped directly from a gas well to the end consumer, never being stored locally in large amounts. When cooled to liquid form, however, as much as 80,000 tons can be stored in insulated tanks on land or aboard ship. In this form it is especially hazardous if it escapes by accident from its container, spilling onto ground or water and turning very rapidly into gaseous form, whereupon it will mix with air and then burn if ignited. By its very nature, an LNG import terminal and its associated tanker traffic constitutes a hazardous industrial complex which could experience accidental fires that might harm surrounding populations and property.

To build and operate an LNG terminal at the Beaumont site, Rabaska must obtain permission from national and provincial authorities. The authorities' objective in safety regulation is to limit, but not necessarily prevent, harm to persons and property outside the confines of the terminal site, should there be an accidental release of LNG at the site. The principal harmful effects are two: vapor plumes or clouds that can be ignited outside the site boundaries and harmful thermal radiation from on-site fires that extends across the site borders. But the authorities' safety rules do not consider all credible spills on the site or any from the LNG tankers while in transit to the terminal or being unloaded, a significant oversight that fails to protect public safety.

This report explains the safety hazards that will be associated witht the Rabaska project. It delineates the geographic extent of harmful effects that could be expected from LNG spills at the site or from marine tankers approaching it.

2 Site selection criteria

The official site selection rules (CSA)[1] require the LNG terminal owner to install extensive technological features that will limit the harmful consequences of an accidental spill of LNG to within the property line enclosing the terminal. The harmful effects are twofold: combustible mixtures of vapor and air, such as might be driven by the wind blowing over an evaporating pool of spilled LNG, and thermal radiation from a fire burning above a liquid spill on the site. The types of spills to be considered are also twofold: a spill from transfer piping connecting the storage tanks and the regasification or unloading facilities, and the failure of the primary storage tank enclosure.

Limiting these effects at a terminal requires the construction of impounding areas surrounding potential spill sources so as to collect the spilled liquid and slow its vaporization or burning rate. If the spills are sufficiently small or slow, harmful effects will not extend beyond the site boundaries. For transfer line spills, the LNG is collected in a central impounding area. For storage tank spills, the inner storage container is surrounded by a secondary containment dike which can contain all the LNG that might spill from the inner primary container.

The potential for harmful effects to humans from a given spill decreases with distance from the spill site. The harmful effect of ignitable natural gas vapor is measured by the flammability distance, a distance down wind from the spill site at which the vapor has been so diluted by mixing with air that it cannot be ignited. Any ignition at a closer distance can propagate a flame, but that flame will

[1] Canadian Standards Association CSA Z276-01.

not propagate beyond the flammability distance. If the latter distance lies within the site boundary, no flame can extend beyond that boundary.

Thermal radiation from on-site LNG fires fed by an evaporating pool of spilled LNG can cause first, second or third degree burns to the skin of humans exposed to the radiation, depending upon the intensity of radiation. For a given fire, this intensity decreases with distance from the fire. The least intense thermal radiation that CSA rules allow humans outside the site boundary to be exposed to is 5 kilowatts per square meter, an amount that produces second degree burns after only thirty seconds exposure.[2]

The CSA requirements for the proposed Rabaska terminal can be estimated from the Environmental Impact Statement for the Irving Oil project in New Brunswick.[3] This project, consisting of storage tanks and an unloading pier, employs the technology likely to be used at the Rabaska facility. For the Rabaska facility, it is to be expected that neither radiation nor flammability will exceed the CSA limits beyond the site boundary.

3 Risks that the CSA standard ignores

There are several important public safety risks that are not considered in the CSA regulations discussed above.

1. First of all, CSA's regulations ignore 'worst case' spills, in which the primary containment system, whether on land or marine tanker, fails, allowing LNG to spill onto ground or water, where it would evaporate or burn. Because the lateral extent of such spills would be so much greater than those considered in the CSA regulations, it is to be expected that their harmful effects would exist very far beyond the site boundaries, including the marine tanker route to the terminal.

2. Secondly, CSA allows damaging thermal radiation beyond the site boundary as long as its level is below 5 kilowatts per square meter. However, it is not until the thermal radiation intensity falls below 1.6 kilowatts per square meter that there is no damage to exposed humans. A safe radiation distance for fires would be that for which the thermal radiation level does not exceed 1.6 kilowatts per square meter. Distances at which the radiation exceeds this value would define a thermal radiation danger zone.

To show how public safety can be adversely affected by credible spills that have been overlooked by the CSA standard, we have calculated these effects[4], summarized in Table 1 and described below.

3.1 Thermal danger zones

The thermal radiation danger zones for the largest spills from a storage tank and a marine tanker at the unloading pier, listed in Table 1, are shown in Figure 1. Both of these extend well beyond the site boundaries, especially so for the tanker spill with fire. Altogether, about 1.8 square kilometers

[2]More intense and thereby more damaging exposure is permitted depending upon land use characteristics at the site boundary.

[3]Environmental Impact Statement, Irving Oil, Ltd. Liquefied Natural Gas (LNG) Marine Terminal. Environment and Local Government, New Brunswick. May 2004. (http://www.ceaa-acee.gc.ca/010/0003/0012/report_e.htm).

[4]The methods used for this assessment are identical to those contained in "Consequence assessment methods for incidents involving releases from liquefied natural gas carriers", Report 131-04 GEMS 1288209, ABS Consulting, Inc., May 13, 2004, (available on FERC web site at www.ferc.gov/industries/gas/indus-act.asp) and its Attachment 1 of June 29, 2004, as listed on the FERC site at http://ferris.ferc.gov/idmws/search/feregensearch.asp under docket AD04-6.

Table 1: Flammability and radiation distances for 'worst case' spills

Spill source	Volume (cubic meters)	Flammability danger zone (km)	Thermal radiation danger zone (km)
Storage tank	160,000	6.3	1.5
Tanker hold	23,000	6.3	4.2

of land in the Beaumont-Levis area is affected by the storage tank spill with fire, while 7 square kilometers of land in the Beaumont-Levis area and 4 square kilometers of land in Ile d'Orleans are at risk from a tanker spill with fire at the unloading pier.

3.2 Flammable vapor danger zones

The blue circles in Figure 2 depict the flammability danger zone for a spill, without fire, from both a storage tank and the marine tanker while located at the terminal pier. For any such spill, the flammable vapor plume or cloud would extend from the spill site about 6 kilometers in the downwind direction, encompassing an area of about 6 square kilometers.

3.3 Tanker danger zones

Spills from a fully loaded LNG tanker can occur not only at the unloading dock, as shown in Figures 1 and 2, but also at any point along the ship channel while approaching the terminal. At each point along the ship's route, thermal radiation and flammable vapor danger zones, of the sizes given in Figures 1 and 2, will move with the ship's travel toward the terminal. It is clear that danger zones extending about 5 kilometers inland from the waterfront on both sides of the St. Lawrence River will exist all along the approach path to the terminal.

4 Conclusions

1. **The CSA safety requirements for the proposed Rabaska LNG terminal will not prevent harm to humans outside the site boundary because they ignore large spills on land and all spills from marine tankers, whose harmful effects spread well beyond the terminal's boundaries.**

2. **Thermal radiation danger zones from these spills extend beyond both shores of the St. Lawrence River, as far as 4 kilometers from the spill location. Flammable vapor danger zones extend even further, about 6 kilometers from the spill, also encompassing both shores.**

3. **For a tanker spill anywhere along the route leading to the LNG terminal, thermal radiation and flammable vapor danger zones will encompass both shores to distances where the river width exceeds 12 kilometers.**

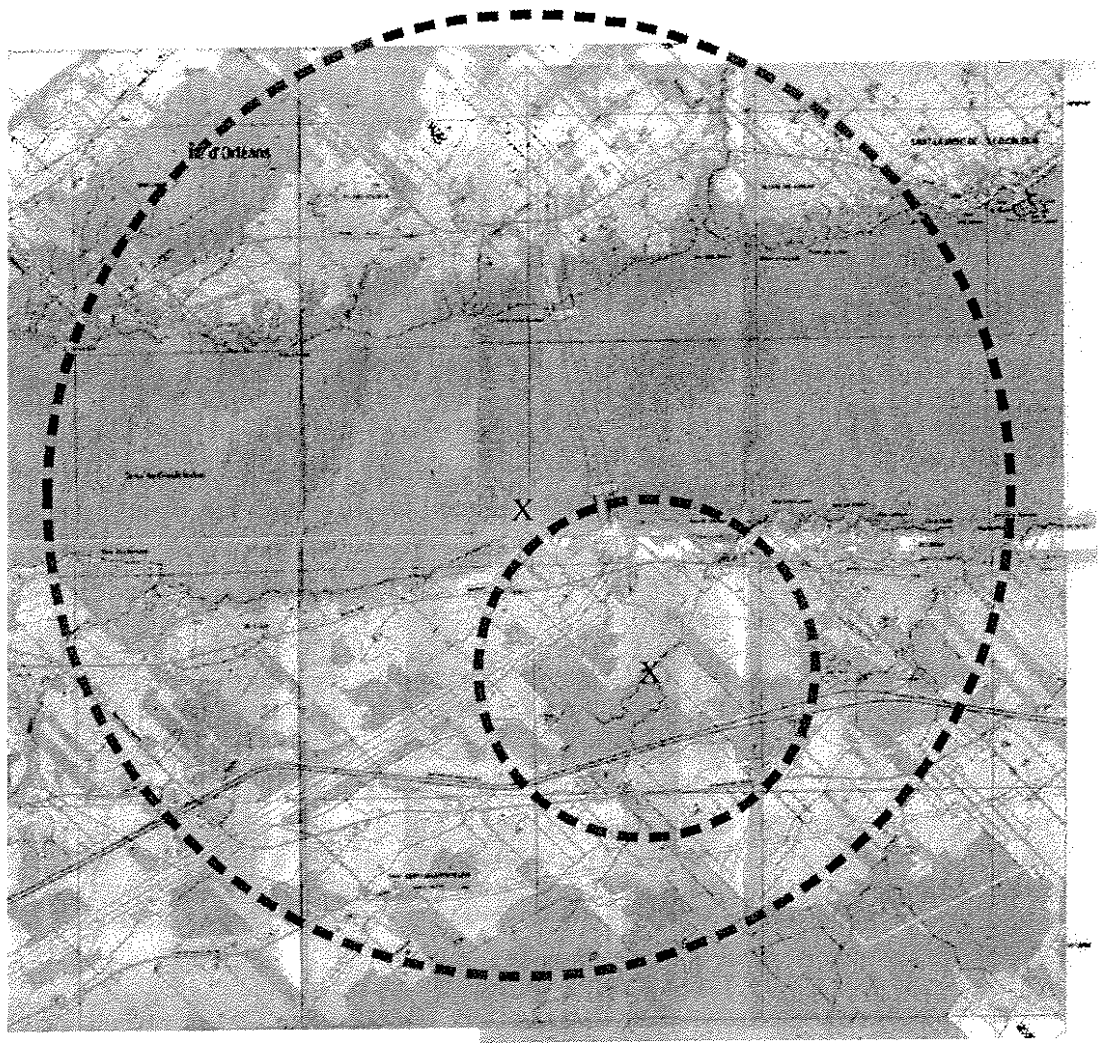

Figure 1: The thermal radiation danger zones for spills listed in Table 1. Red circles are distances to radiation intensities of 1.6 kW/m^2 for a spill with fire; smaller for loss of primary containment of land storage tank, larger for spill from one hold of LNG tanker. *X* marks the spill location.

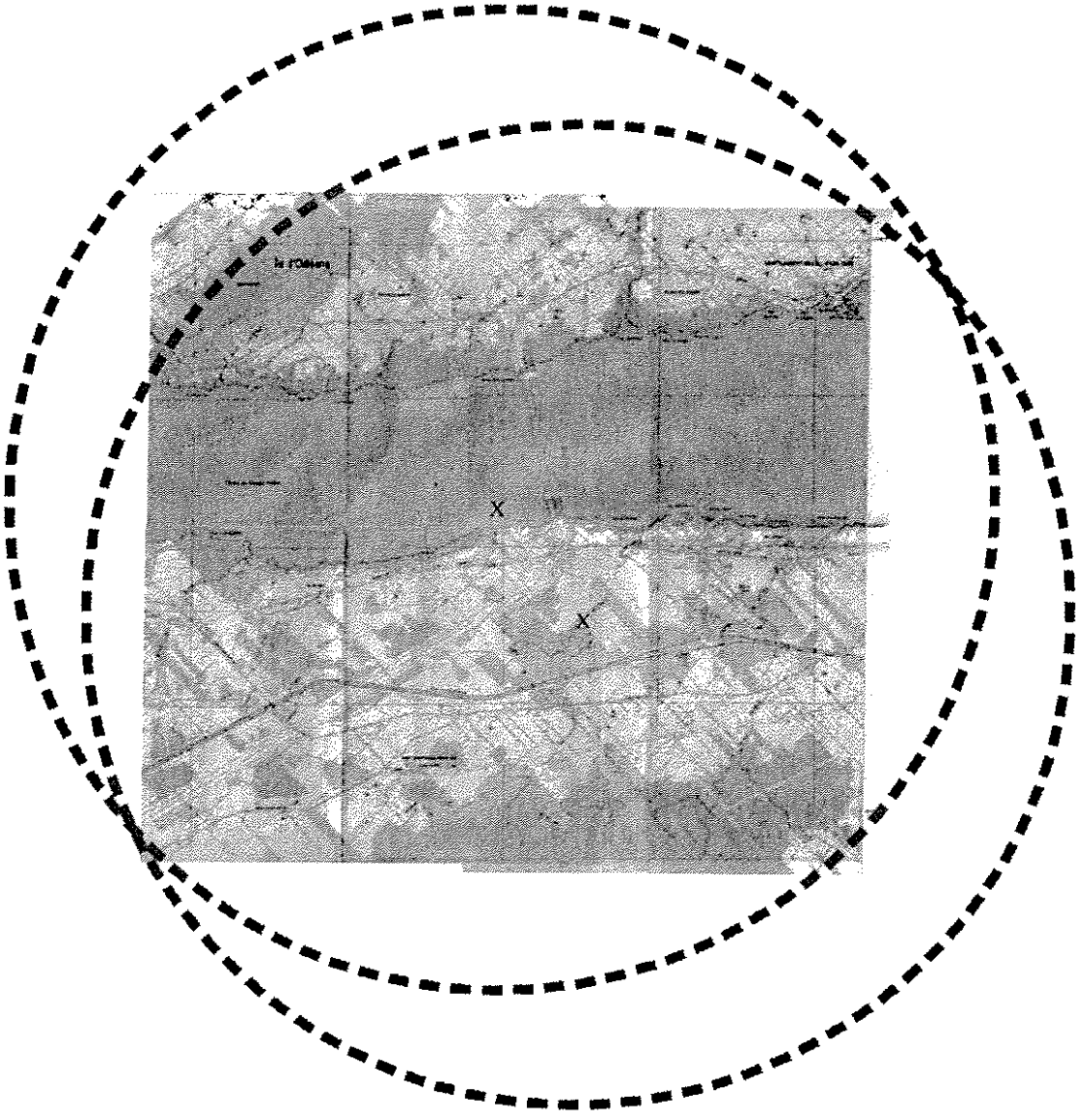

Figure 2: The flammable vapor danger zones for spills listed in Table 1. Blue circles are distances to an LNG vapor concentration of 2.5 % for a spill without fire. *X* marks the spill location.