Hazard Risk Analysis

Hazardous Material Spills, Explosions and Leaks

Hazardous Material Spills, Explosions and Leaks

This section discusses hazardous material spills, explosions or leaks either on a specific site (in situ) or during the transportation of hazardous materials. Various explosions and leaks are presented including those involving gas, mines and other causes.

Explosions and Leaks

Definition

Explosions occur when natural gas, propane, sewer, or gasoline pipelines crack or burst either, by accident, poor design, or because of corrosion. Explosions can also happen when there is a build-up of flammable gases (e.g., in grain silos or mines) or pressurized liquids and gases (such as in boilers). One type of unusual explosion is soil-generated, usually created by new construction on contaminated soils.

Leaks can occur through human error, structural failure, or construction mistakes. Leaks can happen in many different types of containers, reservoirs, and pipelines, as well as from transportation vehicles, ships and planes.

Discussion

Explosions by their very nature are usually surprises. They provide little warning time or a chance for people to avoid the situation. Explosions can also vary in size, from small explosions that causes damage in one office building, to larger explosions which result in the evacuation of hundreds of people. Individual gas leaks are often caused by construction crews who are

unfamiliar with existing gas lines. More serious incidents happen when gas leaks seep into sewer systems.

Explosions can also set off fires that could do more damage than the initial event. Explosions can cause buildings to collapse and can release toxic fumes. The people who accidentally set off the explosion are often killed or severely injured, so it can be difficult to find out if the explosion caused other potential hazards.

Mine explosions are usually caused by a buildup of explosive gases underground in the mine. These gases can be set off by a spark or by miners entering, working or leaving the area.

Mistakes in how explosives are handled underground can also cause life-threatening explosions. It is difficult, in many cases, to determine the security risk of live ammunition, or explosives, that are carried into military bases or that have been used during tests and exercises. Old military field firing ranges always have the potential to have buried explosives under the ground which could become exposed.

Gas and oil leaks can occur as a result of transportation accidents, deteriorating underground tanks, and cracked or burst pipelines. It is obvious to state that an oil spill, no matter how small, will have an immediate impact on the natural environment. Large oil pipeline leaks in Canada have occurred as a result of corrosion in older pipes, however, even new pipelines have had their share of leaks – principally as a result of human error.

It Happened Here…

On December 25, 2020, a slag pit eruption occurred at the No. 4 Blast Furnace at the ArcelorMittal Dofasco steel factory in Hamilton. Thankfully there were no injuries; however, the event caused a significant air emission.

On November 28, 2019, a major explosion took place at a soil reclamation operation near Princeton. There were no injuries and the cause of the explosion was unknown.

On October 9, 2018 an explosion and fire ripped through Canada's largest refinery Monday, injuring several workers in what its owner called a "major incident." The blast was believed to be the result of a malfunction in the diesel refining section of the Irving Oil refinery in St John's, New Brunswick. Officials said all the plant's workers were accounted for after the fire, and 4 people received hospital treatment for minor injuries.

On October 9, 2018, a 36-inch natural gas pipeline in Prince George, British Columbia, ruptured and exploded, and nearly all gas imported into the Pacific Northwest at Sumas — a Washington town on the border with Canada — was cut off. By 3 a.m. the next day, all natural gas-fired plants in the Northwest were shut down. The plant was shut down for nearly a week after the disruption.

On October 25, 2014, five people were injured after a massive industrial explosion in Sarnia, Ontario, Canada. The explosion occurred at Veolia ES Canada Industrial Services that offers industrial cleaning and maintenance services.

On July 20, 2009, the Peace River Mainline (a TransCanada natural gas pipeline) in northern Alberta exploded, sending 50-metre-tall flames into the air and razing a two ha wooded area on the traditional territory of the Dene Tha' First Nation. The explosion happened only 50 km away from the Dene Tha' community of Chateh. According to a report by the National Energy Board, the pipeline spewed 1.45 million cubic metres of natural gas – equivalent to the volume of 580 Olympic-sized pools – over a period of hours before the flow was stopped and the fire was put out.

On April 14, 2002 100 people within a 4 km radius were evacuated from Brookdale, Manitoba (38 households) following a gas explosion at a ruptured pipeline.

On January 25, 1999 a series of gas explosions at the Solex Gas Liquids plant sent 60m high flames into the air near Taylor, British Columbia (population 1,143). A state of emergency was declared and the entire town was evacuated. Fifteen injuries were reported, all were firefighters who were inside fighting the blaze when the explosion happened.

Gas Explosions and Gas Leaks – Human-caused

If your community does not have natural gas and if there are no natural gas pipelines near your community you can safely state that it is "Not Applicable."

Hazard Rating	High Risk ☐	Low Risk ☐	Need More Info ☐	Not Applicable ☐

Yes	No	Need More	Not Applicable	FACTORS
☐	☐	☐	☐	Power plants, oil sands, propane distribution facilities, and other industrial sites and plants are at risk for gas explosions and leaks. Does your community have any of these facilities located in or around it?
☐	☐	☐	☐	Earthquakes can cause gas explosions. Is your community at risk for earthquakes and do you have gas pipelines near your community (Refer to section on earthquakes)?
☐	☐	☐	☐	Natural gas is the main source of gas leaks and explosions. Do the homes and buildings in your community receive natural gas?
☐	☐	☐	☐	Gray cast iron pipes are known to become brittle, and many utilities are experiencing failure with it. Pipe failure can cause gas explosions. Is your community's gas supplied through gray cast iron pipes?
☐	☐	☐	☐	Old pipes fail more frequently. Are the pipes that supply your community's gas old?

Mine Explosions – Human-caused

Although safety practices have improved over the years, there is always the risk of a mine explosion.

It Happened Here…

On September 18, 1992, an explosion at the Giant Gold Mine in Yellowknife killed nine workers. All the men killed were either replacement workers or employees who had crossed the picket line in a very bitter, violent labour strike that has been going on for the past four months. In 1995, a man named Roger Warren -- a Giant Gold Mine employee who had been on strike in 1992 -- was convicted of nine counts of second-degree murder for planting the bomb that killed the victims. He was given a life sentence with no chance for parole for 20 years.

On May 9, 1992 at 5:18am a mixture of methane gas and coal dust exploded at the Westray Mine in Plymouth, Nova Scotia (population unknown). All 26 people on shift died, 11 bodies were never recovered. Unfortunately, prior to the disaster there were many complaints to the union about poor working conditions.

If your community does not have any mines in close proximity to it you can safely state that this is "Not Applicable."

Hazard Rating	High Risk ☐	Low Risk ☐	Need More Info ☐	Not Applicable ☐

Yes	No	Need More	Not Applicable	FACTORS
☐	☐	☐	☐	In order to be at risk from mine explosions a community must be located near a mine. Does your community have a mine located in or near it?
☐	☐	☐	☐	Most mining explosions seem to happen at coal mines. The most common disaster at coal mines are gas explosions resulting from coal and gas outbursts. Does your community have a coal mine located in or around it?
☐	☐	☐	☐	Certain materials can sometimes self-heat and then suddenly ignite, a process called 'spontaneous combustion'. Spontaneous combustion of sulphide ores is a significant risk when sulphide ore deposits are mined. Does your community have a sulphide ore mine located in or around it?
☐	☐	☐	☐	Lightning can often cause mining explosives to accidentally ignite. Is your community at risk for lightning (refer to the atmospheric hazards section on lightening)?

Oil and Gas Pipeline Leaks - Human-caused

There are numerous oil, gas, airplane fuel, propane and other pipelines in Canada. These pipelines are subject to leaks, fires and explosions.

It Happened Here…

On June 13, 2020 a spill of light crude oil from the Trans Mountain Pipeline in Abbotsford, B.C. was estimated at between 150,000 to 190,000 litres, or up to 1,195 barrels.

On January 23, 2017 A pipeline in Saskatchewan leaked 200,000 liters (52,834 gallons) of oil in an Indigenous community, near Stoughton. The spill came seven months after another major incident in Saskatchewan, in which a Husky Energy Inc pipeline leaked 225,000 liters into a major river and cut off the drinking water supply for two cities.

In June 2013 a burst pipeline gushed 2.5 million gallons (9.5 million liters) of toxic waste onto more than 4.5 million square feet (420,000 square meters) of muskeg, in northern Alberta. Members of the local First Nation, the Dene Tha' expressed concern that the leak may have been going on for a long time before either official report because of the extent of the dead and dying plants affected by the spill.

On June 7, 2012 the Sundre Petroleum Operators Group, a not-for-profit society, notified Plains Midstream Canada of a major oil pipeline failure near Sundre, Alberta that spilled an early estimate of between 1,000 and 3,000 barrels of light sour crude oil (~159-477 cubic metres) into Jackson Creek, a tributary of the Red Deer River. The river is one of the province's most important waterways, providing drinking water for thousands of Albertans. This recent spill occurred just weeks after another oil pipeline burst in Alberta in late May, spilling an estimated 22,000 barrels of oil and water (~3,497 cubic metres) across 4.3 hectares of muskeg in the northwest part of the province near Rainbow Lake. A couple of weeks after the accident, the company downgraded the estimate to 5,000 barrels of sweet crude oil with no water (~795 cubic metres).

June 24, 2008, a pipeline rupture leaked up to 200 barrels of sweet crude oil in the Red Deer River, causing a popular recreation destination in Alberta, Gleniffer Lake, the reservoir of Dickson

Dam south of Sundre, to close for eight days while efforts were made to contain and clean up the oil leak. The spill forced downstream recreation communities on Gleniffer Reservoir to shut off their drinking water supply intake. Once the David Thompson Health Region determined that the water was safe, it allowed these two raw water intakes to reopen June 27, 2008. Prior to this date, Pembina Pipelines paid for water to be trucked into the communities.

At 6:18pm on April 15, 2007, 990 cubic metres of crude oil were released into a wetland area due to a ruptured pipe near Glenavon, Saskatchewan (population 104). Damages were kept at a minimum as 912 cubic m were recovered.

On October 10, 2006, the Rainbow Pipe Line Company became aware of a crude oil spill on its pipeline 20 kilometres southeast of Slave Lake. Roughly 7,924 barrels of oil (~1,260 cubic metres) poured into a series of ponds near the northern Alberta town, despoiling wildlife habitat.

If your community does not have a pipeline near your community you can safely state that this is "Not Applicable."

Hazard Rating	High Risk ☐	Low Risk ☐	Need More Info ☐	Not Applicable ☐

Yes	No	Need More	Not Applicable	FACTORS
☐	☐	☐	☐	In order to be at risk from an oil pipeline leak a community must be located near a pipeline. Does your community have an oil pipeline located in or near it?
☐	☐	☐	☐	Older pipelines have a higher risk of corrosion. Is the pipeline near your community older, and is it not often inspected for corrosion?
☐	☐	☐	☐	Oil pipelines leaks can be minimized if an Emergency Response Team is located in near proximity. Are Emergency Response Teams capable of dealing with a pipeline burst located more than an hour away?
☐	☐	☐	☐	Pipelines are sometimes damaged on purpose by community members. Have there been known cases of intentional damage to a major pipeline in or near your community?

Other Explosions and Leaks - Human-caused

Military training grounds, sites where extensive blasting has taken place are all places where the potential for other types of explosions may take place.

It Happened Here…

In June 1988, six soldiers were killed in a blast during a training course were working with explosives capable of blowing up a small house, an official said. Three other soldiers were injured in Monday's blast near the Canadian Forces Base in Chilliwack, British Columbia.

Hazard Rating	High Risk ☐	Low Risk ☐	Need More Info ☐	Not Applicable ☐

Yes	No	Need More	Not Applicable	FACTORS
☐	☐	☐	☐	Former live-fire military training facilities can be contaminated with unexploded ammunition that can explode if triggered. Does your community have a former live-fire military training facility in or around it?
☐	☐	☐	☐	Blasting techniques used on steel can cause explosions. Does your community have steel blasting facilities in or around it?
☐	☐	☐	☐	There are records of explosions at textile plants and clothing factories. Does your community have a textile plant in, or around it?
☐	☐	☐	☐	Dust explosions are associated with industries that produce flammable dust as a by-product of their industrial processing. Do the industries in your community produce flammable (or 'ignitable') dust as a by-product?

Hazardous Material Spill

Definition

In Canada, hazardous material spills can happen under two circumstances: 1) spills, leakage, or accidents involving materials on site; and 2) spills, leakage, or accidents that happen when hazardous materials are transported by aircraft, rail. ship or truck.

Hazardous materials can involve any materials that are considered dangerous by Transport Canada. These involve toxic gases, radioactive material, acids, and any number of chemicals and goods. Hazardous materials can also include gas or oil spills when they pose a risk of fire, explosion, or damage to the environment.

Discussion

CANUTEC is the Canadian Transport Emergency Centre operated by Transport Canada to assist emergency response personnel in handling dangerous material emergencies. CANUTEC has set up a scientific data bank on over 750,000 chemicals manufactured, stored, and transported in Canada. The centre is staffed by professional scientists specialized in emergency response and experienced in interpreting technical information and providing advice. CANUTEC receives around 30,000 calls per year with over 1,000 of those calls required an emergency report.

Dangerous goods include explosives, compressed and liquefied gases, flammable and combustible materials, oxidizing materials and organic peroxides, poisonous and infectious substances, radioactive materials, corrosives, and miscellaneous dangerous goods. The list of materials that are declared hazardous in transport is identical to that for fixed facilities.

Various facilities where hazardous materials are manufactured, processed, stored, treated, and disposed of are considered in situ hazardous material sites. The potential sites for hazardous materials incidents are many. Many rural sites that produce and process natural resources will create and use hazardous materials. These can include: pulp and paper mills, sawmills, mines, oil and gas drilling sites, refineries, slaughterhouses, and tanning of hides. Industrial sites involved in making of pharmaceuticals, fertilizers, paints are also sources of hazardous material spills. Gas and oil pipelines can rupture and spill their contents into the environment.

It Happened Here…

On October 28, 2020 Hazmat teams responded to a leak at the 3M research plant north of Highway 401. One firefighter and one other person suffered minor injuries as a result of the leak, and preliminary information from the scene indicated it was an ammonia leak.

On September 13, 2020, a woman is dead and 10 people, including paramedics and firefighters, are injured following a chemical spill involving hazardous materials in Mississauga, Ontario. The substance came from inside a house and was contained to the house.

On July 16, 2007 sulphur dioxide was mistakenly released into the air from the AV Cell pulp mill when a pipe broke near Atholville/Tide Head, New Brunswick (population 1,317). The leak lasted for 15 minutes. No evacuations occurred nor were injuries reported.

Hazard Rating	High Risk ☐	Low Risk ☐	Need More Info ☐	Not Applicable ☐

Yes	No	Need More	Not Applicable	FACTORS
☐	☐	☐	☐	Areas where previous hazardous materials spills have occurred are at greater risk. Has your community experienced a hazardous material spill in the past?
☐	☐	☐	☐	Chemical manufactures and other industrial sites (such as active pulp and paper mills, forest mills, nuclear power plants, etc.) can produce hazardous material. Does your community have a chemical manufacturer and/or other industrial sites in or near it?
☐	☐	☐	☐	Areas where large quantities of dangerous materials are being handled are at risk. Does your community have any of these types of areas in or around it?
☐	☐	☐	☐	Chemicals stored under pressure (greater than normal pressure) pose a greater risk than those not under pressure. Does your community have chemicals stored under pressure in or around it?
☐	☐	☐	☐	Over time storage containers can deteriorate, increasing the risk of leaks. Does your community have a hazardous material in a long-term storage area?
☐	☐	☐	☐	The waste from mining processes, known as waste rock or tailings, can contaminate the surrounding areas. Does your community have a mine located in or around it?
☐	☐	☐	☐	Medical care facilities can sometimes produce large amounts of biomedical or infectious wastes. For a number of years, these wastes were dumped in municipal landfills and often left there for several days between collections. This concentration of wastes poses a threat to regional health. Was your community's dump a site for biomedical and infections wastes in the past?
☐	☐	☐	☐	Extreme natural events (such as volcanic eruptions, earthquakes, landslides, hurricanes, tornadoes, blizzards, floods, forest fires) can trigger a hazardous material spill. Is your community at risk for any of these extreme natural events (Refer to the relevant sections for these hazards)?
☐	☐	☐	☐	There is a greater risk to communities if hazardous materials sites are not inspected frequently and if these sites aren't adequately regulated. Are hazardous materials sites in your community unregulated and/or not often inspected?

Hazardous Material Spills – Air Transport – Human-caused

Planes typically carry both non-hazardous and hazardous materials around the world, including the fuel on board. When one of these airplanes crashes, the potential exists for a hazardous material spill.

It Happened Here…

On November 10 1993, a plane left Sandy Bay Ontario and crashed shortly after take-off. All seven persons aboard were killed and the fuel that was on board the aircraft spilled into the swampy area of the crash site.

Hazard Rating	High Risk ☐	Low Risk ☐	Need More Info ☐	Not Applicable ☐

Yes	No	Need More	Not Applicable	FACTORS
☐	☐	☐	☐	Is your community located in a hazardous material air route?
☐	☐	☐	☐	There is a risk of a hazardous material spill from air transport if your community is at risk for air crashes. Is your community at risk for air crashes (refer to the section on Accidents)?

Hazardous Material Spills – Marine Transport – Human-caused

Oil tankers and other marine vessels typically carry both non-hazardous and hazardous materials on the ocean, in lakes and rivers. When one of these marine vessels is grounded or is involved in an accident, the potential exists for a hazardous material spill.

It Happened Here…

On May 11, 2016, in Plumper Bay, near Esquimalt, British Columbia, a barge spilled approximately 27,000 litres of diesel fuel which was recovered from the area using booms, sorbents and skimmers. The recovered oily waste was sent to an approved facility for disposal.

On February 4, 1970 a ship ran aground on Cerberus Rock in Chedabucto Bay, Nova Scotia (population 911) during heavy rain and winds. An oil spill ensued causing catastrophic damage to the coast and the surrounding communities.

If you don't have any lakes, rivers or oceans that boats or ships can navigate then you can safely state that this is "Not Applicable."

Hazard Rating	High Risk ☐	Low Risk ☐	Need More Info ☐	Not Applicable ☐

Yes	No	Need More Info	Not Applicable	FACTORS
☐	☐	☐	☐	Is your community located in hazardous material marine transportation route?
☐	☐	☐	☐	There is a risk of a hazardous material spills from marine transport if your community is at risk for marine accidents. Is your community at risk for marine (refer to the section on Accidents)?

Hazardous Material Spills – Land Transport – Human-caused

Tanker trucks and other vehicles typically carry both non-hazardous and hazardous materials across the country. When one of these vehicles is involved in an accident, the potential exists for a hazardous material spill.

It Happened Here…

On April 4, 2016, a cab and trailer were separated in a highway crash, with the trailer leaving the road surface and moving approximately 100 feet down an embankment. It is estimated that the trailer lost approximately 20,000L of diesel fuel with an undetermined amount entering the water at the Similkameen River.

At 5:50am on Oct 2, 2009 a tanker truck carrying sulphuric acid collided with another vehicle causing the contents to spill in Sunnybrook, Alberta (population 68). The highway remained closed until midnight while crews cleaned up the spill. No one was seriously injured.

On October 14, 2006 two vehicles collided near Caledon, Ontario. Diesel fuel and sulphuric acid leaked from the tractor trailer causing all eastbound lanes to be shut down as clean-up crews contained the spill; 4 individuals died as a result of the crash.

Hazard Rating	High Risk ☐	Low Risk ☐	Need More Info ☐	Not Applicable ☐

Yes	No	Need More Info	Not Applicable	FACTORS
☐	☐	☐	☐	Is your community located in hazardous material trucking route?
☐	☐	☐	☐	There is a risk of a hazardous material spills from trucks and other transport vehicles if your community is at risk for road accidents. Is your community at risk for road accidents (refer to the section on Accidents)?

Hazardous Material Spills – Rail Transport – Human-caused

Canadian rail companies carry millions of rail cars containing hazardous material over the course of a year. Unfortunately, there have many rail derailments involving hazardous materials in

It Happened Here…

On September 14, 2020 a CN train derailed in Hope B.C. at Hunter Creek near the Fraser River that was carrying potash. There were 60 rail cars off the tracks and 20 rail cars overturned. Train cars have been removed from the bridge and train tracks. Environmental contractors arrived to the incident site to install sediment fencing and containment boom.

On October 18, 2010 more than a dozen cars of a freight train carrying ammonium nitrate, sulphuric acid and sodium cyanide left the tracks near Glendale, Ontario (population 957). Toronto-Montreal passenger trains had to be rerouted through Ottawa adding 2 hours to the trip while freight services were halted. Via Rail stopped selling passenger tickets along the route for the duration of the clean-up.

On June 14, 2010 a Canadian Pacific cargo train collided with a garbage truck spilling around 4000 gallons of diesel fuel near Grande Pointe, Manitoba. As a result of the incident, 22 train cars derailed, and the garbage truck driver experienced serious injuries.

If your community does not have any rail lines running through, or close to, your community you can safely state that this is “Not Applicable.”

Hazard Rating	High Risk ☐	Low Risk ☐	Need More Info ☐	Not Applicable ☐

Yes	No	Need More Info	Not Applicable	FACTORS
☐	☐	☐	☐	Is your community located near a rail hazardous materials route?
☐	☐	☐	☐	There is a risk of a hazardous material spill from rail transport if there is an accident involving hazardous materials. Is your community at risk for rail accidents (refer to the section on Accidents)?

Risk Analysis Resources

Hazardous Material Spills – Dangerous Goods and Oil Spills

Health Canada provides details regarding workplace hazardous materials and related warnings and advisories.

Keywords: WHMIS Canada

Transport Canada provides details regarding the transportation of dangerous goods.

Keywords: transport Canada dangerous goods

The Western Canada Marine Response Corporation has information regarding the National Oil Spill Preparedness and Response Regime which provides the framework for preparedness and response for shipsource oil spills in Canadian waters south of the 60th parallel.

Keywords: National Oil Spill Preparedness and Response Regime

Pipeline Incidents

The Transportation Safety Board of Canada lists all reported pipeline incidents that have occurred

Keywords: Transportation Safety Board of Canada pipeline incidents

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