The Hazards of Emerging Fuels and an Inadequate Infrastructure

By Lieutenant Chris Zisel

photo courtesy City of Quebec, official Twitter account

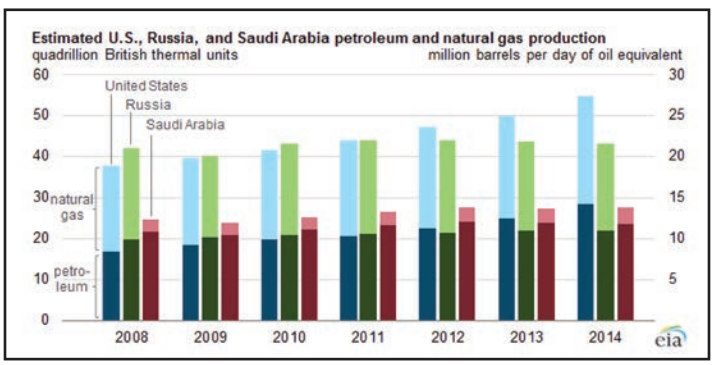
Once the 1.6 million gallons of crude oil that the Canadian train was carrying ignited, the July 6, 2013, explosion and fire that resulted devastated the town of Lac-Megantic.

On July 6, 2013, a Canadian train, bound for the Irving Oil Refinery in Saint John, New Brunswick, lost control and crashed in Lac-Megantic, Quebec. The train was transporting 72 cars of crude oil extracted from North Dakota's Bakken Oil Formation. Of the 72 cars that were involved in the accident, 68 of them breached, spilling an estimated 1.6 million gallons of crude oil. When the oil ignited, an immense explosion and fire ensued, which completely devastated the town. The fire burned for two days and required numerous agencies to respond before it finally was put under control. In the end, the accident claimed 47 lives, burned more than 30 buildings and displaced 2,000 of Lac-Megantic's 6,000 residents.

On December 20, 2012, the 597-foot oil tanker, *Stena Primorsk,* ran aground in the Hudson River, just seven miles south of Albany, New York. The vessel was transporting approximately 12 million gallons of crude oil from Albany to the same oil refinery in Saint John, New Brunswick. The grounding, which was attributed to a failure in the vessel's steerage, ripped a 13- by six-foot hole in the hull of the vessel and risked spilling millions of gallons of crude oil into the Hudson. Fortunately, a potential disaster was averted due to the vessel's doubled-hulled design, a safety feature that was implemented after the Exxon *Valdez* oil spill.

Historically, the United States' energy supply and demand model was based upon the import of millions of gallons of crude oil from OPEC nations. However, with the discovery of new oil and gas deposits, coupled with technological improvements in drilling (particularly with hydraulic fracturing and horizontal drilling), the U.S. now is able to extract much more oil and natural gas than it has in the past. Due to these factors, the U.S. has surpassed Russia and Saudi Arabia as the world's number one producer of crude oil and natural gas. It has been estimated that this production will supply our nation for decades to come, with enough surplus to support an export-driven model.

Although the discovery of these new oil and gas deposits has increased U.S. supply, some of the properties associated with these



courtesy U.S. Energy Information Administration

emerging fuels, coupled with an inadequate infrastructure to effectively transport them, has led to a significantly increased hazard potential. This can be evidenced by the aforementioned Lac-Megantic and *Stena Primorsk* accidents.

These factors are particularly alarming for the Port of NY/NJ, which is the nation's third largest port and contains the greatest amount of storage and the most movement of flammable liquid of any port in the United States. This can be attributed to New York's geographical location in relation to many of these oil and gas deposits and that these fuels either are stored in the Port of NY/NJ or transited down the Hudson River to refineries throughout the world.

The accident that occurred in Lac-Megantic, however, was exacerbated by the fact that the train was transporting crude oil from the Bakken Oil Formation. Primarily located in North Dakota and Canada, the formation is approximately 200,000 square miles and contains billions of gallons of crude oil. According to some estimates, it produced more than 29 million barrels of oil in 2013, with 900,000 barrels produced on a daily basis.

photo by John Carl D'Annibale, Times Union newspaper

The Stena Primorsk *ran aground in the Hudson River on December 20, 2012. However, none of the 12 million gallons of oil it was carrying was lost, thanks to the oil tanker's double-hulled design.*

The oil extracted from the Bakken region is composed differently than other types of traditional crude. Lab tests have shown that it is more consistent with gasoline and contains similar levels of benzene, toluene, ethylbenzene and xylene. Bakken also has been shown to release natural gas bubbles when it's agitated, making it exceptionally more volatile to transport than other types of crude. Although lab samples tend to vary, the generalized properties of Bakken crude oil follow:

Specific Gravity	0.7-0.8	Floats on Water
Vapor Density	2.5-5.0	Heavier than Air
Vapor Pressure	280-360 mm Hg	Moderate Volatility
Explosive Limits	.4%-15%	LEL–UEL
Flash Point	-30	Degrees F

BAKKEN CRUDE OIL CONTAINS HYDROGEN SULFIDE GAS

Once Bakken has been extracted, due to the region's remote location and lack of adequate pipeline access, a significant amount of the oil is loaded onto railcars where it either is transported to St. Louis, Missouri, or Albany, New York, for further distribution. Once the oil that is shipped to Albany arrives, it is transported either by train down the western shore of the Hudson River or by tanker/barge down the river itself, through the Port of NY/NJ, to refineries.

The final destination of most tanker transits are in Saint John, New Brunswick, whereas barges usually terminate at facilities along the east coast of the U.S.

Along with its inherent volatility, a major concern of transporting Bakken by rail are the DOT-111 rail tank cars that are used in the process. The National Transportation Safety Board (NTSB) has come out against the use of these cars, stating they are "susceptible to damage and puncture during collisions." Although these cars are noted to have poor safety records, it is still estimated that 82 percent of the cars employed to transport Bakken are DOT-111s. While some of these cars have been retrofitted with safety upgrades, they are done so on a voluntary basis, as they are subject to little oversight or regulation by the government.

One of the major contributing factors in the Lac-Megantic accident was the use and breach of the DOT-111s. It also should be noted that as it relates to the Port of NY/NJ, there are currently 10 to 20 trains traveling south along the western shore of the Hudson each week with millions of gallons of Bakken crude oil as cargo.

While transporting Bakken by rail raises significant concerns, transporting it by vessel is equally alarming. Although the Stena Primorsk no longer transits the Hudson River after her accident, the Bahamian flagged vessel, Afrodite, took its place and continued down the Hudson with millions of gallons of Bakken crude

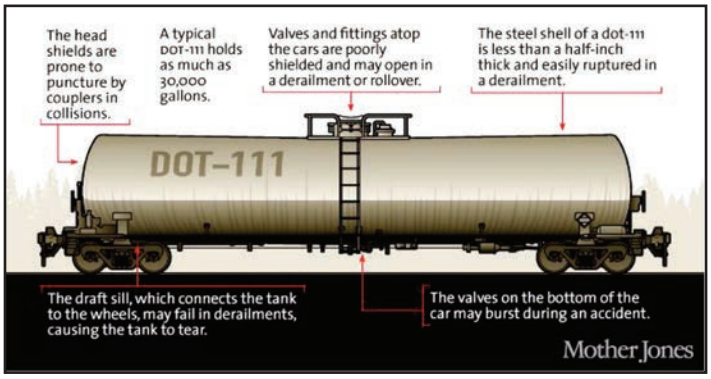


photo courtesy MotherJones

According to the NTSB, the DOT-111 rail tank cars are "susceptible to damage and puncture during collisions."

as cargo. Although recently re-assigned, the Afrodite, or any other tanker transporting Bakken, may become vulnerable to mechanical failure or human error, as did the Stena Primorsk. This would be exceptionally more hazardous if it were to occur in a densely populated area with high vessel traffic, such as in the Port of NY/NJ.

The oil that is not transported by tanker is transported by barge, which uses tugboats to power and navigate them downstream. Many of these tugboats, however, are decades old and not subject to the strict safety standards that larger vessels and tankers are. Moreover, many of these tugs do not possess redundant operating systems if their main propulsion or steerage systems fail. It should be noted that of the 14 tugs that transport approximately 3.2 million gallons of Bakken down the Hudson on a daily basis, there have been numerous, recorded incidents that have involved collisions, groundings and engine failures.

Another fuel that has emerged and may begin to pose significant risk to the Port of NY/NJ, is Canadian Tar Sands Oil. The Canadian Tar Sands Region is located in Alberta, Canada, and contains approximately 2.2 trillion barrels of crude oil. The oil that is extracted from this region is much thicker than other kinds of crude and typically is used in asphalt applications. Due to its viscosity, it can't be transported efficiently through pipelines, so it is either heated or diluted with chemicals in order to facilitate its transport. Once the oil has been treated, it then is loaded on truck, rail or vessel, where it generally is shipped to refineries in the Gulf of Mexico.

(Continued on page 28)

The Hazards of Emerging Fuels and an Inadequate Infrastructure

(Continued from page 15)

There are plans, however, for this oil to be transported down the Hudson, using the infrastructure that's already in place to transport Bakken. Global Partners, a major fuel transport company, has applied for permits to install industrial heaters to heat rail tank cars and barges at its Albany facility. This would allow them to ship Canadian Tar Sands Oil from Alberta to Albany and then load it on heated trains and barges for transport down the river.

Canadian Tar Sands Oil presents a different, yet equally hazardous, set of challenges if a breach or spill occurs. The chemicals that are used to dilute the oil tend to evaporate before the oil itself. In this case, emergency personnel who respond to a spill or breach will experience elevated levels of benzene, toluene, ethylene and xylene. After these diluting chemicals evaporate, the remaining oil will sink, especially when in saltwater or influenced by heavy sediment or wave action. As with the infrastructure problems that are inherent in the transportation of Bakken, a bitumen spill would present serious health risks, severely impact the environment and require immense cleanup efforts that undoubtedly would restrict the free movement of transportation within the Port of NY/NJ.

Such oil spills generate serious health risks, impact the environment and necessitate extensive cleanup efforts. photo courtesy www.desmogblog.com

Due to its newfound abundance and limited environmental impact, natural gas is another fuel that increasingly is being used. Natural gas can be extracted either from oil fields in its natural, gaseous state or it can be extracted from crude oil after it's treated. Along with the U.S.' abundance of crude oil, the U.S. now produces more natural gas than we consume and the industry has begun steps to export the fuel.

Transporting natural gas, however, requires that it be cooled and condensed into a liquid, where it is approximately 600 times smaller than it is in its gaseous state. This increases export capacity, reduces shipping costs and increases the profit margins for the shipping companies. The liquefied natural gas (LNG) then is transported by truck, rail or specialized LNG vessels that can continue the export process overseas.

LNG also increasingly is being used to fuel marine vessels. Current pricing, limited environmental impact and estimates that it can extend life expectancy of marine engines by 50 percent are driving the trend. Many companies now are exploring converting older vessels to LNG power and contracting new builds with LNG as its primary source of power. Within the Port of NY/NJ, the Staten Island Ferry currently is in the process of initiating pilot programs that would transfer some of its vessels to LNG power, while using LNG bunker barges to refuel them. Although somewhat new to the market, LNG-powered vessels seem to be a direction that the industry is heading toward, as evidenced by current investment and development projects. It should be noted that some estimates forecast that in 20 years, approximately 9,000 vessels, all weighing more than 500 gross tons, will be powered by LNG.

Main hazards associated with the transportation of LNG include a large-scale release or spillage of gas and subsequent vapor dispersion. Although LNG vessels do not transit the Port of NY/NJ, there are numerous LNG facilities that service LNG vessels located along the east coast of the U.S. A LNG release could occur at any one of these facilities, necessitating a regional response, or on a vessel itself that is in transit to or from one of these facilities. Moreover, these terminals and vessels present a maritime security threat, where ill-inspired actors could decide to target them in a terrorist attack.

The concerns regarding the use of LNG-powered vessels inside the Port of NY/NJ are somewhat similar, as more shore-side facilities, barges or trucks will have to be constructed or used in order to refuel a growing LNG fleet. This will be complicated by the fact that since these LNG-powered vessels are so new to the market, there are not a lot of regulations governing the safe construction or refueling of these vessels. Although some protocols are in place, they are more or less guidelines, which were developed for larger vessels and large-scale LNG refueling operations. As the industry grows, a closer look into the construction and refueling operations of smaller LNG vessels will be necessary.

To conclude, the discovery of new oil and gas deposits, coupled with technological innovations that facilitate their extraction, has provided the U.S. with an abundant amount of oil and natural gas.

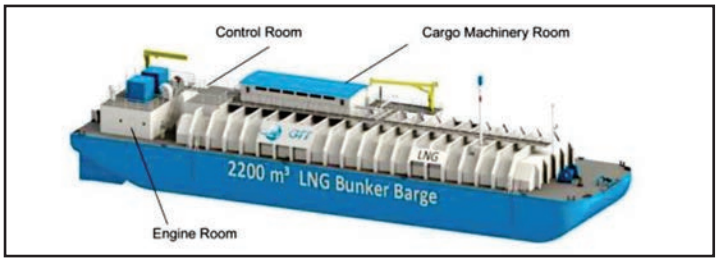


photo courtesy www.motorship.com

A large-scale release or gas spillage and vapor dispersion are some of the hazards of transporting LNG.

The U.S.' infrastructure, however, primarily is designed for import and does not possess adequate export capability. As a result, an inadequate and unregulated infrastructure is being used to transport or utilize fuels that possess volatile or hazardous properties. Due to New York's geographical location, many companies are transporting these fuels by rail or vessel down the Hudson River to refineries. With the surplus of these fuels, it should be anticipated that a larger contingent of trains, tankers and barges will be operating in or transiting the Port of NY/NJ, creating additional traffic and the likelihood of additional accidents. ■

NYS Report, "Transporting Crude Oil in NYS"

An important indicator that dictates the volume of traffic transporting crude oil is its price. The higher the price of oil, the more vehicle, rail and vessel traffic.

About the Author:

Lieutenant Christopher Zisel has served the FDNY since 2003. He is assigned to Division 3. He is a Lieutenant in the U.S. Coast Guard. This is his second article for *WNYF.*