

IS THERE A NEED FOR IMPROVED PUBLIC AND WORKER SAFETY FOR PETROLEUM REFINERIES?

By Scott Grant, P.Eng.



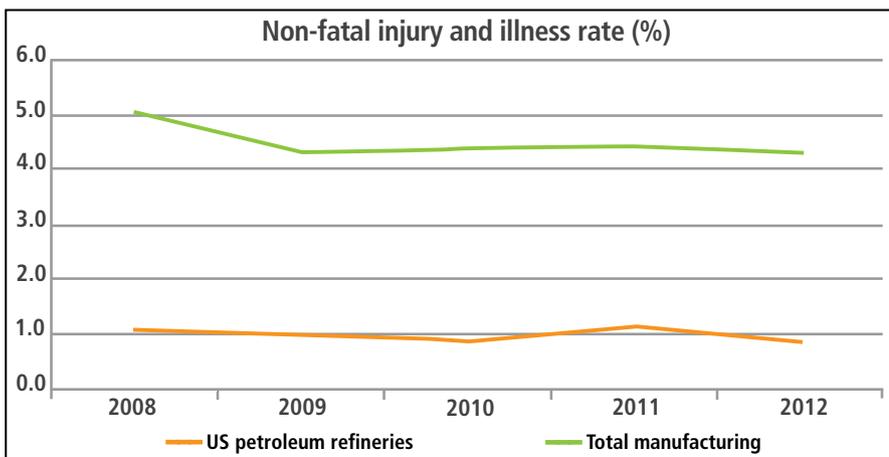
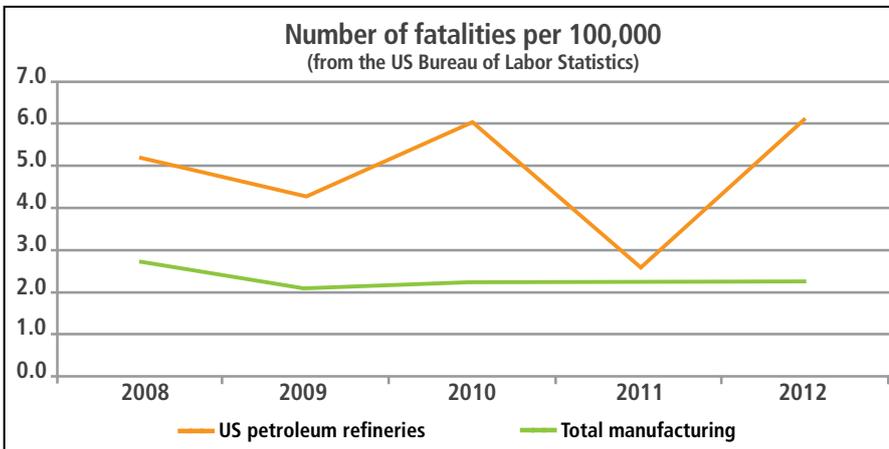
**ONTARIO CENTRE
FOR ENGINEERING
AND PUBLIC POLICY**

A SERIES OF incidents at petroleum refineries in the US and subsequent investigations by the United States Chemical Safety Board resulted in a review by the state of California of risks to worker and public safety from petroleum refineries.

There are six petroleum refineries in Ontario: four in the Sarnia area, one in Nanticoke and a smaller one in Mississauga. Should a similar review of worker and public safety be conducted for Ontario petroleum refineries?

INVESTING IN SAFETY

The business of refining crude oil is complex and profitability requires balancing many different factors and inputs. The varying nature of the crude oil input to a petroleum refinery and such aspects as density, sulphur content and price create both engineering opportunities and challenges.



Worker safety and minimizing risk to surrounding communities have always been important considerations for petroleum refining engineering and operations due to the inherently hazardous nature of the raw materials and fuel produced. For example, the figures presented here were developed from US Bureau of Labor Statistics data and provide an illustration of both the inherent dangers and significant workplace safety successes of the petroleum refining industry. Information from the Ontario Workplace Safety Insurance Board suggests that lost-time claims as a result of accidents or illness for 2013 are relatively low for areas of the province where petroleum refineries are located.

In both Canada and the US there are comprehensive standards for piping, pressure vessels, transportation systems and fuel safety, and they work together toward the objective of reducing risk and improving system predictability. In addition, process hazard analysis is a common and ongoing activity to ensure the safe and profitable operation of petroleum refineries. Regulatory oversight for the manufacturing and transport of fuels is provided by a number of agencies with different roles from the Ontario ministries of labour and environment; to the Technical Standards and Safety Authority; to the federal departments of transportation and environment; and the Transportation Safety Board of Canada.

However, safety is not a static concept. Managing safety risks involves keeping abreast of changes in raw materials, manufacturing processes and aging equipment, and expanding knowledge based upon experience and past incidents in the sector. Changes in the

[POLICY ENGAGEMENT]

character of the crude oil input to petroleum refineries are anticipated to be factors that affect the safety of transportation systems and refining processes.

RECENT INCIDENTS AND A CALL FOR APPLYING LESSONS LEARNED

On August 6, 2012, the Chevron petroleum refinery in Richmond, California, experienced a catastrophic pipe failure in the crude unit and there was a subsequent release of flammable hydrocarbon process fluid. Nineteen Chevron employees were engulfed by the resulting vapour cloud and serious injury was narrowly avoided when the cloud ignited. The resulting fire took a number of days to extinguish and caused approximately 15,000 people from the surrounding area to seek medical treatment for respiratory problems. The Richmond Chevron incident occurred despite the presence of legislative mechanisms designed to protect against such accidents.

The United States Chemical Safety Board (US CSB) was formed as part of the US *Clean Air Act* amendments of 1990. The US CSB is an independent federal agency charged with investigating industrial chemical accidents. Its staff includes chemical and mechanical engineers, industrial safety experts and other specialists with experience in the private and public sectors. In addition, under the same 1990 amendments, the United States Congress also empowered the following two regulatory efforts:

- The United States Environmental Protection Agency was required to promulgate regulations, eventually known as “risk management plan rules,” to prevent and respond to chemical accidents; and
- Also under the US *Clean Air Act*, the United States Department of Labor was directed to develop and implement a similar occupational safety and health administration standard, known as the Process Safety Management (PSM) Regulations, as a complementary effort that focuses on preventing workplace chemical accidents.

Individual state and local authorities share the responsibility with the US federal departments in implementing the federal risk management and PSM requirements. These US requirements are at least as stringent and comprehensive as related Canadian federal and Ontario requirements. Canadian federal and provincial requirements are often based upon a subset of similar US legislation.

In October 2014, the US CSB published a regulatory report of the Chevron incident (www.csb.gov/assets/1/19/Chevron_Regulatory_Report_11102014_FINAL_-_post.pdf) and following are some of the key conclusions:

1. Tests conducted on the ruptured pipe at the Richmond Chevron refinery determined that it had experienced extreme thinning near the rupture location due to sulfidation corrosion. In 2007, a similar pipe failure occurred in the crude unit due to sulfidation corrosion and caused a fire that required the initiation of a shelter-in-place order for the surrounding community. The US CSB concluded the incidents could have been prevented by implementing improved and readily available corrosion-resistant metallurgy.
2. The US CSB investigation also concluded that Chevron metallurgists, materials engineers and piping inspectors had expertise regarding sulfidation corrosion but they had limited practical influence to implement their recommendations. For example, they did not participate in the crude unit process hazard analysis and did not affect decisions concerning control of sulfidation corrosion during a crude unit maintenance effort.
3. The US CSB investigation included a review of recordable incidents at petroleum refineries across the country and concluded there is a considerable problem with significant and deadly incidents at petroleum refineries over the last decade. The US CSB noted there are more recordable incidents for US petroleum refineries than any other industry despite the fact that US petroleum refineries comprise roughly one per cent of the 13,000 facilities the federal risk management plan requirements cover.
4. The California regulators sharing responsibility in enforcing the risk management planning and process safety management requirements lack technical staff with the necessary skills, knowledge and experience to provide direct oversight of petroleum refineries in California.
5. Under the current requirements, facility operators must control hazards when conducting a process hazard analysis but there is no requirement to reduce the risks to a specified “as-low-as-reasonably-practical” level.

The US CSB also reviewed safety practices of the US nuclear industry and the US National Aeronautics and Space Administration, as well as requirements in other jurisdictions, such as the United Kingdom, Australia and Norway. These jurisdictions were considered leaders in chemical plant and petroleum refinery safety.

The US CSB notes that major industrial incidents have been catalysts for significant regulatory reform to improve the safety of industrial facilities around the world. One such shift in the United Kingdom, Australia and Norway was towards what has become known as the “safety case regime.” In this approach, a facility owner is regularly required to make a case to the regulator of the safety of its operation. The US CSB concludes that the safety case regime also represents an improvement over current US requirements for chemical plants and petroleum refineries because it requires a combination of comprehen-



sive risk management and rigorous oversight by a technically competent regulator. Independent studies of the success of the safety case regulatory regime were also noted by the US CSB in its Richmond Chevron regulatory report.

The US CSB investigation of the Richmond Chevron incident went beyond simply identifying the specific cause of the accident (i.e. sulfidic corrosion of a pipe) and conducted a root-cause analysis that resulted in a number of policy recommendations. The governor's office in California also published a report, *Improving Public and Worker Safety at Oil Refineries, February 2014* (www.calepa.ca.gov/Publications/Reports/2014/RefineryRpt.pdf), in response to the Richmond Chevron incident. This California report supports the conclusions of the US CSB report where it also recommended a shift in the safety regime, including the formation of an inter-agency refinery task force to carry out safety improvements and promote more coordinated agency oversight of refineries.

These recent incidents and subsequent reviews in the US are anticipated to be relevant to Ontario because there is evidence of similar problems here. For example, on October 7, 2014, the Ontario environmental commissioner published his 2013/2014 annual report, *Managing New Challenges*. In it, there is a chapter: "MOE Continues to Fail the Aamjiwnaang First Nation," where the commissioner says the Ontario Ministry of the Environment and Climate Change must do more to resolve air pollution issues that impact the First Nation community near Sarnia. The report refers to a series of incidents in 2013 that were identified as being caused by pipe failures at a nearby petroleum refinery. Community members complained of a strong rotten egg and gasoline smell that was evident for several hours, and the report says many residents experienced red eyes, headaches, nausea, throat and skin irritation, dizziness, shortness of breath and coughing. There was also concern about how the incident was managed (e.g. concerns with a delayed response from community sirens and differing information being provided by authorities dur-

ing the course of the event). In the report, the environmental commissioner also concludes the Ministry of the Environment and Climate Change needs to be more proactive in ensuring adverse effects from these facilities are minimized.

Back to the original question: Should a review of worker and public safety be conducted for Ontario petroleum refineries?

Although petroleum refining operators have been successful at minimizing non-fatal injury and illness rates, incidents at petroleum refineries in other jurisdictions have triggered the need for improved assessment of worker and public safety. The results of the US CSB and State of California reviews are particularly relevant because they were completed recently and there are regulatory and commercial linkages between the two countries. In summary, based upon recent experiences with petroleum refinery incidents in both the US and Ontario, it would be reasonable to conduct a review of worker and public safety for Ontario petroleum refineries.

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ENGINEERS WORKING TOGETHER

An interagency team of professional engineers from a range of disciplines, organizations and perspectives should provide a leadership role in a review of public and worker safety for Ontario petroleum refineries. Such a collaborative effort would provide the necessary credibility to communities, workers and business leaders. Σ

Scott Grant, P.Eng., has been a combustion and air pollution engineer in Ontario for over 28 years. He is also a member of the executive committee of the Professional Engineers Government of Ontario (PEGO) bargaining agent.