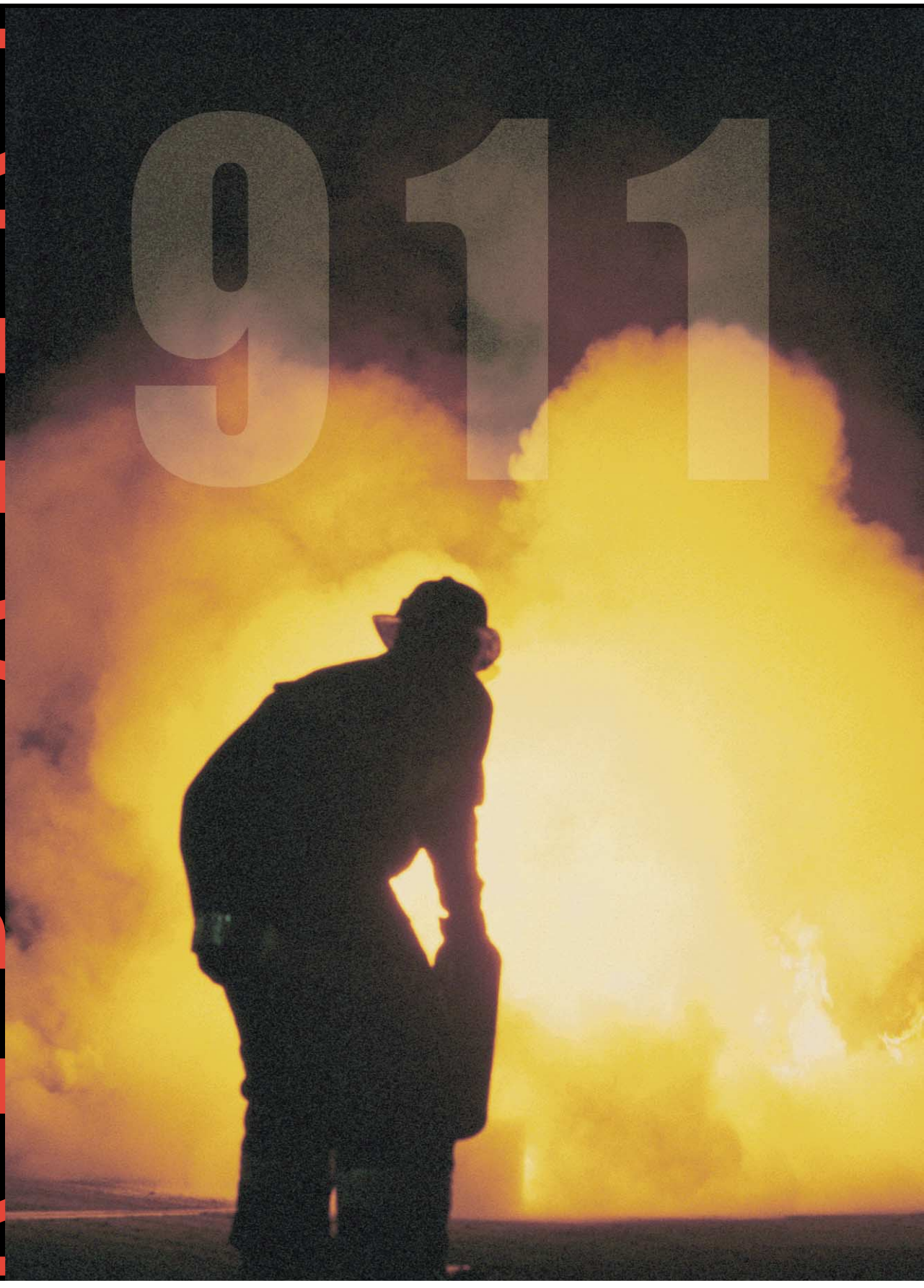
RED ALERT



In the wake of the 9/11 terrorist attacks, professional engineers are becoming increasingly involved with emergency preparedness, loss control and risk management. Some consulting engineering firms have even formed security divisions. The Canadian Council of Professional Engineers is currently scanning this area as an emerging, interdisciplinary field, and intends to develop a research paper by the end of this year.

It can be broadly divided into two aspects: the ways and means to prevent disasters from occurring, and the strategies for dealing with them once they have happened. From protecting our homes, waterworks and critical infrastructure to securing the Internet and dealing with the threats of hazardous materials, P.Engs are more than ever on the front lines of public protection.

In the midst of most emergencies faced in the industrialized world, the hottest spot is often in the fire department. "The key people at a scene, we have a significant investment in making sure that response is there," says Ed Gulbinas, P.Eng., a manager in the Ontario Fire Marshal's applied research section. Gulbinas' office employs about 20 professional engineers in three sections, both in contingency planning and in the field.

In the heat of it

"You can get into situations where the environment is complex. Maybe it requires the expertise of an electrical or chemical engineer or someone who's got the mechanical knowledge to look into the natural gas piping in a facility to see if that's how the fire started," Gulbinas says. "You need engineers to understand and determine the interrelationships of the various components. It boils down to who has the technical capability to identify and address the risks involved."

Project management capability is also needed to design the framework for the emergency response teams to follow, Gulbinas says. Included in that framework is:

- process: getting the right people at the table to handle different types of emergencies;
- risk assessment: determining what the current response capabilities (equipment, personnel, etc.) are and what they should be;
- training: performing dry runs and determining shortcomings; and
- evaluation: assessing and if necessary modifying the plan.

His office also offers programs on hazardous material management, terrorist threats and related dangers to law enforcement and other emergency responders. He's had a full plate during these last few years. "First it was Y2K, then 9/11 and now the power failures," he says. "But the benefit to those of us in Ontario is that none of these have been very serious for us. We haven't had a lot of deaths or injuries. So what we've been doing is finding weaknesses in our procedures."

Finding ways to improve upon emergency medical services is another area where professional engineers are contributing to public safety. A good example is the advent of digital mapping in emergency response. Not so long ago, paramedics had to rely on maps of various scale and employ basic principles of land navigation in the heat of their battle to reach the sick or injured.

Today, the paramedics rely on three-dimensional, computer-generated digital maps that can even guide helicopters to land at designated intersections or rooftops. Much of this advance can be attributed to people like Malcolm MacLeod, P.Eng., who began working on the innovations with other engineers and technicians for the Toronto EMS/Ambulance Services in the mid-1980s. "It was a different concept for them," he says. By 1998, response times for ambulances in Toronto had improved by 40 per cent, with no increase in budget during the technology rollout.

by dwight hamilton

Danger zones

Effective emergency response often depends on professional engineering expertise. Here are some examples.

Shortly before midnight on November 10, 1979, Canadian Pacific Railway freight train number 54 was on a routine run and about 30 km from downtown Toronto. But beneath its 33rd car something had gone wrong. The tanker car's red-hot undercarriage careened off the track, causing the tanker and another 23 cars to derail. The cargo contained propane, styrene, toluene, caustic soda–and one car was filled with pressurized liquid chlorine. Some of the propane cars exploded on impact, and within 60 seconds styrene and toluene had ignited, causing a fire that could be seen 100 km away. By the next day, the Mississauga train derailment had caused the evacuation of more than 200,000 people. How bad could it have been? "Had there been a chemical release and an air inversion, and had people been left in their homes with the windows closed and the A/C off, instead of evacuated, there could have been mass casualties," says Guy Crittenden of *HazMat Management* magazine. "They would have had to shelter in place, however, had there been a toxic release and not enough time to evacuate."

Engineering area: Chemical

Like Chinese water torture, the 1998 ice storm that affected eastern Ontario and southern Quebec began with just a few delicate drops, but kept on building and building until a breaking point was reached. In five days, about 70 mm of ice had accumulated in the Ottawa-Carleton region. Trees snapped like twigs. Roads were of no use. And the weight of accumulated ice made steel hydro towers crumble to the ground, snatching power from about 700,000 people in Ontario in the dead of winter. When a state of emergency was declared, Larry O'Keefe, P.Eng., was assigned the role of generator coordinator for Ottawa's Emergency Measures Unit. "This is one storm I'll never forget," he later wrote in *Engineering Dimensions*.

Engineering area: Electrical

Y2K was perhaps the world's most notable disaster that didn't occur. The Year 2000 problem was really a plethora of related issues surrounding how computers, their software and nearly every known electronic product process dates and time. It was believed that the inability of these machines to maintain or receive correct date/time information would wreak havoc in critical environments, like nuclear power stations and military installations. There was also widespread fear of a meltdown in world financial markets due to the use of computerized trading, with potential liability lawsuits estimated to top $1 trillion in the United States alone. But due to extensive re-writing of computer code and hardware replacement, an IT apocalypse was avoided.

Engineering areas: Software, computer

Before May 2000, Walkerton was just another small town in the peaceful countryside of southern Ontario. But when its drinking water system became contaminated with lethal E.coli bacteria, the community made headlines around the world. After seven people died and 2300 became ill, the public demanded accountability. Before the month was out, PEO had offered assistance to the Ontario government and its agencies, as well as to the Town of Walkerton, to ensure that future occurrences could be prevented. In the wake of the 9/11 terrorist attacks, the safety of public water supplies became even more crucial as the spectre of reservoirs being deliberately contaminated was raised.

Engineering area: Civil

Just after the power went out on August 14, a Toronto Transit Commission operator exclaimed: "It's a total communications breakdown. It's almost impossible to handle a situation like this." The situation was the largest electrical blackout in North America's history, creating chaos and leaving about 50 million people in the dark. Most of Ontario, including Toronto, Ottawa and Windsor, in addition to New York City, Chicago, Detroit and Cleveland were hit on one of the summer's hottest days just as the afternoon rush hour began. An estimated 9300 sq. km. were affected and it took several days to restore adequate power to all areas.

Engineering area: Electrical

Back to school

Because the study of risk and loss control is a relatively new discipline in its own right, there is considerable academic research underway. One of the major players is the Institute for Catastrophic Loss Reduction, established at the University of Western Ontario in 1998.

Alan Davenport, PhD, P.Eng., its research director, says that over the last decade the problem of natural disasters like floods, tornados, earthquakes and hurricanes has become much worse. Notwithstanding their toll in lives lost, such events have sent insurance premiums skyrocketing. In the year the institute was founded, Canadian insurers and governments doled out over $3 billion in claims.

After government reports on the 1996 Saguenay Valley floods urged stakeholders to find means and methods to prevent a reoccurrence, the Ordre des Ingénieurs du Québec (OIQ) formed an expert committee from its membership that resulted in development of a special course on risk management for engineers that will be offered by the University of Sherbrooke.

"The order played its role," says Claude Lizotte, ing., OIQ director of professional affairs. "Knowing there was a need and noticing there was no training available to fulfil it, we sent out an RFP to several universities. Engineers are recognized by the public as those who have the ability to minimize risk with many projects and we develop products or services that minimize the damage to life or property." The course will attempt to address additional competencies engineers require to deal better with disasters, and innovative organizational approaches to assist employees in reacting to them.

OIQ feels introducing the course is timely. Daniel Jolin, ing., OIQ training counsellor, personally believes the world is becoming a riskier and more uncertain place, and engineering for it is tougher. "Our cities are much bigger now and there's a lot more people in the design process and the way we manage manufacturing," he says. "There's also pressure today to shorten the time taken to complete a project while engineers have less resources."

OIQ is also working on a campaign to sensitize employers about encouraging a culture of prevention within their organizations and just hosted a training workshop under the patronage of the Organization for Economic Cooperation and Development. About 30 experts from Europe, Asia, Latin America, the U.S. and Canada brainstormed over the engineering competencies required to manage natural, industrial and technological risks. "We wanted to know what different countries' experiences with risk management and continuing education were," says Jolin. "Our objective was to open the debate."

Better safe

The Infrastructure Security Partnership (TISP) was created in the United States to exploit the collective experience of engineers and related professionals to protect that country's critical infrastructure. Chaired by Lawrence Roth, PE, the organization was formed shortly after 9/11 and has held meetings, teleconferences and workshops on security preparedness. As part of the continuing education program of the American Society of Civil Engineers, recently introduced concepts and tools have included risk management procedures, threat and consequence assessments, fault trees, consequence mitigation and adversary sequence diagrams.

The Ontario Society of Professional Engineers (the Society) dispatched its then-president, Catherine Karakatsanis, P.Eng., to Washington, D.C., to attend

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Catherine Karakatsanis, P.Eng., commenting on an infrastructure security workshop in Washington, D.C.

a TISP workshop on transportation security. "They seemed thrilled to get a Canadian perspective and an opportunity to work together," she says. "And I thought it was a good model that we could use in Ontario."

Shortly afterward in April 2002, the Society proposed a "Critical Infrastructure Response Initiative" of its own. The idea was to develop comprehensive guidelines and a vulnerability assessment tool to enable governments to assess in detail portions of the province's infrastructure, so that they might be better protected from disasters and disruption of both natural and human origin. The Society identified four areas to look at:

- water and sewage systems;
- transportation networks (roads, railways and public transit);
- electrical power generation and transmission, both conventional and nuclear; and
- communication and data networks, including the Internet.

In its proposal for startup financing from Industry Canada, the Society emphasized that because everyday life in Ontario is underpinned by engineered technology, it is critical to assess infrastructure to prevent, resist and recover from any disruption that would seriously threaten our daily lives. Despite this–and the fact that the U.S. engineering profession won contracts for more than $100 million from various levels of government for vulnerability assessments–the Society was unsuccessful in obtaining the project financing.

One of the issues that must be addressed is that when most of Ontario's roads, waterways, communications systems and the like were designed and constructed, the myriad threats now faced by the industrialized world were largely unheard of and could not be anticipated. "The security of public infrastructure has always been of critical concern for the engineers designing it," says John Gamble, P.Eng., president, Consulting Engineers of Ontario. "But, of course, the potential threats to infrastructure have become much more complex since 9/11."

What direction governments will take in risk management tomorrow is anyone's guess. But some P.Engs feel the time to start dealing seriously with security is now. "As professional engineers, we have a statutory mandate to protect the public and we have always risen to that," says Karakatsanis. "I think we are the profession that can help the most, so we have an obligation to speak up about what we think governments should be doing about this."

On your doorstep

The new Emergency Readiness Act 2002 (Bill 148) passed by Queen's Park in April 2003 is intended to improve the government's ability to prevent and respond to large-scale disasters. Not all municipalities in Ontario have emergency plans and fewer than half of them have training programs in place or hold regular exercises. This will change. In its provisions the Act:

- requires all municipalities to have programs that include an emergency plan, training and exercises, and public education;
- sets consistent standards for emergency programs;
- establishes a central repository for emergency plans; and
- requires a provincial hazard identification and risk assessment.

Emergency programs in the province are developed and implemented by Emergency Management Ontario, a division of the Ministry of Public Safety and Security. The division carries out its mandate by assisting provincial and community officials to develop and enact the programs and by providing public education products and training for emergency management staff. In addition, the division responds to emergencies itself by giving advice and assistance to community officials and coordinating the provincial and federal responses.