

BACKGROUND

TRANSPORTATION OF NUCLEAR SUBSTANCES IN CANADA



Why transport nuclear substances?

Nuclear energy is a clean and affordable source of electricity that meets about 15% of Canada's electrical needs.

To maintain this energy source, nuclear power plants depend on the safe, efficient, and reliable transportation of the full range of nuclear fuel-cycle materials. This includes uranium ore from mines, uranium oxide (yellowcake) produced in mills, fuel bundles for reactors, and spent fuel destined for safe, secure storage.

The transportation of radioactive isotopes is also essential to nuclear applications such as medical diagnosis and therapy, food irradiation, crop research, industrial gauges, and non-destructive testing.

Canada exports about 19% of the world's uranium supply and about half of the world's radioactive isotopes.

Transportation safety

Nuclear substance transportation is extremely safe for several reasons, including:

- » safe engineering of vehicles and containers;
- » qualified, trained personnel;
- » rigorous inventory tracking and accountability;
- » independent, professional regulatory bodies; and
- » careful analysis of the rare accidents that occur.

Transportation regulations

The nuclear industry is one of the most heavily regulated industries in Canada. The industry's regulator, the Canadian Nuclear Safety Commission (CNSC), has set uncompromising standards for safety, and ensures compliance through regular inspections. These regulations both reflect and influence international standards.

The responsibility for ensuring the safe transportation of nuclear substances is jointly shared between the CNSC and Transport Canada. The CNSC is concerned with the health, safety, and security of the public, and the protection of the environment as it relates to radioactive

material. Transport Canada deals with the transportation of all classes of dangerous goods.

The CNSC sets out standards in its Packaging and Transport of Nuclear Substances Regulations, and has adopted the International Atomic Energy Agency's (IAEA) Regulations for the Safe Transport of Radioactive Materials. Transport Canada's rules are outlined in its Transportation of Dangerous Goods Regulations.

Transportation through Montreal

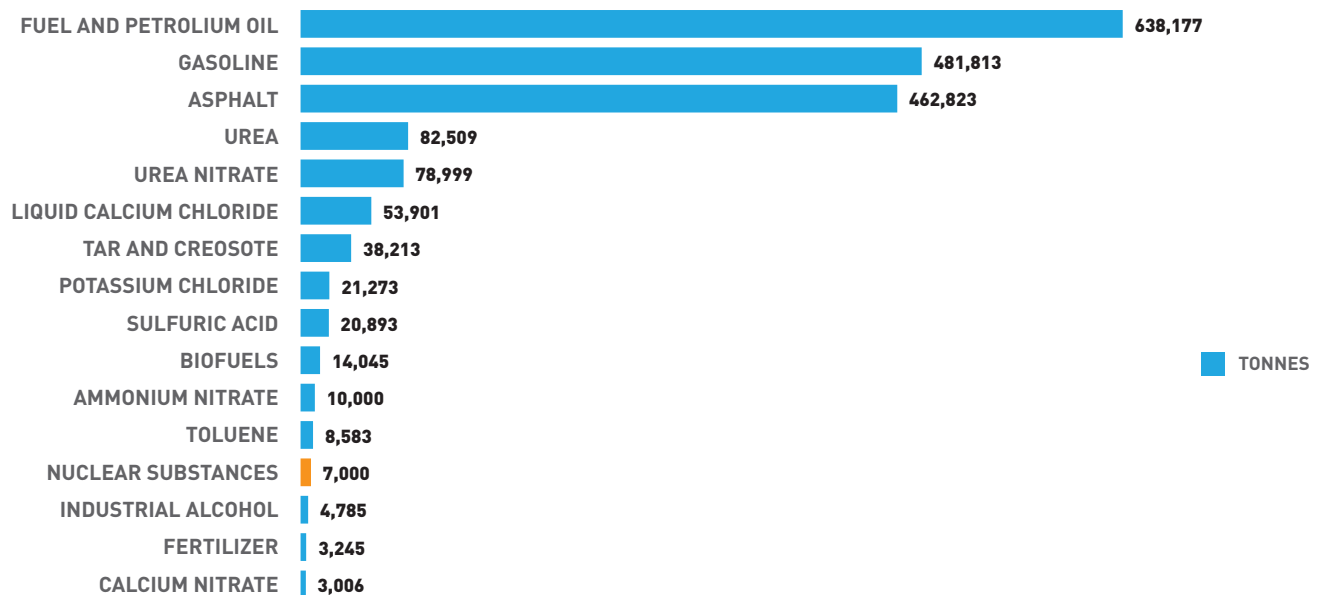
Approximately one million packages of nuclear substances are transported in Canada every year. They move by land, air, and sea – under strict regulation that ensures that they pose very little threat.

Roughly 6% of these packages (about 60,000) travel through Montreal. Most of these (50,000) are packages of medical isotopes, carried by truck. Another 9,000 pass through the Montreal-Trudeau airport, while 1,500 pass through the Port of Montreal. In 2013, packages bearing nuclear substances represented about 0.2% of the port's traffic.

Imports of nuclear substances arrive from Kazakhstan, Australia, Namibia, the United Kingdom, the Netherlands, Germany, and France. Exports leave the port for the United Kingdom, the Netherlands, Germany, France, and Argentina.

The following graph shows the amounts of the various dangerous goods that were transported through the St. Lawrence River and the Great Lakes in 2009. Nuclear substances made up a very small amount of the total and represented a comparatively low risk.

DANGEROUS GOODS TRANSPORTED THROUGH THE ST. LAWRENCE RIVER AND THE GREAT LAKES IN 2009



SOURCE: CANADIAN NUCLEAR SAFETY COMMISSION

Canadian exports and imports

Canada exported 16,431 tonnes of uranium and uranium by-products (excluding isotopes) in 2013, earning just over \$1.6 billion. The countries to which the greatest quantities were exported were:

- » the United Kingdom (5,958 tonnes),
- » the United States (5,079 tonnes),
- » Germany (1,601 tonnes),
- » France (1,647 tonnes),
- » China (916 tonnes),
- » the Netherlands (805 tonnes),
- » South Korea (287 tonnes),
- » Argentina (126 tonnes), and
- » Japan (3 tonnes)

Canada imported about half as much in uranium and uranium by-products as it exported (8,567 tonnes). The bulk of the imports arrived from:

- » Australia (2,456 tonnes),
- » Kazakhstan (2,397 tonnes),
- » Namibia (1,336 tonnes),
- » Malawi (1,180 tonnes),
- » the United States (1,064 tonnes), and
- » the Czech Republic (82 tonnes)

Canada is one of the largest producers and exporters of isotopes for use in food and agriculture, industry, medicine, and consumer products such as smoke detectors.

In 2013, the country exported nearly \$300 million worth of radioactive elements and isotopes to 62 countries around the world. By far the biggest customer was the United States, which purchased nearly two thirds of the supply. Other significant buyers included China, Japan, the Netherlands, Germany, and Brazil.

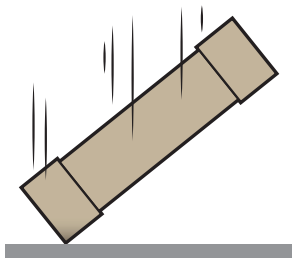
Radioactive isotope imports amounted to \$51 million, with the United States being the principal supplier. Canada imported radioactive isotopes from 21 countries in total.

Transportation packages

In Canada, the packaging of nuclear substances is based on the characteristics of the nuclear material they contain, regardless of the mode of transportation:

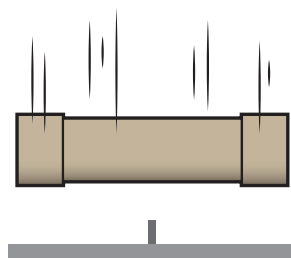
- » Ordinary industrial containers are sufficient for low-activity materials such as uranium ore and yellowcake.
- » Type A packages are designed to withstand minor accidents, and are used for medium-activity materials, such radioactive isotopes.
- » Type B packages are robust and very secure casks used for spent fuel and highly radioactive waste. These packages have shielding for gamma and neutron radiation, even under extreme accident conditions. Type B packages are required to undergo stringent testing, which can include free-drop testing, puncture testing, thermal testing, immersion testing, and simulated aircraft accidents. These packages must survive:
 - » a 9-metre (30-foot) free-fall onto an unyielding surface;
 - » a 1-metre (40-inch) free-fall onto a steel rod;
 - » a 30-minute, fully-engulfing fire at 800°C (1475°F); and
 - » an 8-hour immersion under water.

PACKAGE TESTING



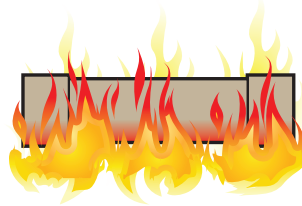
FREE DROP

A 9-metre (30-foot) free-fall onto an unyielding surface



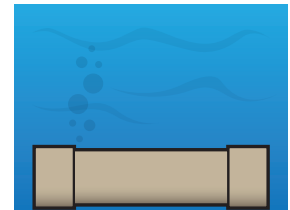
PUNCTURE

A 1-metre (40-inch) free-fall onto a steel rod



THERMAL

A 30-minute, fully-engulfing fire at 800°C (1475°F)



IMMERSION

An 8-hour immersion under water

- » Small amounts of high-activity materials, such as plutonium, are transported, by aircraft, in Type C packages. These offer even greater protection in accident scenarios than Type B packages do. They can survive being dropped from an aircraft at cruising altitude.

Accidents in Canada

Considering that approximately one million packages of nuclear substances are transported in Canada every year, the transportation accident rate is extremely low. Only three important accidents – that is, accidents that required the presence of CNSC staff – have occurred in the past 15 years.

No transportation accidents in Canada have ever caused harm to the public, nor have any accidents had environmental consequences as a result of the radioactive nature of the nuclear substances being transported.

Sources

“Transport des substances nucléaires – Survol de la réglementation de la CCSN régissant le transport des substances nucléaires.” Canadian Nuclear Safety Commission. 11 September 2014.

“Les enjeux de la filière uranifère au Québec - Manutention et entreposage de la cargaison de classe 7 dans le Port de Montréal.” Port of Montreal. 2014.

Canadian International Merchandise Trade Database. Statistics Canada. 2014.