

CNSC's Regulatory Efforts for Improvement in Response to Transport Events

Rajesh Garg, Canadian Nuclear Safety Commission, Ottawa, Canada
Lacey Wallace, Canadian Nuclear Safety Commission, Ottawa, Canada

Introduction

Canada is a major producer and shipper of radioactive material. Each year more than a million packages are safely transported in Canada. The safety record with the transport of radioactive material in Canada has historically been excellent; there have never been any serious injuries, overexposures or fatalities, or environmental consequences attributable to the radioactive nature of such material being transported or being involved in a transport accident. In Canada, the Canadian Nuclear Safety Commission (CNSC) is the agency of the federal government entrusted with regulating all nuclear facilities and nuclear-related activities, including the packaging and transport of nuclear substances. The CNSC's *Packaging and Transport of Nuclear Substances Regulations* (PTNSR) 2015, which govern radioactive materials transport, incorporates the International Atomic Energy Agency's *SSR-6 Regulations for the Safe Transport of Radioactive Material* with an ambulatory reference (as amended from time to time) instead of a static reference to the IAEA Regulations.

Notwithstanding the demonstrated safe transport of radioactive material in Canada, the CNSC is committed to continuous improvement in its regulatory oversight. To that end, any transport-related event reported to the CNSC is tracked and reviewed for any lessons to be learned that may inform regulatory oversight. This paper presents four case studies highlighting more high profile transport-related events that happened in the last decade in Canada, and describes the CNSC response to these events, including lessons learned. The paper then presents the initiatives taken by the CNSC in improving its response to transport-related events.

1.0 Background

In order to provide context for the case studies that are the main focus of this paper, the following sections provide background information on: what are *dangerous occurrences* as defined in the PTNSR 2015; the CNSC reporting requirements for such events; CNSC roles and responsibilities during a transport event; and how the CNSC tracks and responds to events related to the transport of radioactive material.

1.1 Reportable dangerous occurrences and reporting requirements for events

This section provides information on *dangerous occurrences* as defined in the PTNSR 2015 that are reportable to the CNSC and the reporting requirements for such events.

According to Section 35 of the PTNSR 2105 *dangerous occurrences* are defined as:

- a conveyance carrying radioactive material is involved in an accident;
- a package shows evidence of damage, tampering or leakage of its contents;
- radioactive material is lost or stolen;
- radioactive material has escaped from its containment system during transport;
- fissile material is outside the confinement system during transport;
- the level of non-fixed contamination during transport exceeds the limits;
- there is a failure to comply with the provisions of the CNSC Regulations.

The consignor, carrier or consignee of a package of radioactive material involved in a *dangerous occurrence* must immediately make a preliminary report of the situation to the CNSC. A full report must be submitted within 21 days that, besides other information, must include the probable cause and the actions taken to prevent its recurrence. Section 36(2) of PTNSR 2015 requires that the consignor, carrier or consignee must have an expert in radiation protection (e.g., a radiation safety officer) to assess the situation. The expert must report the results of the assessment as soon as feasible to the CNSC.

Note: "As soon as feasible" means as soon as possible after becoming aware that a dangerous occurrence is reportable.

The CNSC has an assigned duty officer who is available to receive calls 24 hours a day, seven days a week and who receives the initial event report and endeavors to gather as much detail as available at the time of the initial report. Getting key information about the situation is critical to determining the appropriate response to an event.

1.2 CNSC roles and responsibilities during a transport event

For transport-related events, local emergency services (e.g., fire services and local police) are normally the appropriate responsible authority for securing the site, on-site actions and informing the public about on-site conditions. When requested, the consignor is responsible to provide any technical assistance to the first responders. For certain types of radioactive materials, the consignor is required to have a Transport Canada approved Emergency Response Assistance Plan (ERAP). For any event, the licensee is responsible for the cleanup and recovery of the radioactive material.

CNSC response to a transport event involving radioactive material varies widely based on the risk posed by the radioactive material. All events reported to the CNSC are reviewed and categorized using a consistent, risk-informed approach. The process is also intended to ensure that the regulatory response to each report is both appropriate and timely in the context of the risk, and potential public interest in the event being reported.

The CNSC's regulatory role during a transport event is:

- (a) to ensure that appropriate actions are taken and to enforce relevant regulatory conditions to reduce the risk to health, safety, security and the environment;
- (b) to provide appropriate technical advice and support, as requested or required;
- (c) to coordinate and cooperate with licensee, provincial, federal and international response organizations; and
- (d) to report to the public, government and the CNSC organization on the CNSC response.

1.3 CNSC event tracking and reporting systems

The CNSC has primarily two event tracking systems:

a) Central Event Reporting and Tracking System (CERTS)

This event reporting and tracking system is primarily used to track events related to nuclear facilities and is not in the scope of this paper.

b) Event Information and Tracking System (EITS)

This event reporting and tracking system is primarily used to track events related to the use and transport of radioactive material. EITS allows for recording of event details, tracking of these events, detailed searching, and the creation of reports. The CNSC makes use of the information in this database as one input into its continuous regulatory improvement efforts in responding to transport events.

The CNSC posts information on all the events related to radioactive material in its yearly Regulatory Oversight Reports, which are publicly available. Any significant events are also reported publicly through our Commission meeting process.

2.0 Higher profile transport related events case studies

The following section presents four case studies, in chronological order, highlighting four higher-profile transport-related events that happened over the last decade in Canada and reported in accordance with PTNSR 2015. It describes the CNSC response to these events, including lessons learned from each case study.

2.1 Case Study 1 - Shifted cargo carrying yellowcake during rough sea conditions aboard Marine vessel MCP Altona in Vancouver

On January 4, 2011, Cameco notified the CNSC that a sea shipment containing natural uranium concentrate, also known as yellowcake, en route from Canada to China had encountered extremely rough seas in the Pacific Ocean and that there was the potential for damage of the packages containing the uranium concentrate, which were packaged inside sea containers. The vessel, MCP Altona, returned to Canada on January 15, 2011.

The MCP Altona event consisted of: exploratory activities to determine the extent of the damage to the cargo; recovery of the uranium concentrate, repackaging and shipment of items to the Key Lake facility in Saskatchewan, and; remediation activities in order to bring the MCP Altona back to its uncontaminated state.



Shifted cargo carrying yellowcake during rough sea conditions aboard Marine vessel MCP Altona in Vancouver

The MCP Altona event drew upon CNSC staff from a number of directorates and divisions, with different technical skills and expertise. CNSC staff provided regulatory oversight of the event from positions both on-site and off-site during all phases of the project.

Work occurred outdoor in an industrial marine environment from January 2011 to May 2011. The range of challenges that the CNSC inspectors faced included taking a tug boat to board the MCP Altona which was at anchor approximately two nautical miles South East of Victoria, BC to perform initial assessment of the vessel. Given that the event occurred over winter months in a maritime environment, weather conditions for the work were sometimes undesirable and created additional hazards.

Over the course of the remediation, the staff continued to overcome challenges related to regulating the activities at an unlicensed site located in a unique high-risk marine environment while ensuring safety as radioactive material (yellowcake) was handled at the site and transported to Key Lake in Saskatchewan, and communicating and working closely with other regulatory bodies and local agencies. The staff overcame these challenges by calling on the wide breadth of expertise and knowledge within the CNSC and putting together a multidisciplinary team of inspectors and technical support including utilizing the resources of the CNSC Lab.

Following the MCP Altona event, a lessons learned report was prepared in an effort to identify any risks associated with the on-site response and off-site oversight associated with this event. Topics covered in the review and assessment were logistics and administration, operational requirements, occupational health and safety and laboratory services. Both best practices and areas for improvement were examined to develop the recommendations in this report.



Recovery – Cleanup of cargo hold



CNSC Inspector verifying cargo hold

Some of the lessons learned and recommendations from this event were:

- communications and logistics are crucial in making a response work effectively and efficiently
- The CNSC response team members' experience and understanding of risk management was a key factor to ensuring their health and safety and those of others while on the ship.

The report recommended a number of improvements to CNSC internal processes to ensure its readiness to respond to similar events in the future, for example the report recommended developing a communication strategy, and developing standard plans and procedures for CNSC's physical response to unplanned events. ~~The~~

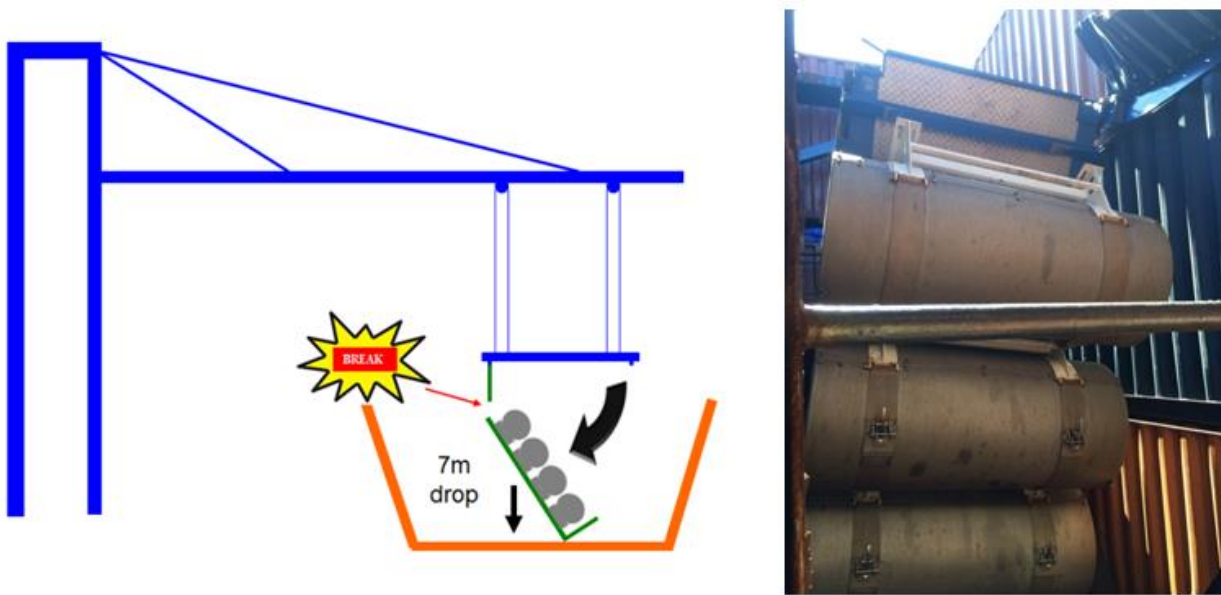
Overall, the CNSC response to the Altona event was successful in achieving the regulatory goals of verifying that the licensee mitigated the event and completed an effective cleanup. On-site staff ensured that the event was handled in a safe manner, in accordance with the CNSC's mandate.

Case Study 2 - UF₆ package dropped from a height of 7 m while unloading in Halifax

On March 13, 2014, CNSC was notified by the Canadian Transport Emergency Centre, CANUTEC, that there had been an event at the Port of Halifax involving a shipment of four cylinders containing Uranium Hexafluoride (UF₆) composed of low-enriched uranium in a Type B(U)F package. The vessel, Atlantic Companion, was docked in Halifax and was being off-loaded. During the unloading operation, the flat rack containing four UF₆ cylinders weighing about 18,000 kg was accidentally dropped back into the ship's cargo hold, from an elevation of about 7 meter (23ft). The crane involved in the event was a Paceco ship-to-shore crane with a 40 metric ton capacity.

Immediately after the event, Halifax fire department's HAZMAT team arrived on the scene. The vessel was evacuated and an exclusion zone was established around the vessel. The fire department measured radiation dose rate of 2 $\mu\text{Sv/h}$ at approximately 6 meter from the packages; consistent with the information on transport documents. The vessel was evacuated, and a 50 meter exclusion zone was enforced around the vessel. The consignor, RSB Logistic Inc. also notified the CNSC of the event and indicated that their ERAP had been activated.

From the consignor's report, one side of the flatrack was not properly secured to the crane. This resulted in all the weight (18,000 kg) being supported by only one side of the flat rack. The unsecured side moved downward in a pendulum motion towards vertical position and caused it to shear off from the flat rack base.



UF6 package dropped while unloading in Halifax

The event happened late night on March 13th and a CNSC inspector was dispatched to the site early next morning. The

Upon arrival, the CNSC inspector took additional measurements and following his assessment, he confirmed that all four packages were intact and that there was no release of contents as a result of this event. He observed the four UF6 cylinders safely being off-loaded from the ship and the recovery and any required clean-up operations.

On March 25, the packages involved in the event were opened. A visual examination of each cylinder was performed. The cylinders were declared free of damage and were transferred inside new overpacks.

From this event, the CNSC observed that the regulatory system worked as expected. The package withstood the drop without breach as per the package design certificate. The first responders took immediate actions and contacted CANUTEC. CANUTEC as well as the licensee promptly contacted the CNSC Duty Officer. The licensee responded effectively in implementing its emergency response plan as per the licence and complied with regulatory requirements. At no time during this process was there a risk to health and safety of the workers or to the environment.

Following a review of lessons learned for this event, the CNSC updated procedures to document internal processes for approving emergency travel. This helped ensure that staff are available to respond quickly to off-site events that require a regulatory presence.

2.2 Case Study 3 - Rolled over truck carrying yellowcake near Swift Current, SK

On January 11, 2016, Cameco reported to the CNSC that a truck transporting a sea container loaded with uranium concentrate drums was involved in a single vehicle traffic accident near Swift Current, SK, about 270 km from Saskatoon. The shipment consisted of 63 steel drums, each containing natural uranium concentrate, in powdered form and stacked two rows high within a 20-foot ISO freight container loaded onto a trailer. The truck and trailer carrying the sea container rolled over on its side, the container became detached from the trailer with severe damage, and it appeared to be breached with some evidence that a small amount of yellowcake had spilled on the ground. The highway was closed to traffic in both directions for 1 km. The driver of the vehicle suffered minor injuries.

In response, Cameco communicated with the local emergency response personnel department, activated their ERAP and dispatched a Cameco team from their corporate offices in Saskatoon. It was determined that there was a small amount of contamination on the exterior of the container. The contamination was cleaned up and the container was sealed with expanding foam to ensure there would be no more escape of radioactive material. The damaged container was placed into an oversized container and transported to Cameco's Saskatoon facility.

The area where the accident occurred was surveyed and no contamination was found. There was no radiological impact to the health and safety of persons or the environment as a result of this event, however, the event was reported to the Commission because it received significant media coverage and had relatively high public visibility since it resulted in a road closure for several hours.

CNSC staff communicated with Cameco to obtain further information and confirmed that the ERAP was activated and that response personnel were on their way. CNSC staff were also in communication with the first responders on the scene to provide advice as needed. A CNSC inspector was dispatched to the scene who provided regulatory oversight by ensuring that the recovery plan addressed the protection of the health and safety of workers, the public and

protection of the environment. The event was posted on the CNSC website and social media channels.



Rolled over truck carrying yellowcake near Swift Current

The lessons learned report from this event was prepared following CNSC staff feedback on the CNSC response to this event. Topics covered in the review and assessment were logistics and administration, operational requirements, occupational health and safety and laboratory services. The report recommended that the CNSC review its process for approval of information related to the event to be posted on the CNSC website in an effort to avoid delays in posting of the information.

Based on other recommendations from the report, the CNSC has now provided access to better communication devices to its site staff to efficiently communicate with other CNSC staff and offers them the training on source recovery, contamination control and applicable transport regulations to help them determine if the licensee's response to an event is acceptable.

2.3 Case Study 4 - Landfill Sets Off Alarm in North Bay, Ontario

On July 14, 2017, the CNSC was notified by a landfill site in North Bay, Ontario that a bin containing scrap metal had triggered the facility's radiation portal alarm. Initial reports suggested the radiation dose level from the scrap metal load was about 7 Sv which is 7000 times the allowable dose to the public in a year and which converts to lethal dose. Although CNSC staff

believed at that time that this high reading was unlikely to be correct, staff nonetheless advised the caller that access to the bin be restricted for at least 30 meters until further investigation. After further measurements were taken by the local fire department, dose rates of 0.56 mSv/hr at 1 meter from the bin and 1.46 mSv/hr on contact were reported. On July 27, CNSC inspectors arrived on the site and measured a maximum dose rate of 1.3 μ Sv/h on contact with the bin.

A hired consultant identified the source of radiation to be from a cable used in an old jet from the Second World War. The consultant proceeded with the proper disposal of the cable.



Contaminated cable found in the North Bay event

The lessons learned from this event was that it is always possible that incorrect information can be reported to the CNSC when unidentified radioactive material are found in transport. Therefore, it is difficult to gauge an appropriate response commensurate to the unidentified risk. The CNSC responded to this event with a precautionary approach, recognizing that there was uncertainty with respect to the nature and scale of the hazard.

In light of this situation, an analysis on the frequency and types of unidentified radioactive material found in transport was conducted using EITS. The study was done to identify trends in reporting frequency as well as identifying the common isotopes found in the waste loads.

3.0 Initiatives taken by CNSC for regulatory improvements in response to transport events

After analyzing lessons learned from these and other events, the CNSC conducted a number of internal continuous improvement initiatives.

First, the CNSC reviewed and updated its processes and procedures to assess the extent of CNSC involvement in the event of a transport event, on response time requirements, and what response

is required, once on site. The procedure provides guidelines if a response to an event location is required immediately, or after the event for follow-up and information gathering purposes, or not at all. Any decision to send an inspector to the site of an event is made at the management level. In all cases, CNSC staff are not the first responders. The structured process and associated procedures for review and follow-up increases the efficiency and effectiveness of the CNSC regulatory response.

Some of the criteria for responding at the site of an event include, but are not limited to:

- If the security and safety of the radioactive material cannot be assured.
- If there is potential for exposure to radiation in excess of normal occupational exposures.
- If the event occurred in a high-traffic area or in an unlicensed location.
- If an inspector's presence is requested by first responders or other governments/departments.

In addition, the CNSC created work instructions to clearly define the roles and responsibilities of CNSC management and staff during a field response to ensure that a uniform approach is followed by the management team and the Single-Point-of-Contact.

4.0 Conclusion

CNSC staff provides regulatory oversight of transport related events from positions both on-site and off-site. Overall, as demonstrated through the case studies described above and from lessons learned it was reinforced that the regulatory system has worked as expected. In each case, the CNSC response to these events was successful in achieving the regulatory goals of verifying that the licensee mitigated the event and completed an effective cleanup, as required. For events where there was no on-site regulatory oversight provided, off-site staff ensured that the events were handled in a safe manner, addressing the protection of the health and safety of workers, the public and the environment in accordance with the CNSC's mandate. As a regulator, the CNSC also took into consideration public perception of these events in responding to these events.

Nevertheless, from the lessons learned from these case studies, the CNSC has taken a number of initiatives including reviewing and updating our processes and procedures related to response efforts for on-site and off-site regulatory oversight during a transport event and creating work instructions to clearly define the roles and responsibilities of CNSC management and staff during a field response.