Public Attitudes Research (PAR) on the Transportation of Used Nuclear Fuel

Final Report

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Hill & Knowlton

Contents

Executive Summary

The Nuclear Waste Management Organization (NWMO)'s Adaptive Phased Management (APM) is Canada's plan for the safe, long-term management of used nuclear fuel, focusing on a deep geological repository. It's a flexible, step-by-step process that allows for learning and adjustments over many decades, incorporating public input and scientific advancements. Transportation is one component of APM, as it involves the safe and secure movement of all used nuclear fuel from various interim storage sites across Canada to a permanent storage facility.

Public input has been key to the development of the NWMO's transportation program. The main objective of the 2023-24 public attitudes research (PAR) was to understand the public's informational needs. The PAR consisted of:

- An online survey of 3,319 randomly selected adult residents of Ontario (n=2,020), Quebec (n=799), and New Brunswick (n=500), conducted in September-October 2023.

- Ten 90-minute focus groups held in November 2023 and March 2024, including two in each of Thunder Bay, Vaughn, London (in Ontario), Montreal, Quebec, and Saint John, New Brunswick.

Awareness of the Plan to Transport Used Nuclear Fuel and Sources of Awareness

Overall, aided awareness (i.e., based on a brief description provided to survey respondents) of the plan to transport used nuclear fuel from temporary to permanent storage is 33%, including 10% saying they have "definitely" heard of it. Awareness is highest in Ontario and lowest in Quebec.

In the focus groups, awareness was almost universal among Thunder Bay participants, low in the other Ontario and Saint John sessions, while in Montreal only one participant knew about the plan.

Among survey respondents the main source of awareness is, by far, news reports/current affairs programs (e.g., TV, newspapers, radio, podcasts), as identified by 61% of respondents. The NWMO is identified by 10% of survey respondents. Focus group results are very similar: "It was on the news a couple of years ago…".

Confidence in the Transportation of Used Nuclear Fuel Today and by 2043

As measured in the survey, the public's current level of confidence in the safety and security of used nuclear fuel transportation is low at 33% for rail and 29% for truck transportation. As a basis of comparison, confidence in transporting oil by rail is 45%.

Thinking ahead to 2043 when the transportation of used nuclear fuel to a deep geological repository is planned to start, public confidence rises significantly to 44% compared to only 25% who indicate low confidence (a close to 2:1 ratio of high to low confidence). We note that confidence is substantially higher in Ontario at 48%. Most focus group participants expressed confidence in the safe transportation of used nuclear fuel by 2043, often citing the available time for planning and technological advancements.

Initial Questions and Concerns

The following key questions and concerns (among others) emerged from the research (prior to exposure to fact-based information):

- Safety is the primary concern and prompts questions about accident/incident scenarios and responses.
- The risk of sabotage/terrorist attack is top of mind for quite few people.
- Given previous accidents, notably the Lac-Mégantic rail disaster, there is interest in knowing how the transportation of used nuclear fuel "will be different".
- There were many questions about shipment frequency and duration, modes, and potential routes (e.g., Would the used fuel pass through densely populated areas?).
- There were questions about the transportation package, with a some seeing this aspect as the key to safe and secure transportation.

Meeting Information Needs: Feedback on Fact-Based Information

Survey respondents were asked to rate the extent to which eight fact-based information items increased or decreased their level of confidence in the safety and security of use nuclear fuel transportation. The most reassuring and useful fact-based information touches on the regulatory framework, transportation package certification, and package demonstration trials and testing.

Focus groups participants were invited to provide feedback on draft content for two fact sheets: one on accident probability, and the other on transportation package performance. Overall, both types of content were described as clear and easy to understand, as well as relevant and useful: "It's like you're reading my mind and answering every question I have when I read this." Participants often noted that the documents complemented each other, albeit with many agreeing that the package performance fact sheet content was more informative and reassuring.

The most common overall criticism of content was that it was likely designed to "reassure" and therefore had to be taken with a grain of salt. In terms of information gaps, participants wanted to know about accident/incident scenarios and emergency response plans.

Usefulness and Impact of Fact-based Information

Survey respondents were twice asked to rate their level of confidence that used nuclear fuel transportation could be done safely and securely by 2043: once at the beginning of the survey (Time 1) and again towards the end of it, after exposure to fact-based information (Time 2). Confidence increased significantly: from 44% at Time 1 to 60% at Time 2). Similarly, the percentage of low confidence scores (i.e., rated 1 to 3 on a 7-point scale) decreased from 25% at Time 1 to 16% at Time 2. The focus groups findings are consistent with these results.

Information Sources, Preferred Communication Channels and Format

- Interest in learning more about the transportation of used nuclear fuel is relatively high at 61%.

- Survey respondents identified local and national TV news as their most important source of information about events in their region of the province.

- Technical experts (i.e., scientists, engineers, the CSNC, the NWMO) and first responders emerged as the most trusted information on use fuel transportation.

- In terms of format, in-depth content, such as longer articles and videos, tends to be preferred.

Implications for Engagement and Content Development

The research results provide guidance for the on-going development of public engagement approaches and informational content, based on the following conclusions:

- There is a significant openness among the public to learning more about the transportation of used nuclear fuel.
- Safety is the paramount concern.
- Consistent with previous research, fact-based information, notably the salience of the transportation package, increases confidence in the safety and security of used fuel transportation.
- Certain sources and communication channels and formats are preferred.

Objectives and Methodology

Objectives

The used fuel Transportation Program is a major part of Adaptive Phased Management (APM), Canada's plan for the safe, long-term management of used nuclear fuel.[1] Within the next 20 years, the Nuclear Waste Management Organization (NWMO) will start to move Canada's used nuclear fuel from licensed interim storage facilities to a deep geological repository.

Public input has been key to the development of the transportation program. Previous rounds of Public Attitude Research (PAR) focussed on the NWMO's Transportation Planning Framework. The 2023-24 research described in this report centers on public engagement and communications.

A survey and focus groups were implemented in the three provinces that store significant amounts of used nuclear fuel (i.e., Ontario, Quebec, and New Brunswick, referred to in the rest of this report as "nuclear provinces"). The research was designed to meet the following objectives:

[1] Through the Government of Canada's 2002 Nuclear Fuel Waste Act, the NWMO was federally mandated to design and implement Canada's plan for the safe, long-term management of the country's used nuclear fuel. The NWMO conducted a three-year study and dialogue with Canadians, Indigenous Peoples and technical experts. At the end of this process, in June 2007, the federal government selected Adaptive Phased Management (APM) as Canada's plan for used nuclear fuel. The NWMO is responsible for implementing this national environmental infrastructure project, subject to the necessary regulatory decision-making process.

- Gauge public awareness, knowledge, and comfort with the plan to transport used nuclear for the APM project over time.
- Identify information gaps.
- Determine information format preferences (e.g., video, print, level of detail).
- Identify regional/local information sources.
- Obtain feedback on fact-based information (e.g., factsheets) aimed at informing the public about the transportation aspect of Canada's plan for the long-term management of used nuclear fuel.

Methodology

The research consisted of a survey and focus groups, beginning with the survey. Research participants were randomly selected members of the public living in Ontario, Quebec, and New Brunswick. The methodological specifications are presented in the table below. The survey questionnaire and focus group moderators guide were designed by Hill and Knowlton in consultation with the NWMO. The fact-based informational handouts were developed by the NWMO based on publicly available technical reports. The handouts are contained in Appendix A.

The Survey
Respondents self-completed a 10-minute bilingual online survey. A total of 3,319 randomly selected adult residents of Ontario (n=2,020), Quebec (n=799), and New Brunswick (n=500) were surveyed between September 14th to October 13th, 2023. Respondents were sourced from Canadian research panel supplier Logit Group. Quotas based on Census data and data weighting ensure representation by gender, age, and region. The overall margin of error associated with a probability-based sample of this size is 1.7% 19 times out of 20.
The Focus Groups
A total of 10 90-minute focus groups were held in five cities, including two sessions in each of the following locations: • Ontario: Thunder Bay, Vaughn, London • Quebec: Montreal (including one session conducted in French) • New Brunswick: Saint John The Ontario focus groups took place the week of November 13, 2023, while the rest were held the week of March 18, 2024.

Each session had seven to nine participants, with approximately 80 people overall participating in the focus groups. CRC Research Inc. conducted the recruitment.

The recruitment approach ensured that each session included a cross-section of participants based on both sociodemographic (e.g., age, gender, education) and attitudinal (e.g., perceptions of nuclear power) characteristics.

Participants received a small cash honorarium to thank them for their input and to cover transportation, childcare, and other costs.

Detailed Findings

The survey and focus groups were designed to be complementary and covered a common set of issues. Overall, both the quantitative and qualitative findings are mutually reinforcing and consistent with past PAR on transportation, including:

- Awareness of the plan to transport used nuclear fuel from temporary to permanent storage is low overall but higher in Northern Ontario.
- Many concerns and questions about the transportation of used nuclear fuels are accompanied by curiosity, pragmatism, and an openness to learning more.
- According to research participants, their initial assumptions about what the transportation of used nuclear fuel entails underestimate the safety and security of the process (compared to what is planned).
- Fact-based information (e.g., transportation package testing, the regulatory framework, international experience) reassures people about the safety and security of used nuclear fuel transportation.
- Experts are seen as most credible sources of information on the topic of used nuclear fuel transportation, including scientists and engineers, first responders, the Canadian Nuclear Safety Commission (CNSC) and the NWMO.
- Socio-demographically, men have higher awareness of the plan to transport used nuclear fuel to permanent storage and are more confidence the fuel can be transported safely by 2043. They also have greater interest in learning more about the issue. These same differences are also found among the university educated respondents to the survey.

The detailed findings of the survey and focus groups are presented below, organized by theme/study issue.

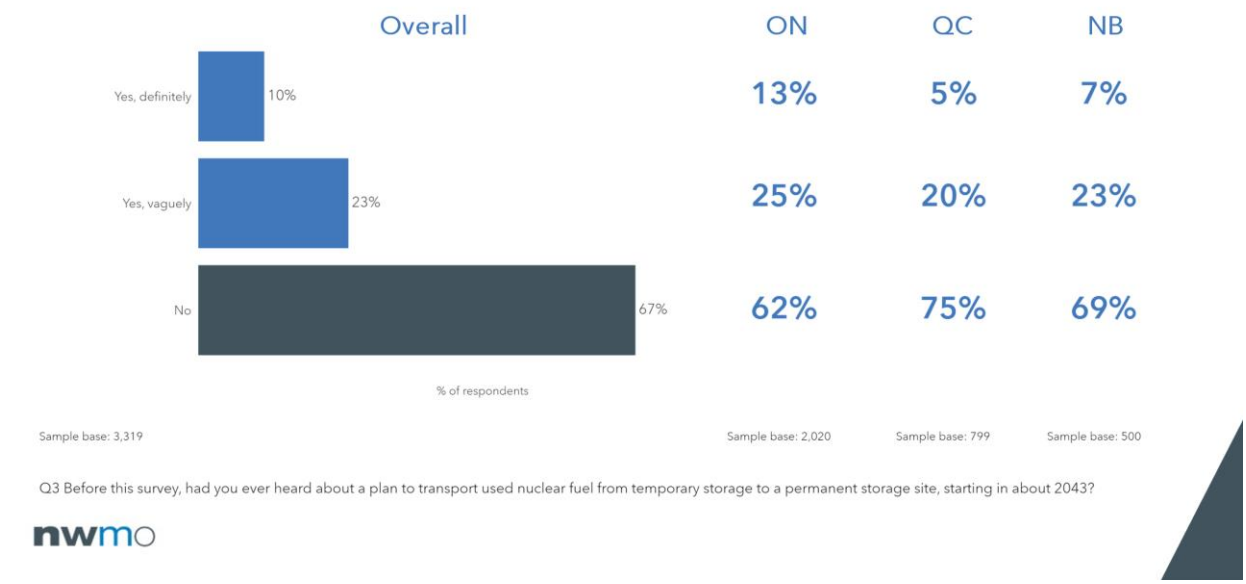
Awareness of a Plan to Transport Used Nuclear Fuel from Temporary to Permanent Storage

Survey respondents were provided with the following description and asked if they had ever heard about a plan to transport used nuclear fuel from temporary storage to a permanent storage site, starting in about 2043?

- Canada has been generating electricity from nuclear power for decades.
- Today, a little over 3 million used nuclear fuel bundles are safely managed in above-ground temporary storage facilities in Ontario, New Brunswick, Quebec, and Manitoba.
- Canada has a plan for the safe long-term management of the country's used nuclear fuel which involves transporting it to a permanent storage facility where it will be placed inside a deep geological repository more than 500 meters below ground.
- The repository is expected to be built in either Northern Ontario or Southwestern Ontario.
- The used nuclear fuel bundles would be transported by truck and possibly rail starting in about 2043.
- The Nuclear Waste Management Organization (NWMO) is responsible for implementing this plan.

Overall, aided awareness (based on the above description) is 33%, including 10% saying they have "definitely" heard of this. (Exhibit 1). Provincially, awareness is highest in Ontario (38%) and lowest in Quebec (25%). Within Ontario, two-thirds of residents of the northern part of the province recall hearing something.

Exhibit 1: Awareness of a Plan to Transport Used Nuclear Fuel to Permanent Storage



The focus groups began with a preliminary discussion of Canadian and provincial use of nuclear power, including perceived pros and cons, and assumptions about how used nuclear fuel is currently managed. Several participants, particularly in Thunder Bay, mentioned that one of the biggest challenges associated with using nuclear power to generate electricity was the production of nuclear waste: "They need to store the rods somewhere and they're running out of room".

Few, if any, participants had a solid grasp of current used fuel management. The most common assumptions were that the fuel was being permanently stored "underground" (e.g., in a "bunker"), or in water, either at the plants or possibly "thrown" into bodies of water (e.g., "the ocean"): "They put it on site and in pools by Pickering and Darlington." In Saint John, awareness of the Point Lepreau plant was high: "It's just 30 minutes down the road." But knowledge and awareness of used nuclear fuel was average.

Awareness of a plan for the long-term management of Canada's used nuclear fuel, based on moving it to a permanent location, was almost universal among Thunder Bay participants, while a few in the London and Saint John sessions recalled hearing something about it. Across the two Montreal focus groups one participant knew about the plan. It is worth noting that the participants who were not aware expressed a lot of interest in knowing more about what was being planned.

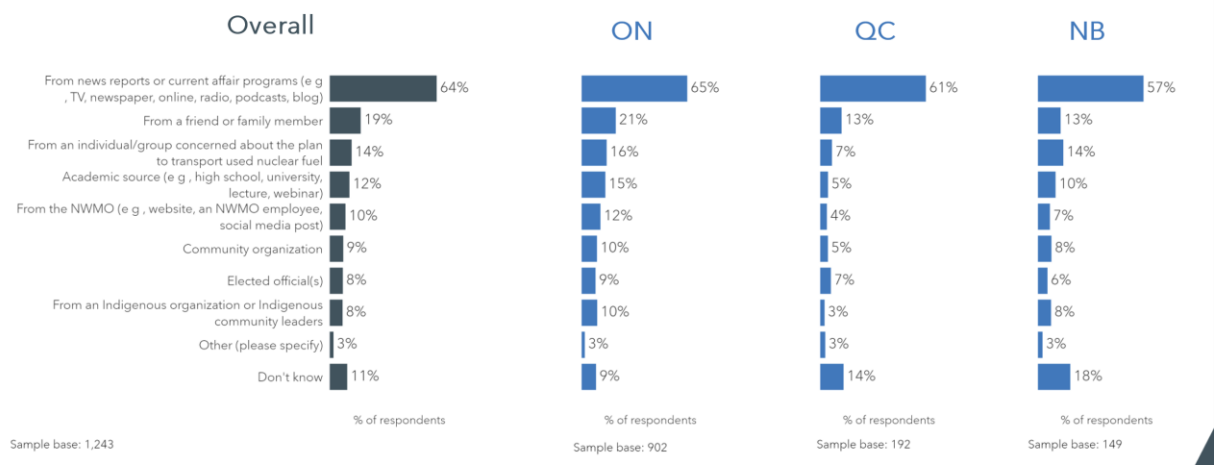
Sources of Awareness

Survey respondents with at least vague awareness of the plan to transport used nuclear fuel from temporary to permanent storage were asked a follow up question about their source(s) of information. As shown in Exhibit 2, the main source of awareness is, by far, is news reports/current affairs programs (e.g., TV, newspapers, radio, podcasts), identified by two in three respondents.

Respondents from Ontario are much more likely to have heard about the issue from multiple sources, including from the NWMO. This is particularly true in Northern Ontario.

Older respondents are much more likely to have become aware through media/news, while younger respondents point to a broader array of sources, including academic ones and the NWMO (with the two possibly related through assignments).

Exhibit 2: Sources of Information



The focus group results correspond to what we see in the survey. Collectively, the minority of participants who recalled hearing about the plan to transport used nuclear fuel to permanent storage reported hearing about it from local media (e.g., radio, newspapers): "It was on the news a couple of years ago, something about burying it and that some people were protesting." Also mentioned were university classes, word of mouth, as well as lawn signs and bumper stickers expressing concern in Thunder Bay: "They're hard to miss."

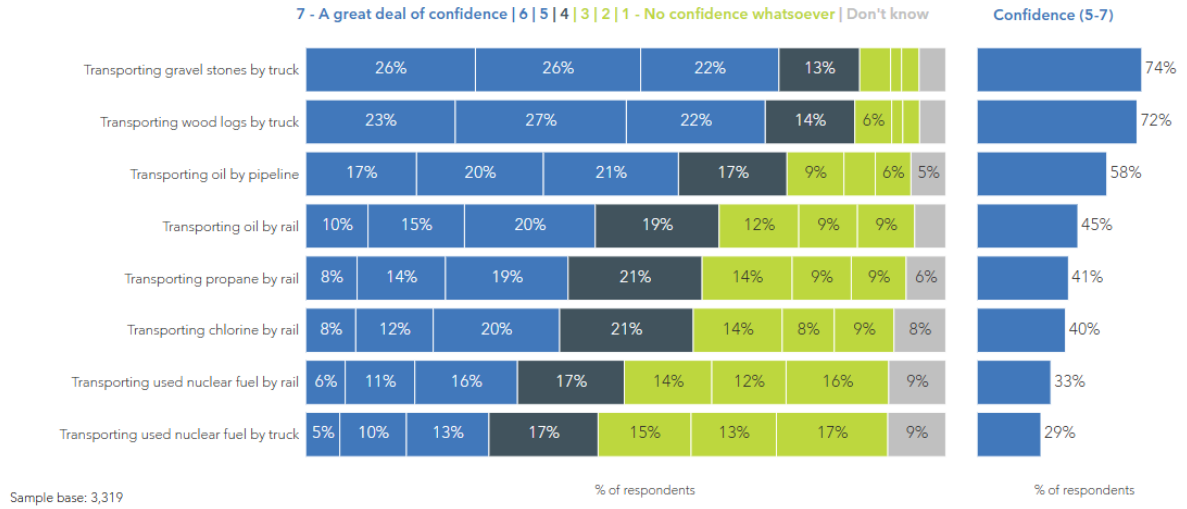
Confidence in the Transportation of Used Nuclear Fuel Today and by 2043

The survey assessed the public's current level of confidence in the safety and security of used nuclear fuel transportation relative to other cargo, including some dangerous goods. Then respondents were asked about their level of confidence that used nuclear fuel could be transported safely and securely by 2043, which is the approximate time shipments would begin.

Exhibit 3 reveals that, overall, respondents have the lowest confidence in the safety and security of used fuel transportation, with their confidence in rail versus truck mode about equal at about one in three (33 percent in rail and 29 percent in truck transportation). In comparison, confidence in the transportation of gravel stones by truck is 74 percent and transporting oil by rail (a dangerous good) is 45 percent.

Analysis indicates that confidence levels in Quebec are lower when it comes to the transportation of dangerous goods, including used nuclear fuel. The New Brunswick results are similar to Ontario's.

Exhibit 3: Relative Confidence in the Current Safety and Security of Used Nuclear Fuel Transportation



Sample base: 3,319

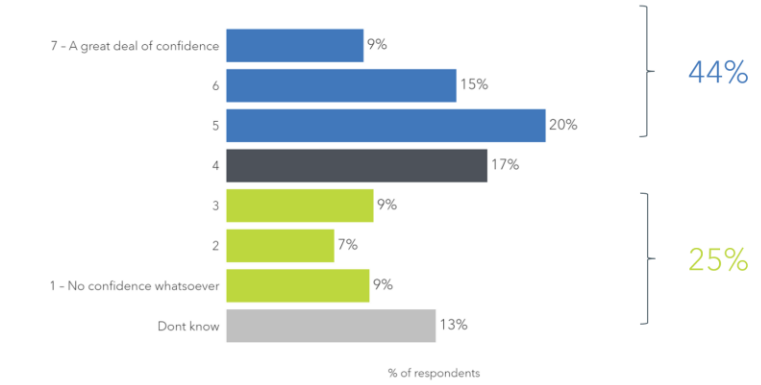
Every day in Canada and around the world, natural resources and other products are transported by truck, rail, pipelines, and by ship. Overall, how much confidence do you have in the safety and security of each of the following?

nwmo

Thinking ahead to 2043, participants' level of confidence that used nuclear fuel can be transported safely and securely by that time rises significantly to 44%. (See Exhibit 4).

Confidence is significantly higher in Ontario at 48 percent, compared to 41 percent in New Brunswick and 38 percent in Quebec. Within Ontario, confidence is higher in the North, though a somewhat polarized.

Exhibit 4: Confidence that Used Nuclear Fuel can be Transported Safely and Securely by 2043



Sample base: 3,319

Q6 How much confidence do you have that used nuclear fuel can be transported safely and securely by the year 2043?

nwmo

In an open-ended follow-up question, survey respondents were asked to identify any concerns or questions they had about the transportation of Canada's used nuclear fuel from temporary to permanent storage? Their responses are summarized in Exhibit 5 below.

Exhibit 5: Survey Respondent Concerns & Questions About the Transportation of Used Nuclear Fuel	
Q8 What, if any, concerns, or questions do you have about the transportation of Canada's used nuclear fuel from temporary to permanent storage? Please tell us about one of two of them	
Theme	Quote
Safety is the primary concern for respondents. There are concerns surrounding the threat of potential accident and a particular interest in learning about the plans in place in case an accident was to occur.	"The safety of moving is concerning. What extreme safety protocols and protection plans will there be in place for the safety of citizens and the environment." "What type of impact could that have on humans and animals and even the environment in general if something happens while trying to transport it." "Quelles sont les conséquences en cas d'accident?" "What happens in case of an accident or spill"

Exhibit 5: Survey Respondent Concerns & Questions About the Transportation of Used Nuclear Fuel	
Q8 What, if any, concerns, or questions do you have about the transportation of Canada's used nuclear fuel from temporary to permanent storage? Please tell us about one of two of them	
While less frequent, some respondents express concern of sabotage or terrorist attacks	"Attaques terroristes" "Many things can go wrong with a truck not to mention as well that it is very susceptible to terrorist attack or hijacking." "Security breaches and accidents may lead to spillage."
Respondents also express concerns as a result of previous accidents (e.g., Lac-Mégantic)	"Manque d'infos et pensons aux déraillements de trains (Mégantic))" "Le mode de transport ex: par train… souvenez-vous de Mégantic) et le trajet emprunte" "Canada has a record of unsafe transport i.e., Lac- Mégantic) etc., causing disastrous derailments. Pipelines leaks are not unheard of."

Qualitative session participants were given a five-slide document outlining the basics of Canada's plan for the long-term management of used nuclear fuel (e.g., who the NWMO is, the amount of used nuclear fuel involved, current storage and locations, proposed deep geological repository solution, and potential host community locations. Participants were also asked to focus their comments on the plan's transportation aspect by 1) imagining how this material might be transported, and 2) discussing their opinions and questions on the safety and security of used nuclear fuel transportation.

Consistent with past qualitative research, the transportation dimension of the plan was top of mind for many participants. In terms of expectations, most imagined (and hoped) that the transportation of used nuclear fuel would be "different" than that of other hazardous materials, particularly since it would not begin for another 20 years or so (i.e., allowing for technological advancements): "A lot will change. There will probably be driverless trucks then." Other differences commonly identified were special/additional driver training, escorts, specially designed containers, trucks and rail cars, and dedicated routes. There was considerable discussion of modes, with many feeling that rail would be the safest option (notwithstanding the Lac-Mégantic disaster, and, more recently, the Ohio derailment, both of which were raised by participants). Human error, and road and weather conditions were often mentioned as important consideration, particularly in Montreal and Thunder Bay.

Participants reiterated questions about shipment frequency and duration, modes, and potential routes (e.g., Would the used fuel pass through densely populated areas?). They were also curious about accident/incident scenarios and responses (e.g., the worst-case scenario, role of first responders, road closures and evacuations, potential for environmental contamination, size of

evacuation zones): "I'd like to know how they would contain it." There were also some assumptions and questions about the transportation package: "I'm imagining a container made of steel." "I'm still in support, but I need to know how the product is bundled at the facility, because then it's transferred onto the truck. It's about the bundle, not the truck." There were also questions about road closures and other inconveniences, this was especially relevant to residents of the densely populated city of Montreal: "Would they close down the highway?"

Consistent with the survey results (which shows an almost 2:1 confidence ratio), most participants expressed confidence that used nuclear fuel can be transported safely by 2043. Key to this view was the time the NWMO has to plan and for new technologies to be developed: "I think it's great that there is so much time, and new technology". "The more planning, the more likely you are for success." "I think roads will be better too." "A lot of studies will come; risks will be lowered." "Technology will improve, but the plan could change in 20 years, so they should allow for flexibility and adaptation."

As discussed later in this report, participants asked about accident scenarios and worst-case possibilities. They reasoned that while the odds of accidents or incidents might be very small, they were not zero, which led them to wonder what could happen: ""I feel the same way about that as I feel about shipping crude from Alberta to St-John. 99% of the time it's fine, it's great. It's that one time when you can get a disaster where people can die. I'm a pragmatist. It doesn't mean that I don't think we should do it, it's just that I think we are kidding ourselves if we don't think that something will happen at some point."

Information Gaps and Needs

A significant part of the research was devoted to identifying common questions and knowledge gaps, as well as obtaining the public's feedback on the clarity and usefulness of fact-based information. The results will be used by the NWMO to inform the development of informational materials for the public.

Fact-Based Information

In the survey, respondents were asked to assess eight fact-based information items. Exhibit 6 presents the full wording of the eight items.

Exhibit 6: Full Text of Fact-Based Information Items
Radioactive materials are safely transported in Canada every year. This includes everything from life-saving medical radioisotopes to waste generated from the production of electricity. The Canadian Nuclear Safety Commission (CNSC) and Transport Canada provide a strong regulatory framework and oversight for the transportation of radioactive materials including used fuel, guided by the strict standards of the International Atomic Energy Agency (IAEA). The Atomic Energy Agency (IAEA) has established a classification system and certification standards for packages used to transport radioactive materials. Packages must meet rigorous test requirements to demonstrate compliance and to ensure they

Exhibit 6: Full Text of Fact-Based Information Items

protect people and the environment under normal transportation conditions and severe accident conditions.

Over the years, there have been several trials for used nuclear fuel packages to show that transportation packages are able to withstand severe accident conditions. For example, a locomotive was crashed at 130 km/hr into a 23-metric ton used fuel package on a tractor-trailer at a simulated rail crossing. The transportation package did not release its contents.

According to a study by the U.S. Department of Energy that examined the history of worldwide used fuel transportation between 1962 and 2016, transportation of used fuel has been accomplished routinely and safely for decades. There have been no injuries or loss of life due to the radioactive contents of these shipments.

Between 2010 and 2019, 98 out of 38,296 truck-tractor collisions (less than 0.3% of truck-tractor collisions) on Ontario provincial highways involved dangerous goods. Only one incident (0.003%) involved a vehicle carrying radioactive materials.

The NWMO is developing its transportation approaches in collaboration with first responders, other transportation experts, and based on the input and feedback from thousands of Canadians and Indigenous peoples.

Before a single transportation package is shipped, the NWMO's transportation plans must undergo rigorous regulatory approvals by (regulators).

Transportation will not happen until at least the 2040s and the NWMO will continue to update its plans with the latest technologies and international best practices to ensure the safety of people and the environment.

Analysis reveals that most of the information items were deemed useful by respondents. As in past research, we found that information about the regulatory framework (e.g., certification standards) and transportation package safety trials are among the most useful. Conversely, information in the form of statistics about truck-tractor collisions involving dangerous goods was found to be less useful to respondents.

The Fact Sheet Content

In the focus groups participants were invited to provide feedback (e.g., clarity, usefulness, improvements) on draft content for two fact sheets that the NWMO is considering for public release: "What Happens if there is an accident?", which focusses on accident probability, and "Confidence in transportation package performance", which addresses package standards, design, and testing. (See Appendix A for the fact sheets).[2] The content was developed by the NWMO based on research

[2] Note: The NWMO has since developed emergency response engagement materials.

conducted by its technical team and informed by the survey results. Each two-page fact sheet began with essentially the same content description of the NWMO's transportation plan.

Overall, the content for each of the two factsheets was well-received, particularly the information pertaining to package performance. Both documents were described as clear and easy to understand, as well as relevant and useful. In making this last point, several noted that what they'd read directly addressed some of their key concerns and questions: "It's like you're reading my mind and answering every question I have when I read this."

Participants often noted that the documents complemented each other, in that seeing one without the other would leave them with some questions: "They go together." The salient gap identified by participants was that neither document addressed emergency response: "This talks about the low chances of an accident, but what happens if there is an accident?"

Most participants agreed the package performance fact sheet content was more informative and reassuring: "I like the first one better. It gives me more confidence." Some said it provided them with useful perspective from which to understand risk: "If the package is designed to be safe, then the transportation itself doesn't matter as much." "Accidents can't be prevented, but we can make the package as safe as can be." "You realize that it's about the safety of package, not so much the truck or the train."

Transportation Package Demonstration Trial Video

The focus groups moved from discussion the fact sheets to a short video describing Canada's plan and transportation package design, testing and demonstration trials (i.e., free-drop test, puncture test, thermal test, and immersion test).

Participants were impressed by the video, particularly the demonstration trials (i.e., locomotive crashing into the package and the rail car propane explosion next to the package). Both the rigor of the testing and the results of the demonstration trials were reassuring: "That's what I wanted to see." There was also agreement that images were much more effective at conveying information than text: "I feel much more confident than after just reading about it."

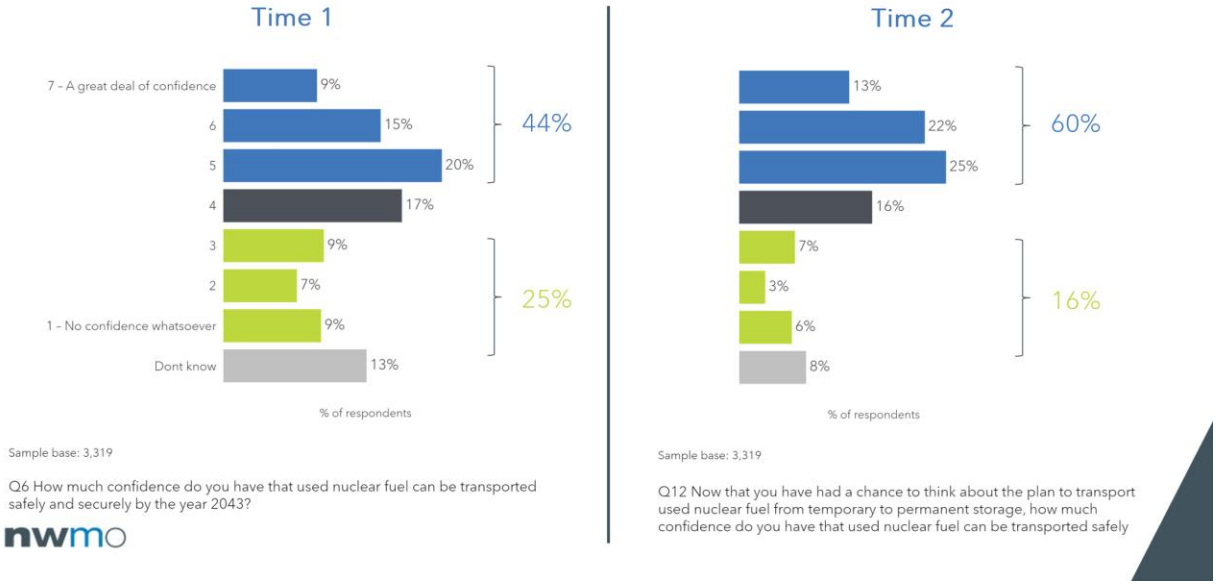
Viewing the video also led some participants to suggest that the factsheet include images to, for example, convey the strength of the transportation package.

Usefulness and Value of Fact-based Information

Survey respondents were twice asked the rate their level of confidence that used nuclear fuel transportation could be done safely and securely by 2043: once at the beginning of the survey (Time 1) and again towards the end of it, after exposure to fact-based information (Time 2).

As shown in Exhibit 8, respondent confidence increased significantly: from 44% at Time 1 to 60% at Time 2). Similarly, the percentage of low confidence scores (i.e., rated 1 to 3 on a 7-point scale) decreased from 25% at Time 1 to 16% at Time 2. The positive impact on confidence is largest in Quebec.

Exhibit 8: Impact of Fact- Based Information on Confidence (Time 1 vs. Time 2)



A different analysis of the same dataset reveals that overall (across the three provinces), close to half of all respondents (43 percent) registered an increase in confidence from Time 1 to Time 2. It is important to note that this is based on an analysis of positive movement. For example, someone who rated their confidence to be 1 out of 7 at Time 1 and then 2 out of 7 at Time 2 is considered to have moved positively (i.e., because their lack of confidence has diminished). Similarly, a respondent who moved from a 6 to a 5-confidence rating, or who shifted from "Don't Know" to a rating of 3, is considered to have registered negative movement.

Only 12 percent of the sample moved negatively, while 45 percent provided the same ratings at Times 1 and 2 (i.e., no movement). Positive movement is fairly consistent across the provinces.

In an open-ended follow-up question, respondents whose confidence level had either increased or decreased were asked "why" their believed their view had shifted. The results are presented below (Exhibit 9).

Exhibit 9: Analysis of Respondents Comments on Reason for Their Shift in Confidence	
Compared to when you first began this survey, your level of confidence that used nuclear fuel can be transported safely and securely by the year 2043 has gone up. Why do you think that is?	Compared to when you first began this survey, your level of confidence that used nuclear fuel can be transported safely and securely by the year 2043 has gone down. Why do you think that is?

• **Respondents largely feel more confident due to learning new information from the survey.**
  • "The information provided has been reassuring"
	• **Some respondents feel generally uncertain or scared by the subject matter.**
	  • "No confidence in nuclear"
	  • "I'm just more worried now"

• **Increased confidence as a result of learning more about the process and regulations.**
  • "Seeing the amount of regulations and safety checks being imposed. And the testing"
• **Some respondents felt an increase in confidence upon learning transportation will not being until 2043.**
  • "Before 2043 there may be safe solutions to move and dispose of radioactive waste materials"
• **A few respondents note feeling reassured upon learning the number of agencies involved.**
  • "I was not aware of the many agencies involved"
	• **A few respondents mention a general lack of faith in governments and/or regulatory bodies.**
	  • "because I have very little trust in government bodies."
	  • "I don't have much faith in the so called experts"
	• **Few respondents not that they fear an accident is inevitable.**
	  • "I think it's an enormous risk transporting extremely dangerous contents of that natures, period. No ifs and no buts."
	  • "On roads, we have idiot drivers, and the transport drivers seem to be inept. Recipe for disaster. Uncertain about rail."
	• **There are concerns about environmental safety.**
	  • "Very concerned about the safety risks to the environment."

Towards the end of the focus groups, participants were asked to identify the most "important/useful" information they'd read or heard during their session. The four most commonly mentioned points were:

- The strength of the transportation package and rigor of testing: "The testing was most important."

- A long and impressive track record of safe radioactive materials, including used nuclear fuel, internationally and within Canada: "Packages tested and proven safe. And other countries are doing it."

- International experience and consensus: "Standards developed by international community."

- The project timeline, including 20 years of lead time before transportation begins: "It's reassuring that the whole process has been taking so long."

The qualitative sessions ended by having participants identify any new or lingering questions they had about the plan to transport used nuclear furl from temporary to permanent storage. Their questions are summarized below, in rough order of prominence:

- What happens if there is an accident or incident? What are the likely scenarios and response plans?

- Where are the most likely sources of "human error" and how will these be mitigated (e.g., truck drivers)?

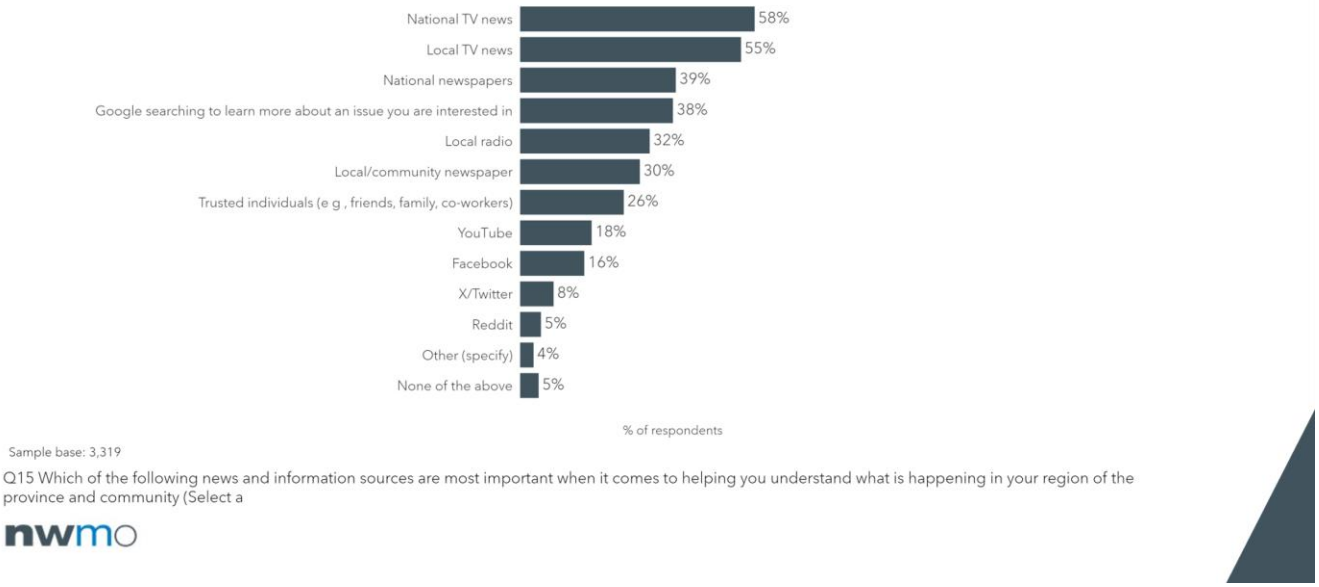
- How will drivers be selected and trained?
- Are Indigenous communities being consulted?
- Funding/who is paying (e.g., taxpayers)?
- What routes will be used?
- Is the transportation plan environmentally sustainable (i.e., mitigation of environmental impacts of transportation on the environment)?
- How can monitoring be assured so far into the future?
- Are there alternatives to the deep geological repository-based plan (e.g., used nuclear fuel recycling)?
- Who are "the people behind" the NWMO, IAEA, etc. (e.g., government, industry, experts, elected officials)?

Information Sources

In addition to assessing information gaps, the survey asked respondents to identify their most important sources of information for helping them understand what is happening in their community or region of the province. These results will help guide the NWMO's on-going public engagement and communications.

As shown in Exhibit 10, TV news is at the top of the list. Local newspapers and radio are part of a second tier of importance. Social media is relatively less important, but with YouTube and Facebook ahead of X/Twitter.

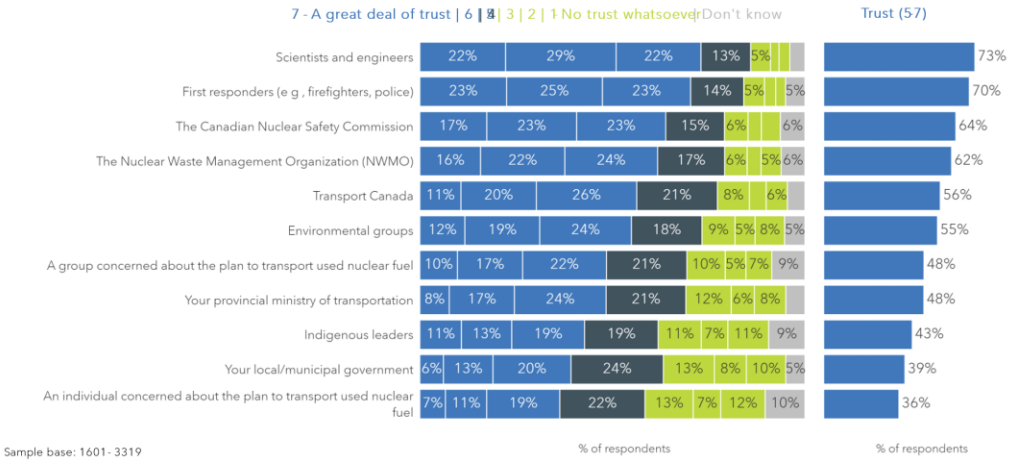
Exhibit 10: Regional Information Sources



There are wide generational divides with respect to the information sources respondents use to understand what is happening in their region and community: 18-to-34- year-old respondents are more likely to opt for social media and informal sources such as friends/family. Conversely, the 55 and older segment points to traditional sources, such as TV news and newspapers. The in-between generations are more likely to draw on a wider mix of sources.

The survey also gauged trust in potential information sources for providing respondents with information on the transportation of used nuclear fuel. Consistent with past research, scientist and engineers emerge as most trusted, along with first responders. A second tier of trusted sources is occupied by the CNSC and the NWMO. (See Exhibit 11).

Exhibit 11: Trust in Potential Information Sources



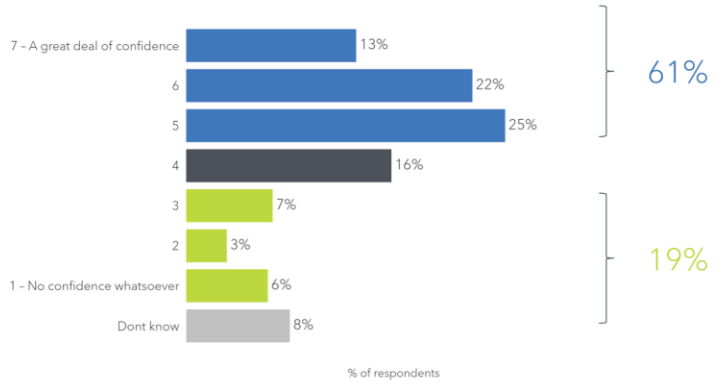
We note that more men and the university educated have trust in the CNSC and the NWMO compared to other respondents.

Interest in Learning More About the Transportation Plan and Preferred Medium

Most respondents (61%) say they are interested in learning more about the plan to transport used nuclear fuel to permanent storage, with 36% being very interested (i.e., rated 6 or 7 out of 7).

Interest is consistent across provinces, though somewhat higher in Ontario. This question was asked at the end of the survey.

Exhibit 12: Interest in Learning More About Used Nuclear Fuel Transportation to a Permanent Storage



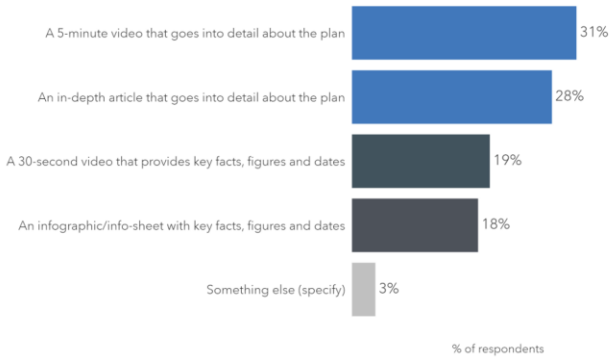
Sample base: 3,319

Q12 Now that you have had a chance to think about the plan to transport used nuclear fuel from temporary to permanent storage, how much confidence do you have that used nuclear fuel can be transported safely and securely by the year 2043?

nwmo

There are many ways to communicate with the public about the used nuclear fuel transportation plan. Respondents who indicated interest in learning more about the topic were asked to select their preferred option among a list of four possibilities. As shown in Exhibit 13, respondents much prefer a 5-minute video over a 30 second version and an in-depth article over an infographic. These results suggests that when it comes to learning about the transportation of used nuclear fuel, the public is more likely to be looking for more in-depth information.

Exhibit 13: Preferred Options for Learning More (Asked Only of Those Interested in Learning More)



Example of something else include:

- Videos longer than 5 minutes
- More interested in sources of information than format
- Scientific studies

Sample base: 3,319

Q17 Which one of the following would you prefer to learn more about the plan to transport used nuclear fuel from temporary to permanent storage, staring in about 2043? (Select only one)

nwmo

Interest in learning more about the plan to transport use nuclear fuel to permanent storage is consistent across age groups, but videos are preferred by younger people, while an in-depth article is most often selected by seniors. The university educated expressed greater interest in learning more about the plan to transport used nuclear fuel, as well as doing so through an infographic/info-sheet.

Implications for Engagement and Content Development

The research results provide the following guidance for the on-going development of public engagement approaches and informational content.

Openness to Learning More

Public awareness of the transportation plan to transport used nuclear fuel from temporary to permanent storage is low, with news and current affairs programs serving as the primary information source for those with some awareness. However, this limited awareness, coupled with the technical nature of the topic, appears to create a pragmatic openness to learning more. Sixty-one percent of survey respondents expressed interest in further information, significantly higher than observed in other public policy surveys. Similar eagerness was found among focus group participants. This underscores the potential for effective public engagement.

Safety as a Paramount Concern

Both survey and focus group participants consistently prioritized safety concerns related to the transportation of use nuclear fuel. Questions focused on potential risks to people and the environment, and how these risks will be mitigated compared to other hazardous materials (i.e., How the transportation of used nuclear fuel would be "different"). This aligns with previous research and highlights the need for clear and reassuring communication about safety protocols.

Meeting Information Needs: The Positive Impact of Fact-Based Information and the Salience of the Transportation Package

Fact-based information presented during the research had a demonstrably positive impact, reassuring participants in both surveys and focus groups. In the survey, the most useful and reassuring information pertained to:

- The regulatory framework.
- Certification standards for transportation packages.
- Demonstration trials and testing of these packages.

Focus group discussions about the fact sheet content further revealed that:

- The content was accessible and effectively addressed concerns. Information on package performance was particularly relevant and engaging.

- Referencing international standards, regulations, and comparable practices in other countries was valuable and responds to a common question (i.e., about what "other countries are doing").

- Accident statistics, while potentially concerning in the survey context, were perceived as compelling and reassuring during focus group discussions. This suggests the importance of framing such data within a broader context of safety measures.

- Details about package design, modeling, and testing conveyed transparency and rigor.

- Acknowledging the Mississauga train derailment and Lac-Mégantic rail disaster demonstrated an understanding of public concerns.

- Further information is needed regarding potential accident scenarios and response protocols, as well as measures to minimize human error.

Preferred Communication Channels and Content

Survey results indicate a strong preference for receiving information from technical experts (i.e., scientists, engineers, the CSNC, the NWMO) and first responders. There is also a preference for in-depth content, such as longer articles and videos. This suggests a need for accessible, yet detailed information delivered by trusted sources.

Appendix A: Draft Fact Sheet Content

Fact sheet: What happens if there is an accident?

Introduction:

The Nuclear Waste Management Organization (NWMO) often hears questions and concerns about accident risks associated with transporting used nuclear fuel. So, they gathered, analyzed and assessed available collision data in Ontario, Quebec and New Brunswick to understand the types of collisions people are concerned about, including accident probabilities. This fact sheet describes some of the information collected as part of that work.

Canada's Plan:

Before beginning, it is important to understand a little bit about Canada's Plan for the management and transportation of used nuclear fuel, including the regulatory framework that guides the NWMO's work.

- Canada's plan includes transporting used nuclear fuel from current interim storage facilities – at or near nuclear facilities (e.g., power plants or research reactors) in Quebec, New Brunswick and Ontario – to a deep geological repository.
- It will involve either road transport, or a combination of road and rail transport. Internationally, both of these modes have proven track records for safely transporting dangerous goods.
- Transportation is anticipated to start in the 2040s, once the repository at the preferred site is operational, and will take approximately 45 – 50 years.
- Transportation of used nuclear fuel is a common practice internationally and has occurred on a small scale in Canada. In Canada, it is regulated by the Canadian Nuclear Safety Commission and Transport Canada. These regulations are set based on international standards developed by the International Atomic Energy Agency.
- To meet the regulatory requirements, the NWMO must use a Type B package to transport used nuclear fuel. Type B packages are among the most protective and are commonly used to transport used nuclear fuel. They provide containment and a high level of shielding against radiation. They are designed, tested and certified to ensure they withstand severe accident conditions.
- In 60 years of transporting used nuclear fuel there has never been a transportation accident that has led to human or environmental harm as a result of a radioactive release.

What was learned:

There are thousands of trucks on our highways and trains on our rail lines every day. Of those, hundreds involve transporting dangerous goods. Radioactive materials are a specific class of

dangerous goods, known as Class 7. Used nuclear fuel is a specific type of Class 7 material that has specific transportation requirements such as the requirement for a Type B package.

Historically, there have been very few collisions in Ontario, New Brunswick and Quebec involving road transport of radioactive materials.

- Between 2000 and 2022, there were 492 rail incidents involving Class 7 materials. Of those, 58 involved Type B transportation packages (not carrying used nuclear fuel). none of these involved a loss of contents.
- Between 2010 and 2019, 38,296 trucks were involved in collisions on Ontario highways – 98 of those (less than 0.3%) involved dangers goods and only one (0.01%) involved a vehicle carrying radioactive materials. For context, approximately one million packages containing radioactive materials are safely transported in Canada every year.
- Between 2021 and 2019 2,972 trucks were involved in collisions on New Brunswick highways – 27 of those (less than 1%) involved dangerous goods and none involved vehicles carrying radioactive materials.
- Available Quebec data does not break down collisions based on type of dangerous good.

This historical information, along with a probability assessment, tells us that the probability of a transportation collision involving trucks capable of transporting Type B packages and trains is very low. It was also found that certain transportation conditions can lead to a greater probability of collision, specifically inattentive drivers and winter weather/road conditions.

How does the NWMO use this information?

While this information provides confidence and underlines the importance of having a strong regulatory framework around the transportation of used nuclear fuel, it is important that the NWMO look at methods of mitigating potential accidents. This includes the development of detailed security and emergency management plans, as per strict regulatory requirements. It also includes:

- Constant contact with a 24-7 Transportation Communication and Control Centre;
- Use of security escort vehicles;
- Use of speed limiters;
- Enhanced driver training; and
- Modifying shipments during inclement weather.

For more information about our conceptual preliminary transportation plan, please go to: [Preliminary-transportation-plan--December-2021--EN.ashx (nwmo.ca)]

Fact sheet: Confidence in transportation package performance

Introduction:

The Nuclear Waste Management Organization (NWMO) often hears questions and concerns about how they will protect people and the environment when transporting used nuclear fuel, especially if there is an accident. To do this, the NWMO will be relying heavily on a specific type of package, called a Type B package. The NWMO has collected information about the international track record for Type B packages. This fact sheet shares some key facts.

Canada's Plan:

Before beginning, it is important to understand a little bit about Canada's Plan for the management and transportation of used nuclear fuel, including the regulatory framework that guides the NWMO's work.

- Canada's plan includes transporting used nuclear fuel from current interim storage facilities – at or near nuclear facilities (e.g., power plants or research reactors) in Quebec, New Brunswick and Ontario – to a deep geological repository.
- It will involve either road transport, or a combination of road and rail transport. Both of these modes have proven track records for safely transporting dangerous goods.
- Transportation is anticipated to start in the 2040s, once the repository at the preferred site is operational and will take approximately 45 – 50 years.
- Transportation of used nuclear fuel is a common practice internationally and has occurred on a small scale in Canada. In Canada, it is regulated by the Canadian Nuclear Safety Commission and Transport Canada. These regulations are set based on international standards developed by the International Atomic Energy Agency.
- To meet the regulatory requirements, the NWMO must use a Type B package to transport used nuclear fuel. Type B packages are among the most protective and are commonly used to transport used nuclear fuel. They provide containment and a high level of shielding against radiation. They are designed, tested and certified to ensure they withstand severe accident conditions.
- In 60 years of transporting used nuclear fuel there has never been a transportation accident that has led to human or environmental harm as a result of a radioactive release.

Did you know?

*Approximately **one million packages** containing radioactive materials are **safely transported** in Canada every year. This includes sources used by industry, waste generated during power generation activities, and life-saving medical radioisotopes.*

A bit more about the package:

Type B packages are designed to withstand severe accident conditions. In fact, they have to be tested to prove that they can withstand those conditions. International standards and Canadian regulations require that **four tests** are performed, including: free-drop test, puncture test, thermal test, and immersion test. About those tests:

- The International Atomic Energy Agency (IAEA) regulations allow physical testing, and analytical calculations, or a combination thereof.
- Physical testing can include full-scale tests, scale model tests, or mock-ups of specific parts of a package.
- Analytical tools (i.e., computer modelling) are well suited to aspects of package certification, such as assessing a package's response to the fire test.
- In practice, a package design for used fuel typically uses a combination of computer modelling, scale model testing and full-scale mock-ups of package components to take advantage of the strengths of each type of testing:
    - For example, the NWMO already holds a certification for a Type B Transportation Package, call the Used Fuel Transportation Package. When the Used Fuel Transportation Package was certified in Canada, a scale model test was used for impact and fire testing, and computer modeling was used for fire and immersion testing.

What the NWMO knows from international experience and best practice:

- The World Nuclear Association currently estimates that about **15 million packages of radioactive material are transported around the world each year**. Additional estimates show that since 1961, when the IAEA's safe transport regulations were first issued, it is likely that over one billion nuclear material consignments have been safely completed.
- Several demonstration trials in the United States, United Kingdom, Germany and Japan have been conducted over the last five decades to validate the effectiveness of IAEA package safety standards and the performance of packages under accident conditions. These demonstration trials have shown that transportation packages can survive severe, real-world accidents with no release of radioactive materials.
- Several real-world accident reconstructions have been done, including Baltimore Tunnel Fire, Caldecott Tunnel Fire, MacArthur Maze Fire, and Newhall Pass Tunnel Fire to prove the same point.
- In addition, when looking at accidents such as the Mississauga Train Derailment (1979) or Lac Mégantic (2013), it was found that none of the forces (impact, puncture or explosion) would be sufficient to breach a transportation package wall or welded closure area of a transportation package.

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