Canadian Nuclear Safety Commission | Commission canadienne de sûreté nucléaire

CMD 23-M14

Date: 2023-01-31
File / dossier : 6.02.04
Edocs pdf : 6969764

Written submission from CNSC Staff

Mémoire du personnel de la CCSN

Follow up from November 2, 2022 Commission Meeting

Suivi découlant de la réunion de la Commission du 2 novembre 2022

Update on Canada's Participation at the 7th Review Meeting of the Joint Convention on the Safety of Spent Fuel Management and on the Safety of Radioactive Waste Management (CMD 22-M40, November 2, 2022 Commission meeting)

Mise à jour au sujet de la participation du Canada à la Septième réunion d'examen de la Convention commune sur la sûreté de la gestion du combustible usé et sur la sûreté de la gestion des déchets radioactifs (CMD 22-M40, réunion de la Commission du 2 novembre 2022)

Commission Meeting

Réunion de la Commission

March 2, 2023

Le 2 mars 2023

Canada

Canadian Nuclear Safety Commission | Commission canadienne de sûreté nucléaire

MEMORANDUM **NOTE DE SERVICE**

To / A	Denis Saumure, Commission Registrar c.c. Nancy Greencorn, Director, WDD; Kavita Murthy, Director General, DNCFR; Ramzi Jammal, Executive Vice-President, ROB	Security Classification – Classification de sécurité: Unclassified Our File – Notre référence: e-Doc 6928877 WORD e-Doc 6962541 PDF	
From / De	Shona Thompson, Senior Project Officer, WDD	Your File – Votre référence: File No.: 5.01	
		Date: January 31, 2023	Tel. No. – Nº de tél.: 613-809-4059

Subject / Objet: **Update on CNSC Staff Presentation CMD 22-M40 to the Commission on the 7th Review Cycle of the *Joint Convention on the Safety of Spent Fuel Management and on the Safety of Radioactive Waste Management***

Background

During the Commission Meeting on November 2, 2022, CNSC staff presented CMD 22-M40 to the Commission on the 7th Review Cycle of the *Joint Convention on the Safety of Spent Fuel Management and on the Safety of Radioactive Waste Management* (Joint Convention). During the session, the Commission requested the following information that CNSC staff committed to provide after the Commission Meeting [1]:

1. The President: "Give me a sense of how much interest, though, there is with the public and the national report and the kind of – you know, is it useful, is that the vehicle to communicate with the public around how waste is managed in this country. I just want to get a sense of that."
2. President Velshi wanted a better understanding of the uptake of the national report by the public and whether it is a useful vehicle to communicate with the public on how waste is managed in this country.
3. Member Remenda: "So out of curiosity, how does this compare with the amount of high-level radioactive waste held by other member states? I'll say that I noticed in a subsequent slide that we now have 30 hockey rinks full of high-level waste. And so, I'm unsure that other countries that aren't so hockey mad as ours used such a measure, I'd be interested in that comparison."
4. Commission Member Dr. Remenda asked for additional information on how our amount of high-level radioactive waste compares with other member states. President Velshi added that it would be useful information to get in light of a comment by a commission member from the US Nuclear Regulatory Commission during a recent visit at the Darlington dry fuel storage facility to the effect that they have by volume an order of magnitude less than the CANDU reactors for the same years of operation because they use enriched uranium and not natural uranium fuel.

> The President: “I think that will be useful information to have. I recently visited the Darlington dry fuel storage facility with a commission member from the US Nuclear Regulatory Commission, and he told that they have by volume maybe an order of magnitude less than the CANDU reactors for the same years of operation because they use enriched uranium and not natural uranium fuel. So, I think that would be good information for us to have.”

Clarification

As of June 30, 2021, Canada’s spent fuel inventory consisted of approximately 3.1 million bundles. If stacked like cordwood, all this used nuclear fuel could fit into nine hockey rinks from the ice surface to the top of the boards, not 30. This information was provided in an Annex in CMD 22-M40 that was presented to the Commission on November 2, 2022.

Request for Information 1

Canada’s 7th National Report to the Joint Convention was published on the CNSC public website in both English and French on May 6, 2021. From May 6, 2021 to November 2, 2022 (the date of the Commission Meeting), Canada’s 7th National Report had been accessed from the CNSC public website the following number of times:

Page views in English	1,889
Page views in French	278

From May 6, 2021 to January 16, 2023, Canada’s 7th National Report had been accessed from the CNSC public website the following number of times:

Page views in English	2,099
Page views in French	323

From June 20, 2022 to January 24, 2023, responses to questions raised from the peer review of Canada’s 7th National Report had been accessed from the CNSC public website the following number of times:

Page views in English	66
Page views in French	21

Conclusions

CNSC staff received feedback from one member of the public on Canada’s 7th National Report to the Joint Convention, that led to an addendum of the Report correcting and clarifying some of the inventory data that was presented. The addendum is posted on the CNSC public website.

Request for Information 2

Part A

To provide a comparison of high-level radioactive waste (HLW) generated in Canada versus HLW generated in the United States of America (USA), one Nuclear Generating Station in Canada (a Pressurized Heavy Water Reactor (PHWR)) and two Nuclear Generating Stations in the USA (one Boiling Water Reactor (BWR) and one Pressurized Water Reactor (PWR)) were compared, under the assumption that they are representative of the nuclear power industry in their respective country.

The results of this comparison can be seen in Table 1 below. The information was gathered from each country's most recent national reports submitted to the Joint Convention and to the *Convention on Nuclear Safety*, unless otherwise noted with a reference.

In Canada's National Reports to the Joint Convention, spent fuel inventory is reported in both mass and volume. In the USA's National Reports to the Joint Convention, spent fuel inventory is reported only in mass. Therefore, the comparison seen in the table below was conducted solely using the mass of spent fuel in each respective country. Due to this, it is important to note that there is considerable variation among fuel assemblies designed for the different types of reactors. Fuel for western PWRs is built with a square lattice arrangement and assemblies are characterized by the number of rods they contain, typically, 17x17 in current designs. A PWR fuel assembly stands between four and five meters high, is about 20 cm across and weighs about half a tonne (500 kg). BWR fuel fabrication takes place in much the same way as PWR fuel. PHWR fuel rods are about 50 cm long and are assembled into 'bundles' approximately 10 cm in diameter that weigh about 24 kg. [2] When comparing PHWRs to PWRs and BWRs, it should also be taken into consideration that PHWRs utilize natural uranium fuel, whereas PWRs and BWRs utilize enriched uranium fuel. Using natural uranium fuel eliminates the need for fuel enrichment facilities, including the resulting radioactive waste generation, proliferation concerns, and many more considerations.

For each Station in Table 1 below, the National Reports to the Joint Convention presented the total mass of spent fuel generated to date, for the entire operating lives of the reactors. Since the reactors have all been in operation for different periods of time, the total spent fuel mass was divided by the number of years in operation, to provide an approximate mass of spent fuel that is generated per year of operation.

Of note, when comparing the Stations in the table below, Arkansas Nuclear One has half the capacity of both the Darlington Nuclear Generating Station and the Browns Ferry Nuclear Plants, and so the HLW Mass per Year of Operation for Arkansas should be doubled to make the data comparable.

Table 1: HLW Generation in Canada Versus the USA

Station	Country	Technology	Years of Operation	Capacity (MWe)	Total HLW Mass (kg)	Total HLW Mass (MT[1])	HLW Mass (MT[1]) per Year of Operation
Darlington Nuclear Generating Station (4 Units)	Canada	PHWR	33	3,512	11,493,896	11,494	348
Browns Ferry Nuclear Plants (3 Units)	USA	BWR	49	3,954 [3]	2,429,000	2,429	50
Arkansas Nuclear One (2 Units)	USA	PWR	49	1,694 [4]	1,626,000	1,626	33[2]

Note: [1]Metric ton

[2]This should be doubled to 66 before it is compared to the other Stations in this table since the Station has half the capacity of the other Stations.

Part B

The following analysis uses data extracted from each country's National Report, submitted in 2020, to the 7th Review Meeting of the Joint Convention. In Canada's National Report, low-, intermediate-, and high-level radioactive wastes are presented as volumes, which allows a percentage comparison of each of the classes of radioactive waste against the total volume of radioactive wastes in Canada. To compare other countries radioactive waste inventories to Canada's, countries were selected that also presented their radioactive waste inventories as volumes (Argentina, France, Netherlands, and the United Kingdom).

Many countries presented their high-level radioactive waste (HLW) inventory in terms of activity and/or mass in their most recent National Reports (including the USA). Comparing a radioactive waste inventory in activity or mass is not comparable to a radioactive waste inventory in volume, and so these countries were not selected for comparison.

Based on this, an analysis was conducted on how much HLW, by volume, a country had as a percentage of the total volume of radioactive wastes in that country.

Data from the following countries was used in this analysis: Canada, Argentina, France, Netherlands, and the United Kingdom. The information is summarized in the Table 2 below.

Table 2: Summary

Contracting Party	Technology	Fuel Type	Reprocessing[1]	Volume of HLW (m^3)	HLW Volume as a Percentage of Total Radioactive Waste Volume
Canada	Pressurized Heavy Water Reactor (PHWR)	Natural uranium	No	12,718	0.5
Argentina	Pressurized Heavy Water Reactor (PHWR)	Natural uranium	No	198.88	2.46
France	Pressurized Water Reactors (PWR) and Boiling Water Reactors (BWR)	MOX fuel and enriched natural uranium	Yes	140	0.53
Netherlands	Pressurized Water Reactor (PWR)	MOX fuel and enriched uranium	Yes	109.8	0.91
United Kingdom	Mainly Advanced Gas-cooled Reactors (AGR)	MOX fuel	Yes	2,150	1.62

Note: [1]If spent fuel is reprocessed, it is expected that the volume of HLW in that country would be significantly lower than if spent fuel is not reprocessed.

Additional details, including the percentage volume of low- and intermediate-level wastes, for each of the selected countries is summarized in appendix A.

Conclusions

In Canada, spent fuel and radioactive wastes are currently managed in interim storage facilities that are safe, secure, and environmentally sound. Interim storage facilities are continually monitored by the licensees and the CNSC to ensure fitness for service.

References

[1] Minutes of the Canadian Nuclear Safety Commission (CNSC) Meeting held on November 1, 2, and 3, 2022. December 12, 2022. Minutes of Meeting.

[2] World Nuclear Association Public Website, Nuclear Fuel Fabrication - World Nuclear Association (world-nuclear.org)

[3] Tennessee Valley Authority Public Website, Browns Ferry Nuclear Plant (tva.com)

[4] Encyclopedia of Arkansas Public Website, Arkansas Nuclear One - Encyclopedia of Arkansas

Appendix A: Additional Details

For each country below, information is provided on the reactor technology used, if spent fuel is reprocessed in that country, and the volume for each class of radioactive waste as a percentage of the total volume of radioactive waste in that country.

Table 3: Canada

CANADA		
Technology	CANDU (Pressurized Heavy Water Reactor (PHWR))	
Spent fuel reprocessing	No	
Type of waste	Volume in m^3 (as of December 31, 2019)	Percentage of total volume
Low level	2,524,670	98.9
Intermediate level	15,681	0.6
High level	12,718	**0.5**
Total	2,553,069	100%

Table 4: Argentina

ARGENTINA		
Technology	Pressurized Heavy Water Reactor (PHWR)	
Spent fuel reprocessing	No	
Type of waste	Volume in m^3 (as of December 31, 2019)	Percentage of total volume
Low level	7,680.36	95.10%
Intermediate level	196.9	2.44%
High level	198.88	**2.46%**
Total	8,076.14	100%

Table 5: France

FRANCE		
Technology	Pressurized Water Reactors (PWR) and Boiling Water Reactors (BWR)	
Spent fuel reprocessing	Yes	
Type of waste	Volume in m^3 (2018 annual production)	Percentage of total volume
Very low level	20,000	75.64%
Low and intermediate level, short-lived	6,000	22.69%
Low level, long-lived	100	0.38%
Intermediate level, long-lived	200	0.76%
High level	140	**0.53%**
Total	26,440	100%

Table 6: Netherlands

NETHERLANDS		
Technology	Pressurized Water Reactor (PWR)	
Spent fuel reprocessing	Yes	
Type of waste	Volume in m^3 (as of December 31, 2019)	Percentage of total volume
Low level	11,962	99.09%
Intermediate level		
High level	109.8	**0.91%**
Total	12,071.8	100%

Table 7: United Kingdom

UNITED KINGDOM		
Technology	Mainly Advanced Gas-cooled Reactors (AGR)	
Spent fuel reprocessing	Yes	
Type of waste	Volume in m^3 (as of April 1, 2019)	Percentage of total volume
Very low level	1,040	0.78%
Low level	27,400	20.67%
Intermediate level	102,000	76.93%
High level	2,150	**1.62%**
Total	132,590	100%