Radioactive waste classification, characterization and management

- **Classification according to International Atomic Energy Agency (IAEA)**

Type of waste (IAEA)	Recommended disposal
exemption waste **EW**	exemption/clearance
very low level waste **VLLW**	landfill disposal
very short lived waste **VSLW**	decay storage
low level waste **LLW**	near surface disposal
Intermediate level waste **ILW**	intermediate depth disposal
high level waste **HLW**	deep geological disposal

Note that IAEA classification scheme is based primarily on considerations of long term safety. An IAEA safety requirement is that "radioactive waste shall be characterized and classified in accordance with requirements established or approved by the regulatory body". The IAEA's classification guide warns that radioactive waste classifications "may differ from State to State and even between facilities in the same State" and "this has given rise to difficulties in establishing consistent and coherent national waste management policies and implementing strategies, and can lead to less than optimal levels of safety."

- **Classification in Canada**

The Canadian Standards Association (CSA) group, in collaboration with industry, government and the CNSC has developed a standard that recognizes four main classes of radioactive waste: Low-level radioactive waste (LLW), Intermediate-level radioactive waste (ILW), High-level radioactive waste (HLW), and Uranium mine and mill tailings. The CNSC **allows waste owners to implement their own classification systems and to vary them for any given waste management facility.** The CSA Group developed a standard that includes a radioactive waste classification system (CSA N292.0-14), which takes into account IAEA safety guide GSG-1, Classification of Radioactive Waste, along with the needs of the Canadian industry, but it is too vague.

Canada has an enormous quantity of nuclear waste but no sound strategy for managing it. The CNSC has allowed "disposal" of uranium mine, mill and refinery wastes, albeit in systems that require perpetual care. There are no approved long-term strategies for low and intermediate-level wastes containing long-lived radioisotopes and for high-level wastes. Canada continues to develop nuclear projects without solution for the wastes!

Radioactive waste category	Volume in Canada
Low-level	2,359,385 m^3 (98.1% vol.) 71% is historic waste
Intermediate-level	33,155 m^3 (1.4% vol.)
High-level	11,089 m^3 (0.5% vol.)
Uranium mine and mill waste	387 millions tonnes

Reference: data from *Inventory of radioactive waste in Canada, 2016*

The numbers are completely different in the *7th Canadian National Report for the Joint Convention on the Safety of Spent Fuel Management and on the Safety of Radioactive Waste Management*. This report was prepared by the Canadian Nuclear Safety Commission (CNSC, 2020).

Table D.6: Total volume of L&ILW in Canada

Waste category	Volume (as of December 31, 2019)	Percentage of total
Low-level radioactive waste	2,075,022 m^3	98.7%
Intermediate-level radioactive waste	15,681 m^3	0.7%
Uranium mine and mill tailings	218 million tonnes	

Reference: *7th Canadian National Report for the Joint Convention on the Safety of Spent Fuel Management and on the Safety of Radioactive Waste Management*, 2020

There is another category of waste that can be LLW or ILW: the disused radioactive sealed sources. Most disused sealed sources are small, but their radioactivity may reach 10^{17} Becquerels. According to the IAEA TRS-436 guidelines:

- (<**10^7** Becquerel) Cobalt-60 disused sources are **LLW**
- (**10^7** Becquerel< value <**10^{14}** Becquerel) Cobalt-60 disused sources are **ILW**

- (<**10^6** Becquerel Cesium-137 disused sources are **LLW**
- (**10^6** Becquerel< value <**10^{15}** Becquerel) Cesium-137 disused sources are **ILW**

Reference: **IAEA's classification guide,** page 41

Most of the radioactivity CNL's proposed "engineered containment mound" would be from the Cobalt-60 disused sources. CNL has fee-for-service contracts to manage Cobalt-60 and Cesium-137 sources waste from all over the world.

General problematic

- Vague definitions of waste classes (LLW, ILW, HLW) result in less than optimum levels of safety, confusing documents and standards from different regulators.
    - CSA standards
    - CNL documents (acceptance criteria, safety analysis, etc.)
    - CNSC regulation documentation (RegDoc)

- A precise boundary between LLRW and ILRW is not provided.
- The contact dose rate of 2 mSv/h has been used in some cases to distinguish between LLRW and ILRW in the past but only in the context of the security of the worker manipulating the wastes.
- Need for clarity on how federal wastes are being classified.
- Lack of clear, transparent and accurate data on federal radioactive wastes.
- Continuing absence (or removal) of available information on activity and specific radionuclides in the Government of Canada's radioactive waste stored at the Chalk River Laboratories and Whiteshell Laboratories.
- Absence of adequate explanations for the changes in ILW, LLW and contaminated soils reported for Chalk River and Whiteshell in the 7th report relative to the 6th report. Lack of credibility for this report.
- Comparing data from the 7th report to data in the 6th report: for Chalk River, the reported volume of ILW decreased by 95% - from 19,648 to 1,050 m3. Were did the ILW disappeared?
- Changing the definition of LLW to accept more ILW in the category of LLW is inacceptable.
- Rules and standards do not protect people if there is no readily available solution.
- No plan from AECL to manage intermediate level wastes on the long term.
- No social, technical and scientific acceptance for the permanent management of high level radioactive waste in DGR partly because the wastes would not be retrievable and monitored permanently.
- Since the start of the GoCo contract in 2015, public funds paid to the CNEA consortium have approached $5 billion. During the same period, AECL's reported liabilities increased by $332 million.
- Radioactive wastes near water and populated areas are dangerous but their transportation in less populated area is risky and there is no social acceptance from remote communities.
- In the new *Impact Assessment Act*, the exemption of nuclear reactors up to 200 MWth, and of new reactors built at existing nuclear plants (up to 900 MWth) is not acceptable.

Proposed actions

- Need for more precise radioactive waste classification and characterization to determine detailed inventories and acceptance criteria for a particular waste management facility.
- LLW "classification" should not depend on the design of a particular facility to adapt the limits on long-lived radionuclides accepted in this facility.
- Focus on practical disposal solutions for each category of waste instead of developing more papers and exceptions.
- Search for more robust temporary storage with a longer life for the radioactive waste.
- Permanent monitoring should be mandatory in long-term waste management facilities for all classes of waste.
- Stop the creation of new wastes when there is no proper solution for their management.
- Stop the development of new nuclear projects without evaluating the cost and the consequences of their wastes.
- No entombment of the old nuclear reactors in respect of AIEA guidelines.
- No abandonment of radioactive waste invoking that it is not practical solution to remove them.
- All nuclear projects including SMR should be submitted to an environmental impact assessment.
- Canada should report an exact inventory of radioactive waste (description of the material, volume or mass, activity, specific radionuclides) being held in storage, being disposed of, resulting from past practices.
- Given the increased amounts of public money allocated by Canada's Parliament for accelerated decommissioning, and plans for three new disposal facilities, clear, transparent and accurate data on federal radioactive wastes should be a high priority to insure a real decrease in AECL's liabilities.