May 29, 2017

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Canadian Nuclear Laboratories Near Surface Disposal Facility Project / PFP 2016-NSDF04-Csullog-CA

CEAA Reference number: 80122

I have updated my comments on the EIS to include comments on CNL's Integrated Waste Strategy (IWS). Please see the below Word document:

During my initial review of the EIS, I was not provided with a copy of CNL's Integrated Waste Strategy (IWS) document. After submitting my initial review comments to the CNSC I was provided with a copy of CNL document CW-508600-PLA-006, "Canadian Nuclear Laboratories Integrated Waste Strategy Summary Document". My comments on that summary document follow next.

In my initial comments I wrote (see Page 6) that if CNL is relying on a cradle to grave strategy, it not only needs to provide details of the various pathways, it also needs to describe a management system that indicates how wastes are collected at point-of-origin and are routed through all stages to their endpoints without loss of chain-of-command. In other words, it is insufficient to only provide an A to B pathway, it is essential to show the verifiable process for ensuring that waste go from A to B and not A to C, etc.

Document CW-508600-PLA-006 provides no insight into such a management system. Document CW-508600-PLA-006 is a very high level plan that excludes any detail on the mechanics of how the strategy will be implemented. From what I can see, CNL's cradle to grave strategy identifies the various cradles and graves but provides no meaningful information about how wastes from the various cradles will be put into the appropriate graves.

The application form for the CNSC's Participant Funding Program included the question, "What are the Funding Applicant's issues and concerns in relation to the project". My answer follows:

> *My concerns are that Canadian Nuclear Laboratories:*
>
> *- does not have rigorous chain of command controls over its wastes,*
> *- does not rigorously track its wastes from point of origin to endpoint,*
> *- has inadequate waste characterization,*
> *- has waste management staff with an insufficient understanding of waste classification,*
> *- has inadequate waste segregation and routing procedures,*
> *- has an existing WIRKS [Waste Inventory Record Keeping System] with a lot of bad or missing data, and*
> *- may not properly migrate data from its existing WIRKS to a new system*
>
> *The last point may be moot if WIP-III is shown to be rife with bad data.*

In short, CNL appears to have a holistic strategy for its wastes but it has not revealed any detail of the underlying management system that is needed to carry out that strategy (at least in any of the documents made available to me). Canadian Nuclear Laboratories has said WHAT it wants to do but has provided insufficient information about HOW it intends to do it.

The application form for the CNSC's Participant Funding Program also included the questions, "Why should funding be provided for this information? Explain how this information would add value to the CNSC's regulatory process?". My answer follows:

> *Just prior to leaving AECL in 2010, I made a presentation on the big picture to my management and point-by-point* ***I demonstrated how AECL lacked the infrastructure to ensure cradle-to-grave radioactive waste management****. That presentation gives me the framework to assess CNL's waste management infrastructure… … My proposal to review CNL's existing infrastructure is a key component of any NDSF assessment.*

It has been 7 years since I made my presentation at AECL and in that time many of the deficiencies that I identified may have been addressed. However, my position remains the same that for the CNSC to consider the licensing of the NSDF, CNL must provide details of the management system that is needed to support its IWS. As noted, identifying the cradles and the graves is not sufficient – details of the rigorous chain of command controls for waste tracking and routing must be provided to the CNSC and assessed, preferably in the context of my big picture presentation. It is my recommendation that the CNSC request a copy of my big picture presentation, which was e-mailed to my manager Pierre Wong in late January 2010 as it would provide a solid basis for evaluating CNL's management system for waste tracking and routing.

One final point, no where did I see any mention of the passing of information to future generations in CNL's plans for the NSDF. This is a key component of any radwaste disposal project.

Excerpts from the EIS - **Executive Summary**	Comments
The NSDF is required to be operational by March 2020	Required by whom and why is it required by 2020?
Accidents and Malfunctions Assessment Results… … Damage to radioactive waste packages during the handling and emplacement of wastes within the engineered containment mound.	Stage 1 includes wastes currently in storage – has CNL assessed the integrity of waste packages currently in storage, which would be needed to assess these accidents? Is the most likely scenario incident(s) from recovering unstable waste from storage and (re)packaging for the NSDF? See Page 51 of my comments.
The current CRL waste management practice is to safely store radioactive waste on-site in individual facilities in accordance with current licence conditions.	Guidance for Calculating the Indicator of Sustainable Development for Radioactive Waste Management [1]- Has CNL assessed if its wastes are safely stored (i.e., are they in a form suitable for storage)? Storage will continue to be practiced in parallel with the NSDF – will CNL assess its storage practices in that context? See Page 51 of my comments.

1 http://www.un.org/esa/sustdev/natlinfo/indicators/isdms2001/guidance_for_ISD_RW.pdf

Excerpts from the EIS - **Volume 1**	Comments
1.0 Introduction Essentially all of the waste to be emplaced in the NSDF will be low-level waste (LLW); however, the NSDF Project may also accept approximately 1% by volume of intermediate-level waste (ILW) and mixed wastes... ...ILW are wastes with higher levels of radioactivity that may require shielding for worker protection during handling, **and may contain higher concentrations of longer-lived radionuclides** (IAEA 2009).	IAEA 2009:[2] Classification of Radioactive Waste. General Safety Guide No. GSG-1. November 2009. ISBN: 978-92-0-109209-0. see pages 13 and 14 for long-lived nuclide limits in LLW. Page 14 states, "Intermediate level waste is defined as **waste** that contains long lived radionuclides in quantities **that need a greater degree of isolation from the biosphere than is provided by near surface disposal**", which would likely preclude them from the NSDF.
2.1 Introduction Canadian Nuclear Laboratories (CNL) is proposing the development of a facility for the disposal of up to 1,000,000 cubic metres (m3) of solid radioactive **waste from legacy waste management areas**, current operations, and future environmental remediation and decommissioning projects at Chalk River Laboratories (CRL) property and its other business locations. The Near Surface Disposal Facility (NSDF) Project will provide a safe, permanent solution at the CRL property for the disposal of low-level waste (LLW) and other acceptable waste streams and replace the current CNL practice of placing waste in ~~**interim**~~ storage. The intent of this section is to provide an overview of the existing, planned and anticipated waste disposition routes of CNL radioactive wastes, describe the purpose of the project as it relates to this overall waste disposal strategy, and to present alternative means of carrying out the proposed NSDF Project.	What are the "legacy waste management areas"? This term is used multiple times in EIS Vol. 1 but these areas are not described. The term does not appear at all in Vol. 2, only "...long-term management of large quantities of waste from legacy waste...". IAEA Safety Glossary [3]- storage: The holding of radioactive sources, spent fuel or radioactive waste in a facility that provides for their/its containment, with the intention of retrieval... ... Storage is by definition an interim measure, and the term **interim storage would therefore be appropriate only to refer to short term temporary storage** when contrasting this with the longer term fate of the waste. **Storage as defined above should not be described as interim storage**.

2 http://www-pub.iaea.org/MTCD/publications/PDF/Pub1419_web.pdf
3 http://www-ns.iaea.org/standards/safety-glossary.asp

Excerpts from the EIS - **Volume 1**	Comments
2.2 CNL Integrated Waste Strategy Canadian Nuclear Laboratories has developed an Integrated Waste Strategy (IWS) which concisely details "cradle to grave" pathways for all CNL waste streams, from generation to final disposition. The IWS is based on CNL's waste inventory and forecast data and founded on the fundamental principles of waste avoidance, minimization and re-use. It enables the assessment of the quantities and types of waste across the spectrum of waste that CNL manages, (e.g., from clearable waste to used fuel). The NSDF will provide the main disposition route for waste arising from near-term decommissioning and demolition and legacy waste clean-up activities. The LLW debris and soils that will arise from these activities represent more than 80 percent (%) of the total radioactive waste volume forecast to be generated through 2045.	A cradle to grave strategy has two components – the pathways for wastes and the chain-of-command system that assures wastes are managed within their appropriate pathways. See Appendix 1. If CNL is relying on a cradle to grave strategy, it not only needs to provide details of the various pathways, it also needs to describe a management system that indicates how wastes are collected at point-of-origin and are routed through all stages to their endpoints without loss of chain-of-command. In other words, it is insufficient to only provide an A to B pathway, it is essential to show the **verifiable process** for ensuring that waste go from A to B and not A to C, etc. Waste from "legacy waste management areas" (regardless of what these areas are) were most certainly not subject to rigorous chain-of-command controls, leaving high uncertainties as to: A. whether or not wastes thought of as LLW are actually ILW (having levels of long lived nuclides precluding near surface disposal) since commonly measurements were restricted to gamma emitters and many waste had no radionuclides at all reported) or B. LLW and ILW were not properly segregated even if they were properly classified.

Excerpts from the EIS - **Volume 1**	Comments
Table 2.2-1, ILW Planned Disposition: - ~~Interim~~ storage until a **final disposal** facility is available - Limited quantities of ILW may be suitable for disposal in the NSDF Project (see Section 2.2.2.1)… 2.2.2.1 Near Surface Disposal Facility The NSDF comprises an engineered containment mound (ECM), Waste Water Treatment Plant (WWTP), supporting facilities for NSDF operations, and various site infrastructure. Radioactive waste will be emplaced in the ECM and as necessary, treated in advance of shipment to the NSDF. The **NSDF <u>will</u> accept** LLW, **ILW** (less than 1% by volume), and other wastes that meet the WAC. The anticipated wastes that will be disposed in the ECM are further described in Section 3.2.	The use of "final disposal" should be discouraged since disposal itself means end point disposition. Section 2.2.2.1 does not clarify why some "ILW may be suitable for disposal in the NSDF Project", it simply states, "The NSDF will accept… …ILW", without justification other than they would "meet the WAC". As noted above, **intermediate level waste** is defined as waste that contains long lived radionuclides in quantities that **need a greater degree of isolation from the biosphere than is provided by near surface disposal**", which should preclude them from the NSDF. Regarding, "The NSDF will accept LLW, ILW (less than 1% by volume)", small volumes of ILW may have quantities of long-lived radionuclides that could adversely affect the long term safety of the NSDF if not adequately quantified. The volume of ILW is likely irrelevant.

Excerpts from the EIS - **Volume 1**	Comments
As shown in Table 2.2-1 and on Figure 2.2-1, **the NSDF provides a disposal solution** for low-level waste, a very small amount of intermediate-level waste (**ILW**; estimated to be approximately 1% by volume)… … **Each** of the above waste streams ~~**are**~~ is discussed further below. 2.2.2.2 Intermediate Level Waste Repository The IWS recognizes the need for a disposal solution for ILW. The feasibility of locating an ILW repository deep underground within bedrock at CRL has been assessed and it was determined that CRL bedrock is suitable for such a facility. To determine the best way forward, further options and locations need to be identified and studied, and national discussions held. Treatment of ILW may be required to meet the WAC for the future repository.	The statement indicates that the NSDF ***is*** suitable for some ILW. The statement "**Each** of the above waste streams ~~**are**~~ is discussed further below" is misleading since section 2.2.2.2 states NOTHING of the characteristics of ILW other than an away from surface repository is needed for ILW. Two points : A. Why would consider ILW in the NSDF if it feels a separate repository for ILW may be required? B. What are the characteristics of some ILW that could possibly be suitable for the NSDF? The very definition of ILW (IAEA 2009) [4] indicates **intermediate level waste** … … **need a greater degree of isolation from the biosphere than is provided by near surface disposal**".
A breakdown of the waste classes in storage in 2015 and predicted to be in storage/disposal in 2100, by total volume, is presented in Figure 2.2-2	Figure 2.2-2 shows the distribution of wastes, by IAEA classes, according to "as-generated" volumes, not "as-managed". AECL did not start routinely classifying wastes according to IAEA classes until after the IAEA's NEWMDB database [5] required Member States to compare their own waste classification schemes with the IAEA's classification scheme (post 2000). To the best of my knowledge, up until 2010 that classification was only used to report to the IAEA and to the Joint Convention, it was not used in day-to-day waste management operations. In 1999, prior to the implementation of the NEWMDB and in anticipation of its reporting requirements, a first attempt was made to compare AECL's waste classification with the

4 http://www-pub.iaea.org/MTCD/publications/PDF/Pub1419_web.pdf
5 http://newmdb.iaea.org

Excerpts from the EIS - **Volume 1**	Comments
	proposed IAEA waste classes. See the end of Appendix 1 (page 58). Historically AECL's wastes were not managed as LLW, ILW, etc. and, therefore, the "as-generated" distribution of wastes may bear little resemblance to the "as-managed" distribution where LLW and ILW were not properly segregated. While at AECL-CRL, I developed the Waste Identification Program (WI Program)[6] **which did not use the IAEA's waste classes**. That program or something similar may be in place and may still not be using the IAEA waste classes in day-to-day operations. Using the WIP-III database's algorithms within the WI Program**,** multi-digit waste class "codes" were assigned almost 100% based on the **estimated (and not verified)** radionuclide content of wastes to indicate where wastes should be stored and possibly disposed. AECL had minimal waste characterization capabilities in the late 1990's (and targeted to only IRUS wastes) [7], therefore code assignment was rarely based on analytical data or verified estimates. The EIS needs to address two issues: A. What is the distribution, by IAEA classes for wastes "as-managed". This would require a detailed assessment of historical records to see how much LLW-ILW co-mingling exists (as well as clarification of what the "legacy waste management areas" are). The

6 http://www.wmsym.org/archives/1997/sess36/36-27.htm
7 http://www.wmsym.org/archives/1993/V1/81.pdf

Excerpts from the EIS - **Volume 1**	Comments
	problem with this approach would be the lack of verifiable characterization data for perhaps a majority of the waste currently in storage. B. How did AECL/CNL derive Figure 2.2-2 given the lack of characterization data and the fact that historically, and maybe even now, waste management operations used the WI Program waste class codes and not the IAEA's waste classification scheme? To present Figure 2.2-2 as at least a partial basis for its waste management strategy, the EIS has to demonstrate the relevance and validity of the Figure. Indicating that 95% of waste in storage, by volume, is LLW may be misleading both to the public and to strategic planners if "as managed", a strategically significant portion of LLW is actually a mix of LLW and ILW and, therefore, may have to be managed as ILW. Given the nature of the work conducted on the CRL site over decades, the historical lack of effective waste management, and only the fairly recent management system to track wastes, it is not unreasonable to assume that ILW (that … **need a greater degree of isolation from the biosphere than is provided by near surface disposal**) are mingled with LLW in storage. How does the NSDF project plan to address this situation?

Excerpts from the EIS - **Volume 1**	Comments
2.2.2 Intermediate Level Waste & Low Level Waste Historically, ILW and LLW have been stored on CNL sites as Low and Intermediate Level Waste (L&ILW) and segregated based on handling and storage requirements. To facilitate storage and handling, ILW and LLW are segregated to the extent practicable	As per my previous comment, the statement that, "**Historically**, ILW and LLW have been stored on CNL sites as Low and Intermediate Level Waste (L&ILW) and segregated based on handling and storage requirements" may be misleading. As mentioned, these waste classifications were not used historically and may not even be in use in day-to-day operations today. The phrase "stored on CNL sites as Low and Intermediate Level Waste (L&ILW)" appears to contradict Figure 2.2-2, which implies that LLW and ILW were managed separately – the phrase appears to confirm that LLW and ILW were managed together (co-mingled), even if the IAEA waste classification was not used. Regarding, "segregated based on handling and storage requirements", historically this was based on radiation fields, package size/type and other physical parameters – wastes were NOT segregated according to suitability for long-term storage or disposal. A misrepresentation of historic practices, even unintentionally, puts into doubt strategic planning for the future since moving to the future requires a detailed knowledge and understanding of the past. For me, the text in Section 2.2.2 raises doubts and concerns about the ability to adequately demonstrate the characteristics of waste from "legacy waste management areas" to allow their dispositioning in the NSDF. It would seem to me that it would be more cost-effective and prudent to include these wastes in an ILW repository or in an Above Ground Concrete Vault facility (see Page 15).

Excerpts from the EIS - **Volume 1**	Comments
2.3 Purpose of the Project … The NSDF Project will enable CNL to move from its current practice of ~~**interim**~~ waste storage and to direct waste disposal… … To respond to these requirements, CNL intends to reduce its radioactive waste stores, to decommission more than 100 buildings and structures that are not needed for future CNL missions, and to remediate various WMAs at the CRL property. **Candiand** Nuclear Laboratories… … Canadian Nuclear Laboratories **aims** to have the NSDF operational and ready to accept waste by March 2020…	The IAEA Safety Glossary **[8]** states the following: • *direct disposal. Disposal of spent fuel as waste*. "direct waste disposal", assuming the IAEA definition is not being used, may be possible for much of the wastes, especially for decommissioning and remediation wastes, but in some cases storage may still be needed for practices like decay-storage. In this case, there may truly be interim storage. **If the NSDF proponents want to conform to IAEA guidance, then they also have to ensure conformance with IAEA terminology.** To ensure that the NSDF is implemented in the desired time frame ("*The NSDF is required to be operational by March 2020*", **again WHY, especially when Sec 2.3 states the project "aims" to achieve a March 2020 target?**), I believe the scope of operations should be limited to include characterized, radioactive wastes arising from decommissioning and remediation activities and, where applicable, characterized wastes from "radioactive waste stores". These "radioactive waste stores" (again, what are the "legacy waste management areas") likely could be limited in the near-term to bunkers and storage buildings and to wastes that have not only been characterized but properly tracked from point-of-origin to their storage facilities with their waste tracking labels still attached and legible. If the NSDF really MUST be "*operational by March 2020*" and if that is to ensure that decommissioning and remediation

8 http://www-ns.iaea.org/standards/safety-glossary.asp

Excerpts from the EIS - **Volume 1**	Comments
	activities have a disposal option available (and won't be delayed because there is no disposal), then the NSDF proponents should initially limit NSDF operations to the proverbial "low hanging fruit".
2.5 Alternative Means for Carrying out the Project ...Facility Type (Near Surface vs. Deep Underground): - Near Surface Disposal Facility - Geological Waste Management Facility (GWMF)... ... The preferred option for disposal of LLW and **short-lived ILW** is in near surface disposal facilities (IAEA 2001). A near surface disposal facility is a suitable and technically feasible means of disposing of LLW and ILW and the effectiveness of such facilities for disposal of LLW and ILW has been demonstrated as illustrated through the following near surface facilities currently in operation globally.... ... ...Within Canada, CNL is implementing the Port Hope and Port Granby Projects, on behalf of the Government of Canada, in eastern Ontario for the safe, long-term management of historic LLW arising from the operations of the former Eldorado Nuclear Ltd. These projects are building near surface engineered mounds for the **storage of LLW** that are similar in design that that proposed for the NSDF... ...The safety of the NSDF post-closure is provided by means of passive features (e.g., ECM cover system) that will end the	Regarding, "Facility Type", I feel that the selection of only the NSDF and GWMF as alternatives was too limited. Why was a VLLW facility not considered for decommissioning wastes and trace contaminated soils from remediation? Why was an intermediate-depth (cavern) concept not considered? Away from surface does not imply only deep geological. Once again, the IAEA definition of ILW is waste that ... **need a greater degree of isolation from the biosphere than is provided by near surface disposal**. "*Short-lived ILW*" is confusing and, in addition, high-activity, short lived waste like Co-60 sources actually have levels of Ni-59 and Ni-63 that may preclude disposal in an NSDF. The NSDF Project seems to be considering LLW with high levels of short-lived radionuclides, like Co-60 and Cs-137) and not short-lived ILW. Regarding comparing Port Hope with the NSDF, previously I have communicated [9] my frustrations with the Port Hope facility to AECL management, to Port Hope Project staff and to the CNSC. The Port Hope work was promoted internationally by Natural Resources Canada (NRCan) staff as a long-term waste management facility. When I pressed them on the issue their

9 https://www.dropbox.com/s/5cgxwhye2jxa40j/Question-about-the-Port-Hope-LongTerm-Waste-Management-Facility.pdf?dl=0

Excerpts from the EIS - **Volume 1**	Comments
need for active management, which is in alignment with IAEA Requirement 5 of SSR 5 (IAEA 2011…	response was always the same, it's a long-term waste management facility, designation as storage or disposal is not relevant. When I asked the CNSC whether the Port Hope facility was a storage or disposal facility, I was told that the facility was "suitable for disposal", which was a not a direct answer to my question. The EIS states, "These projects are building near surface engineered mounds for the **storage of LLW** that are similar in design that that proposed for the NSDF" where the NSDF is for disposal, NOT for storage. Are we comparing apples and oranges here or do we have apples using different names for the same thing? If the Port Hope and NSDF facilities are truly comparable in design and function, then they have to be truly comparable in purpose – disposal. I feel that it would not be appropriate for the CNSC to allow 500+ years storage for Port Hope wastes (next to highway 401), which have long-lived radionuclides at low concentration and NSDF disposal of shorter lived LLW (in a remote location) for seemingly similar concepts. Regarding, "*The safety of the NSDF post-closure is provided by means of passive features (e.g., ECM cover system) that will end the need for active management*" – this is the same cover system as Port Hope's proposed facility, which, if designated as long term storage instead of disposal, will need active management in perpetuity ("*The safety of long term storage requires the maintenance of the industrial, regulatory and security infrastructure as described in previous sections*" - extracted from the position paper cited below). Port Hope is cited as a similar design with different objectives, which I cannot rationalize.

Excerpts from the EIS - **Volume 1**	Comments
	For completeness, see Radioactive Waste Management and Decommissioning Discussion paper DIS-16-03 [10] where disposal licensing is included and The Long Term Storage of Radioactive Waste: Safety and Sustainability- A Position Paper of International Experts [11]
Table 2.5-3 Above-ground concrete vaults area proven disposal technology and generally used for LLW. The AGCV offers a level of containment that exceeds the requirement for the vast majority of the NSDF waste volume forecast.	Has an assessment been done to show whether or not the ECM also "*offers a level of containment that exceeds the requirement for the vast majority of the NSDF waste volume forecast*"? If most of the waste volume may be very low level waste (VLLW) from decommissioning and demolition (39%) and remediation (37%) per Table 3.2.1-1, would it not be more advantageous economically to implement a hybrid VLLW-LLW facility where the VLLW component provides a lower cost, lower level of containment suitable for VLLW? I suggest that the NSDF proponents and the CNSC investigate AECL report RC-2015, "STDF Concept Assessment Project Final Report", which describes a VLLW facility concept that would be suitable for bulk decommissioning and remediation wastes. Given the importance of the statement that the AGCV concept is overkill and the NSDF concept is suitable, the proponents should provide details of how their conclusion was achieved. In addition, "*exceeds the requirement for the vast majority of the NSDF waste volume forecast*" does not appear to include the containment requirements for the ~1% ILW to be emplaced (the minority of the volume). Was the containment requirement for ILW assessed for both the AGCV and NSDF concepts?

10 http://nuclearsafety.gc.ca/eng/pdfs/Discussion-Papers/16-03/Discussion-paper-DIS-16-03-eng.pdf
11 http://www-pub.iaea.org/MTCD/publications/PDF/LTS-RW_web.pdf

Excerpts from the EIS - **Volume 1**	Comments
2.5.3 Facility Design … An advantage of this mound-type repository design is that the waste is emplaced above the groundwater table and the waste stays dry as long as the protective barriers are intact, which may be on the order of hundreds of years…	In a January 19, 2017 workshop on the both the NPD disposal and the NSDF projects, a question was raised concerning the level of the Ottawa River over the life of the NPD facility assuming that the existing dam upstream may not last. The response was that the river level would rise significantly and, as I recall, rise above the level of the top of the repository. Has such a scenario been taken into account for the NSDF relative to the issue of the ECM and the current water table level and its variation?
3.2 Integrated Waste Strategy Canadian Nuclear Laboratories **IWS for the CRL property** includes waste disposal strategies identified for each of the waste classes. Section 3.1.2, Project Overview, starts with, "As described above, the NSDF Project site is approximately 34 ha, and is almost completely forested" and Section 3.2.1, Waste Types and Volumes, starts with "Sources of the waste to be placed in the ECM will primarily originate from CRL operations and decommissioning activities, including legacy radioactive wastes currently stored on the NSDF Project site…". …Sources of the waste to be placed in the ECM… including… those which will be generated from the demolition and decommissioning of structures at CRL… … The wastes suitable for disposal in the ECM will include a wide range of bulk and packaged solid radioactive low level wastes and similar waste origins. These wastes have or will arise through CNL activities, including:	The IWS is not limited to the CRL property since it includes the management of radwastes at or for sites like Whiteshell and NPD. It is worthwhile to include cross references to Table 2.2-1 and Figure 2.2-1 in the opening paragraph for Section 3.2. The phrase "including legacy radioactive wastes currently stored on the NSDF Project site" appears strange given the phrase "the NSDF Project site is approximately 34 ha, and is almost completely forested". Are these "legacy radioactive wastes" in the middle of a forest? In addition, previously I stated the following and the above only muddles the situation: What are the "legacy waste management areas"? This term is used multiple times in EIS Vol. 1 but these areas are not described. The term does not appear at all in Vol. 2, only "…long-term management of large quantities of waste from legacy waste…" The NSDF proponents need to explain the difference, if any, between demolition wastes and decommissioning wastes, that is, why is a distinction made at all? I understand that a facility can be decommissioned in the context of its current activities and repurposed without demolishing it. So, does this

Excerpts from the EIS - **Volume 1**	Comments
- demolition of existing and future buildings… - operational and legacy wastes currently in ~~interim~~ storage…	statement cover the decommissioning of some facilities without their demolition and others with their demolition? In one case, the "contents" of the building would be waste and in the other case, the "contents" and the building itself would be waste (except whatever can be reused or recycled). The phrase, "demolition of existing and future buildings" does not include the term decommissioning (page 3-7). What are the legacy wastes and from which storage facilities?
1.2.1 Waste Types and Volumes Waste characteristic information (i.e., type and volume) is central to determining how waste will be handled, and is the basis for specific waste packaging, handling, and placement practices. Waste information is necessary to select appropriate handling procedures for bulk wastes, routine packaged wastes, and high-activity or high-hazard waste that require special handling or shielding. In addition, for bulk wastes, the waste constituents, such as concrete, wood, brick, and metal must be described to an extent that allows assessment of waste placement efficiency, stability, and optimum placement and waste segregation strategies.	Yes, "Waste characteristic information (i.e., type and volume)" is important for handling but no mention is made of the radiological and physical/chemical characterization to needed assure that the waste being handled is actually suitable for the NSDF in the first place. The text implies the waste is suitable for the NSDF and that the importance of "waste information" is solely for the efficient and effective emplacement of the wastes in the NSDF.
3.2.1 Waste Types and Volumes **The waste characterization** is based on conservative assumptions as **most of the waste to be disposed of in the NSDF has not yet been characterized** or generated. The properties of future waste are based on projections using known waste that have been fully characterized. A range of waste radiological, chemical and physical properties have been considered and included in the waste characterization. Waste characterization will continue throughout the design, construction, and operation of the NSDF Project. The	What waste characterization? Where is this information? Section 3.2.2, Waste Acceptance Criteria, states what is acceptable for the NSDF but, as yet, I have yet to find any actual information about the characteristics of any wastes in this document. If this information exists it needs to be referenced. Does "The waste characterization" refer to an estimated radionuclide inventory, an estimated hazardous materials inventory, etc. based on historical information (which is minimal)? If so, this is not waste characterization and should be cited as "the estimated source term of the NSDF".

Excerpts from the EIS - **Volume 1**	Comments
following section provides a summary of the waste types and expected volumes for each waste type. Less than 1% by volume of packaged wastes will be intermediate-level waste (ILW) such as spent ion-exchange resins, compacted trash, immobilized liquids and miscellaneous items	Regarding, "future waste are based on projections using known waste that have been fully characterized", what wastes have been fully characterized? If this information exists it needs to be referenced. If most waste has not been characterized, how reliable are the future waste projections? Regarding, "A range of waste radiological, chemical and physical properties have been considered and included in **the waste characterization**", again, this should be cited as "the estimated source term of the NSDF". Regarding, "The following section provides a summary of the waste types and expected volumes for each waste type.", the information provided does not make any mention of the radionuclide inventories in the various waste types, which is critical information for determining if the wastes are LLW (suitable for the NSDF) or ILW (likely unsuitable for the NSDF according to the IAEA definition). If "immobilized liquids" include bituminized waste from the Waste Treatment Centre (WTC), this waste may not suitable for the NSDF due to an inventory of long lived radionuclides, such as C-14, Cl-36, I-129, Nb-94, Th-230 and U-235 (Intrusion Resistant Underground Structure (IRUS) Preliminary Safety Assessment Report (PSAR)) [12]. It is worth noting that the radiological characteristics of bituminized wastes proposed for IRUS were determined by rigorous analytical measurements. The PSAR for IRUS indicated that this waste was suitable for near surface disposal but IRUS was an AGCV concept, which

12 http://www.iaea.org/inis/collection/NCLCollectionStore/_Public/29/009/29009904.pdf

Excerpts from the EIS - **Volume 1**	Comments
	according to the EIS would provide a much higher level of containment than the NSDF. Given that, the NSDF containment of bituminized waste needs to be assessed if this waste is being considered for the NSDF. In addition, as discussed below, the in-growth of long lived nuclides was not dealt with in the IRUS PSAR and an expert's opinion is that such in-growth might preclude this waste from near surface disposal. If compacted wastes include bales from the WTC, this waste may also not be suitable for the NSDF, due to an inventory of long lived radionuclides, such as C-14, Cl-36, I-129, Nb-94, Th-230 and U-235 (IRUS PSAR) [13]. It is worth noting that the radiological characteristics of baled wastes destined for IRUS were determined by rigorous analytical measurements. The PSAR for IRUS indicated that this waste was suitable for near surface disposal but IRUS was an AGCV concept, which according to the EIS would provide a much higher level of containment than the NSDF. Given that, the NSDF containment of baled waste needs to be assessed if this waste is being considered for the NSDF. In 2008 I had discussions with an expert from Whiteshell Labs. Based on the characteristics of bales presented as part of the IRUS disposal concept's PSAR, this expert concluded that bales were not suitable for surface disposal due to the in-growth of long lived nuclides (in-growth was not dealt with in the PSAR). This conclusion was shared with senior management in the Decommissioning and Waste Management Division.

[13] http://www.iaea.org/inis/collection/NCLCollectionStore/_Public/29/009/29009904.pdf

Excerpts from the EIS - **Volume 1**	Comments
	Spent ion exchange resins, if classified as ILW, are unlikely to be suitable for the NSDF due to an inventory of long lived nuclides. The NSDF proponents can refer to the relevant "waste blocks" identified within the WI Program [14]. Is this one of the fully characterized wastes? If not, what percentage, by volume, of this stream is characterized sufficiently to designate it for the NSDF? Regarding, "Less than 1% by volume of packaged wastes will be intermediate-level waste" (IRUS volume), it is worth noting that the reference waste inventory in the IRUS PSAR consisted of 1912 m^3 of bales (compacted waste) and bituminized waste (immobilized liquids) in an AGCV concept. This inventory was classified as LLW and suitable for near surface disposal. As noted, the in-growth of nuclides puts the IRUS safety case in doubt as to whether or not these wastes were actually suitable for near surface disposal so the issue needs to be revisited in the context of ILW in the NSDF. Based on 1,000,000 m^3 , an inventory of 1% ILW would be 10,000 m^3, or roughly 5x the IRUS inventory and in a facility with a lower containment capability than an AGCV. As such, expectations of including up to 1% of the volume of the NSDF inventory with ILW need careful consideration. Referring back to Table 2-5-3 on page 2-32, the following appears: Criteria: Economic Feasibility, Lifecycle Cost

14 http://www.wmsym.org/archives/1997/sess36/36-27.htm

Excerpts from the EIS - **Volume 1**	Comments
	Alternative 1 – (ECM): $600M Alternative 2 – (AGCV): $3,400M The above appears to be based on 1,000,000 m^3 of LLW + ILW for both concepts. A more reasonable scenario might be to cost out the NSDF for 990,000 m^3 LLW and an AGCV for 10,000 m^3 ILW, even if an ILW away-from-surface repository is being considered. The following italicized text is from the IRUS PSAR and in the context of the EIS statement, "**most of the waste to be disposed of in the NSDF has not yet been characterized**". The NSDF project needs to consider restricting the NSDF inventory for its initial safety case (e.g., to decommissioning and remediation wastes with minimal radioactive contamination) and presenting a comprehensive plan for expanding the NSDF inventory and re-submitting its safety case in concert with detailed, specific plans to characterize wastes with higher radionuclide inventories that would have a higher impact on NSDF performance. If the 2020 target is crucial to ensure no delays in decommissioning/remediation activities, then it seems logical and prudent that the NSDF should focus on getting operational approval for these wastes and put other, higher impact wastes, on a later timetable. *WASTE CONTAMINANT INVENTORY* *A detailed knowledge of the waste inventory is of fundamental importance when preparing the safety case for waste disposal. AECL has characterized the waste in a pragmatic and organized fashion by:* *(i) systematically identifying on-site and off-site waste streams and waste blocks;*

Excerpts from the EIS - **Volume 1**	Comments
	(ii) employing inference methods (based on process knowledge) to predict the content of the wastes; *applying analytical methods specifically developed at CRL for the determination of radionuclide levels in CRL waste streams;* *(iv) carrying out analyses on the identified wastes;* *(v) applying administrative systems and databases to meet auditing, reporting, and inventory control requirements; and* *(vi) educating producers of waste about the importance of waste characterization and waste control.* *The* ***nature of CRL operations is such that a wide variety of wastes are generated, and the variability in the wastes exceeds that associated with the routine operation of, for example, a large power reactor or an isotope user or producer****. In recognition that a major effort will be required to characterize the AECL waste streams and waste blocks for future disposal on a major scale, an approach was taken that permits proceeding with disposal into the IRUS facility, while at the same time accommodating the fact that* ***the characterization of all waste streams or waste blocks would take years. <u>That approach was to restrict the inventory in IRUS</u>, for the purposes of this safety case****, to the three waste streams described in Section 1.2* Has the NSDF Project compared its proposed/existing waste characterization and waste acceptance systems and methodologies to those in other countries, such as USA-

Excerpts from the EIS - **Volume 1**	Comments
	Department of Energy RADIOACTIVE WASTE MANAGEMENT MANUAL[15]? The DOE document would appear to be an appropriate starting point for comparison since many DOE sites, like CRL, the "*nature of… …operations is such that a wide variety of wastes are generated, and the variability in the wastes exceeds that associated with the routine operation of, for example, a large power reactor or an isotope user or producer*".
3.2.3 Waste Acceptance Criteria Variance Process … If … … the NSDF will not accept the waste for disposal. The generator will have to make other arrangements such as waste processing and treatment, off-site disposal, or disposal at another type of facility.	What about storage since off-site disposal, or disposal at another type of facility may not be available options?
3.3.1 Design Requirements … The NSDF Project will provide containment of radioactive contamination for a minimum of 500 years until it has decayed to levels that do not present a risk to the public and environment… …A substantial amount of the waste would exceed unconditional clearance levels after 500 years. The Safety Analysis Report demonstrates that even after failure of some of the design features, the wastes do not present a risk to the public and environment (see Section 5.0)…	See my comments on Page 43.

15 https://www.directives.doe.gov/directives-documents/400-series/0435.1-DManual-1-chg1/@@images/file

Excerpts from the EIS - **Volume 1**	Comments
3.3.2 Strategic Requirements The disposal facility **must meet** the following strategic requirements: - be available by 2020 to enable the CRL site revitalization through improved environmental management of Government of Canada legacy waste liabilities and the decommissioning of outdated infrastructure at the CRL property and other business locations; …	As stated previously, if the 2020 target is crucial to ensure no delays in decommissioning/remediation activities, then it seems logical and prudent that the NSDF should focus on getting operational approval for the wastes from these activities and put other, higher impact wastes, on a later timetable.
3.5.3.2 Wastewater Treatment Process	What are the plans for characterizing the wastes that will be generated from waste water treatment? Historically, for example, AECL used ion exchange (IX) technology to clean water, which resulted in IX resins that we so radioactive that they had to be shielded. The size of the resin containers, sometimes 200L drums, precluded putting them into hot cells for characterization or sampling them for analysis. I, along with a colleague, repeatedly requested that such IX systems include a side-flow, mini column that could be used to characterize the main columns. To my knowledge, this was never implemented. If the Waste Water Treatment Plant is going to generate additional, potentially quite active wastes, then plans should be in place ahead of time to characterize such wastes. I did not see any reference to such plans (e.g., nothing appears in Section 3.5.4.2.1, Waste Water Treatment Building" or Section 3.5.4.2.5, "Vehicle Decontamination Facility" (historically at AECL, due to the lack of waste characterization support and the nature of decontamination operations, uncharacterized, highly variable wastes were routinely generated).
3.6.1 Engineered Containment Mound 3.6.1.1 Waste Profiling, Acceptance and Verification Process 3.6.1.1.1 Waste Profiling Process	How will the Waste Acceptance team be qualified, i.e., what training, experience? Will there be written procedures to follow and if so, who will qualify them and how will the

Excerpts from the EIS - **Volume 1**	Comments
The CNL Waste Programs and Waste Operations teams will have a qualified Waste Acceptance team to review the generator's waste processes, profile and operations in order to approve waste for emplacement into the ECM. All waste is the responsibility of the generator until it has been accepted by the Waste Operations… … All waste accepted at the NSDF must be profiled prior to disposal. Profiling the waste material contents includes the following information, activities, and documentation to support and validate the waste profiling process … The waste profiling process consists of the following steps: - waste characterization; - Waste Profile Record completion and submittal; - Waste Profile review and approval by the waste acceptance team; and, - notice of approval to transport to the NSDF	procedures be qualified? How does "review the generator's waste processes, profile and operations" apply to waste generated in the past from a variety of generators and for waste that is not be adequately profiled? Does "generator's waste processes" mean the processes that give rise to the generator's waste (I am not sure what a waste process is)? What is a waste profile – is it the average characteristics of a waste stream or waste block where the variance from the average is specified (e.g., waste contains Cs-137 = 1E6 Bq/m^3 +/- 30%, Am-241…)? Is it the specific characteristics of a specific waste item? While one of the steps in profiling is "waste characterization" it is not clear what this involves. Previous to indicating this step, the EIS states, "**Profiling** the waste material contents **includes** the following information, **activities**, and documentation ***to support and validate*** **the waste profiling process**" which is compliance monitoring as opposed to waste characterization itself. The EIS needs to specify the options for actual waste characterization, such as gamma spectrometry, **representative** sampling and radiochemical analysis (for hard to measure nuclides), chemical analysis, computer aided tomography, etc. While generators retain responsibility for waste until they are accepted by Waste Operations, it is not clear from the last profiling step "notice of approval to transport to the NSDF" if profiling is a generator responsibility or not. As worded in the EIS, Waste Operations could accept waste then profile it

Excerpts from the EIS - **Volume 1**	Comments
	(whatever that means) prior to NSDF acceptance. Is profiling (again, it is unclear what that is) a generator responsibility that is required prior acceptance by Waste Operations? If it is a generator responsibility, the NSDF proponents need to demonstrate that generators can actually meet their responsibilities (do they have the facilities, the methodologies and the trained staff to profile their wastes). If it is not a generator responsibility, the EIS makes no mention of waste characterization facilities under Waste Management Operations or NSDF project control. It seems anomalous that a Waste Water Treatment Building is described yet no characterization facilities are described. If, as the IRUS PSAR states, "*A detailed knowledge of the waste inventory is of fundamental importance when preparing the safety case for waste disposal*", it seems anomalous that no details of waste characterization facilities, methodologies, personnel or responsibilities for this critical part of the NSDF are provided in the EIS. Regarding, "Waste Profile Record completion and submittal", since it is unclear if a profile refers to the average characteristics of a waste stream or waste block, it is not clear if a waste profile record is NSDF project terminology for a waste data sheet or what is known in many places as a waste manifest. Is a Waste Profile Record what the WI Program [16] called a waste block data sheet? For me, it is simply unclear how wastes are to be characterized and documented.

16 http://www.wmsym.org/archives/1997/sess36/36-27.htm

Excerpts from the EIS - **Volume 1**	Comments
3.6.1.1.1 Waste Profiling Process (continued) …The Waste Profile serves the following functions:… … provides a historical record of each waste stream;…	This statement appears to say that profiling applies to the average characteristics of a waste stream. Such profiling is common for cases where routine wastes have average characteristics within specified limits, such as routine Nuclear Power Plant operations wastes. Such profiling can be applied to some routine wastes at CRL from facilities such as fuel fabrication, isotope production, etc. However, as noted in the IRUS PSAR [17], "*The nature of CRL operations is such that a wide variety of wastes are generated, and the variability in the wastes exceeds that associated with the routine operation of, for example, a large power reactor or an isotope user or producer*", that is, establishing the average characteristics of most CRL wastes, including defining the variability of those characteristics, is a major, and possibly impossible, challenge. In addition, profiling, if it is to establish the average characteristics of a routine waste, does not apply to decommissioning and remediation wastes, which are not tied to routine processes, and require case-by-case characterization, not profiling in the sense of average characteristics.
Section 3.6.1.1.2 Waste Acceptance Process Early in the waste acceptance process, the generator is required to sample waste, where applicable, to accumulate analytical data on each waste stream. The waste generator must determine the physical and chemical characteristics of the waste with sufficient accuracy and detail to provide proper designation and management of such waste…	What is the definition of a waste stream (it is not defined in the IAEA's Safety Glossary [18] or the IAEA's Radioactive Waste Management Glossary) [19]? Historically at AECL, since there were so many different wastes generated at CRL overall and even by a single facility, such as hot cells, isotope production and research reactors,

17 http://www.iaea.org/inis/collection/NCLCollectionStore/_Public/29/009/29009904.pdf
18 http://www-pub.iaea.org/MTCD/publications/PDF/Pub1290_web.pdf
19 http://www-pub.iaea.org/MTCD/publications/PDF/Pub1155_web.pdf

Excerpts from the EIS - **Volume 1**	Comments
	the concept of waste blocks was introduced by the WI Program [20]. Some 40 to 50 waste blocks were identified for NRU alone. To some extent, waste blocks were linked to where wastes were generated at CRL but some blocks were similar enough in radiological properties to be assigned the same waste categories (storage and disposal option). These blocks together could be considered a waste stream based on expected storage and disposal options. What is the CNL approach? Is the concept of waste blocks, as implemented in the WI Program, still in place? If so, the requirement for generators to "sample waste, where applicable, to accumulate analytical data on each waste stream" would appear to be carried out, at least partially, at the waste block level, not at the waste stream level. **This is not an academic exercise** – historically generators argued that they did not understand waste management requirements, they were just doing their jobs. Conceptually, it was easier for them to understand the concept of characterizing a waste block from a given process they performed as opposed to characterizing the "streams" of waste for storage and disposal. If generators are responsible for waste characterization, it is key that they understand what is expected of them (from the EIS, I do not understand what is expected and this was my area of responsibility for decades). As discussed previously, if waste characterization is solely a generator responsibility, the NSDF proponents need to

20 http://www.wmsym.org/archives/1997/sess36/36-27.htm

Excerpts from the EIS - **Volume 1**	Comments
	demonstrate that generators can actually meet their responsibilities (do they have the facilities, the methodologies and the trained staff to accumulate analytical data on each waste stream). To what extent has the NSDF Project and waste operations taken into account the following IAEA document?: Strategy and Methodology for Radioactive Waste Characterization (2007) [21] The referenced document describes characterization for cases ranging from wastes with consistent properties to unique wastes. Given the importance of "*A detailed knowledge of the waste inventory is of fundamental importance when preparing the safety case for waste disposal*", as presented to the AECB as part of the IRUS PSAR in the 1990's, the NSDF needs to provide a detailed description of the facilities, methodologies, and training in place or to be in place to gain this "*detailed knowledge of the waste inventory*" for the NSDF. So far in my review of the EIS, I have not seen such information. Dr. Kerry Burns (AECL retiree) led the development of the methodologies and his staff conducted the characterization of the wastes proposed for the IRUS facility in the 1990s. Dr. Burns, in my opinion, is the most qualified person in Canada to assess the requirements for and the state of waste characterization in support of the NSDF. I recommend that Dr. Burns be contracted to review waste characterization and compliance monitoring at CRL. Given the importance of this

21 http://www-pub.iaea.org/MTCD/publications/PDF/te_1537_web.pdf

Excerpts from the EIS - **Volume 1**	Comments
	issue, external oversight by such a highly qualified technical expert, whose expertise is directly in this area, is essential.
3.6.1.1.2 Waste Acceptance Process (continued) …The waste generator must determine the physical and chemical characteristics of the waste with sufficient accuracy and detail **to provide proper designation and management of such waste.** This includes, but is not limited to, sufficient knowledge to demonstrate that the waste is not prohibited from disposal at the ECM…	Regarding, "**to provide proper designation** and management of such waste", I interpret this to mean "to allow the proper storage or disposal option to be selected". Historically, within the WI Program [22], the WIP-III database had algorithms that used the radionuclide inventories reported for a waste block (Bq) and compared them with limits for the IRUS and Improved Sand Trench (IST) facilities as well as guidance for storage facilities and automatically assigned the storage and disposal category codes (as they appear on waste block data sheets), as described in the following excerpt from the WI Program: *WIP-III includes "auto categorization" routines that also greatly reduce the time to QFS wastes. In order to assign a disposal category, WMDO staff have to compare the levels of contaminants reported for waste packages (on data sheets) with administrative limits for contaminants for various disposal facilities. Since Performance Assessments predicted that contaminants would have their maximum effect at different times after a disposal facility is closed, contaminants were placed into various groups and WMDO staff have to calculate the fraction of disposal limits for each contaminant in a package and then perform sums of fractions for each group of contaminants and repeat this for various disposal options. This tedious and time consuming task was replaced by auto categorization routines in WIP-III, which use lookup tables that have administrative limits for contaminants for various the disposal options being considered.*

22 http://www.wmsym.org/archives/1997/sess36/36-27.htm

Excerpts from the EIS - **Volume 1**	Comments
	My understanding is that the WIP-III database has or is being replaced at CRL. Unsolicited, I contacted CRL staff on a number of occasions asking if the principal functions of WIP-III would be retained in its successor. No feedback was received. In the context of "**to provide proper designation**" of wastes, my questions are: 1 Are generators to provide this proper designation or does this responsibility remain with waste operations? Note, the first paragraph of Section 3.6.1.1.2 states, "This information is then used to complete the Radioactive Waste Profile Record" while the end of Section 3.6.1.1.1 states that the Waste Profile Record is reviewed and approved by the Waste Acceptance Team. This can be interpreted as "proper designation" is done by generators prior to waste acceptance. This needs to be clarified. 2 Is the autocategorization function a part of the WIP-II replacement? 3 If the answer to 2. is Yes, what QA has been performed to ensure that autocategorization works as desired? 4 If the answer to 2. is No, how will "proper designation[s]" be assigned for wastes to ensure that NSDF accepts wastes suitable for NSDF?

Excerpts from the EIS - **Volume 1**	Comments
search results for "records" and "database" in the context of waste management records: page 3-7: CRL identifies and tracks several hundred waste sources via its Waste Tracking Database pg 3-10: Packages will have a label or another unique identifier to enable waste tracking and to associate waste characterization records. pg 3-34: The administration building includes office space, a meeting room, a records room, a washroom facility and a lunch room pg 3-36: The Waste Profile serves the following functions:… maintains an operating record of waste material shipments including receipt, acceptance, storage, and disposal;… … provides a historical record of each waste stream… pg 3-46: A Waste Placement Mapping Plan will be developed to facilitate accurate recording and documentation of cell and ECM development, as well as the placement locations of the different waste types in the cells pg 3-63 The record of settlement for the closed cells is a measure of anticipated settlement performance for the then-open disposal cells that are closed during the closure period. pg 3-73: The post-operational monitoring program is intended to:… …provide records for facility closure and for regulatory review.	This EIS provides no significant information about data and records management associated with the cradle-to-grave management of wastes. Noticeably missing are any references to activities and systems that are described in documents such as the following (not even a basic discussion of requirements for record keeping in support of disposal): "Maintenance of Records for Radioactive Waste Disposal ", IAEA technical document TECDOC-1097, August 1999 [23] "Waste Inventory Record Keeping Systems (WIRKS) for the Management and Disposal of Radioactive Waste ", IAEA technical document TECDOC-1222, June 2001 [24] "Records for Radioactive Waste Management up to Repository Closure: Managing the Primary Level Information (PLI) Set ", IAEA technical document TECDOC-1398, July 2004 [25] G.W. Csullog, "The Link Between Performance Assessment and Quality of Data ", Second International Seminar on Radioactive Waste Products, 28 May - 1 June 1990, Jülich, Germany. [26] G.W. Csullog, M.A. terHuurne, M.T. Miller, N.W. Edwards, V.R. Hulley and D. J. McCann, "Assessing Inventories of Past Radioactive Waste Arisings at Chalk River Laboratories ", presented at Waste Management '98, Tucson, Arizona, 1998 March. [27]

23 http://www-pub.iaea.org/MTCD/publications/PDF/te_1097_prn.pdf
24 http://www-pub.iaea.org/MTCD/publications/PDF/te_1222_prn.pdf
25 http://www-pub.iaea.org/MTCD/publications/PDF/te_1398_web.pdf
26 https://inis.iaea.org/search/search.aspx?orig_q=RN:23078555
27 http://www.wmsym.org/archives/1998/html/sess46/46-02/46-02.htm

Excerpts from the EIS - **Volume 1**	Comments
3.6.1.2 Waste Placement … Waste is placed to maximize its in- place density and reduce void space to limit the potential for future settlement of the waste…	USNRC 10 CFR 61 (see general comment section on Page 53) states, "*Waste must have structural stability. A structurally stable waste form will generally maintain its physical dimensions and its form, under the expected disposal conditions such as weight of overburden and compaction equipment, the presence of moisture, and microbial activity, and internal factors such as radiation effects and chemical changes. Structural stability can be provided by the waste form itself, processing the waste to a stable form, or placing the waste in a disposal container or structure that provides stability after disposal.*" Disposal regulations in the USA for a near surface disposal facility require waste to be structurally stable, not just emplaced in manner that limits future settlement. If preventing/limiting NSDF subsidence is a performance objective, the emplacement strategy to limit future settlement of the waste would appear to be inadequate if the NSDF does not have sufficient inherent structural stability (in other words, it is likely to collapse). I simply cannot find enough info about the facility's design in the EIS. Obviously the project has considered settlement to be an issue but the EIS does not say why, what that implies, or how the project plans to address possible facility subsidence (see Page 48 of my comments).
Type 5 – Packaged Waste (page 3-48) Wastes having activity greater than 400 Bq/g for alpha–emitting radionuclides and 10,000 Bq/g for long lived beta radionuclides will require special packaging and/or treatment to ensure the radioactive wastes remain isolated	IAEA General Safety Guide GSG-1 [28], Classification of Radioactive Waste, states, "**The regulatory body should establish limits for the disposal of long lived radionuclides** on the basis of the safety assessment for the particular disposal facility. A limit of 400 Bq/g **on average**

28 http://www-pub.iaea.org/MTCD/publications/PDF/Pub1419_web.pdf

Excerpts from the EIS - **Volume 1**	Comments
and contained in the waste packages. The expected life span for these packages will be confirmed during final design. Section 3.2.2, Waste Acceptance Criteria Based on the analysis of long-term performance of NSDF (criterion 1) and benchmarking against WAC for existing near-surface disposal facilities (criterion 2), it is recommended that the total specific activity of any waste consignment accepted for disposal at NSDF shall not exceed the following values: - **4,000 Becquerels per gram (Bq/g)** for all alpha-emitting radionuclides; and	(and up to 4000 Bq/g for individual packages) for long lived alpha emitting radionuclides has been adopted in some States [10-12]... [10] Code of Federal Regulations, Title 10, Part 61, "Licensing Requirements for Land Disposal of Radioactive Waste", 1992. [11] FRENCH MINISTRY FOR INDUSTRY AND RESEARCH, Surface Centres for Long Term Disposal of Radioactive Waste with Short or Medium Half-Life and with Low or Medium Specific Activity, Basic Safety Regulations, Regulation No. I.2., Paris (1984). [12] KIM, J.I., et al., German approaches to closing the nuclear fuel cycle and final disposal of HLW, "Corrosion Behavior of Spent Fuel" (Proc. Int. Workshop Überlingen, 1995), J. Nucl. Mater. 238 (1996) 1–10..." Neither CNSC Regulatory Policy P-290 (CNSC 2004) nor Guide G-320 (CNSC 2006), both of which are cited in Section 1.4.2 of the EIS, ***Relevant*** Standards, Codes and Guidelines, indicate radionuclide limits for disposal facilities, therefore, in Canada, the regulatory body has not established limits for the disposal of long lived radionuclides. If, indeed, the two cited CNSC documents are relevant to the implementation and if, indeed, radionuclides limits are a key element, how do the NSDF proponents justify the disposal of wastes having activity greater than 400 Bq/g, especially given IAEA GSG-1 [29] specifies **400 Bq/g on average** for waste packages? This is particularly significant given the issue of subsidence and the fact that both the US and French examples cited in GSG-1 include measures against subsidence (US, waste stability; France, AGCV) to ensure the facilities retain their integrity – something that appears to be lacking for the NSDF mound. Regarding, "**any waste consignment** accepted for disposal at NSDF shall not exceed the following values.. ...4,000

[29] http://www-pub.iaea.org/MTCD/publications/PDF/Pub1419_web.pdf

Excerpts from the EIS - **Volume 1**	Comments
	Becquerels per gram (Bq/g)", it is not clear if the 400 Bq/g value is the average per consignment, per waste block, per waste stream or that average for the facility as a whole. This needs to be explicitly stated. Finally, once again, **intermediate level waste** is defined by the IAEA as waste that contains long lived radionuclides in quantities that **need a greater degree of isolation from the biosphere than is provided by near surface disposal**", which should preclude them from the NSDF.
3.8 Management of Waste Generated by the Project … radioactive wastes, including other wastes that meet the WAC, are segregated based on the acceptance criteria as set out by the Waste Receiver, and may include segregation by physical, chemical, and radiological content, as well as packaging and labelling criteria… No radioactive waste is expected to be generated during site preparation and construction activities. In the event any material is found to be contaminated with radioactive material, it will be separated and managed according to existing procedures established for all CNL operated sites	See my comments on the Waste Water Treatment Plant on page 24. As is the case throughout the EIS, a key element is not mentioned, that is, how will the wastes be characterized? These non-routine wastes, like decommissioning and remediation wastes, cannot be profiled and require case-by-case characterization. Section 3.2.1, Waste Types and Volumes, states, "The waste characterization is based on conservative assumptions as **most of the waste to be disposed of in the NSDF has not yet been characterized** or generated." and from that point onward to Section 3.8, little or no detail is provided or referenced on how wastes will be characterized other than to say they will be profiled. This lack of detail or reference to detail is puzzling given that a critical component of any disposal facility is the knowledge of what that facility will hold. An impact statement without a delineation of what is being assessed for its impact is, in my view, odd to say the least.

Excerpts from the EIS - **Volume 1**	Comments
3.10.1 End-state Objective … result in an appropriate final cover slope over the ECM to mitigate the effects of settlement… Interim cover and final cover system placement progresses as disposal cells are filled. The early placement of the final cover system during the operating period ensures that anticipated settlement of the final cover system over these closed disposal unit cells occurs during the operational period	see my comments regarding 3.6.1.2 Waste Placement on page 33. The EIS, unless I missed it, does not provide a cross-section of the ECM, therefore, it is difficult to assess how the project plans to mitigate the effects of settlement. As noted, with the US approach (wastes must be stabilized to minimize settlement) or the French approach (AGCV concept), it is hard to see how the NSDF approach of "Waste is placed to maximize its in- place density and reduce void space to limit the potential for future settlement of the waste" will actually successfully mitigate the effects of settlement. Since this issue is raised at least 2X in the EIS, it appears to be a concern of the project but, in my opinion, insufficient information is provided on how the project plans to deal with that concern. Regarding, "The early placement of the final cover system during the operating period ensures that anticipated settlement of the final cover system over these closed disposal unit cells occurs during the operational period", this only refers to the initial, short term settlement. It does not address the following, as noted in 10CFR 61 (see my General Comments), "*Waste must have structural stability. A structurally stable waste form will generally maintain its physical dimensions and its form, under the expected disposal conditions such as weight of overburden and compaction equipment, the presence of moisture, and microbial activity, and internal factors such as radiation effects and chemical changes. Structural stability can be provided by the waste form itself, processing the waste to a stable form, or placing the waste in a disposal container or structure that provides stability after disposal.*". How are the factors cited above dealt with by the NSDF project in the context of settlement?

Excerpts from the EIS - **Volume 1**	Comments
3.10.3 Decommissioning of Wastewater Treatment Plant, Infrastructure, and Support Facilities	When I was involved in the design and implementation of the Waste Reception Centre at AECL, essentially the front door to the waste management areas, a key component that I insisted on was building in features to facilitate future decommissioning of the WRC. Why? During the Tunney's Pasture decommissioning work, the AECB would not allow the project to open up sections of the ventilation system to get samples for analysis due to the inherent hazard of particulate scattering. So, when designing the WRC, I asked for small access doors to be installed at key areas of the ventilation system and behind these doors coupons were installed. The doors could be opened and coupons removed to analyze for deposits to provide initial data on the degree and nature of radioactive contamination in the system. Are any of the project's facilities, like the WWTP, being designed with future decommissioning in mind? Is this stated anywhere in the EIS (I may have missed it)? If features to facilitate decommissioning are being included, a statement to this affect should be in the EIS to assure readers that decommissioning is thought out completely. That applies to any new facility at CRL (I sincerely hope such features are essential components of any facility design).
Section 4 PUBLIC AND ABORIGINAL ENGAGEMENT ACTIVITIES	Section 4 contains topics outside of my area of expertise – I am confident there are other reviewers who will provide meaningful feedback.
Section 5 ENVIRONMENTAL EFFECTS	Section 5 was scanned but not reviewed in detail since, up to this point in the EIS, the NSDF as described appears to be a black box regarding what it will actually contain. Critiquing Section 5, a 649 page assessment of the impacts of a black box would be a futile exercise for me considering my focus is the facility's inventory and how it will be controlled. Therefore, at

Excerpts from the EIS - **Volume 1**	Comments
	this point in my review I switched from reviewing the EIS to reviewing the Facility Performance Assessment, document 232-509240-ASD-001, to gain more insight into the proposed contents of the NSDF. My review of document 232-509240-ASD-001 focused on the tasks of defining and controlling the inventory. Prior to my comments on document 232-509240-ASD-001 (in the next table) it is worth noting that at this point in my review (April 30, 2017), CNL has still not provided me with a copy of its Integrated Waste Strategy (IWS) document that was requested March 21, 2017. The IWS is supposed to detail CNL's cradle to grave waste management strategy. My intent is to review the IWS document in the context of my comments on Section 2.2 CNL Integrated Waste Strategy on Page 6 and Appendix 1 on Page 56. My comments on the EIS continue on Page 48 after my comments on document 232-509240-ASD-001.

Excerpts from **doc. 232-509240-ASD-001**, Revision R0	Comments
1.7 Near Surface Disposal Facility Lifecycle … a conservative scenario where the cover system fails at the end of the Institutional Control period, approximately 300 years after the closure of the facility, was considered… 4.1 Waste Categories and Volumes … Low Level Waste is defined as follows: - International Atomic Energy Agency, GSG-1: "Waste that is	Regarding cover failure, please see my comments regarding settlement on Page 33 and Page 36. Document 232-509240-ASD-001 cites the IAEA and the CSA for the definition of LLW but no citation is provided for ILW. It is very odd that the IAEA GSG-1 [30]description of LLW is cited but not the GSG-1 description of ILW, which states "**Intermediate level waste** is defined as waste that contains long lived radionuclides in quantities that **need a greater**

30 http://www-pub.iaea.org/MTCD/publications/PDF/Pub1419_web.pdf

Excerpts from **doc. 232-509240-ASD-001**, Revision R0	Comments
above clearance levels, but with limited amounts of long lived radionuclides… … - Canadian Standards Association: N292.0-14: "Low-level Waste contains… …These two definitions of LLW, while not identical, provide a consistent framework and encompass waste streams containing predominantly short lived radionuclides as well as limited quantities of long-lived isotopes… … Intermediate-Level Waste contains higher quantities of long-lived radionuclides and may require shielding to ensure that it can be handled and stored in a safe manner… … Examples of suitable ILW waste streams may include short lived higher activity waste requiring shielding, immobilized liquid effluent from CRL operations, and ion exchange (IX) resins… …The volumes of the NSDF waste have been estimated in the Waste Forecast Analysis [4-3] and supporting memorandum [4-4]… … [4-3] NSDF Waste Forecast Analysis, 185-508600-REPT-014, 2016 September. [4-4] Expected Waste Volumes for Near Surface Disposal Facility (NSDF), 232-508120-022- 000, Revision 0, April 2016…	**degree of containment and isolation from the biosphere than is provided by near surface disposal. Disposal in a facility at a depth of between a few tens and a few hundreds of metres is indicated for ILW**". Instead, document 232-509240-ASD-001 cites the classic, day-to-day operational ILW description for handling this waste, not for its long-term management. It would appear that, for the NSDF, what the project is calling ILW would actually be LLW, with limited amounts of long lived radionuclides and with short-lived nuclides (half lives less than or equal to Cs-137) with sufficient activity to warrant shielding. It is my opinion that the definitions for both LLW and ILW should be the ones based on their long-term management, the NSDF project should not use the definition of ILW that is tied to its handling, i.e., it requires shielding, instead of its long-term management **The issue that I cited for the ILW definition is particularly odd** given the statement "These two definitions of LLW, while not identical, provide a consistent framework and encompass waste streams containing predominantly short lived radionuclides as well as limited quantities of long-lived isotopes" **since the definition for ILW is not within a consistent framework** (LLW uses the IAEA definition, ILW uses a classic, operational definition). Regarding, "Examples of suitable ILW waste streams may include **short lived higher activity waste** requiring shielding", this reinforces my statement that "It would appear that, for the NSDF, what the project is calling ILW would actually be LLW, with limited amounts of long lived radionuclides and with short-lived nuclides (half lives less than or equal to Cs-137) with sufficient activity to warrant

Excerpts from **doc. 232-509240-ASD-001**, Revision R0	Comments
	shielding". Documents 185-508600-REPT-014, 2016 September and 232-508120-022- 000, Revision 0, April 2016 were requested from CNL on April 3, 2017 (not received as of April 30, 2017)
4.2 Radionuclide Inventory As part of the PA for the NSDF, an estimate of projected radionuclide inventory was generated, based on data from the Waste Inventory Program, reflecting operational wastes currently in storage at CRL. Characterized inventory of wastes placed in storage between 1995 and 2015,was extrapolated to estimate radionuclide composition of wastes generated prior to 1995 at CRL, as well as those wastes that will be generated and disposed of at the NSDF in the future[4-3].	Regarding, "based on data from the Waste Inventory Program", no reference was provided. I assume this is the WIP-III database referred to previously in my comments (on Pages 9, 30 and 31). If WIP-III was used to project the radionuclide inventory for the NSDF, then the EIS should address or at least acknowledge the following issues: From Page 9: 1. Historically AECL's wastes were not managed as LLW, ILW, etc. 2. The WIP-III database used multi-digit waste class "codes" almost 100% based on the **estimated (not known or verified)** radionuclide content of wastes to indicate where wastes should be stored and possibly disposed. 3. It is not unreasonable to assume that ILW (that … **need a greater degree of isolation from the biosphere than is provided by near surface disposal**) are mingled with LLW in storage. How did the project compile inventories of waste according to LLW and ILW classes when WIP-III does not use these classes? Estimating the radionuclide inventory of a waste class would first rely on effectively collating the wastes in that class. For reference, see Page 58 for how I attempted this in 1999. Regarding, "Characterized inventory of wastes placed in

Excerpts from **doc. 232-509240-ASD-001**, Revision R0	Comments
	storage between 1995 and 2015", see next: From Page 30: 1. Historically… …the WIP-III database had algorithms that… …used the radionuclide inventories reported for a waste block… … [to] automatically assign[~~ed~~] the storage and disposal category codes. 2. From Appendix 1: Prior to the mid-1990's, AECL did not have a cradle to grave management system for its wastes at CRL or at any of its other sites. From 1999 to 2006, the system described in the paper cited above "faltered" (this was the term approved by my management for my publically available paper). In 2006, I was asked to rebuild much of what had "faltered" (see the reference after this paragraph). In 2010, just prior to leaving AECL, I made a presentation to my manager and staff in our department detailing how much the system from the 1990's had "faltered" and my inability to effectively rebuild it. The "characterized" waste stored from 1995 to 2015 was subject to cradle to grave waste management that was only in place a few years prior to 2010, I cannot speak for 2010 to 2015. In addition, the vast majority of these wastes were not analytically characterized, instead, their properties were estimated on the basis of mass balance assessments of the process that generated them. As such, the statement, "Characterized inventory of wastes placed in storage between 1995 and 2015" must be taken with a grain of salt since effective cradle to grave management was mostly not in place, therefore effective segregation of LLW and ILW would have been difficult to verify and the wastes were not actually characterized, their properties were estimated. The project needs to provide a least a description of how it qualified its

Excerpts from **doc. 232-509240-ASD-001**, Revision R0	Comments
	inventory estimate within document 232-509240-ASD-001 rather than (possibly) including this information in a bibliography. Specifying the inventory for the NSDSF is critical component of the project – demonstrating that the project effectively "projected [the] radionuclide inventory" for the performance assessment would instill confidence for future projections. Not doing a defensible job on the inventory projection would have the opposite effect. Regarding, "projected radionuclide inventory… …as well as those wastes that will be generated and disposed of at the NSDF in the future", if WIP-III was the basis for the projected inventory, the following need to be addressed in the context of going forward during NSDF operation. From Page 31: 1. My understanding is that the WIP-III database has or is being replaced at CRL. 2. Are generators to provide this proper designation or does this responsibility remain with waste operations **[this is the issue of waste classification, making sure the right wastes are emplaced in the NSDF]?** 3. Is the autocategorization function a part of the WIP-III replacement? 4. If the answer to 2. is Yes, what QA has been performed to ensure that autocategorization works as desired? 5. If the answer to 2. is No, how will "proper designation[s]" be assigned for wastes to ensure that NSDF accepts wastes suitable for NSDF?
4.2 Radionuclide Inventory (continued) …Thus, by using radionuclide concentrations in waste streams, which were generated during operations, to represent the total ECM inventory, the total radionuclide	I interpret this to mean the following for the NSDF: - 15% of waste vol. is from past waste, where radionuclide inventories were or may have been reported

Excerpts from **doc. 232-509240-ASD-001**, Revision R0	Comments
inventory within the ECM has been overestimated. This conservatism mitigates uncertainties in the inventory of historic and future waste by ensuring that potential radiological impacts are not underestimated. … The inventory was then screened to remove waste streams ~~which~~ that did not meet safety objectives for near-surface disposal and precedence of near-surface disposal at similar facilities elsewhere… … The inventory was also adjusted to account for decay of relatively short-lived radionuclides, such as tritium and cobalt-60, …	- 85% of waste vol. will be from future decommissioning and remediation and wastes will be far less radioactive - NSDF radionuclide inventory was estimated for the performance assessment to be 100/15 times the inventory of past waste, so highly over estimated. One problem with the approach is that much of past waste had little or no radionuclide reporting (the EIS states "**most of the waste to be disposed of in the NSDF has not yet been characterized**"). Historically easy to measure, short lived radionuclides were reported (e.g. Co-60, Cs-137) and long lived beta and alpha radionuclides were typically not reported. Therefore if one is relying on a historical inventory where long lived nuclides were not reported, then the calculation boils down to 100/15 x 0 for the long lived radionuclides in a lot of past waste. The conclusion that the "the total radionuclide inventory within the ECM has been overestimated" using the cited methodology has to be proven by a rigorous assessment of past wastes, otherwise the conclusion is suspect and the uncertainty may not be mitigated. **In fact, if the approach taken by the project is not defensible, that serves to heighten uncertainty about the project.** Another problem with the approach is related to the issue of nested packages. An example of nested packages are individual bales of waste placed into what was called a "red crate". While the radionuclides for bales were reported (see next paragraph) on their individual data sheets, for many years the WIP-III database did not have the feature of adding up the radionuclides for the individual bales to, for example, create a tally for the red crate. As a result, a red crate's data sheet would not show any radionuclides, so in effect,

Excerpts from **doc. 232-509240-ASD-001**, Revision R0	Comments
	radionuclide inventories for bales would "disappear". If the radionuclides for red crates were part of the "15% of waste vol. is from past waste", doing the 100/15 calculation would also result in 100/15 x 0 for these wastes, making the calculation even more suspect. Another problem with the approach is related to the issue of "reported nuclides" as most of the "reporting" relied on estimates of waste characteristics within the WI Program [31], which were not verified analytically in most cases. For bales, which were part of the proposed IRUS disposal concept, pre-2000 analytical verification was done for bales. However, after that point verification was carried out for a number of years but the data were lost. Over the years, the characteristics of bales would have changed as processes and operations changed on the CRL site, however, the radionuclides "reported" initially for bales were not adjusted. This is the case for many waste blocks at CRL – their characteristics likely changed over the years but their estimated characteristics were likely not adjusted. As such, the uncertainty of the characteristics of wastes with "reported" nuclides is unknown, making the 100/15 calculation even more suspect. Regarding, "The inventory was then screened to remove waste streams which did not meet safety objectives…", with high uncertainty about some past wastes, i.e., those with little or no reporting of long lived radionuclides, it would not be hard to imagine not removing some "streams" due to a lack of knowledge (they may have unreported inventories of long lived nuclides that could preclude them from the NSDF).

31 http://www.wmsym.org/archives/1997/sess36/36-27.htm

Excerpts from **doc. 232-509240-ASD-001**, Revision R0	Comments
	Massaging an inventory (leave this, take out that) when the components of that inventory are poorly characterized or not characterized at all might be an academic exercise. Regarding "account for decay", please see the discussion on in-growth of radionuclides on Page 19. Were in-growth calculations done at all?
4.2 Radionuclide Inventory (continued) …For the purposes of an accident consequence assessment during operations, it was conservatively assumed that only wastes currently stored within bunkers in WMA B will be involved in the postulated transportation accidents…	What about transportation accidents for wastes from the MAGS and SMAGS storage facilities? Waste in ISO containers in MAGS/SMAGS may not be efficiently packed and actions would have to be taken (the EIS states, "*Packaged waste will not include large steel shipping containers unless the void space inside the container is less than 10% of the container volume.*"). For me this implies opening ISO containers, assessing void space, and possibly reducing void space, which appears to be a candidate for "*accident consequence assessment during operations*". If waste retrieved from WMA B bunkers represent the conservative accident scenario, am I to assume that wastes will not be recovered from Area C (these would likely be in worse physical shape than bunkers)? My questions also stem from my previous questions about "what at the legacy waste areas?" – see Page 5. If these legacy waste areas were listed, I would not have to ask about Area C for possible waste recovery if it was not on the list.
4.4 Waste Acceptance Criteria … The safety analysis will require the radionuclide inventory to assess the safety of the design… … Qualification – Wastes will have to be produced under	As a reminder of previous comments, the two aspects of the inventory are (1) what is the projected inventory and (2) how will it be controlled (see my comments on Page 6)? In the EIS and document 232-509240-ASD-001, details of the inventory projection are limited and details of how the inventory will be controlled are essentially absent (see below). These appear to

Excerpts from **doc. 232-509240-ASD-001**, Revision R0	Comments
approved waste generator QA arrangements, which detail the effective management and control of the waste from its generation to its acceptance by **CRL** for disposal at the NSDF….	be major weaknesses for the NSDF project. Regarding the "*approved waste generator QA arrangements*", this would appear to be some form of revival of the Waste Identification Program (WI Program) that "faltered" and had not been successfully reinstated as of 2010. A detailed, regulatory review of these "*approved waste generator QA arrangements*" is essential to assess NSDF inventory control, especially given that, historically: 1. waste generators did not have the resources, procedures or trained staff to characterize their wastes, 2. waste generators did not know how to classify their wastes for storage and disposal (that function was performed by the WIP-III autocategorization algorithm within waste management operations), and 3. the WI Program developed the procedures for waste collection/transfer to waste operations and waste collection points signs, both of which were posted in generators' facilities – how were these implemented within the "*approved waste generator QA arrangements*"? Part of "*control of the waste from its generation to its acceptance*" is identifying where various wastes are generated and specifying how they are collected to ensure proper segregation prior to transfer to "CRL". "acceptance by **CRL**" implies the acceptance of wastes from non-CRL sites and that the "*approved waste generator QA arrangements*" would also be implemented at these other sites.

Excerpts from **doc. 232-509240-ASD-001**, Revision R0	Comments
10.1 Inventory The NSDF inventory is represented by operational wastes currently in storage and those that will be generated prior to closure in 2070, which will be dominated by decommissioning and environmental remediation waste streams. The assessed inventory is presented in Section 4. It should be noted that the radiological capacity will also be bounded by the NSDF WAC, which limits the activity of long lived alpha-emitters and beta-gamma emitters to 4,000 Bq/g and 100,000 Bq/g respectively….	As a reminder, IAEA GSG-1 [32] states, "The regulatory body should establish limits for the disposal of long lived radionuclides on the basis of the safety assessment for the particular disposal facility. **A limit of 400 Bq/g on average (and up to 4000 Bq/g for individual packages) for long lived alpha emitting radionuclides** has been adopted in some States [10–12].". The recommended limit is 400 Bq/g on average with exceptions for individual packages at 4,000 Bq/g. The project needs to be clear as to whether or not it is adhering to the 400 Bq/g on average limit – that is not clear from Section 10.1, which is part of conclusions for document 232-509240-ASD-001.
10.4 Operations … Key uncertainties associated with this analysis have been reviewed and indicate high confidence levels in the forecast due to conservatism in the assumptions underpinning the assessment…	Just a reminder of what I said on Page 43," The conclusion that the "the total radionuclide inventory within the ECM has been overestimated" using the cited methodology has to be proven by a rigorous assessment of past wastes, otherwise the conclusion is suspect and uncertainty may not be mitigated. In fact, if the approach taken by the project is not defensible, that serves to heighten uncertainty about the project."

32 http://www-pub.iaea.org/MTCD/publications/PDF/Pub1419_web.pdf

Excerpts from the EIS - Volume 1 (continued)	
6.0 MALFUNCTIONS AND ACCIDENTS …Internal Hazards:… …- failure of the ECM containment system due to excessive settlement;… … 13 malfunctions and accidents could not be screened out (i.e., were deemed to be credible events), and therefore, require a consequence assessment. These events are described in Table 6.4.1-1….	Failure of the ECM due to excessive settlement is not listed in Table 6.4.1–1, therefore it is not considered a credible event. Please refer to my comments about settlement on Page 33.
6.6 Emergency Preparedness … the following environmental programs and emergency response procedures will be in effect for the NSDF Project… … Nuclear Materials and **Safeguards Management Compliance Program**…	The following is in the context of possible depleted uranium (DU) disposal in the NSDF. One source of DU may be DU metal used for shielding of highly radioactive sealed sources. My recollection is that AECL had a contract related to DU management in the past, I do not recall when. I believe CAMECO may have also sent DU contaminated waste to AECL, not sure. States conclude safeguards agreements with the IAEA in order to fulfil their non-proliferation commitments. The IAEA applies safeguards pursuant to three types of safeguards agreements, one type is a comprehensive safeguards agreement (CSA). *Guidance for States Implementing Comprehensive Safeguards Agreements and Additional Protocols* (IAEA Services Series No. 21) found under the 'Assistance for States' webpage at www.iaea.org/safeguards. Under a CSA, a State undertakes to accept IAEA safeguards in accordance with the terms of the safeguards agreement, on all source or special fissionable material in all peaceful nuclear activities within the territory of the State, under its

Excerpts from the EIS - Volume 1 (continued)	
	jurisdiction, or carried out under its control anywhere. The IAEA has the corresponding right and obligation to ensure that such safeguards are applied to all such material, for the exclusive purpose of verifying that it is not diverted to nuclear weapons or other nuclear explosive devices. Source or special fissionable material subject to safeguards is defined in Article XX of the IAEA's Statute, and includes uranium, plutonium and thorium. The term 'source material' does not apply to ore or ore residues. **Depleted uranium (DU) is included in the definition of 'source material' and, thus, is considered nuclear material subject to safeguards.** States with a CSA in force are required to provide information to the IAEA about inventories and flows of all nuclear material (including DU) and to facilitate access by the IAEA to conduct inspections at facilities and locations where such material is present. Therefore, when managing DU it is important to ensure the relevant safeguards obligations under a CSA are met. Nuclear material, including DU, continues to be subject to safeguards until such time as it is determined by the IAEA that safeguards can be terminated on such material. INFCIRC/153 (Corr.) states in paragraph 11 that "*safeguards shall terminate on nuclear material subject to safeguards…upon determination by the Agency that it has been consumed, or has been diluted in such a way that it is no longer usable for any nuclear activity relevant from the point of view of safeguards, or has become practicably irrecoverable*." **DU in the form of metal used as shielding will not meet the requirements for termination of safeguards.** CSA States have the right to request that nuclear material,

Excerpts from the EIS - Volume 1 (continued)	
	including DU (that was previously reported by the State to the IAEA) be exempted from safeguards. Exemption may be requested for such nuclear material that is either a small quantity (less than one effective kilogram) or that is used for a non-nuclear purpose (such as a counterweight in a crane, or shielding in a container). If the IAEA grants the exemption, the State is not required to submit accounting reports in respect of this material and the Agency no longer routinely verifies it. However, **the nuclear material remains subject to safeguards**, and pursuant to an Additional Protocol, the IAEA retains rights of access to certain locations containing exempted material. If exempted nuclear material is to be processed or stored together with non-exempted material or if it is to be exported outside of the State, the State authority that is responsible for safeguards must arrange in advance for the reapplication of safeguards to that material. In such cases, the State Authority must send a letter to the IAEA requesting de-exemption of the relevant items. **It is common that DU used as shielding has been exempted from safeguards**. This **use of the term** 'exempted' in the field of safeguards **is not the same as the its use in the regulatory domain**, such as commonly used in the context of radiation safety. **Nuclear material exempted from safeguards should always remain subject to national regulatory control,** until such time as the material is no longer subject to safeguards (e.g. exported out of the State, or safeguards terminate on the material). **If a State plans to dispose of DU metal** at a suitable location in the State, **such as a low-level radioactive waste repository**, the DU at such location will be reported by the State Authority to the IAEA in an inventory change report as 'transferred to retained waste' and the State and the IAEA

Excerpts from the EIS - Volume 1 (continued)	
	should consult on the appropriate safeguards measures to be applied. 'Retained waste' is a term defined in IAEA INFCIRC 153 (Corr.) as "*nuclear material generated from processing or from an operational accident, which is deemed to be unrecoverable for the time being but which is stored*." This also applies to nuclear material for which the conditions of termination are not met, but for which the State has no desire to recover the material for further use. This would typically apply to DU metal no longer useful and emplaced into a disposal facility.
10.1 Data Management	As mention previously (see Page 32) the EIS provides no significant information about data and records management associated with the cradle-to-grave management of wastes.
11.0 CONCLUSIONS ...The current CRL waste management practice is to safely store radioactive waste on-site in individual facilities in accordance with current licence conditions...	While I agree with "*in accordance with current licence conditions*", to my knowledge AECL/CNL has never assessed that its wastes are safely stored in the context of the Indicator of Sustainable Development for Radioactive Waste Management (ISD-RW, Guidance for Calculating the Indicator of Sustainable Development for Radioactive Waste Management) [33], which was developed by the IAEA at the request of the United Nations. Factor 1 of the ISD-RW, for storage, includes the question, "Did you perform an assessment of existing and future waste regarding their **suitability for storage**" where "Form suitable for storage means that for the conditions and time of storage, packages remain retrievable (without package degradation that would cause significant health, safety or environmental impacts). The assessment should consider the waste package

33 http://www.un.org/esa/sustdev/natlinfo/indicators/isdms2001/guidance_for_ISD_RW.pdf

Excerpts from the EIS - Volume 1 (continued)	
	as well as the facility ". Without this type of safety assessment for storage, the risk of handling waste during recovery from storage facilities would likely be higher than for facilities for which such assessments were performed and actions taken to ensure waste form and package integrity for the duration of storage (like in the Netherlands) **[34]**. As I recall, in the past, when AECL submitted its first iteration of the IRUS PSAR (Intrusion Resistant Underground Structure (IRUS) Preliminary Safety Assessment Report (PSAR)) **[35]**, the AECB questioned AECL's opening statement that it had been safely storing wastes for >40 and, based on this track record, AECL was in a strong position to move to disposal. The AECB basically said "show us that you have assessed safe storage" if that is the track record that establishes your ability to move to disposal. It is my opinion that nothing has changed now that we have CNL making its proposal to the CNSC. For me, **CNL should** not **justify its move to disposal based on a** practice to safely store waste without actually assessing that practice. For me, CNL needs to move to disposal as soon as it can for various reasons, such as to enable the remediation of contaminated lands **AND** to **move from un-assessed storage practices to disposal.**

34 http://newmdb.iaea.org/Admin/Reports/GetReport.aspx?IsoCode=NL&PeriodID=10&SiteID=&TypeID=0

35 http://www.iaea.org/inis/collection/NCLCollectionStore/_Public/29/009/29009904.pdf

General Comments
The EIS is a lengthy, complex document that is likely hard to assess by "the average concerned citizen". As an example, the following italicized text is from the United States Nuclear Regulatory Commission (USNRC) document, " 10CFR PART 61 [36]— LICENSING REQUIREMENTS FOR LAND DISPOSAL OF RADIOACTIVE WASTE". The text provides a concise summary of the US requirements to license a radioactive waste facility like the NSDF. Section 1.4.2 of the EIS, "Relevant Standards, Codes and Guidelines" appears to indicate that no similar, disposal specific regulatory requirements exist in Canada. First, it would be advantageous for "the average concerned citizen" to see a list of NSDF performance objectives similar the USNRC regulatory requirements and second to see cross references to EIS sections that demonstrate how these performance objectives are or will be met. For example, 10 CFR Part 61 states, "*The disposal site must be generally well drained and free of areas of flooding or frequent ponding. Waste disposal shall not take place in a 100-year flood plain, coastal high-hazard area or wetland*" and, on page 9-3 the EIS states, "In addition, the low point of the ECM has an elevation of approximately 160 metres above sea level (masl), while the 100-year flood elevation for the portion of the Ottawa River adjacent to the CRL property is 155 masl". I had to do a search within the EIS to make this comparison. The EIS needs to provide an easy to follow roadmap from how the NSDF is supposed to perform to how performance was assessed. Section 2.4 of the EIS, "Project Design Principles" does not provide enough nearly the level of detail of facility requirements that is provided by 10CFR Part 61. If this information is/will be provided in a performance assessment document for the NSDF, the EIS needs to, as a minimum, delineate those performance requirements and cross reference how the are/will be met. ***§ 61.50 Disposal site suitability requirements for land disposal*.** [37] *(a) Disposal site suitability for near-surface disposal. (1) The purpose of this section is to specify the minimum characteristics a disposal site must have to be acceptable for use as a near-surface disposal facility. The primary emphasis in disposal site suitability is given to isolation of wastes, a matter having long-term impacts, and to disposal site features that ensure that the long-term performance objectives of subpart C of this part are met, as opposed to short-term convenience or benefits.* *(2) The disposal site shall be capable of being characterized, modeled, analyzed and monitored.* *(3) Within the region or state where the facility is to be located, a disposal site should be selected so that projected population growth and future developments are not likely to affect the ability of the disposal facility to meet the performance objectives of subpart C of this part.*

36 https://www.nrc.gov/reading-rm/doc-collections/cfr/part061/

37 https://www.nrc.gov/reading-rm/doc-collections/cfr/part061/part061-0050.html

General Comments
(4) Areas must be avoided having known natural resources which, if exploited, would result in failure to meet the performance objectives of subpart C of this part. *(5) The disposal site must be generally well drained and free of areas of flooding or frequent ponding. Waste disposal shall not take place in a 100-year flood plain, coastal high-hazard area or wetland, as defined in Executive Order 11988, "Floodplain Management Guidelines."* *(6) Upstream drainage areas must be minimized to decrease the amount of runoff which could erode or inundate waste disposal units.* *(7) The disposal site must provide sufficient depth to the water table that groundwater intrusion, perennial or otherwise, into the waste will not occur. The Commission will consider an exception to this requirement to allow disposal below the water table if it can be conclusively shown that disposal site characteristics will result in molecular diffusion being the predominant means of radionuclide movement and the rate of movement will result in the performance objectives of subpart C of this part being met. In no case will waste disposal be permitted in the zone of fluctuation of the water table.* *(8) The hydrogeologic unit used for disposal shall not discharge groundwater to the surface within the disposal site.* *(9) Areas must be avoided where tectonic processes such as faulting, folding, seismic activity, or vulcanism may occur with such frequency and extent to significantly affect the ability of the disposal site to meet the performance objectives of subpart C of this part, or may preclude defensible modeling and prediction of long-term impacts.* *(10) Areas must be avoided where surface geologic processes such as mass wasting, erosion, slumping, landsliding, or weathering occur with such frequency and extent to significantly affect the ability of the disposal site to meet the performance objectives of subpart C of this part, or may preclude defensible modeling and prediction of long-term impacts.* *(11) The disposal site must not be located where nearby facilities or activities could adversely impact the ability of the site to meet the performance objectives of subpart C of this part or significantly mask the environmental monitoring program.* *(b) Disposal site suitability requirements for land disposal other than near-surface (reserved).* ***§ 61.56 Waste characteristics*.**[38] *(a) The following requirements are minimum requirements for all classes of waste and are intended to facilitate handling at the disposal site and provide protection of health and safety of personnel at the disposal site.*

38 https://www.nrc.gov/reading-rm/doc-collections/cfr/part061/part061-0056.html

General Comments
(1) Waste must not be packaged for disposal in cardboard or fiberboard boxes. *(2) Liquid waste must be solidified or packaged in sufficient absorbent material to absorb twice the volume of the liquid.* *(3) Solid waste containing liquid shall contain as little free standing and noncorrosive liquid as is reasonably achievable, but in no case shall the liquid exceed 1% of the volume.* *(4) Waste must not be readily capable of detonation or of explosive decomposition or reaction at normal pressures and temperatures, or of explosive reaction with water.* *(5) Waste must not contain, or be capable of generating, quantities of toxic gases, vapors, or fumes harmful to persons transporting, handling, or disposing of the waste. This does not apply to radioactive gaseous waste packaged in accordance with paragraph (a)(7) of this section.* *(6) Waste must not be pyrophoric. Pyrophoric materials contained in waste shall be treated, prepared, and packaged to be nonflammable.* *(7) Waste in a gaseous form must be packaged at a pressure that does not exceed 1.5 atmospheres at 20 °C. Total activity must not exceed 100 curies per container.* *(8) Waste containing hazardous, biological, pathogenic, or infectious material must be treated to reduce to the maximum extent practicable the potential hazard from the non-radiological materials.* *(b) The requirements in this section are intended to provide stability of the waste. Stability is intended to ensure that the waste does not structurally degrade and affect overall stability of the site through slumping, collapse, or other failure of the disposal unit and thereby lead to water infiltration. Stability is also a factor in limiting exposure to an inadvertent intruder, since it provides a recognizable and nondispersible waste.* *(1) Waste must have structural stability. A structurally stable waste form will generally maintain its physical dimensions and its form, under the expected disposal conditions such as weight of overburden and compaction equipment, the presence of moisture, and microbial activity, and internal factors such as radiation effects and chemical changes. Structural stability can be provided by the waste form itself, processing the waste to a stable form, or placing the waste in a disposal container or structure that provides stability after disposal.* *(2) Notwithstanding the provisions in § 61.56(a) (2) and (3), liquid wastes, or wastes containing liquid, must be converted into a form that contains as little free standing and noncorrosive liquid as is reasonably achievable, but in no case shall the liquid exceed 1% of the volume of the waste when the waste is in a disposal container designed to ensure stability, or 0.5% of the volume of the waste for waste processed to a stable form.* *(3) Void spaces within the waste and between the waste and its package must be reduced to the extent practicable.*

Appendix 1: Waste Tracking at CRL, Historical Perspective

This Appendix is based on the following conference paper (see Appendix 2 for related info).

AECL's Information System for LLW Inventories in Relation to International Perspectives [39] (Proceedings 23rd NIRMA Conf. 1999), by Gregory W. Csullog, Atomic Energy of Canada Limited, Chalk River Laboratories Chalk River, Ontario, A copy of this paper will be provided to the CNSC.

Section 2.2 of the EIS, "CNL Integrated Waste Strategy" states the following:

> "*Canadian Nuclear Laboratories has developed an Integrated Waste Strategy (IWS) which concisely details "cradle to grave"* ***pathways*** *for all CNL waste streams, from generation to final disposition*".

Regarding the above, on Page 6 of my comments I wrote the following:

> *A cradle to grave strategy has two components – the pathways for wastes and the chain-of-command system that assures wastes are managed within their appropriate pathways. See Appendix 1.*
>
> *If CNL is relying on a cradle to grave strategy, it not only needs to provide details of the various pathways, it also needs to describe a management system that indicates how wastes are collected at point-of-origin and are routed through all stages to their endpoints without loss of chain-of-command. In other words, it is insufficient to only provide an A to B pathway, it is essential to show the verifiable process for ensuring that waste go from A to B and not A to C, etc*.

My review of this EIS indicates that CNL has described ***what*** it plans to do with the variety of CNL wastes but it has provided little or no information about ***how*** it plans to manage those wastes. In that context, the paper cited above describes the cradle to grave system implemented at AECL in the 1990's. While that system applied broadly to AECL's wastes, the impetus for its creation was to provide support for the IRUS disposal concept, also a near surface disposal facility (an AGCV in the terminology of the EIS).

Prior to the mid-1990's, AECL did not have a cradle to grave management system for its wastes at CRL or at any of its other sites. From 1999 to 2006, the system described in the paper cited above "faltered" (this was the term approved by my management for my publically available paper). In 2006, I was asked to rebuild much of what had "faltered" (see the reference after this paragraph). In 2010, just prior to leaving AECL, I made a presentation to my manager and staff in our department detailing how much the system from the 1990's had "faltered" and my inability to effectively rebuild it. That presentation should be on file in AECL/CNL archives ("the big picture"). Realistically, for all CNL sites, only CRL implemented a cradle to grave system for radioactive wastes and that system was only fully in place for a few years up to 2010. The IWS document will let me know what has happened with cradle to grave waste management since 2007.

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39 https://www.dropbox.com/s/8a89rpnderjxjmd/NIRMA1999.pdf?dl=0

The Waste Identification Program at Chalk River Laboratories [40], (Proceedings NIRMA Conf. 2007), by G.W. Csullog, Atomic Energy of Canada Limited, Chalk River Laboratories Chalk River, Ontario.

To reiterate, the EIS states that the "*(IWS)… …concisely details "cradle to grave"* ***pathways***", but no significant detail is provided of the administrative system that is in place or that will be in place to assure that wastes are managed within their appropriate pathways.

As an example, please refer to the following image from first the conference paper cited above:

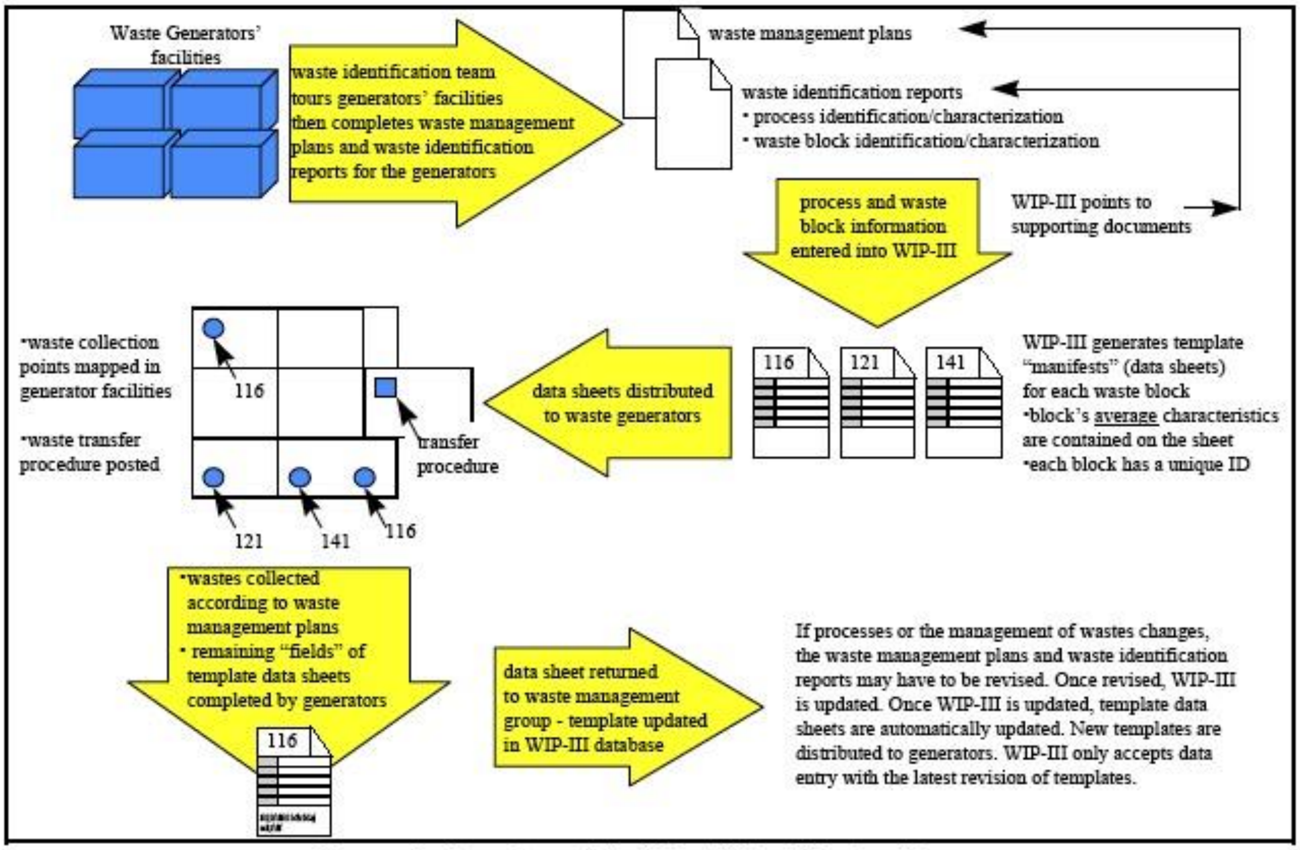

Figure 7: Overview of the Waste Identification Program

The image indicates that waste collection points for each "waste block" were identified and marked in the facilities where wastes were generated. The average characteristics of waste blocks were **estimated** (but not verified analytically) **by waste management operations staff** and pre-filled waste data sheets were provided for generators. Generators, who were given face-to-face guidance, would put their wastes at the designated collection points and, when the wastes were picked up by waste management operations, they would be accompanied by the appropriate waste data sheets. When this system "faltered", many waste collection point signs were taken down or fell down and generator training was discontinued. In other words, front-end control of cradle to grave declined.

40 https://www.dropbox.com/s/tx9ctas8tegtup9/NIRMA2007.pdf?dl=0

The above system failure is very significant for facilities that generate(d) a wide range of wastes, from a radiological perspective. The waste data sheets cited above indicated the suggested storage and disposal options for wastes based on their estimated characteristics. The disposal options were (terms in parentheses indicate approximate IAEA waste classification).

IST (VLLW), IRUS (LLW) and greater than IRUS (ILW)

Without strict front-end control, generators could either place their wastes at the wrong collection point (e.g., an ILW waste bag place at an LLW collection point – such cases were documented even when the management system was fully in place and routinely checked) or use the wrong waste data sheet. With system failure, the likelihood of misrouting waste likely increased (i.e., the chance of mingling LLW and ILW likely increased).

The EIS needs to include some discussion of the cradle to grave management system currently in place at CRL along with a discussion of how this system is monitored to ensure that wastes are properly characterized, classified and routed to the appropriate storage facility, and in the future, the appropriate disposal facility. One can then compare this system with the one from the 1990's to assess improvements or deficiencies in the current system.

As it stands, the EIS is a lengthy document that spends little time discussing how the inventory of the EIS will be determined and how it will be controlled, The exception is a discussion waste acceptance but such acceptance in the absence effective front-end controls is suspect.

Regarding the EIS statement in Section 2.3, Purpose of the Project, "… The NSDF Project will enable CNL to move from its current practice of **interim** waste storage and to direct waste disposal…", if direct disposal is taken as by-passing storage, failures within a cradle to grave management system take on added importance for obvious reasons.

As an FYI, the following image shows how AECL's waste class codes were used to estimate waste inventories according to the IAEA's waste classes in 1999. The following estimates are for wastes "as generated", not "as managed" – mingling LLW and ILW would likely result in ILW.

Table 1: Categorization of AECL-CRL wastes according to the IAEA WMDB Questionnaire and Total CRL and WL waste arisings to Dec 31, 1996

All WIP-III Records (June95 - June98)

Volume	Class	
8.46	001	
31.00	002	
1032.80	003	stockpile
3589.96	110	
78.12	210	
1503.35	220	
76.05	230	
17.40	240	
0.01	330	
0.27	340	
0.04	342	
0.10	343	
0.19	420	
0.15	421	
7.76	440	
0.29	442	
0.52	444	
34.04	520	
1.70	530	
11.21	540	
0.04	542	
17.00	620	
1.40	630	
12.88	720	
0.62	820	
0.73	821	
0.04	823	
0.26	830	
4.28	834	G1 components
71.39	950	Laidlaw
50.00	004	stockpile (reactor pit)
5397.84		does not include Laidlaw and stockpile volumes

IAEA Group	Total Vol Since June 95	% LILW	WIP-III Codes
LILW-SL	5210.89	96.90	001, 002, 110, 210, 220
LILW/LL	166.73	3.10	230, 240, 330, 420, 421, 520, 530, 620, 630, 720, 820, 821, 823, 830, 834
Spent Sources			included in LILW-SL and LILW-LL
Alpha (fuel fab)			included in LILW-LL
HLW (see note 2)	11.25		540, 542
Spent Fuel	8.97		340, 342, 343, 440, 442, 444 (incudes some unirradiated fuel)
Decomm			included in LILW-SL and LILW-LL
Mine/Mill Tailing			not applicable to AECL-CRL
	5397.84		

CRL Wastes (AECL-MISC-306-96)

Facility	1996 Inventory (m^3)
Area B - Bunker	11660.0
Area B - Tile	1155.7
Area C	87136.0
Area D (LLRWMO)	504.0
Area G (see note 1)	34.4
Total	100490.1

Note 1: 4921 bundles at nominal $0.007 m^3$/bundle
Note 2: mostly cemented Mo-99 waste

WL Wastes (AECL-MISC-377-96)

Waste	1996 Inventory (m^3)
LLW	19364
MLW	844.7
fuel (see note 1A)	15.9
Total	20224.6

Note 1A: 2268 bundles at nominal $0.007 m^3$/bundle

Appendix 2: Communications with CNL about the IWS

From: Greg Csullog < removed for privacy >
Subject: reminder of document requests
Date: April 10, 2017 at 10:14:12 AM EDT
To: Pat Quinn <Pat.Quinn@CNL.ca>
Cc: names removed for privacy

Hi Pat:

Please see my requests from Mar 21st and Apr 3rd.

Greg (removed for privacy)
We make a living by what we get - We make a life by what we give

==== Mar 21st request ====
Hi Pat:

The EIS for the NSDF states, "Canadian Nuclear Laboratories has developed an Integrated Waste Strategy (IWS) which concisely details "cradle to grave" pathways for all CNL waste streams, from generation to final disposition." Is there an IWS document available to read?

==== Apr 3rd request ====
Pat:

One of the documents cited in the EIS is "Performance Assessment for Near Surface Disposal Facility to support the Environmental Impact Statement", 232-509240-ASD-001, Revision R0. Document 232-509240-ASD-001 cites the following two documents in Section 4, NEAR SURFACE DISPOSAL FACILITY WASTE INVENTORY.

[4-3] NSDF Waste Forecast Analysis, 185-508600-REPT-014, 2016 September.
[4-4] Expected Waste Volumes for Near Surface Disposal Facility (NSDF), 232-508120-022-000, Revision 0, April 2016.

May I have copies of Ref 4-3 and 4-4 from document 232-509240-ASD-001?

Begin forwarded message:
From: Greg on G-Mail < removed for privacy >
Subject: Re: Request for reference material - Near Surface Disposal Facility Environmental Impact
Date: March 29, 2017 at 07:27:09 EDT
To: ">Communications" <commaecl@cnl.ca>
Cc: names removed for privacy

Hi Pat:

First, please note this e-mail is copied to a group of people with whom I have been discussing the EIS for the NSDF and to my contact at the CNSC. After sending you this e-mail, I will add it as an appendix to my comments on the EIS. For privacy, I will mask out the e-mail addresses of those CCd.

Regarding, "CNL is currently processing your request", for reference, my request follows:

The EIS for the NSDF states, "Canadian Nuclear Laboratories has developed an Integrated Waste Strategy (IWS) which concisely details "cradle to grave" pathways for all CNL waste streams, from generation to final disposition." Is there an IWS document available to read?

Due to a meeting in Vienna at the IAEA in early May, I have to complete my review of the EIS and submit my comments to the CNSC by the end of April. Having spent more time reviewing the EIS since requesting the IWS document, I feel that it is essential that I review the IWS document in order to effectively review the EIS. Not knowing the size or complexity of the IWS document, I believe that I need to receive it by April 14.

According to the EIS, the IWS is the basis of CNL's waste management strategy. However, the EIS indicates ***what*** CNL's strategy is but it provides essentially no detail ***how*** that strategy will be implemented. Clearly there are a variety of wastes and a variety of end points for those wastes. The EIS indicates that the right wastes will be put into the right facilities but provides little or no detail of the systems and mechanisms in place, or that will be in place, to achieve the strategy. The EIS almost reads like a request to operate a facility with a "trust us", we will show you how we will operate it later. It is hard to assess the environmental impact of a black box.

I see three scenarios regarding my request

1. My request is not fulfilled because CNL is unable to provide IWS documentation
2. My request if fulfilled but the IWS documentation does not adequately explain how CNL's waste management strategy will be implemented
3. My request is fulfilled and the IWS documentation adequately explains how CNL's waste management strategy will be implemented.

I am hoping for scenario 3.

Greg (from my iPad)
We make a living by what we get - We make a life by what we give
and as Tom Wilson said, ***"dig it til the sun goes down"***

On Mar 24, 2017, at 11:51, >Communications <commaecl@cnl.ca> wrote:

OFFICIAL USE ONLY / À USAGE EXCLUSIF
Hello, you are receiving this e-mail as follow-up to your request for reference material in support of the Near Surface Disposal Facility Environmental Impact statement.

Please note that provision of the reference documents is subject to prior review, and release is subject to the document classification etc. CNL is currently processing your request.

We understand that this request is in support of your review of the Draft Environmental Impact Statement and will move it along a quickly as possible.

CNL will be in contact with you via e-mail as materials become available.

Pat Quinn

Patrick Quinn
Director, Corporate Communications
Canadian Nuclear Laboratories
Pat.Quinn@CNL.ca
Tel. 613 584 8811 ext. 43417
<image003.png>