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Final submission from William Turner

Mémoire définitif de William Turner

In the Matter of the

À l'égard des

Canadian Nuclear Laboratories (CNL)

Laboratoires Nucléaires Canadiens (LNC)

Application from the CNL to amend its Chalk River Laboratories site licence to authorize the construction of a near surface disposal facility

Demande des LNC visant à modifier le permis du site des Laboratoires de Chalk River pour autoriser la construction d'une installation de gestion des déchets près de la surface

Commission Public Hearing
Part 2

Audience publique de la Commission
Partie 2

May and June 2022

Mai et juin 2022

Canada

Final Submission by W. Turner
Addressing CNL's Answers & Engineered Containment.

Submitted May 31, 2023

1 Summary

This report addresses the answers CNL provided [1] to the questions raised in my supplementary submission [2]. It also evaluates the link between "Characterization" and "Decision Making" (see my oral intervention [3]) with respect to "engineered containment" as described by Dr. Rowe in his report [4].

Sections 2 through 2.5 below (except for minor editorial revisions) includes a word-for-word copy of the answers CNL provided in their letter [1], and my responses to those answers. Although my supplementary submission [2] included requests for further information from both CNL and the CNSC staff, only those questions directed to CNL were answered [1]. Regrettably, CNL's answers failed to address several crucial safety issues, including but not limited to: abandonment, non-rad contaminants, intrusion by scavengers, and measurement uncertainties. That said, several questions were neglected. Furthermore, CNL did not address any issues raised in my written intervention [5]. Thus, CNL's answers are incomplete.

Section 3 below address the critical the link between "Characterization" and "Decision Making" [3, 5], This section specifically addresses Dr. Rowe's proposed "engineered containment" [4]. In summary, the results of "characterization" described by Dr. Rowe cannot support the 300-year "containment" required.

Consequently, approval of CNL's proposed "Near Surface Disposal Facility" would represent an undue risk to the health and safety of Canadians and the environment, contrary to the purpose of Canadian Environmental Assessment Act (CEAA 2012) and the Nuclear Safety and Control Act (NSCA). Hence, the Commission should refrain from granting approval to CNL's proposed facility.

NOTE: Unless indicated, the slide numbers below refer to the slides from my oral presentation [3].

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[1] Ms. N. LeBlanc, email to W. Turner, "*Responses to questions from your Near Surface Disposal Facility (NSDF) hearing intervention*", 2023-03-10. For CNL's Answers see the attached letter, Ms. S. Faught, letter to W. Turner, "*Re: Canadian Nuclear Laboratories' written response to questions contained in Mr. William Turner's intervention submitted as part of the Near Surface Disposal Facility public hearing process*", March 10, 2023. I assume the Commission has a copy of this email and letter.

[2] W. Turner, email to Interventions, "*Supplementary Questions*", June 2, 2022

[3] W. Turner, *Characterization and Decision Making*, CMD 22-H7.64A

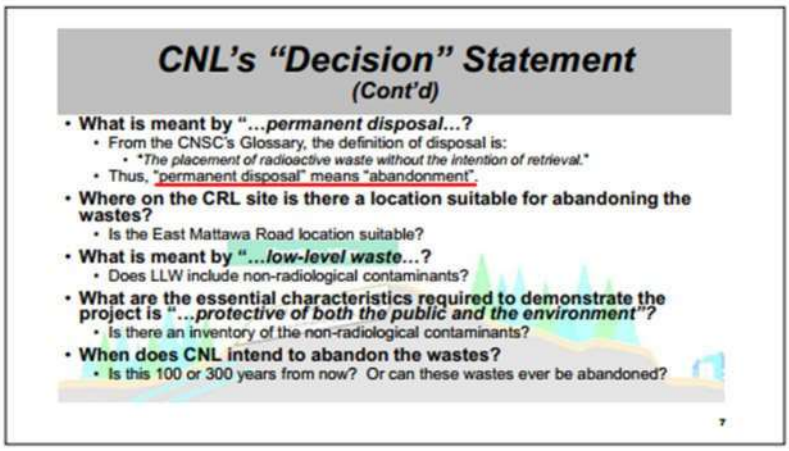
[4] Dr. Kerry Rowe, *Near Surface Disposal Facility Geomembrane Relative Performance Report*, 232-503212-REPT-024, Final, R. Kerry Rowe Inc., 28 February 2019

[5] W. Turner, *Characterization and Decision Making*, CMD 22-H7.64

2 CNL's Answers

2.1 Question 1 (Slide7)

I refer the Commission to Slide 7 in which 5 questions were asked. I would like answers to each of these questions from both CNL and the CNSC staff.



2.1.1 CNL's Answer

Permanent disposal means the wastes will be disposed of without the need for retrieval. Disposal does not mean abandonment. 'Disposal facility' implies that CNL will not be applying for a licence to abandon - which is why abandonment is not included as one of the phases of the Project. Institutional controls safeguard the facility for as long as required. CNL is committed to maintain monitoring, surveillance, and maintenance of the NSDF footprint for as long as required.

Atomic Energy Canada Limited (a federal Crown corporation and the owner of the land) is committed to enforcing land-use restrictions on the site for as long as necessary. This includes passive controls such as restrictions placed on the property-deed, and could extend to ensuring that monitoring and maintenance continue for as long as necessary.

2.1.2 Addressing Abandonment

The purpose of the NSCA is to limit "*…to a reasonable level …the risks to … the health and safety of persons and the environment that are associated with the development, production and use of nuclear energy…"* Only if CNL's facility is designed, sited, constructed and operated such that it can be released from regulatory control at some specified time in the future, will there be any assurance that the facility is safe over its entire lifecycle. Anything less presents an unacceptable risk.

Consider this quote from Table 8-1 from the report, "*Near Surface Disposal Facility Safety Case*" [6], under the column "*Modelled in the PostSA*", Row 2:

> *"The land-use restriction on the Facility (and all other Institutional Controls) are assumed to be lost at 300 years post-closure."*

If all controls are "…*lost at 300 years*…", then, *de facto*, CNL has set a 300-year timeline for the facility's release from regulatory control (i.e. abandonment).

Counter to CNL's assertion above that "…*abandonment is not included as one of the phases of the Project*…", consider the first bullet on Slide 8 [3]. According to Regulation SOR-2012-148, abandonment is one phase of a designated project under CEAA 2012. Thus, CNL's answer confirms that its EIS report [7] is incomplete.

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[6] CNL, *Near Surface Disposal Facility Safety Case*, Revision 2, 232-03610-SAR-001, January 2021

[7] CNL, *Environmental Impact Statement for the NSDF Project*; 232-509220-REPT-004, Revision 3, May 2021

2.1.3 CNL's Answer (Cont'd):

The definition of Low Level Waste does not include non-radiological contaminants. However, The Waste Acceptance Criteria (WAC) prohibits acceptance of hazardous non-radiological waste in the engineered containment mound (All waste placed in the ECM will meet the intent of land disposal and leachate requirements in O REG 347 for non-hazardous landfills). CNL will track non-radiological and radiological inventory of the NSDF.

2.1.4 Addressing "*The WAC prohibits the acceptance of hazardous non-radiological waste…*"

Consider this quote from WAC Section 4.2, *Key Constituents of Potential Concern* [8]:

"Key Constituents of Potential Concern (COPC) are chemicals of interest if CNL were to emplace the constituent at its maximum leachable concentration… The COPC were used for NSDF leachate modelling purposes and ***the total quantity of COPCs in the waste must be tracked****; therefore,* ***when the Key COPC*** *…****are present in the waste and/or are part of the waste container****, the concentration or quantity and the uncertainty shall be reported."* [emphasis added]

Apparently CNL's WAC **does** permit non-radiological hazardous wastes in the inventory destined for their Mound.

2.1.5 Addressing "*…the intent of … requirements in O Reg 347…*"

To quote from Page 297 from the May 30th transcript of the Part 2 hearing [9]:

MS. MURTHY: Kavita Murthy for the record.

So the fact that CNL is regulated under the Nuclear Safety and Control Act does not exempt CNL from having to abide by any other regulations that are appropriate. So to that end, Ontario regulations that apply to hazardous waste would be considered part of the regulatory criteria for them.

Thus, with respect to O Reg 347, CNL is required to meet the letter of the law, not just its "intent".

2.2 Question 2 (Slide 11)

CNL neglected to answer the following [2]:

This slide raises three issues with the criteria CNL used in their site selection process, technical and economic feasibility and safety. As stated, if any site were not technically or economically feasible or safe, there would be no project. As such these criteria are irrelevant.

Question for CNL and the CNSC staff: Please justify the use of these criteria in the site selection process.

2.3 Question 3 (Slides 20, 21 & 22)

Slides 20, 21 & 22 – Issue 2 – Non-Rad Contaminants. As discussed in Slide 20 and depicted in Slides 21 & 22, the concentration of two toxic metals, copper and lead, exceed the Canadian Soil Quality Criteria for Agricultural land use by several times. Further, the scrap value of the non-radiological contaminants is $33 million dollars. Both CNL and the CNSC conclude that the proposed mound "is unlikely to cause adverse environmental effects". Please justify this conclusion when the benchmark for these two metals exceed the CSQC by several times. The normal evolution safety scenario does not include an assessment of the dose to a scavenger even though the $33 million scrap value will result in an intentional intrusion by that scavenger. Please justify why this intentional intrusion is not included in the safety assessments.

[8] CNL, *Near Surface Disposal Facility Waste Acceptance Criteria*, 232-508600-WAC-003. Revision 4, November 2020.

[9] CNSC, *Draft-Transcript-Hearing-NSDF-May30-e*

2.3.1 CNL's Answer

The inventory of metals developed for NSDF is conservative in that it does not consider waste diversion options which CNL is committed to apply.

For example: The amount of copper that is found in Table 3.3.1-3 of the EIS is an estimated mass of copper piping associated with radioactively contaminated decommissioning and demolition debris. This represents a conservative estimate with the assumption that all the copper piping in buildings scheduled for decommissioning is radioactively contaminated and would have to be treated as radioactive waste.

2.3.2 Addressing Inventory of Metals As "conservative"

2.3.2.1 Definition

The CNSC defines "conservative calculations" as:

*"**Calculations that are designed to over-predict a parameter** with the intention that the reality will not be greater than the prediction."* [10] [emphasis added]

2.3.2.2 Waste Diversion Options

Since waste diversion activities are specifically designed to "under-predict", they do not meet the definition above.

However, implementing them raise EA issues. CEAA 2012 defines a designated project as:

*"… one or more physical activities that … includes **any physical activity that is incidental** to those physical activities."* [emphasis added]

Surely these *"…waste diversion options…*" are physical activities incidental to the designated project. Since CNL's EIS report does not assess the environmental effects of these activities [7], it is incomplete.

2.3.2.3 Radioactively Contaminated Metals

Since copper metal will never decay, treating the 3,520,000 kg of copper "…*as radioactive…"* is NOT a conservative assumption. Unless it is physically removed, it will remain in the Mound forever.

2.3.3 Addressing Justification for the EA Conclusion

Regretfully, CNL did not provide any justification for their EIS conclusion that their proposed Mound "*is unlikely to cause adverse environmental effects*". Both metals, copper and lead, will remain in the Mound forever at concentrations that exceed the Canadian Soil Quality Criteria by several times (see Slide 21).

2.3.4 CNL's Answer (Cont'd)

Inadvertent human intrusion is assessed in the Post-Closure Safety Assessment:

- borehole driller (acute exposure),

- Resident group builds a house with basement intersecting facility.

- Mass excavation: excavating + mixing wastes and barriers, depositing material to surface, using land for farming.

The Mass Excavation scenario evaluates the consequences of excavating and mixing all wastes and barriers, depositing the material on the surface, and using the land for farming.

Consequences to a scavenger would be bounded by these assessments. All dose exposure scenarios have been calculated to be below regulatory criteria.

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[10] CNSC, REGDOC-3.6, *Glossary of CNSC Terminology*, April 2021

2.3.5 Addressing "*Inadvertent human intrusion*"

Compare the list above with the following:

"…potential exposure groups for the Normal Evolution Scenario":
- *Resident/farmer*
- *Hunting/Recreational"* [11]

Note that the "mass excavation" scenario is included in the PostSA, but not the EIS [11]. Why? Consider this quote from the "Human Intrusion" Section of CMD 22-H7 [12]:

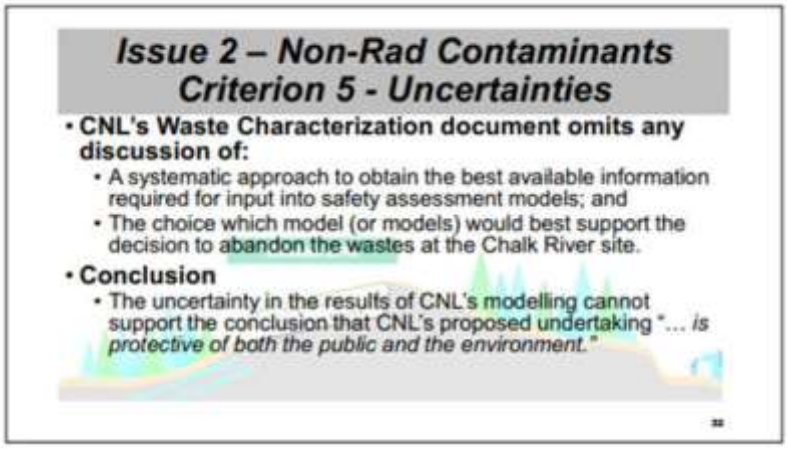
> *"CNSC staff submitted several comments to CNL regarding the human intrusion scenarios in the PCSA.* ***CNSC staff requested that CNL include mass excavation and archaeological dig human intrusion scenarios****…"* [emphasis added]

Since "mass evacuation" is essentially "*dilution is the solution to pollution*", it is clearly an "under-prediction" scenario (see Section 2.3.2.1 above).

Obviously, there is little difference between an "*…archaeological dig human…"* intrusion and that by a scavenger. Both intrusions have a goal to find something of value. Yet, counter to CNSC's request, neither CNL's PostSA nor their EIS report address these two scenarios.

2.4 Question 4 (Slide 32)

Slide 32 - Issue 2 – Non-Rad Contaminants Criterion 5 – Uncertainties. Please provide a description of CNL's systematic approach to addressing uncertainties in both models and measurement.



2.4.1 CNL's Answer

Section 6 of the NSDF Safety Case provides detailed information on the management of uncertainties.

2.4.2 Addressing NSDF Safety Case

Whether or not CNL's Safety Case [6] addresses uncertainties, this question addresses CNL's *Waste Characterization* report [13]. As stated on this slide, this document "*…omits any discussion of…*" a systematic approach to addressing uncertainties in measurement.

2.4.3 CNL's Answer (Cont'd)

The primary method of managing and addressing uncertainties in the Post-Closure Safety Assessment is to identify the key modelling parameters that impact the radiological consequence (dose)

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[11] See Section 5.8.6.1.1.3, *Receptor Selection*, from CNL's EIS report [7].

[12] CNSC, CMD 22-H7. 24 January 2022

[13] CNL, *Waste Characterization*, 232-508600-REPT-002, Revision 4, 2020 February

assessment, and to perform sensitivity analysis on these parameters. With the NSDF, the key uncertainties in the PostSA modelling are:

The actual emplaced radiological inventory at the time of closure.

The duration of institutional controls.

How quickly contaminants move through the groundwater and the environment.

The degradation rate of the engineered barriers.

The effect of climate change.

For the key uncertainties, Sensitivity Analyses were performed to determine the effect of each parameter on the final outcome. In all cases, the results of Sensitivity Analysis remained below acceptance criteria.

For other uncertainties in the modelling, conservative assumptions are used to increase confidence that the assessment is bounding, and demonstrates pessimistic outcomes.

2.4.4 Addressing Uncertainties in Characterization

The 5 key uncertainties listed in CNL's answer above are all related to the uncertainties in modeling. They do NOT address uncertainties in characterization/measurement.

Consider the quote from Section 4.2 of CNL's WAC provided in Section 2.1.4 above.

Apparently, for the non-radiological contaminants, all that is required is to report **the quantities and the uncertainties** when entering the Mound. Since there is no requirement that this information be available before these contaminants arrive, the data could not have been used in CNL's safety modeling. Therefore, for the non-radiological contaminants, all CNL's modeling results are pure guesswork.

2.4.5 CNL's Answer (Cont'd)

Moving forward, uncertainties will be managed by monitoring the Facility's performance during construction, closure, and post-closure periods. Observations, site investigations, and environmental sampling results will indicate if the Facility is performing as intended, and if the assumptions used in the modelling process are consistent with reality. Safety assessments may be updated to reflect current conditions and, if required, to further reduce uncertainty.

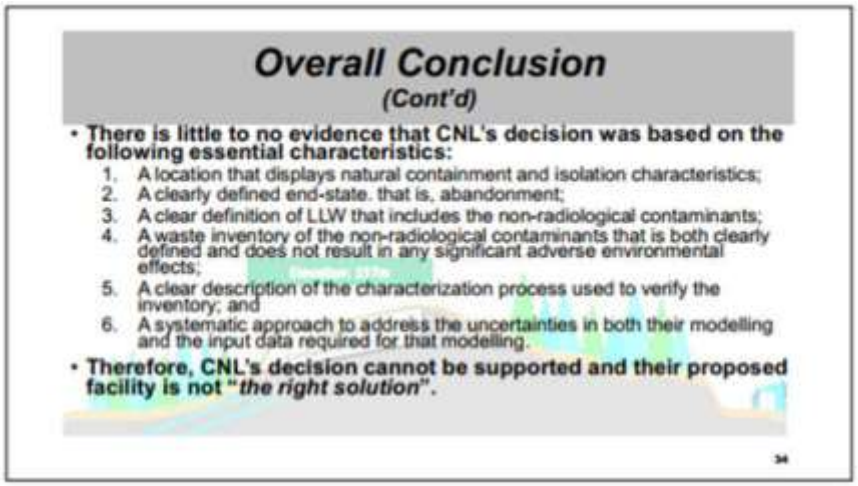
2.4.6 Addressing Monitoring to Verify Performance and Updating Safety Assessments

Suppose the verification monitoring shows that their facility is NOT "*…performing as intended…*", for example: a leak in the base liner. CNL's answer above suggests that the only action that **may be** required is to update their "*Safety assessments …to reflect current conditions…*" Surely this failure requires much more than a model update.

Regrettably, in a review of CNL's EIS [7], and their safety documents, I could find no information that an incident such as a base liner leak is addressed. Again, the EIS report is incomplete (see CEAA 2012, Section 19(1)(a)).

2.5 Question 5 (Slide 34)

Slide 34 – Overall Conclusion If CNL and/or the CNSC has evidence for these 6 essential characteristics, please provide that evidence. Otherwise, there is no link between characterisation and decision making, and the proposed undertaking cannot be supported.



2.5.1 CNL's Answer

1. Containment and isolation of the waste is achieved by the natural and synthetic components of the engineered containment mound. There is a primary liner and secondary liner. The secondary liner provides redundancy in the event of primary liner failure, and includes a combination of natural earthen materials and geosynthetic barrier systems. Control of contaminant migration from the ECM (retardation), is provided by the base liner system geosynthetic clay liners (GCLs) and the compacted clay liner (CCL), without any reliance on the underlying native soils and soil fill materials. The GCL's low hydraulic conductivity retards the flow of leachate in the event it passes the primary or secondary liner into the next sub-layer of the base liner system. The CCL's low hydraulic conductivity retards the flow of leachate into the geosphere. The base liner system has a total thickness of 2.05 m. The base liner system materials were selected based on their compatibility with the leachate characteristics in the ECM arising from the WAC, and required design service life. The multi-component cover system, which includes a general fill layer to provide gamma shielding, a coarse stone layer for mitigating intrusion of biota, and high density poly-ethylene and GCLs control the ingress of water into the ECM.

2.5.2 Addressing Natural Containment and Isolation Features

As can be seen in Figure 1, the Mound has no natural containment and isolation features. Moreover, as described above, the characteristics of the base-liner are "*synthetic*" not natural.

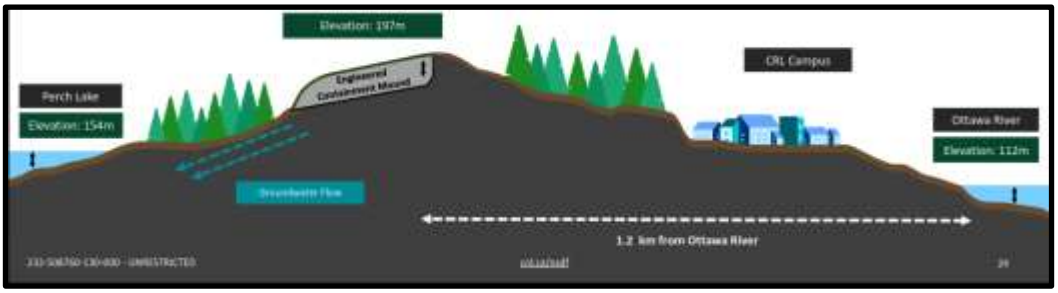


Figure 1: Depiction of the Mound Extracted from Slide 24 (CNL's CMD 22H7.1A)

2.5.3 CNL's Answer (Cont'd)

2. A disposal facility is the end-state of the NSDF. Institutional controls safeguard the facility for as long as required. CNL is committed to maintain monitoring, surveillance, and maintenance of the NSDF footprint as long as required.

2.5.4 Addressing End-state and Abandonment

See Section 2.1.2 above.

2.5.5 CNL's Answer (Cont'd)

3. Non-radiological contaminants are addressed in Section 3.3 of the EIS and the Waste Acceptance Criteria document.

2.5.6 Addressing Non-Rad Contaminants

See Section 2.1.4 above

2.5.7 CNL's Answer (Cont'd)

4. Hazardous waste will not be permitted for disposal in the NSDF. The chemical composition of all wastes placed in the ECM will meet requirements for land disposal and leachate requirements specified under Ontario Regulation 347.

2.5.8 Addressing Ontario Reg 347

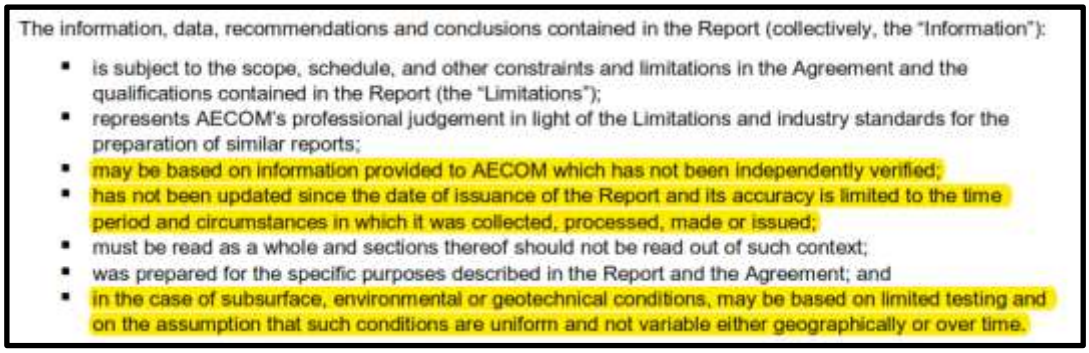
See Section 2.1.5 above

2.5.9 CNL's Answer (Cont'd)

5. All waste intended to be emplaced in the NSDF shall have sufficient characterization data to ensure compliance with the Waste Acceptance Criteria. CNL's waste characterization process ensures characterization plans are developed for waste streams according to the specific data objectives. Since the announcement of the NSDF Project, the Waste Programs department at CNL have revised their procedures and requirements for Waste Characterization of all waste streams. CNL has constructed a new Waste Characterization Facility (WCF). The WCF acts as a hub for waste characterization equipment and processes, thus supporting NSDF operations in the waste characterization requirements. Sample preparation and assay activities take place while also coordinating samples that are sent to other CNL and external laboratories.

2.5.10 Addressing Waste Characterization

CNL's answer above does not provide ""*A clear description of the characterization process used to verify the Inventory*". Furthermore, neither does CNL's Waste Characterization report, [13] (see Figure 2),



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- may be based on information provided to AECOM which has not been independently verified;
- has not been updated since the date of issuance of the Report and its accuracy is limited to the time period and circumstances in which it was collected, processed, made or issued;
- must be read as a whole and sections thereof should not be read out of such context;
- was prepared for the specific purposes described in the Report and the Agreement; and
- in the case of subsurface, environmental or geotechnical conditions, may be based on limited testing and on the assumption that such conditions are uniform and not variable either geographically or over time.

Figure 2: Statement of Qualifications and Limitations from CNL report [13]

2.5.11 CNL's Answer (Cont'd)

6. Section 6 of the NSDF Safety Case provides detailed information on the management of uncertainties, which is summarized above.

2.5.12 Addressing "*Uncertainties*"

Consider this list from Section 6 of CNL's Safety Case [6]:

- *"Uncertainties and confidence in the modelling and waste inventory.*
- *Confidence in the physical design of the Facility.*
- *Confidence in the site characteristics.*
- *Confidence in the assessment results.*
- *Natural analogues.*
- *The treatment of uncertainties and the use of sensitivity cases.*
- *Benchmarking and lessons learned from similar facilities.*
- *Third party reviews of key project documentation."*

Few, if any, of these items are based on conservative calculations (see Section 2.3.2.1 above).

Furthermore, nothing in this list provides a description of "*A systematic approach to address the uncertainties in both* ***their modelling and the input data*** *required for that modelling*." [emphasis added]

For a summary of the seven steps for developing a systematic plan to address measurement uncertainties, see Slide 30 [3].

3 Applying "*Characterization and Decision Making*" to Engineered Containment

While the focus of my oral presentation [3] was on CNL's site selection process and the non-radiological contaminants in the wastes CNL intends to dispose of in their Mound, there is a link between characterization (i.e. evidence) and a decision [5] (see Figure 3).

As generic concepts, they can be used to evaluate all decisions related to CNL's undertaking, including those related to "engineered containment".

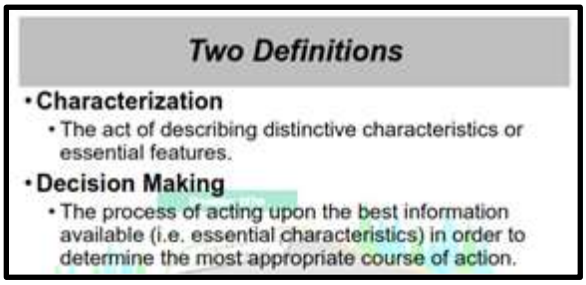


Figure 3: Two Definitions (Slide 4 from [5])

Virtually all CNL's documentation related to their proposed Mound disposal facility, including their website, media advertising, webinars and their presentations to the CNSC, the design life for the containment system is given as 550 years based on Dr. Rowe's report [4]. Because this design life is a critical safety feature of CNL's licence application, assessing Dr. Rowe's proposed "engineered containment" against these two definitions is essential to ensure his calculations are conservative (see Section 2.3.2.1 above).

The following evaluation was prompted by this quote from the transcript of Dr. Rowe's oral presentation (Page 176 from [14]):

> ***"MR. ROWE:*** *Hello? Yes. President Velshi and Commissioners, for the record my name is Kerry Rowe…* ***I also acted as an external reviewer of the NSDF area system and as a reviewer of the studies conducted at Queen's University by a colleague****."* [emphasis added]

I was a bit surprised by this assertion about his "reviewer" roles.

While Dr. Rowe's report makes reference to other studies conducted at Queen's University, its title page identifies Dr. Rowe as the only author and is copyrighted by R. Kerry Rowe Inc. (RKRI) [4].

[14] CNSC, *Draft-Transcript-Hearing-NSDF-May31-e.pdf*

The discrepancy between his opening statement (quoted above) and the title page of his report [4] is concerning. Inconsistencies of this nature suggested that the report itself may contain much more serious contradictions requiring a more detailed evaluation of the proposed containment.

Furthermore, the report itself contains no record that it was reviewed: externally, by CNL, and/or the CNSC staff.

Did anyone question whether his "decision" (i.e. the 550-year design life) could be supported by the "characteristics" described in his report [4] (see Figure 3)?

3.1 What is the "*Engineered Containment*" Decision?

Neither Dr. Rowe's oral intervention [15], his written intervention [16], nor his report [4], describes the 550-year design life "decision".

CNL's report, *Near Surface Disposal Facility Safety Case* [6], provides a description of the decision that Engineered Containment must last 300 years at which time the facility is effectively abandoned (see Section 2.1.2 above).

3.2 What are the Essential Characteristics Needed to Support the Decision?

Since the polymers that make up geomembranes were "invented" less than 100 years ago, historic information beyond that timeframe cannot exist. Therefore, we require evidence that either the current data can be extrapolated or there is new data which addresses the 300-year requirement.

Figure 4 (below) was extracted from the two page "*Statement of Qualifications and Limitations*" contained in his report [4]. Several statements are highlighted in yellow.

Consider the highlighted statements. To quote:

> *"The information …may be* ***based on information*** *provided to RKRI* ***which has not been independently verified***…"; and
>
> *"…is* ***based on limited testing*** *and …on the assumption that such conditions are uniform and not variable either spatially or over time…"*; and
>
> ***"RKRI shall be entitled to rely upon the accuracy and completeness of information that was provided to it and has no obligation to update such information***." [emphasis added]

Are any of these assertions "over-predictions" (see Section 2.3.2.1 above)?

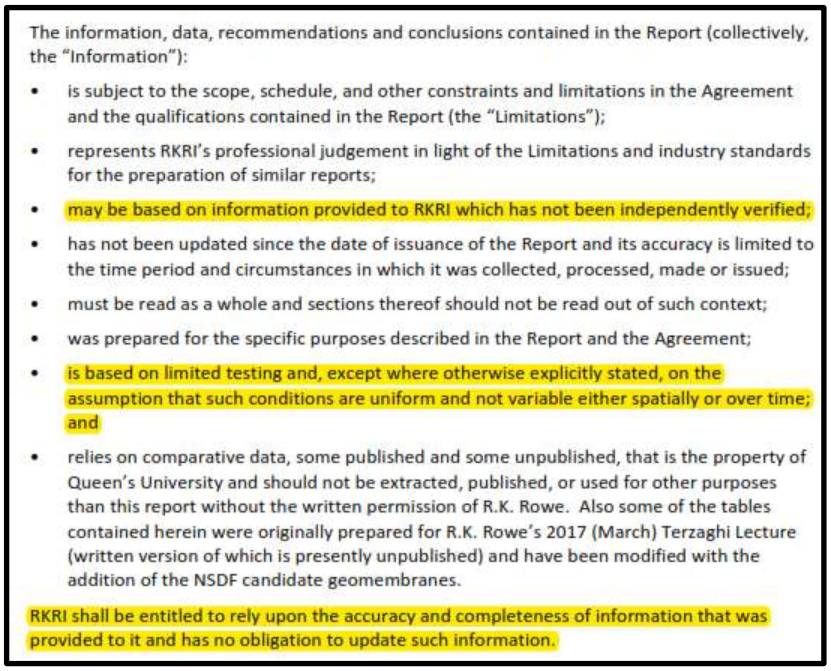
How do these assertions relate to any new evidence required to support the decision?

Since "*RKRI …has no obligation to update such information*", then without an update, the current evidence is unlikely to be the "best available". Without up-to-date knowledge, "*…the most appropriate course of action…*" cannot be determined (see Figure 3).

[15] Dr. Kerry Rowe, CMD 22-H7.60A

[16] Dr. Kerry Rowe, CMD 22-H7.60

For the sake of argument, let us assume that, whether or not this evidence was updated, it is the "best available".



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- must be read as a whole and sections thereof should not be read out of such context;
- was prepared for the specific purposes described in the Report and the Agreement;
- is based on limited testing and, except where otherwise explicitly stated, on the assumption that such conditions are uniform and not variable either spatially or over time; and
- relies on comparative data, some published and some unpublished, that is the property of Queen's University and should not be extracted, published, or used for other purposes than this report without the written permission of R.K. Rowe. Also some of the tables contained herein were originally prepared for R.K. Rowe's 2017 (March) Terzaghi Lecture (written version of which is presently unpublished) and have been modified with the addition of the NSDF candidate geomembranes.

RKRI shall be entitled to rely upon the accuracy and completeness of information that was provided to it and has no obligation to update such information.

Figure 4: Extract from Dr. Rowe's "Statement and Limitations" [4]

3.3 Does Dr. Rowe's "Best Available" Information Support the Decision?

Consider this quote from the "Executive Summary" of Dr. Rowe's report:

> *"This* Geomembrane Relative Performance Report *reviews and comments on the findings of the 9-16 months of data reported by Queen's (2018). It compares the five NSDF candidate GMBs with each other and with other comparator GMBs immersed in the same or comparable solutions. Based on this, an assessment is made of (a)* ***the relative performance*** *and the most suitable GMBs for the Near Surface Disposal Facility (NSDF)* ***based on the available 9-16 months of data,*** *and (b)* ***the likelihood of these GMBs having a service-life that exceeds the required 550 years design-life based on the projected long-term performance for these GMBs***." [4] [emphasis added]

Apparently the "*best available information*" is based on "*9-16 months of data*", with no additional evidence to support either "*…the likelihood…"* or "*…the projected long-term performance …*".

Furthermore, his report provides little to no discussion/explanation as to how to extrapolate the "*9-16 months of data*" to address "*…the likelihood…"* and "*…the projected long-term performance…*". As depicted in Table 1 below, in his report the terms "extrapolate", "extrapolated", and "extrapolation" occur 8 times, whereas the terms "predict", "predicted", and "prediction" occur 97 times [4].

In other words, his "*best available information*" is neither an "over-prediction" (see Section 2.3.2.1 above) nor sufficient to support the 300-year decision (see Section 3.1 above).

3.4 Did Dr. Rowe Use a Systematic Approach to Address Uncertainties?

Slide 30 of my oral presentation [3] lists seven steps in a systematic approach to address the uncertainties in measurement data. To determine whether Dr. Rowe used a systematic approach, I conducted a search of his report [4] on several terms related to measurement and uncertainty. Table 1 summarizes the results.

Table 1: Search Results

Search Term	***Hits***
error	0
measurement	5
uncertainty	6
"extrapolate", "extrapolated", and "extrapolation"	8
differences	12
opinion	20
"no evidence" and "no clear evidence"	24
variability	31
failure	33
expected	46
"estimate" and "estimated"	65
"predict", "predicted", and "prediction"	97

For a report that provides experimental results, one would expect to find detailed discussions on errors, differences, limits to measurement and uncertainties. Instead, as shown in Table 1, we find an overrepresentation of the terms, "opinion" through "predict", with over 200 hits for the last three terms.

Since all 200 hits describe assertions about liner performance, they cannot be "conservative calculations" (see Section 2.3.2.1 above).

Furthermore, consider this quote from line 832 of the report [4]:

> *In **the writer's opinion, the differences are within the normal range of uncertainty** for this type of test prior to depletion to residual at a number of temperatures **and the difference may not be an effect of radionuclides at all** …"* [emphasis added]

- Is *"…the normal range of uncertainty…"* acceptable over the 300 years? (See Section 3.3 above.)
- If *"…the difference may not be an effect of radionuclides…*", were tests done to determine whether these differences did result from the radionuclides?

Obviously, none of these assertions are "over-predictions" (see Section 2.3.2.1 above).

3.5 Using the Easiest Examples for Comparison

The following is the final exchange between the President and Dr. Rowe (Page 197 of [14]):

> ***"THE PRESIDENT**: Dr. Rowe you showed us a comparison with five other facilities in the United States. Did you look at any in Europe by any chance?*
>
> ***DR. ROWE**: I had a limited time for searching.*
>
> *I comparable type of facility in Europe. I'm not saying they don't exist, but I've quite frankly found the easiest ones I could and did the comparison.*
>
> ***THE PRESIDENT:** And based on Dr. Bart and the failure mechanism what is your thought about the ability to treat the waste?*
>
> ***DR. ROWE**: I'm sorry?*
>
> ***THE PRESIDENT:** The ability to treat the waste, you know, based on the leech rate.*
>
> *Is that a feature that would be advisable to have for the NSDF?*
>
> ***DR. ROWE**: I haven't thought about that.*
>
> *It's not normal to do that.*
>
> *I really haven't thought about it.*

I want to think further about it before I give an answer.

THE PRESIDENT*: If you think about the next few days and have a thought on it please do share it.*

I appreciate that."

Considering that, as discussed in Section 3 above, the safety case for CNL's proposed Mound is based on "engineered containment" (i.e. the geomembranes), his admission that he did not spend the time to consider European examples, and that he selected the easiest ones for comparison is unacceptable.

Obviously, selecting the *"…**easiest ones** …*[for] *comparison*", is an "under-prediction" (see Section 2.3.2.1 above).

4 Overall Conclusion

As discussed in Section 2 above, CNL failed to address the questions raised in my Supplementary Submission [2]. Moreover, as the RA under CEAA 2012, the Commission is responsible for the conduct of the EA. Since a licence under the NSCA requires a positive EA decision that the project "*…**is unlikely to cause adverse environmental effects**…*", the current licencing process cannot proceed until CNL addresses the gaps in their EIS [7] discussed in Sections 2.1.2, 2.3.2.2, 2.3.3, 2.3.5 and 2.4.6 above,

Consider Dr. Rowe's interventions [15, 16] and his report [4]. Virtually all of Dr. Rowe's "characterization" results are based on little to no evidence. Furthermore, as depicted in Figure 4, Dr. Rowe states he has no obligation to update that information if new data becomes available. Given the lack of evidence discussed in Sections 3.2 through 3.5 above, one cannot determine whether his predictions are conservative (see Section 2.3.2.1 above). Furthermore, there is little evidence that his "opinions" were independently reviewed (see Section 3 above), thus his predictions remain unverified. In other words, there is no evidence that Dr. Rowe's proposed liner will last 300 years, let alone the projected 550-year design life.

In conclusion, there is no evidence that CNL's proposed undertaking "*…**is unlikely to cause adverse environmental effects**…*" [7].

Therefore, contrary to the purpose of CEAA 2012, and the NSCA, the approval of CNL's proposed "Near Surface Disposal Facility" would represent an unreasonable risk to the health and safety of Canadians and the environment. Hence, the Commission should refrain from granting approval to CNL's proposed facility as currently designed.