Excerpts on uranium, thorium etc. from long version of Strange Lake Initial Project Description (IPD)

Important notes for understanding the contents of this document:

- The **page numbers** in the long version are mentioned before each excerpt.
- Excerpts are grouped by the **keyword** I used to find them.
- All text under the page numbers is text quoted directly from the long version of the IPD unless written in *italics*, in which case it is my summary note.
- I have highlighted in yellow certain parts of longer excerpts that seem especially pertinent. (Remember, I'm just quoting the text so you know what they're saying in the long version -- these are not my views!)

"Radioactivity" (11 mentions of this word in the long version)

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Table 4-1 provides a summary of the consultation activities conducted with Indigenous groups to date, as well as their main comments.

Table 4-1: Government agencies, Indigenous groups, and other stakeholders consulted since 2011 in Quebec

Summary comments from the Nunavik Inuit (Quebec) dated "2023 and ongoing" include this:
- Concerns regarding the radioactivity level and the potential contamination of the environment.

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(Table 4-1 info, continued).

Summary comments from the Nunatsiavut Inuit (Labrador) dated "2023 and ongoing" include this:
− Concerns about the level of radioactivity and the environment contamination

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10.5 Radionuclides

The radionuclides naturally found in the Strange Lake deposit are Thorium (Th-228, Th-230, Th-232) and Uranium (U-234, U-235, U-238). More precisely, natural thorium is practically exclusively Th-232, and a little amount of Th-230. Th-228 is a result of the disintegration of Th-232 in Ra-228 and Ra-228 in Th-228. All the descendants of Th-232 are emitting alpha and beta rays and some gamma rays. U-235 and U-238 are subject to complex disintegration chains (10 and 13 descendants of radionuclides) emitting alpha, beta, and gamma rays before reaching the stable forms of Lead-206 and 208.

However, these naturally occurring radioactive materials will not be modified at atomic level by either the concentration processes (beneficiation plant at mine site), the acid baking process or the hydrometallurgical process. Therefore, the natural radioactivity of these elements won't be modified by the processes. Because of their atomic characteristics, both Thorium (Th) and Uranium (U) will mostly follow the rare earth elements in the various processes. Based on a very preliminary mass balance, the

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https://www.ree.environnement.gouv.qc.ca/projet.asp?no_dossier=3211-14-043

https://www.environnement.gouv.qc.ca/evaluations/directive-etude-impact/directive-realisation-etude-impact.pdf

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https://lenord-cotier.com/2014/05/05/mine-duranium-la-sante-publique-constate-le-manque-de-donnees-disponibles/

Titre

EXTRAITS DU RAPPORT DU GROUPE DE TRAVAIL DE LA DIRECTION DE SANTÉ PUBLIQUE DE LA CÔTE-NORD SUR LES MINES D'URANIUM (25 AOÛT 2014)

Rapport préparé sous la direction de Dr. Raynald Cloutier
http://www.agencesante09.gouv.qc.ca/Document.aspx?id=1195&lang=FR

ENVIRONNEMENT :

« …il est démontré que la **contamination environnementale** provenant d'un site d'exploitation uranifère peut s'étendre sur des distances importantes » (22)

« ...le groupe de travail émet de **sérieuses réserves** concernant la durée des suivis environnementaux et la capacité d'en mesurer les impacts à long terme. Il en est de même pour la gestion des résidus miniers et du déclassement des sites miniers, surtout lorsqu'on considère que **ces résidus resteront contaminés pour plusieurs milliers d'années** » (12)

« Ceci se traduit par une autre préoccupation soulevée par le groupe de travail sur la capacité des organismes réglementaires et gouvernementaux à **garantir à très long terme la sécurité des sites de résidus miniers**, et ce, si on considère que par le passé plusieurs sites ont été abandonnés et laissés aux soins des gouvernements, alors qu'en sera-t-il dans plusieurs milliers d'années ? » (12)

« Toute la question de la **restauration des sites d'exploration** fait [aussi] partie de la problématique de l'uranium... On se questionne sur le comportement de certaines compagnies à ce chapitre et de la capacité des organismes réglementaires à appliquer les lois et règlements actuels à les ramener à l'ordre. Ceci constitue une préoccupation importante pour laquelle **les réponses demeurent encore floues.**" (7)

« Que le **bruit de fond en radionucléides** soit établi de façon précise avant toute exploration uranifère » (22)

« Malgré toutes les dispositions techniques et légales mises en oeuvre, on peut néanmoins admettre que les mines d'uranium, même les plus modernes, ne sont pas à l'abri de défaillances. » (39)

RADIOACTIVITÉ

« La principale préoccupation environnementale reliée aux **mines d'uranium et à ses résidus** demeure la **dispersion de radionucléides…** Ces contaminants radiologiques et chimiques peuvent représenter… un risque pour la santé physique lorsqu'une population y est exposée...» (35)

« La désintégration [radioactive du Thorium 230], que l'on retrouve en abondance dans les rejets des usines de traitement du minerai, engendre au sein du dépôt de résidus la production de radioisotopes fils (226Ra et 222Rn), qui… sont susceptibles de se disperser ... dans tout le dépôt ainsi que dans l'environnement » (38)

SANTÉ :

« Le rapport de l'Institut national de santé publique du Québec met en évidence **la faiblesse ou l'absence d'étude pouvant conclure ou exclure** à un excès de cancers dans la population en lien avec la présence d'une mine d'uranium […] Conséquemment, **le groupe de travail considère que cette situation justifie la poursuite de recherche** tant auprès des populations résidant à proximité des mines actuellement en opération, que de celles ayant cessé leur exploitation » (18)

https://ici.radio-canada.ca/nouvelle/681654/cote-nord-uranium-rapport?partageApp=rcca_appmobile_appinfo_android

https://voute.bape.gouv.qc.ca/dl/?id=00000058847

https://labs.letemps.ch/interactive/2023/groenland/articles.php?url=au-groenland-la-guerre-froide-des-terres-rares

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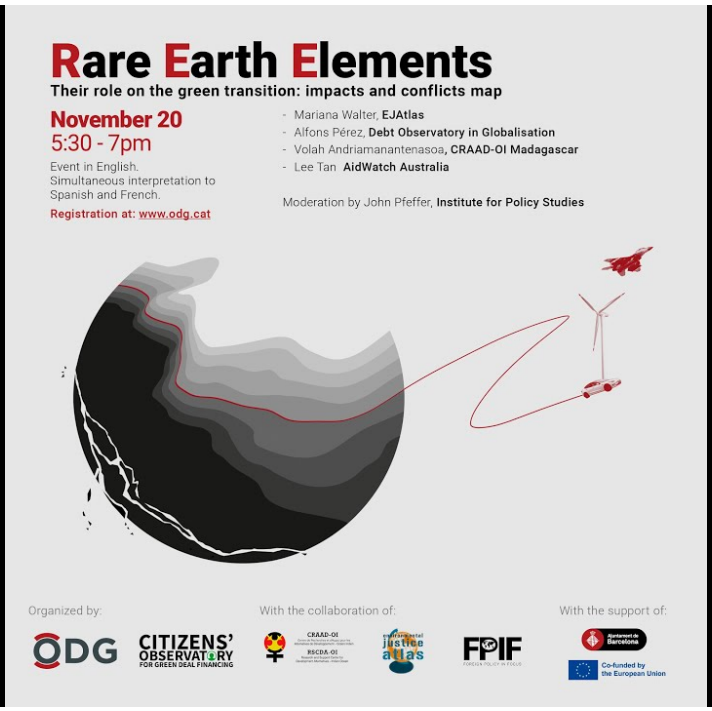

....NCC believes it is essential for governments to be cautious with presumptions about the degree to which advancing toward a net-zero future will increase the demand for critical minerals. We say this for several reasons.

First, with respect to electric vehicles (EVs), a recently published (June 2023) global survey found that more than 25% of mobility users in big cities are considering using shared mobility options[1] rather than private vehicles (e.g., ride-sharing, car-share systems like Canada's CommunAuto,[2] bike-sharing, etc.). This could impact EV sales. Thus, close attention to studies and trends like these is essential in relation to presumptions about demand for critical minerals from the electric vehicle sector.

Second, recognizing that electric car batteries have outsized carbon footprints – in large part due to the mining of the minerals required – automakers and their allies are in a race to decarbonize the car battery, which means that more sustainable innovations are currently under study.[3] This could potentially affect demand for critical minerals in relation to EV batteries.

Third, new innovations are underway that utilize artificial intelligence-based platforms to discover new, more sustainable battery chemistries, in addition to improving battery performance and accelerating battery development. The use of AI to discover more sustainable materials for EV batteries could potentially impact demand for critical minerals. As an example, one California tech startup named Chemix has already begun development on EV batteries that could potentially reduce reliance on critical minerals such as cobalt, lithium, and nickel.[4]

[1] SmartCities Dive, “Growing shared mobility use likely to disrupt urban transportation, private car ownership”, June 30, 2023, https://www.smartcitiesdive.com/news/shared-mobility-disrupt-urban-transportation-cities/654333/.
[2] https://communauto.com/?lang=en. Communauto service is available in Quebec, Ontario, Nova Scotia and Alberta.
[3] McKinsey & Company, “The race to decarbonize electric vehicle batteries”, February 23, 2023, https://www.mckinsey.com/industries/automotive-and-assembly/our-insights/the-race-to-decarbonize-electric-vehicle-batteries. This article notes that production of a typical EV (with a 75-kWh battery pack) emits more than seven tons of CO_2e emissions just from the battery alone.
[4] Ed Garsten, “New Chemix AI-Based EV Battery Development Reduces or Eliminates Cobalt”, *Forbes*, May 2, 2023, https://www.forbes.com/sites/edgarsten/2023/05/02/new-chemix-ai-based-ev-battery-development-reduces-or-eliminates-cobalt/?sh=4eff6d722ae4.

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Uranium Mining: Interview with Dr. Gordon Edwards. Part 2. (Interview from 2014)

Anne Albinus: Danish experts Gert Asmund and Violeta Hansen from the Danish Center for Environment and Energy University of Aarhus have mentioned to me that Cluff Lake is a good example of uranium mining remediation. Do you agree?

Gordon Edwards:

It is much too early to determine the long-term success or failure of remediation efforts at Cluff Lake. There has already been one spectacular failure at that site, and there may be more to come.

The Cluff Lake mine operated for 22 years, from 1980 to 2002. It was the first completely non-military uranium mine in Canada, and the first of a new batch of high-grade uranium mines developed around the rim of the Athabasca Basin, in a remote part of Northern Saskatchewan, far removed from population centres.

A few decades earlier, over five dozen lower-grade uranium mines had operated in an unregulated fashion near the northernmost border of the province, at a place called Uranium City. Starting out as a tent city, it later developed into a thriving mining town – but it is now largely deserted. The population crashed when the mines shut down in 1982. Extensive radioactive contamination occurred at Uranium City because huge volumes of uranium wastes were dumped into surface waters and were scattered far and wide by wind and rain. Hundreds of millions of dollars are currently being spent in an attempt to remediate some 67 abandoned uranium mining and milling sites, most in the vicinity of Uranium City.

In 1977 the Government of Saskatchewan established the Cluff Lake Board of Inquiry into Uranium Mining (also known as the Bayda Inquiry) to determine under what conditions, if any, the newly discovered rich deposits of uranium at Cluff Lake and elsewhere in the Athabasca Basin could be mined in an environmentally acceptable manner. The mining company assured the Board that the most radioactive wastes from the Cluff Lake ore would be safely isolated using an advanced engineering concept. The richest uranium tailings would not be dumped into the environment or flushed into “tailings lagoons” behind earthen

dams, as they were at Elliot Lake in Ontario. Instead, these wastes would be placed in thick-walled concrete vaults designed to last for 100 years or more. The walls of these vaults would be lined inside and out with an impermeable membrane to prevent radon gas from escaping into the atmosphere and to minimize leakage of radionuclides into surface water and/or groundwater. The vaults would be positioned above the water table and below the frost line, to minimize the ravages of extreme weather. Each vault would be surrounded by one or two metres of sand and gravel for extra protection, and to further attenuate radioactive releases. Equipment would be installed to monitor the drainage runoff from the vaults on a regular basis with treatment to remove radioactive contaminants as needed.

On the basis of this testimony, the Cluff Lake Board of Inquiry's Final Report in 1978 recommended that the Cluff Lake mine be allowed to proceed. And indeed, the mining company did build hundreds of concrete vaults to contain the most radioactive tailings. (1) Originally the vaults were stored in a large warehouse but the gamma radiation levels became so high and were so dangerous for the workers that they had to move the vaults outside onto an elevated concrete pad. They were simply stacked on top of each other, as shown in the photo below.

Before long, dozens of these vaults were cracked and leaking – as seen in the photo. Due to faulty preparation, winter freezing and thawing, and heaving of the ground, many of the vaults tipped over; the tailings inside spilled onto the ground and flowed downhill from the elevated knoll where the concrete pad was situated.

The advanced engineering concept put forward by the proponent and endorsed by the Cluff Lake Board of Inquiry had become an abysmal failure – a fiasco. Neither the mining company, nor the Saskatchewan Department of the Environment, nor the Canadian Nuclear Safety Commission, would release any public information on how the problem of the leaking vaults was being dealt with. It took a private citizen, Maisie Shiell, who persisted and finally got information from Washington, DC, using the USA Freedom of Information Act. She discovered that the " leaking vault" problem was "solved" by the company by simply recycling all the radioactive tailings stored in the vaults through the mill once again with the excuse of extracting any residual gold that might remain in the tailings. Then the residues were simply dumped into the tailings lagoon – thereby doing what the company had assured the Board of Inquiry they would never do. To the best of my knowledge, the vaults were also dumped into the lagoon; presumably, they are still there and are likely still leaking. These structures, designed to last for one or two centuries, did not survive for a decade. Dozens were leaking within five years. Meanwhile, the radioactive tailings are known to remain hazardous for millennia.

The Cluff Lake experience is troubling. It illustrates just how wrong the mining companies and regulatory authorities can be when confronted with such a daunting task – keeping radioactive sand out of the environment for hundreds of thousands of years.

It also shows how easily a public body like the Cluff Lake Board of Inquiry can be misled by empty promises. And how unwilling authorities are to acknowledge or document their mistakes.

It is revealing that the 2003 Comprehensive Study Report on the Cluff Lake Decommissioning Project by **the Canadian Nuclear**

Safety Commission, makes no mention whatsoever of these specially engineered but ill-fated vaults promised by the proponent in 1977. The story is not even found in section 2.4 of the CNSC Report, entitled *"Site History".*

The Danish experts that you refer to in your question may be unaware of the history of the radioactive tailings vaults at Cluff Lake because the CNSC has been careful to erase that history from its documents. Indeed, the lack of independence and lack of objectivity of the Canadian nuclear regulatory agency have been pointed out on numerous occasions. It is important to recall that the Government of Canada created the Canadian uranium industry and the Canadian nuclear reactor industry as outgrowths of its direct involvement in the WWII Atomic Bomb Project. The Canadian government has been directly involved in the sales of nuclear reactors and uranium to other countries – sales measured in the hundreds of millions of dollars. In 2008, the Canadian Government fired Linda Keen, the President of the Canadian Nuclear Safety Commission, simply because she tried to enforce the safety requirements that were clearly laid down in the licencing documents for a nuclear reactor at Chalk River Ontario. In doing so, the Government seriously compromised the independence of the regulatory agency.

The Canadian Government has spent billions of dollars supporting, promoting and defending uranium mining and nuclear power. Prime Minister Pierre Elliot Trudeau, the father of our current Prime Minister, Justin Trudeau, even spearheaded an illegal international price-fixing cartel in order to boost the price of Canadian uranium. It is not surprising then that similar attitudes aimed at defending and promoting the nuclear enterprise in Canada, including uranium mining, are to be found in the Government-appointed regulatory body. Back in 1980, when the Cluff Lake mine was just starting up, the British Columbia Medical Association published a 400-page report entitled *Health Dangers*

of Uranium Mining, stating that the Canadian nuclear agency was “Not Fit To Regulate” uranium mining (Chapter 22). That report contributed to the BC Government’s decision to ban uranium mining from the province.

Last year, in July 2015, the President of the CNSC wrote a letter to the Minister of Environment of Quebec denouncing the recommendations and conclusions of a report on uranium mining issued by a provincial environmental assessment panel after a year of public hearings. In his letter, the CNSC President rejected the report's suggestion that uranium mining could pose serious safety challenges. It is highly irregular for any licensing agency to intervene in such a way at the political decision making level. Quebec currently has a moratorium on uranium mining in the province, and is considering whether to ban uranium mining permanently, as has been done in British Columbia and Nova Scotia.

In the USA, the Commonwealth of Virgina has maintained a moratorium on uranium mining since 1982. Under pressure to lift that moratorium, the Government of Virginia asked the US National Academy of Sciences to conduct an inquiry into the potential adverse impacts of uranium mining in Virginia. The NAS Committee charged with conducting that inquiry included a review of uranium mining practices in Saskatchewan, with particular emphasis on the Cluff Lake decommissioning. In that context, the 2012 NAS report (2), *Uranium Mining in Virginia*, was not based solely on documents of the CNSC. The Committee spent four days in Saskatchewan in June 2011, visiting various mine sites and holding a series of meetings – some closed, some open – in which the Committee directly interacted with representatives from the mining companies, the Canadian Nuclear Safety Commission, several Saskatchewan government departments, the Canadian Environmental Law Association, Saskatchewan health authorities, distinguished academic experts in geology and mining engineering, and members of the general public. **Based**

on that experience, the Committee reported a number of important reservations about the long-term safety of the Cluff Lake Decommissioning work.

You may want to ask the Danish experts that you cite in your question whether they have undertaken a similarly detailed review of the Cluff Lake situation before formulating their expert opinion on the matter. Did they visit the Cluff Lake site and interview local residents and other stakeholders?

The Cluff Lake mine only operated for two decades. The hazards and the need for monitoring will persist essentially forever. It must be remembered that the greatest environmental difficulties often arise long after the mine site has been abandoned. As the National Academy of Science Report says:

***"Tailings disposal sites represent potential sources of contamination for thousands of years**, and the long-term risks remain poorly defined. Although significant improvements have been made in recent years to tailings management engineering and designs to isolate mine waste from the environment, limited data exist to confirm the long-term effectiveness of uranium tailings management facilities that have been designed and constructed according to modern best practices.*

***"Significant potential environmental risks are associated with extreme natural events and failures in management** practices. Extreme natural events (e.g., hurricanes, earthquakes, intense rainfall events, drought) have the potential to lead to the release of contaminants if facilities are not designed and constructed to withstand such an event, or fail to perform as designed."*

References

1) Excerpts from the 1978 Final Report of the Cluff Lake Board of Inquiry dealing with those concrete vaults: Section 7 of Chapter 2 is titled 'Waste Disposal'. Sub-section 7(a) discusses the concrete vaults.

2) Box 61. Cluff Lake Decommissioning Project
[Excerpted from pages 185-187 of the 2012 NAS Report " Uranium Mining in Virginia".]

3) Letter written by the President of the CNSC to the Quebec government:
http://ccnr.org/Binder_Letter_BAPE_July_2015_e.pdf

4) Gordon Edwards' letter of February 22, 2016, regarding misinformation provided by the CNSC to the Quebec Government:
http://ccnr.org/CCNR_CNSC_BAPE_2016.pdf

The automakers and suppliers pushing to cut rare earths from EVs

Reuters
November 14, 2023

LONDON, Nov 14 (Reuters) - A growing number of automakers and suppliers are working on electric vehicle (EV) motors that either do not contain rare earths or dramatically reduce the use of materials that are dominated by China.
Here is a list of some of the products automakers and suppliers are working on or have completed as part of this process:
TESLA (TSLA.O)
Tesla initially used induction motors without rare earth permanent magnets, but switched to a permanent magnet motor for the mass-market Model 3 in 2017.
The world's largest EV maker said earlier this year that it has cut heavy rare earths by 25% per vehicle and aims to go rare-earth free in its next-generation EV models.
BMW (BMWG.DE)
BMW uses no rare earth permanent magnets today and has developed a magnet-free externally excited synchronous machine (EESM), which generates a

magnetic field using electric current, that will be included in all of its next-generation EVs.

GENERAL MOTORS (GM.N)
The No. 1 U.S. automaker says it is "exploring options to limit or potentially eliminate rare earth materials in EV motors."
The company has also just invested in Niron Magnetics, a startup developing permanent magnets without rare earths, alongside rival automaker Stellantis (STLAM.MI). Volvo Cars (VOLCARb.ST) is also an investor in Niron.
BORGWARNER (BWA.N)
The U.S. supplier already has an EV motor in production that has reduced heavy rare earth content. The company also has an EV motor in development that is rare earth free.

JAGUAR LAND ROVER (JLR)
The luxury unit of Tata Motors (TAMO.NS) is exploring using two motors on its next-generation EVs, one with rare earths and one without, to reduce its rare earth content per vehicle.
ZF (ZFF.UL)
German supplier ZF has developed an EESM EV motor that could be in production in two years. The company is in talks to supply European, U.S. and Chinese automakers.
VITESCO (VTSCn.DE)
German supplier Vitesco previously produced an EESM EV motor for Renault (RENA.PA) and has developed a new version that should be on the market in 2026.

The company is also working on rare earth free permanent magnets.
RENAULT
Renault used a Vitesco EESM EV motor in its Zoe and Kangoo models from 2011 to 2019 and is working on a rare-earth free EV motor with Valeo (VLOF.PA) that should go into production in 2027. A Renault spokesperson said "things continue to progress well" in the joint project.
NISSAN (7201.T)
Nissan has developed an EESM EV motor for its Ariya crossover and is pursuing a dual strategy of EESM motors and gradually cutting rare earths out of permanent magnet motors.
MERCEDES-BENZ (MBGn.DE)
Mercedes has reduced the heavy rare earth content in its next-generation MMA EV platform to "close to 0%." The German premium automaker says it aims to remove heavy rare earth content entirely.

TOYOTA (7203.T)
Toyota is working on a permanent magnet with a 50% reduction in neodymium, a heavy rare earth.
BENTLEY
The luxury British unit of Volkswagen (VOWG_p.DE) has been researching a motor with rare-earth free magnets and the automaker said it remains "very much committed" to the project.
MARELLI
Auto parts maker Marelli, owned by U.S. fund KKR (KKR.N), says it is "exploring the use of alternative materials for electric motors to meet (automakers') requirements for magnet-free motors," including "evaluating" EESM motors.
EuroGroup Laminations (EGLA.MI) Electric motor component maker EuroGroup Laminations is working on both rare earth free permanent magnet motors and motors with limited rare earth content for automaker customers
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Reporting By Nick Carey; Editing by Sharon Singleton

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Aerial survey of the GRCH July 2022

Department of Fisheries, Forestry and Agriculture of Newfoundland and Labrador

in collaboration with:

Direction de la gestion de la faune du Nord-du-Québec

2022/10/25