The anachronistic proposal for a wet tailings disposal scheme at the Kvanefjeld (Kuannersuit) rare earths / uranium mine in Greenland

Peter Diehl Feb. 11, 2021

In the Environmental Impact Assessment (EIA) for its Kvanefjeld (Kuannersuit) mine project [GML_2020], Greenland Minerals Ltd (GML) presents its decision to select a wet disposal scheme for the tailings arising from the planned processing of local ores for their rare-earths and uranium contents. The tailings, moreover, are to be covered by a water layer in the long term.

This proposal is absolutely anachronistic, given the troubling history of major tailings dam failures, as documented in [WUP_2021] and [WMTF_2021]: wet-disposed tailings are mechanically unstable and tailings dams holding them are subject to sudden failure, often causing serious destruction and loss of lives.
Moreover, wet disposal presents a long-term seepage problem - the proposed geosynthetic membrane liner is only useful in the short term. The seepage problem is aggravated by the proposed use of water rather than soil as a permanent cover over the tailings. And, it remains unclear, how the water cover is to be maintained in the long term.

In the aftermath of the Mount Polley tailings dam failure in British Columbia, Canada, in 2014, the independent expert panel investigating the causes of the failure made clear that this practice must come to an end: "... the Panel firmly rejects any notion that business as usual can continue" [MPRP_2015].
The panel defined a number of principles for best available technology (BAT) in tailings disposal, including dry compacted disposal and no water cover.

GML's wet tailings disposal scheme is diametrically opposed to these best available technology principles.
While in a consultant's report prepared for the company [AMEC_2018], the expert panel report was used in the discussion of the failure mechanism leading to the Mount Polley disaster, neither the consultant, nor GML, did take the BAT principles laid down by the panel into account.

The reason for not selecting dry tailings deposition given by GML in the EIA are possible radioactive dust emissions that may arise during the disposal process, while not all of the tailings have been covered yet.
Oddly enough though, there is no data presented to support the decision, nor any discussion of options for dust suppression during the disposal process.

The *environmental risk assessment* [AMEC_2018] prepared by a consultant for GML comes to the conclusion that the risks from wet and dry tailings disposal are almost equal, with a slight advantage for dry tailings disposal, if any – so no advantage for wet disposal, at least. But anyway, as the details of this comparison are not reported, the significance of its outcome remains unclear.

The *feasibility study* [AMEC_2017] prepared by a consultant for GML comes to the following conclusion:
"Due to the expected high costs associated with the development of a dewatering plant, and environmental impacts (radon/thoron exhalation from desiccated tailings) the development of a filter cake deposition scheme [i.e. dry disposal] is not considered an optimum tailings management arrangement at this time."

This leads us to the real reason for the rejection of a dry tailings disposal scheme: *cost*. In the EIA, however, this aspect is not mentioned at all.

The EIA rather presents the possible emission of radioactive dust as the only reason for not selecting dry deposition, while the consultant's feasibility study refers to the emission of the radioactive gases radon and thoron, but does not mention dust at all.

Radon (i.e. Radon-222) is a radioactive gas emitted from materials containing uranium, while thoron (i.e. Radon-220) is a radioactive gas emitted from materials containing thorium. Since the Kvanefjeld ore contains both uranium and thorium, both of these gases are present here and actually constitute an inhalation hazard. Earthen covers limit the radon and thoron release in the long term, but solutions also exist to reduce the hazard during disposal already.

The problem can be dealt with by limiting the exposed surface area of the tailings during deposition. The U.S. Environmental Protection Agency (EPA) has even made this a *mandatory requirement*: new uranium mill tailings deposits can only be built, if the exposed area during deposition is limited to 16 hectares for wet disposal, or 4 hectares for dry disposal. The U.S. EPA first established this standard in 1989 [EPA_1989], and last revised it in 2017 [EPA_2017]; technical background information can be found in [EPA_1986].

So, other than the EIA suggests, there are no obstacles to a safer dry tailings disposal scheme at Kvanefjeld – except for cost.

Epilogue

Unfortunately, this is an example confirming the concern at how this EIA was prepared, as raised by geologist Ole Christiansen [Sermitsiaq_2021a]:
"I think overall that it is problematic that it is the mining company that leads the way in the statement [EIA], and not an independent consultant. I am aware that independent consultants such as Orbicon and GHD have prepared parts of the report, but the company has been responsible for the merger, and thus the report loses some of its credibility. Because when you put the wolf to guard musk oxen, there is a risk that it does not go as planned, says Ole Christiansen."

REFERENCES

[WUP_2021] Chronology of major tailings dam failures
http://www.wise-uranium.org/mdaf.html

[WMTF_2021] World Mine Tailings Failures
https://worldminetailingsfailures.org/

[GML_2020] Kvanefjeld Project, Environmental Impact Assessment
Greenland Minerals Ltd, 13 December 2020
https://naalakkersuisut.gl/~/media/Nanoq/Files/Hearings/2020/1812_kuannersuit/Documents/EIA%20ENG.pdf

5. Project Alternatives
5.6 Tailings management alternatives p. 91 (p.109 of PDF)
Dry tailings deposition - Filter cake p.97 (p.115 of PDF)
[...] "Under this deposition methodology, a stack or heap of Cake cannot be sequentially covered with earth-fill without sterilising a portion of the capacity of the facility. As a consequence, during the Project's operations phase, the stack or heap would be prone to desiccation and dust emissions unless alternative dust suppression technologies were installed. If dust were to be generated it could be an additional source of radioactive emissions. For these reasons, dry tailings storage was not considered to be the most appropriate technology during the operations phase."

[AMEC_2018] Kvanefjeld Project, TSF Environmental Risk Assessment, Tailings Disposal and Closure Cover Options
Amec Foster Wheeler, January 2018
[72] Wood Group_2018_TSF Env Risk assessment
https://ggg.app.box.com/s/gd6asiwu181v9lned9pmqi4wk8bc8hkr/file/748485713309

4. COMPARATIVE ANALYSIS KVANEFJELD VS RECENT TSF FAILURES p.41 (p.47 of PDF)
4.1 TAILINGS EMBANKMENT DESIGN - MOUNT POLLEY AND SAMARCO FUNDÃO DAM BREACH
[…]
6. CONCLUSION p.48 (p.54 of PDF)
"Of the 12 risks identified for the wet tailings deposition, four were ranked as Moderate and the remaining eight were ranked as Low. For the dry tailings deposition option, a total of 10 risks were identified, with four ranked as Moderate and the remaining six were ranked as Low."

[AMEC_2017] Flotation Tailings and Chemical Residue Storage Facilities Feasibility Study, Kvanefjeld Rare Earth and Uranium Project, Greenland
Amec Foster Wheeler Earth & Environmental (UK) Ltd., June 2017
[1] AMEC_2017_FTSF and CRSF FS
https://ggg.app.box.com/s/gd6asiwu181v9lned9pmqi4wk8bc8hkr/file/748056420351

APPENDIX B - FTSF and CRSF Site Option Review
3.0 TAILINGS DELIVERY OPTIONS
3.4 Filter Cake Disposal p. 3-11 (p.86 of PDF)
"Due to the expected high costs associated with the development of a dewatering plant, and environmental impacts (radon/thoron exhalation from desiccated tailings) the development of a filter cake deposition scheme is not considered an optimum tailings management arrangement at this time."

[MPRP_2015] Report on Mount Polley Tailings Storage Facility Breach
Independent Expert Engineering Investigation and Review Panel, Jan. 30, 2015
https://www.mountpolleyreviewpanel.ca/sites/default/files/report/ReportonMountPolleyTailingsStorageFacilityBreach.pdf

9 Where Do We Go From Here? p.118 (p.126 of PDF)
9.1 PERFORMANCE OF B.C. TAILINGS DAMS
[...] "If the inventory of active tailings dams in the province [of British Columbia] remains unchanged, and performance in the future reflects that in the past, then on average there will be two failures every 10 years and six every 30. In the face of these prospects, the Panel firmly rejects any notion that business as usual can continue."

9.3 BEST AVAILABLE TAILINGS TECHNOLOGY p.121 (p.129 of PDF)
9.3.1 BAT PRINCIPLES
[...] "1. Eliminate surface water from the impoundment.
2. Promote unsaturated conditions in the tailings with drainage provisions.
3. Achieve dilatant conditions throughout the tailings deposit by compaction."

p.122:
"The overarching goal of BAT [Best Available Technology] is to reduce the number of tailings dams subject to failure. This can be achieved most directly by storing the majority of the tailings below ground -- in mined-out pits for surface mining operations or as backfill for underground mines. Both methods require integrating tailings planning into mine planning. This has not been common practice in the industry to date, as the Mount Polley case has shown, and the synergies to be achieved are mostly unexplored. Apart from this, surface storage using filtered tailings technology is a prime candidate for BAT." [...]
"As demonstrated by the Greens Creek [Alaska] case and others, there are no overriding technical impediments to more widespread adoption of filtered tailings technology."

p.123:
"The chief reason for the limited industry adoption of filtered tailings to date is economic." [...]
"While economic factors cannot be neglected, neither can they continue to pre-empt best technology."

[EPA_2017] Revisions to National Emission Standards for Radon Emissions From Operating Mill Tailings, Final Rule
Federal Register / Vol. 82, No. 10 / Tuesday, January 17, 2017 / Rules and Regulations, p. 5142-5180
https://www.govinfo.gov/content/pkg/FR-2017-01-17/pdf/2016-31425.pdf

"§ 61.251 Definitions.
[...]
(f) Phased disposal means a method of uranium byproduct material or tailings management and disposal which uses lined impoundments which are filled and then immediately dried and covered to meet all applicable Federal standards.
(h) Conventional impoundment. A conventional impoundment is a permanent structure located at any uranium recovery facility which contains mostly solid uranium byproduct material or tailings from the extraction of uranium from uranium ore. These impoundments are left in place at facility closure."

"§ 61.252 Standard.
[...]
(2) After December 15, 1989, no new conventional impoundment may be built unless it is designed, constructed and operated to meet one of the two following management practices:
(i) Phased disposal in lined impoundments that are no more than 40 acres [16.2 hectares] in area and comply with the requirements of 40 CFR 192.32(a)(1). The owner or operator shall have no more than two conventional impoundments, including existing conventional impoundments, in operation at any one time.

(ii) Continuous disposal such that uranium byproduct material or tailings are dewatered and immediately disposed with no more than 10 acres [4.05 hectares] uncovered at any time and shall comply with the requirements of 40 CFR 192.32(a)(1)."

see also:
Subpart W: National Emission Standards for Radon Emissions From Operating Mill Tailings
https://www.epa.gov/radiation/subpart-w-national-emission-standards-radon-emissions-operating-mill-tailings#additional-resources

[EPA_1989] 40 CFR Part 61 - National Emission Standards for Hazardous Air Pollutants; Radionuclides; Final Rule and Notice of Reconsideration
U.S. Environmental Protection Agency
Federal Register / Vol. 54, No. 240 / Friday, December 15, 1989 / Rules and Regulations, p. 51654-51715
https://www.epa.gov/sites/production/files/2015-09/documents/december151989finalrule.pdf

Subpart W: p. 51703

"§ 61.252 Standard.
[...]
(b) After December 15, 1989, no new tailings impoundment can be built unless it is designed, constructed and operated to meet one of the two following work practices:
(1) Phased disposal in lined tailings impoundments that are no more than 40 acres [16.2 hectares] in area and meet the requirements of 40 CFR 192.32(a) as determined by the Nuclear Regulatory Commission. The owner or operator shall have no more than two impoundments, including existing impoundments, in operation at any one time.
(2) Continuous disposal of tailings such that tailings are dewatered and immediately disposed with no more than 10 acres [4.05 hectares] uncovered at any time and operated in accordance with § 192.32(a) as determined by the Nuclear Regulatory Commission."

[EPA_1986] Final Rule for Radon-222 Emissions from Licensed Uranium Mill Tailings, Background Information Document
U.S. Environmental Protection Agency, August 15, 1986
https://www.epa.gov/sites/production/files/2015-05/documents/final-rule-for-radon-222-emissions-from-licensed-uranium-mil.pdf

Chapter 7: RADON-222 CONTROL TECHNIQUES
7.3 Control Practices Applicable to New Tailings Impoundments

7.3.2 Phased-Disposal Tailings Impoundment p. 7-24 (p.158 of PDF)
7.3.3 Continuous Disposal p. 7-30 (p.164 of PDF)

[Sermitsiaq_2021a] Chefredaktøren anbefaler: Råstofekspert: Utroværdig rapport, Sermitsiaq AG, Feb. 6, 2021
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