

Environmental and health impacts of uranium mining in Greenland

**Overview on impacts, their evaluation and resulting consequences for
regulation and control**

**Public Conference on mining uranium in Greenland,
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Overview

1. General overview over impacts
2. Specific issue: radiation protection of workers and the public
3. Specific issue: wastes from mining and processing
4. Specific issue: social impacts

1 Overview on impacts

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#	Impact	Operation	Closure	Post closure
1	Occupational radiation	High	Moderate	None
2	Public radiation exposure	High	High	Depending
3	Gaseous emissions & dust	High	Moderate	Depending
4	Liquid emissions processing	High	Moderate	Depending
5	Mining waste storage	High	Moderate	Depending
6	Processing waste disposal	Small	Moderate	Depending
7	Dam Safety	High	Very High	Depending
8	Landscape, visual impacts	Very High	Depending	Depending
9	Social impacts	Very High	Extremely High	Depending

2 Specific issue: Radiation Protection

Occupational exposure:

- Elevated exposure rates during blasting/hauling via dust
- Very high exposure rates in certain processing stages by direct gamma radiation (specific workshops, maintenance and repair in certain stages of the facility)
- Experiences in Germany: disregards of basic protection requirements lead to severe health damages among underground mine workers

→ Requires strict radiation protection regime

Public exposure:

- Elevated exposure rates from radon emissions (and its decay products), range ca. 20 km
- In the closer vicinity (range 2 – 5 km): exposure to dust (alpha exposure via lung pathway)
- Experiences in Germany: exposures up to 5 mSv per year (limit: 1 mSv/a), misuse of contaminated materials, release of materials for road construction, etc.

→ Requires strict radiation protection regime

3 Specific issues: wastes from mining & milling

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Radiation Protection
Sustainable Mining*

Properties of mining & milling wastes:

- Wastes can include toxic constituents (chromium, copper, arsenic, ...)
 - Wastes can include pyrite (acid generation if in contact with oxygen, acidic leachate!)
 - Milling wastes extremely fine grained (subject to intensive leaching, dust if uncovered!)
 - Removal of uranium does not substantially reduce adverse properties
 - Experiences in Germany: High arsenic concentrations, high pyrite content requires thorough disposal concept, leachate from storage facilities requires water treatment
- Consequent and restrictive enclosure policy required**

Waste management during operation:

- Management regime requires compatibility with local climatic conditions (Greenland: operation during the winter season)
 - Dams and waste piles require high mechanical stability with design against local conditions (including low-probability events)
- Robust safety policy required, no compromises in respect to safety**

3 Longterm enclosure of milling wastes

Longterm enclosure of milling wastes:

- Safe enclosure of wastes required over extremely long time scales
 - Design necessary for stability over 1,000 years ++
 - Design against erosion, climate changes, changes in local conditions, etc., required
 - European Mining Waste Directive 2006/21/EC requires sustainable disposal strategy:
 - Waste Management Plan that covers the complete operation
 - Priority of disposal in mine openings
 - Sustainable covering of the wastes
 - Adequate financial provisions required to cover all costs for later disposal of the wastes
 - Experiences in Germany: no waste management plans, no provisions, 8 bn € cleanup costs to be paid by the german taxpayer (36 € per produced kg U, larger than current market price)
- ➔ **Projects on the economic edge: Large risk that cleanup and longterm-care for the wastes will rest with the general public or else local communities will suffer from incomplete cleanups**

4 Social risks

Social impacts of mining:

- Large increase of workers and employment in a very short period
- Very special qualifications required
- Overwhelms local economic and social structures and builds up very specific structures that are very specific for the project

Impacts of mine closure:

- Complete collapse of the specialized economic and social structure
 - Adaption to new situation and complete restructuring required
 - Leaves communities with unresolvable situation
 - German experiences: immediate release of ten thousands of mine workers at Wismut to unemployment, large costs for the social security systems, complete restructuring of the coal mining sector in Northrhine-Westfalia and the Saar region, longer term costs uncovered
- ➔ **The limitation and control of adverse social and economic structural changes is a task that could outweigh any positive economic impacts by far**

- 1. The environmental and health impacts are manifold. To limit those to acceptable levels requires the introduction of strict regulatory regimes and their continuous control by regulators.**
- 2. The mining project requires the introduction of a very strict radiation protection requirement regime. Otherwise adverse radiological impacts would result.**
- 3. The adverse consequences of a failed waste management practice as elsewhere in the mining industry are manifold, a strict regulatory regime is required to avoid large damages to the society as a whole and to local communities. The disposal of milling wastes into lakes is an overall unsustainable practice.**
- 4. The adverse social consequences of large mining projects can have very costly consequences and have to be carefully evaluated.**