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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,

Copenhagen/Denmark, March 16 2016

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

#	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

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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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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

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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**

Summary

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1. The environmental and health impacts are manifold. To limit those to acceptable levels requires the introduction of strict regulatory regimes and their contineous 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.