The Dangers of In-situ leach mining of uranium Stampriet Artesian Basin (SAB) aquifer

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Wings Uranium Project

Headspring Investments

Rosatom

Leonardville area

1st artesian borehole: Stampriet
22 March 1910

110 m3/hr

Application for Pilot Plant by Headspring Investments
Stampriet Transboundary Aquifer System

The only water is Underground. It is the Lifeblood of all farms in the waterless Kalahari.

Stampriet Artesian Basin: SAB

Wings project

STAS
Blankets of mud and sand deposited on top of each other along the margin of a shallow sea.

Aqifer contacts

STAS
Geology
Hydrology

W = aquifer

U Ore

Basin-wide blankets of:
- sandstone (water)
- shale (no water)
- glacial deposits
- Old erosion surface
Mining process: **in-situ leaching (ISL)**

- Borehole with acid - no
- High water table
- Open pit - no
- Underground tunnels - no
- In-situ leaching - yes
Auob Formation water supply

Irrigation (± 80% of total basin consumption)

Bulk water supply for towns (± 11%)

Strongest aquifer by far
Top quality drinking water

Farms access all aquifers
Process of in-situ leaching

Acid leaching: $\text{H}_2\text{SO}_4 + \text{H}_2\text{O}_2$

Alkali leaching: $\text{NaHCO}_3 + \text{H}_2\text{O}_2$
Acid injection, pump out solution, uranium removal, recycle solutions up to 100 times for up to 5 years

Beverley, Australia

IAEA, 2005, p.38
Well-field cut lines
Wellfield surface radioactive contamination

Mine Unit area:
- 20 ha
- 21 m well spacing
- 137 wells
- 29 with surface contamination = 21%

IAEA, 2001, p. 222

Up to 8,500 Wells per 500 ha Wellfield of 24 mine units
Ur-Energy Lost Creek alkali ISL Mine, USA

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- Covers 1,554 ha
- Divided into 19 mine units (MU)
- MU1 in production, MU2 being developed
- 1,400 wells per mine unit; 25 m well spacing
- 26,600 wells in total (injection & production)
- 855 Monitoring wells
- 8 years production (3) & water restoration (5) per mine unit (20 years in some other cases)
Leaching Process
(for dissolving the uranium)

Leach chemical is weak sulphuric acid (battery acid)

Water with dissolved uranium pumped out

Uranium removed in surface plant,

Water + acid re-injected into the orebody

Thousands of wells

Many different chemicals

DRINKING WATER
PROBLEMS

- In-situ leaching:
  - Releases the radioactive decay products of the uranium into aquifer water, Radon, Radium

- Dissolves heavy metals in the aquifer sandstone releasing them into the water, As, Be, Bi, Cd, Cr, Cu, Fe, Mn, Mo, Ni, Pb, Ra, Re, Rn, Sc, Se, Th, Ti, U, V, Zn, +

- Adds sulphate to the water

IAEA 1989, 2001, 2005
USA

24 operations

NO acid leach operation in drinking water aquifers

IAEA, 2016, p. 21; Woods, 2017, p. 5

One acid leach project in construction
Fluvio-deltaic sands
grain size, permeability contrasts
Borehole

Water in porous sand or sandstone

Grain size
0.25-4 mm

10-30% porosity
Total water boreholes 4990

0.1 – 300 m³/hr

+98 boreholes yield more than 40 m³/hr

X = Uranium ore deposit

SAB
Water, irrigation boreholes >10 m³/hr
Total licence area

60-100 km wide
400 km long
3.98 million hectares
60% of basin
South Kazakhstan Uranium Deposits
Mineralised over distances of 45 km

Saline aquifers

130 km
Large-scale ISL operations
IAEA 2001

• Plant capacity: Millions of m$^3$/year of leach solution (p. 247)
• Huge arrays of boreholes (p. 248)
• Injection, leaching, abstraction, all underground
• Solutions continually recycled in and out of aquifer, thousands of tons of reagents (p. 247)
Problems

• Borehole casing breaks (60% of failures) (IAEA 2001) (p. 213-215)

• Pump breakdowns, replacements (p. 213)

• Pipeline breaks (p. 221)

• Accidents – surface contamination (p. 221)
Problems

Many problems are underground where nobody can see them

In the drinking water
PROBLEMS

• Leakage to other aquifers must be prevented – repeatedly mentioned

Water flow rate in pumped boreholes

ISL requires -- ± 1 – 10 m/day

SATS/SAB -- 0.03 – 22 m/day

(72 hours continuous pumping – JICA 2002)
(latter example - pumped at 46 m³/hr, 2.8 m drawdown)

Irrigation pumping
will draw water through the mine area
Problems: Leaking faults, boreholes
Cretaceous erosion of the SAB

Underground map: elevation top of the eroded Karoo sediments and the palaeo Aranos River (70 m.y.) now buried below the Kalahari
Aquifers in contact with each other

Red fault - conduit

Cross contamination highly probable
Straz ISL Mine, Czech Republic
massive groundwater contamination
will take 80 years(?) to clean up

€ Billions

Juda, Nemec, 2022, J. Rad. Protect
Uranium in Drinking Water

• WHO guideline is 0.030 mg/litre
  = 0.03 g/ton of water

• Leach solution can contain up to 600 g/ton uranium
  IAEA, 1989, p. 17

• This exceeds the WHO guideline 20,000 times
PROBLEMS

We are dealing with abnormally high concentrations of dissolved uranium

And dissolved heavy metals

All in the drinking water

Irrigation will draw water through a mine area
Blanket negative perceptions
(Ebola in West Africa)

Don’t eat Namibian meat, fruit, vegetables

Don’t drink Namibian water

This would be a DISASTER

FOR THE WHOLE OF NAMIBIA
The SAB is by far the largest artesian/subartesian basin in Namibia.

Groundwater is a critical & sustainable commodity and must be protected for present and future generations.

Development of uranium in any drinking water aquifer must be prevented.

PREVENT CONTAMINATION BEFORE IT BEGINS
Setting a precedent

• If the pilot plant is approved, it sets a precedent

• It will then be difficult to refuse any full-scale ISL mining project in the SAB
Namibia’s Responsibility

Protect critical, sustainable resources for present and future generations

Protect the health and safety of all Namibians

Cancel all mineral exploration licences in the SAB, prevent any mining in the SAB

Cancel all exploration drilling permits in SAB

The public must help government to achieve these aims
Reference list

Königstein, Vol 7, Bergbau in Sachsen
Thank you for listening