Uranium mill tailings management and disposal in Australia: Past and current practice

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Introduction

• Australia has been a significant uranium producer since the 1950s
• Currently the second largest producer at around 10% of annual global supply from both underground and ISR/LSL mines
• 55% of world uranium now comes from ISL/ISR production, but previously most was from underground and open pit mines which resulted in large volumes of tailings being produced – a NORM residue
• Management and disposal of these residues and wastes has not always been carried out taking the best care of the environment
• The presentation looks at how such management and disposal systems have developed in Australia over the past 75 years or so
• Some very old and small sites have not been included

Ranger mine; Pit 3 development
Australia’s uranium resources
Rum Jungle uranium mine

- Mine operated from 1951 to 1976, uranium production ceased in 1961
- Produced 3,530 t U3O8 from 538,342 t of treated ore
- Tailings were discharged to a dam on a flat part of the site;
- Over time approx. 150,000 t of tailings were lost from the dam to the adjacent river system through overtopping by supernatant flow and wet season rainfall
- 1983-86 an Australian Government remediation project collected up tailings and placed them and impacted soils from the dam area, into Dysons Pit and added a cover of waste rock and soil which was revegetated
- Some small amounts of residual tailings may have been added to the two other open pits on site which are water filled
- Current project under assessment to deal with AMD issues on site
Rum Jungle - current situation

• Environmental monitoring, surveillance and data collection continue
• Since 2009 remediation planning has been on-going in various stages: 1, 2, 2A and 2B are now complete
• These works have been undertaken under a series of national partnership agreements between the Australian and Northern Territory (NT) governments.
• The two prime objectives of the programme are:
  1. Improve the environmental condition on-site and downstream
  2. Improve on-site environmental conditions to support future land use, including cultural values
• All work has been undertaken in consultation with, and participation of, traditional landowners seeking to provide business opportunities where possible
• It is intended that achieving these two major objectives would facilitate the completion of the Finnis Land Claim over the site and enable the handover to the traditional landowners
• The plan is currently seen as having a 15 year project life and was hoped to commence in 2022 but Covid has had an impact on processes
• An EIS was published and has been assessed
South Alligator uranium field

- A number of small open pit and underground mines operated from 1953 to 1960
- Produced c.850 t U3O8. Up to 13 mines with three processing sites but only one mill with tailings deposited on adjacent riverine flat
- Frequent seasonal loss downstream, unknown quantities
- 1986 – c.6,000 t tailings relocated from mill site to Moline mine and mill site for reprocessing to recover about 25kg gold
- Moline tailings dam also failed and was remediated
- Some tailings left on mill site; cleaned up in 1992 in hazard reduction programme
- Roadworks exposed even more remnant tailings in 2001; collected and contained in drums at site
- Relocation of tailings and other wastes from earlier works to new repository 2006-7 – final disposal as part of overall final remediation programme

Sleisbeck open pit mine c. 2002
South Alligator mill site 1986 and 1996
South Alligator Mill site 1986 and 2007
South Alligator

Containment under construction 2007

2002 interim clean up

Containment December 2021
Nabarlek

- Small high grade ore body mined in 143 days in 1979
- Milling on site began in 1980 and tailings deposited directly to pit; initially water covered then sub-aerial
- Post milling tails in the pit were covered with waste rock
- Pit closed out and site remediated after waiting 5 years post operations ending
- Complete containment of tailings in pit
- Revegetation successful but slow after local bush fires
- Monitoring continues
Nabarlek tailings – initial management
Nabarlek pit/tailings remediation 2018
Ranger Uranium Mine

- Mined from 1980 to 2012; Pit 1 1980-95, Pit 3 1997-2012; Produced over 132,000 t U3O8 and 120M cu.m. tailings
- Tailings initially disposed into a bespoke dam built as a water containment 1 Km square
- When Pit 1 was mined out tailings went from mill directly to prepared Pit; Concurrently, a trial to dredge 1Mcu.m. from dam to pit was undertaken
- When Pit 1 reached regulatory capacity (RL 0m) tails went only to dam again. Dam was periodically raised to ensure adequate capacity
- When Pit 3 was mined out base was prepared with underdrain and recovery system using approx. 31M t of waste rock
- Then mill tails went directly to pit and also dredged from Dam (60m cu.m.) initially using one dredge and then two
- Pit 1 allowed to settle for 5 years after wicks installed then rock covered and domed to final form
- All tailings in pit 3 by end 2021 and old dam cleaned to become clean water storage

Pit 3 looking east in 2017
Ranger Mine during operations, May 2011
Ranger Uranium Mine

Dredging trial and first deposition into Pit 1
RUM Pit 3: New dredge, development of underdrain & initial tailings deposition
Ranger Uranium Mine: October 2021

- Dam empty of tailings
- Pit 3 water cover over tailings; transfers nearly complete
- Pit 1: Revegetation of cover on Pit 1
Olympic Dam

- World’s largest identified uranium ore body began operations in 1988
- Copper is main product but 3000+tpa U3O8 produced
- 25% of revenue comes from U3O8
- Mine processes 235,000t of rock/y
- Over 200M t of tailings produced since 1988
- Most tailings deposited in above ground structures extending over 960 ha.; some deslimed tails used in stope backfill underground
- Current cells may be up to 30m high, newer ones may be 40m
- Some cells will be prepared for final closure in the near future
- Some concerns expressed over longevity of structures and potential for groundwater contamination

Image - www.wsj.com
Olympic Dam
tailings
storages
Future Mines

• Recent changes in the politics and economics of energy have seen increased interest in nuclear power generally and SMR in particular.

• Uranium mining is of interest again and production may have to ramp up, or at least see some mines re-open

• While restarting ISL/ISR operations may be easy (relatively) and could meet short term demands it may be necessary to open more “conventional” mines for longer term fuel security.

• Residue disposal and management (norm tailings) will be a major area of interest for communities and regulators to ensure safety and security

• Below grade disposal/containment is to be preferred as a long term measure

• Some very high grade ore mines in Canada are said to have considered underground milling for future developments and keeping tailings underground as well thus eliminating the need for above ground storage and disposal.
Conclusions

• Uranium mill tailings management and disposal practice in Australia has improved considerably since 1950, with continuous improvement.

• Leading practice is arguably found in the Northern Territory where since 1970 uranium mines (Nabarlek & Ranger) have been expected to ensure:
  • (i) The tailings are physically isolated from the environment for at least 10,000 years;
  • (ii) Any contaminants arising from the tailings will not result in any detrimental environmental impact for at least 10,000 years.”

• Future mines will likely be required to adopt new standards for dam construction and operation as well as tailings disposal.