Submission No 49

INQUIRY INTO URANIUM MINING AND NUCLEAR FACILITIES (PROHIBITIONS) REPEAL BILL 2019

Organisation: Geoscience Australia

Date Received: 17 October 2019

Geoscience Australia's Submission to the Standing Committee on State Developments Inquiry into Uranium Mining and Nuclear Facilities (Prohibitions) Repeal Bill 2019

Terms of Reference

1. That:
(a) the Uranium Mining and Nuclear Facilities (Prohibitions) Repeal Bill 2019 be referred to the Standing Committee on State Development for inquiry and report, and

(b) on tabling of the report by the Standing Committee on State Development, a motion may be moved without notice that the bill be restored to the Notice Paper at the stage it had reached prior to referral.

2. That as part of the inquiry:
(a) the New South Wales Parliamentary Library prepare an Issues Paper on the bill,

(b) the committee commission the newDemocracy Foundation to facilitate community input into the bill, such as a citizens panel or jury, to complement the traditional forms of evidence gathering by committees, such as seeking submissions and taking oral evidence, and

(c) the committee respect the foundation's remit as an independent and non–partisan research organisation.

3. That the House notes that the newDemocracy Foundation has offered to provide this service during 2019 and 2020 for no charge to the Parliament.

About this Submission

On receipt of an invitation from the Legislative Council's Standing Committee on State Development on Monday 8 July, Geoscience Australia is contributing a submission to the committee's inquiry into the Uranium Mining and Nuclear Facilities (Prohibitions) Repeal Bill 2019.

Contents

Overview of Geoscience Australia's activities related to uranium

- Geoscience Australia's mission is to be the trusted source of information on Australia's geology and geography for government, industry and community decision-making to contribute to a safer, more prosperous and well-informed Australia. Geoscience Australia sits within the Department of Industry, Innovation and Science.
- As part of our ongoing resources program Geoscience Australia provides geological information and advice on Australia's uranium resources, including the status and production of operating mines and new developments related to uranium exploration.
- Geoscience Australia reports Australia's uranium resources in two annual publications:
    1. AIMR: Australia's Identified Mineral Resources
    2. AERA: Australian Energy Resource Assessment
- Geoscience Australia is also a member of the joint Organisation for Economic Co-operation and Development (OECD), Nuclear Energy Agency (NEA) and the International Atomic Energy Agency (IAEA) Uranium Group (UG). This group coordinates biennial assessments of the world's supply of uranium in order to assess supply capabilities for future demand. It also produces the biennial publication Uranium Resources, Production and Demand, also known as the "Red Book".
- Geoscience Australia's uranium expertise is also regularly called upon to provide information and advice for Environment Protection and Biodiversity Conservation Act (EPBC Act) referrals. This advice typically involves the geological aspects of mining, tailings storage facilities and mine-site rehabilitation.
- Geoscience Australia is the custodian of valuable geoscientific data and information. Our minerals program aligns with the priorities of the National Mineral Exploration Strategy (2017-2022), which aims to generate new exploration opportunities and assist in ensuring the continuity and longevity of Australia's mineral resources industry particularly in undercover greenfields regions. The current Exploring for the Future (EFTF) program is also dedicated to boosting investment in resource exploration in Australia. Our Pre-competitive data program makes data publicly available to support and de-risk decision-making and investment in Australia's resources.
- During Geoscience Australia's Onshore Energy and Security Program (2006-2011), GA provided precompetitive data and knowledge supporting uranium exploration in Australia that reported on fundamental geological controls on uranium occurrences as well as Australia's prospectivity for uranium resources.
- Geoscience Australia supported the Department of Industry, Innovation and Science with geological advice on the establishment of a National Radioactive Waste Management Facility. This included reviewing technical reports on geophysical surveys, geology, groundwater and geohazards such as seismic activity, erosion, flooding and volcanism.

Geoscience Australia's Onshore Energy and Security Program (2006-2011)

Work undertaken by Geoscience Australia during the Onshore Energy and Security Program (OESP) aimed at increasing the prospectivity for uranium resources includes:

- A new geological framework developed for the classification and origins of uranium ore-forming mineral systems; this has been utilised by the IAEA and by other organisations internationally (GA Record 2009/20).
- A comprehensive multidisciplinary study undertaken on uranium mineral systems in the Frome Embayment region of South Australia, covering the Beverley and Four Mile 'sandstone-hosted' uranium deposits (GA Record 2009/40).
- Determining the ages of several uranium deposits in Australia for the first time (GA Record 2011/12).
- A series of studies of the potential for uranium resources in three regions of Australia (northwest Queensland: GA Record 2010/14; South Australia: GA Record 2011/34; southern Northern Territory: GA Record 2012/51)
- The uranium potential of Australian salt lake systems undertaken as part of a study of potash and lithium potential (GA Record 2013/39).

Australia's uranium Resources

Uranium is a mildly radioactive element that is widespread at levels of 1–4 parts per million (ppm) in the Earth's crust. Concentrations of uranium-rich minerals, such as uraninite, carnotite and brannerite, can form economically recoverable deposits. The majority of Australia's uranium occurs in four main types of deposit: iron oxide breccia complexes, unconformity-related resources, sandstone resources and paleochannel/calcrete-style resources.

Once mined, uranium is processed into uranium oxide (U_3O_8), also referred to as uranium oxide concentrate, and is exported in this form. Natural uranium (from mine production) contains approximately 0.7 per cent of the uranium isotope U235 and 99.3 per cent U238.

Australia has the world's largest known resources of uranium, accounting for approximately 30 per cent of the global inventory and is the world's third largest uranium producer. Geoscience Australia estimates that, as at December 2017, Australia had Economic Demonstrated Resources (EDR) of 1,290 kilotonnes of uranium (kt U).This is equivalent to the International Atomic Energy Agency (IAEA) category of Reasonably Assured Resources of uranium recoverable at costs of less than US$130/kg U (RAR <$130/kg U). Australia has large Ore Reserves of uranium amounting to 285 Kt (Table 1) in 2017 of which 271 Kt is attributable to three operating mines (Table 2). As at December 2017, Geoscience Australia estimates that Australia has an additional 909 kt U, mainly as Inferred Resources.

Table 1. Australia's Ore Reserves of uranium as at December 2017

Commodity	Unit	Proved Ore Reserves	Probable Ore Reserves	Proved & Probable Ore Reserves	Total Ore reserves	Mine Production 2017[a]	Reserve Life (years)
Uranium	kt U	89	196	0	285	5.344	53

Source: Australia's Identified Mineral Resources 2018 (https://d28rz98at9flks.cloudfront.net/124309/124309_AIMR.pdf).

Notes

Kt U = thousand tonnes of uranium content.

Reserve Life = Ore Reserves ÷ production.

Figures are rounded so Proved, Probable and Proved & Probable Ore Reserves may not add up to Total Ore Reserves Exactly.

a. Mine production from Office of the Chief Economist, Resources and Energy Quarterly, June 2018.

Table 2. Australia's Ore Reserves and Mineral Resources of uranium at operating uranium mines as at December 2017

Commodity	Unit	No. of Operating Mines[a]	Ore Reserves[b]	Measured and Indicated Mineral Resources[c]	Inferred Mineral Resources[d]	Mine Production[e]	Reserve Life[f] (years)	Resource Life 1[g] (years)	Resource Life 2[h] (years)
Uranium	kt U	3	271	1518	822	5.344	51	284	438

Source: Australia's Identified Mineral Resources 2018 (https://d28rz98at9flks.cloudfront.net/124309/124309_AIMR.pdf).

Notes

Kt U = thousand tonnes of uranium content.

a. Olympic Dam and Four Mile in South Australia and Ranger in the Northern Territory.

b. The majority of Australian Ore Reserves and Mineral Resources are reported in compliance with the JORC Code, however there are a number of companies that report to foreign stock exchanges using other reporting codes, which are largely equivalent. In addition, Geoscience Australia may hold confidential information for some commodities. Ore Reserves are as at 31 December 2017.

c. Measured and Indicated Mineral Resources are inclusive of the Ore Reserves. Mineral Resources are as at 31 December 2017.

d. Inferred Mineral Resources are as at 31 December 2017.

e. Mine production from Office of the Chief Economist, Resources and Energy Quarterly, June 2018. Production data often have a higher level of certainty than reserve and resource estimates and, thus, may be presented with more significant figures.

f. Reserve Life* = Ore Reserves ÷ Production.

g. Resource Life 1* = (Measured + Indicated Resources) ÷ Production.

h. Resource Life 2* = (Measured + Indicated + Inferred Resources) ÷ Production.

*Reserve and resource life for each mineral commodity is calculated by dividing the inventory by production. The resulting ratio is a snapshot in time that can only be used for general impressions because it is an average and it assumes (1) that production rates in the future will remain the same as those used in the calculation, (2) deposits deemed economic/uneconomic remain so in the future and (3) that depleted resources are never replaced.

Production

Australia is the world's third largest uranium producer after Kazakhstan and Canada. In 2017–18, Australia's production of uranium was approximately 5.344 kt U. In 2017, Australia's uranium production was from three operating uranium mines: Olympic Dam and Four Mile in South Australia, and Ranger in the Northern Territory. Australian uranium production is expected to fall in the short term as output from the Ranger mine declines ahead of a cessation of mining activities in January 2021 (Department of Industry Innovation and Science 2019). All of Australia's domestic production is exported.

In South Australia, new mining is proposed at the Honeymoon project, and, in Western Australia, the Cameco Australia, Kintyre and Yeelirrie projects, Toro Energy's, Wiluna project and Vimy Resources, Mulga Rock project have received environmental approval. Development of these projects is contingent on market conditions.

Global uranium production is focused in a small number of countries, with Australia, Kazakhstan, Canada, Namibia, South Africa and Niger accounting for most production. Proterozoic unconformity-related deposits in Canada dominate the categories of lowest production cost; the sandstone-hosted resources of Kazakhstan, Niger and the United States comprise the next cost level. The Australian Olympic Dam breccia complex deposit is dominant in the key cost category of less than US$130/kg U.

Approximately 90 per cent of Australia's total EDR of uranium lies within seven deposits: Olympic Dam and Beverley in South Australia, Jabiluka and Ranger in the Northern Territory and Yeelirrie, Mulga Rock and Kintyre in Western Australia.

Potential supply of uranium for nuclear energy in Australia

All of Australia's mine production of uranium is currently exported. Tonnages of Australian exports have increased steadily from less than 0.359 kt U in 1976 to a record 9.512 kt U in 2005. In 2018, Australia exported 6.167 kt U valued at $635 million[1].

Australia exports all its uranium production to countries within its network of bilateral safeguards agreements which now total 43. These agreements ensure that Australian uranium is used only for peaceful purposes and does not contribute to any military applications. Australian mining companies supply uranium under long-term contracts to electricity utilities in North America, Europe and Asia.

Australia has a strong reputation as a reliable and responsible supplier of uranium to world markets for peaceful purposes. It is well positioned to be able to sustain this role because of its stable commercial environment and very large identified uranium resources that can be produced profitably.

In addition, uranium could potentially be produced as a by-product from deposits where it is currently regarded as deleterious. Some of these deposits host critical minerals, such as rare earths, niobium and zirconium, and government policies that enable the uranium to be used, rather than treated as a waste product, could increase the viability of these deposits for development.

Exploration for new sources of uranium

Despite Australia's already large uranium endowment, only the most economically viable deposits will attract the funding necessary for development. Hence a pipeline of discovery is vital for maintaining Australia's competitiveness and reputation as a trusted supplier of high quality mineral resources to the world.

However, Australia's uranium exploration expenditure has declined substantially over time, mainly as a result of historically low prices following the 2011 Fukushima Daiichi nuclear accident. After Fukushima, prices decreased 38 per cent from US$68/lb in 2011 to US$42/lb in 2012[2] and exploration in Australia went down 49 per cent from $216.4 million in 2011 to $110 .2 million in 2012[3]. The following years generally saw year-on-year falls in both price and exploration expenditure to lows of US$19/lb for price in 2016 and $12.3 million for expenditure in 2018.

In addition to falling exploration levels and low uranium prices, state government policies do not always support uranium exploration or the development of new mines. Victoria bans uranium mining, as does Western Australia (except for the projects that already had approvals prior to 2017). Queensland and New South Wales allow exploration but not mining, with New South Wales currently conducting an enquiry into this arrangement. Only Tasmania (which lacks resources), South Australia and the Northern Territory support uranium mining and only South Australia and the Northern Territory allow the use of local ports for export.

Thorium as a potential nuclear fuel

Uranium is not the only element capable of providing nuclear power. Thorium can also be used for nuclear energy and is about three times more abundant in the Earth's crust than uranium. Unlike the conventional uranium-235 reaction, daughter products from the thorium nuclear reaction are not suitable for weapons applications, thorium reactors do not carry the risk of a nuclear meltdown and they produce less nuclear waste that decays faster to safe levels of radioactivity.

[1] Resources and Energy Quarterly, June 2019
https://publications.industry.gov.au/publications/resourcesandenergyquarterlyjune2019/index.html

[2] See Footnote 1

[3] Australian Bureau of Statistics S 8412.0 Mineral and Petroleum Exploration (modified by Geoscience Australia for constant Australian Dollars).

However, the cost-effectiveness of thorium technology is not yet demonstrated. While a number of thorium reactors have operated in the past, in the United State and Germany, for example[4], thorium technology is still many decades behind uranium technology, and more expensive.

Currently, there are no active thorium reactors in the world. However, the introduction and use of advanced reactor designs could permit the use of thorium, along with other types of nuclear fuel such as uranium-238, but these will require considerable funding and government support for research and development.

Thorium (Th) resources in Australia are mainly associated with mineral sands but also occur with rare earths deposits such as Nolans Bore (Northern Territory), Toongi (New South Wales) and Mount Weld (Western Australia). Because thorium is not currently commercially viable, data is limited but Geoscience Australia estimates that Australia could host the world's second largest resources of around 800 kt Th, or about 10 per cent of the global total.

Conclusions

In regards to economic feasibility, Australia has the largest endowment of naturally occurring, low-cost, uranium in the world. Three Australian mines currently produce uranium profitably from their operations and Australia is the third largest supplier of uranium globally. Other Australian uranium deposits are awaiting better market conditions before development proceeds. Additionally, some operations could potentially produce uranium as a by-product instead of a waste product, increasing their economic viability.

In regards to other relevant matters, Australia is also well endowed with thorium. If thorium technology were to become sufficiently advanced and economically viable, then Australia has large quantities of the prerequisite fuel source.

[4] https://www.world-nuclear.org/information-library/current-and-future-generation/thorium.aspx#References