Environmental regulation of uranium mining in Australia

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Abstract. Uranium mining has been taking place in Australia more or less continuously since the late 1930s but it really only came to the fore after 1945. Environmental protection legislation did not become established until 1976. As a consequence the environmental management of many early uranium mines was virtually non-existent and a number of adverse environmental impacts were recorded. The development of modern uranium mines, essentially since 1970, has been associated with two major issues: a growing understanding by industry and regulators of the need for environmental management and pollution control, and increasing community pressure for minimisation of adverse environmental impacts from all mines. Under these conditions Australia has developed regulatory regimes for uranium mines which incorporate some of the highest environmental standards in the world. This paper sets out to describe how the current uranium mines in Australia are regulated from an environmental viewpoint. The discussion deals with the regulation of underground, open cut and in-situ leach uranium operations in climatic zones varying from the wet-dry tropics to arid deserts.

The regulatory regimes involve a complex mix of federal and state governments as well as traditional Aboriginal Landowners and other significant stakeholders. The paper sets out how these different agencies and organisations work together to ensure that uranium mines are operated in accordance with the expectations of the community in terms of their environmental, health and safety expectations whilst maintaining economic viability and operational efficiency.

Introduction

The generation of electricity using the nuclear cycle was first achieved on a commercial scale at the Calder Hall power plant in the United Kingdom in 1956. This new form of power generation had been hailed as the future for cheap electricity worldwide. As a consequence the search for supplies of uranium, the fuel used in the nuclear fuel cycle was increased. In Australia the Government offered a substantial reward to the discoverer of a major new deposit. At the same time uranium was also in demand for use in nuclear weapons and so the issue of regulation came under consideration to ensure that this strategic material would only be exploited in a controlled manner.

Australia was a major supplier of uranium in the 1950s and 60s and is still considered to be the repository for the world's largest reserves of low-recovery-cost uranium. Australia has been estimated to have 28% of the world's supply of uranium recoverable at a cost of less than $US80/kg Uranium (OECD, 2003). Australia is a significant player in the world uranium mining industry and the Australian Government has the responsibility of managing the nation's nuclear activities in both the national and international arenas.

However, regulation of mining and the protection of the environment are activities that are generally the responsibility of State and Territory governments. But as the Australian Government has undertaken a deepening involvement in environmental protection involving matters of national importance so a system of shared responsibilities has developed. A similar situation has evolved specifically in relation to uranium mining. Hence the environmental management oversight of uranium mining is undertaken by the Australian Government with day-to-day operational regulation undertaken by the Governments of South Australia and the Northern Territory in their own jurisdictions. The Australian Government maintains control through the granting of export permits for the uranium. This is an effective control as there is no domestic market for the output from Australia's uranium mines.

This process of regulation may appear complex but it has been developed to minimise duplication of effort, especially in respect of administrative processes.

Mining Background

The history of modern uranium mining in Australia can be considered to begin with the operation at Rum Jungle (Waggitt, 2004). The discovery of the deposit in 1949 was followed by the decision for the Australian Government to assume ownership of the minerals and to have the site operated on its behalf by a commercial mining company. Australia has a federated system of government. When the 7 colonial states came together to form the Commonwealth of Australia in 1901 the constitution set out which activities would be controlled by the Australian Government and which would be regulated by the State Governments. Mining was deemed to be an activity that was to be controlled by the States although the min-

erals remain the property of the Government with the miners paying an appropriate *pro-rata* royalty for the right to develop the mineral resources.

In the case of uranium the Australian Government decided that it would control the commodity through a number of statutes, including the requirement for an export licence prior to the product being allowed to leave the Australian continent. However the day to day regulation of mining is under the direction of State level authorities. Thus none of the actual mining activities could be regulated directly as this would represent an infringement of the rights of the States. Within each state there is an agency or department charged with the responsibility for regulation of the exploitation of mineral resources, including their environmental management.

The exception was for the uranium deposits of the Northern Territory. As the Northern Territory is a self-governing territory, and not a state, the Australian Government is able to impose an element of direct rule in the regulation of mining. In practice this represents more of an oversight role as the Australian Government does not have the necessary detailed legislation to regulate all the wide range of activities in mines. Hence, for the Northern Territory there is a regulatory regime which is different from that found in South Australia, the only other Australian state where uranium mining is currently active. This paper describes the development of the various regulatory regimes and operations in place in the Australian uranium mining industry in 2004, with specific reference to environmental management.

Historical Operations

Early mining operations were not subject to any environmental regulation and many operations were simply abandoned at the end of their economic life. This was especially true in Australia as exemplified by the uranium mining and milling operations at Rum Jungle (1950-63), Moline (1959-64) and in the South Alligator valley (1953-64), all in the Northern Territory, Radium Hill in South Australia (1954-62) and after the first “life” of the uranium mining at Mary Kathleen in Queensland (1958-63). Rehabilitation was not mandatory anywhere; there was no legal requirement for mining companies to deposit securities against the costs of rehabilitation; little, if any, environment protection legislation was in place at any level, and there was little outcry from the community in most locations. Under these circumstances the lack of rehabilitation was not surprising.

Then the situation changed. Rum Jungle became notorious as the site had become a source of pollution resulting in extensive adverse environmental impacts in parts of the Finniss River catchment. For up to 14 km downstream of the former mine site there were greatly reduced populations of aquatic flora and fauna, both in the watercourse and on the banks. The problem was caused by acid drainage developing from the effects of the tropical temperatures and an annual rainfall of about 1400 mm on the highly sulphidic mining wastes left on the surface. This effluent leached heavy metals, primarily copper, from the waste rock which in turn polluted the watercourses downstream of the site.

This situation remained unchecked apart from a limited program of works in 1977-78 when there was some clean up carried out at the treatment plant area (Verhoeven, 1988). At the same time the Northern Territory achieved self-government, which included assumption of the regulation of mining. In 1982 planning for a program of rehabilitation was begun. The program was to be funded by the Australian Government and it was agreed that the work would be implemented by the Northern Territory Government. The works program was completed in 1986 on the main site, and in 1990 at Rum Jungle Creek South (an outlying ore body developed at the same time as the main site).

The decision to undertake rehabilitation had been brought about because society's expectations were changing. As the community's general awareness of issues such as pollution and environmental protection grew in intensity from the early 1970s onwards, legislators began to put suitable controls in place, including in relation to mining operations. The Australian Government introduced the *Environment Protection (Impact of Proposals) Act* in 1974. This legislation required, *inter alia*, that major development projects, such as new mines, would be required to publish Environmental Impact Statements which would in turn be subjected to a rigorous program of assessment before any development approvals could be given. Uranium mining received special attention in this legislation. The immediate consequence was the instigation in 1975, under this new legislation, of an inquiry into the proposals for development of uranium deposits in the Alligator Rivers Region of the Northern Territory.

The Ranger Uranium Environmental Inquiry (RUEI) was chaired by Mr Justice Fox and was the first inquiry of its type held in Australia. There were two reports produced by the "Fox Inquiry", as the inquiry was more familiarly known. The first report (RUEI, 1977a) dealt with major policy issues in respect of the continuation of Australia in nuclear fuel cycle activities and had 15 recommendations. These included that there was no justification for "a decision not to develop Australian uranium mines", another recommendation stated that "development of Australian uranium mines should be strictly regulated and controlled"; and a third recommendation deferred a decision into development of the "new" Northern Territory mines "until the second Report of this Commission is presented". The Inquiry made no comments in relation to the continuation of the Mary Kathleen operation in Queensland.

The second report (RUEI, 1977b) contained eleven pages of recommendations, all related to the proposed development of the Ranger uranium mine. Amongst the list were recommendations that the Australian Government appoint a Supervising Scientist to exercise a supervisory and integrating role over the environmental research and monitoring programs that would be agreed upon by a Co-ordinating Committee that would also be established. The day to day regulation of the mining operation would remain a responsibility of the Northern Territory Government. The initial authority to mine was issued by the Australian Government under the Atomic Energy Act, despite a recommendation from RUEI that this should not be done. The Authority, issued under s.41 of the Act, also included 44 Environmental Requirements (ERs) which covered environmental aspects of the operation including appointment of suitably qualified staff, use of Best Practicable Technology

(BPT) which was itself defined in the ERs, water management issues and the mandatory return of tailings to mined-out pits at the cessation of mining. The Authority also required the mining company (ERA) to submit annually a costed plan of rehabilitation for assessment by the NT and Australian Governments. Once this plan had been approved by the governments ERA were required to deposit to a trust fund a cash amount at least equal to the approved rehabilitation estimate.

Current Operations

At present (in 2004) there are three active uranium mining operations in Australia.

There are two operations in South Australia, both regulated primarily by the South Australian State Government and located in the arid desert environment in the northern part of the state.

The more established is the Olympic Dam underground mine owned and operated by WMC Resources Limited, which has been in production since 1988. This site is located about 560 km north-north-west of Adelaide and contains the largest known uranium ore body in the world. The ore body is polymetallic with copper as the main source of revenue (75%), followed by uranium (20%) and silver and gold (5%). Uranium production for 2002 was announced as 2867 tonnes U_3O_8more recent operation is the Beverley uranium mine located about 520 km to the north of Adelaide. This is an in-situ leach (ISL) operation that has been in production since November 2000. The production for 2002 was announced to have been 746 tonnes of U_3O_8.

In addition there is a second in-situ leach project under development at the Honeymoon project in South Australia which is still to enter full production after a number of years of trials.

The third site is located in the Northern Territory about 250 km east of Darwin, in the wet/dry tropics. The open cut Ranger mine is owned and operated by Energy Resources of Australia, which in turn is majority owned by Rio Tinto Australia. Ranger production for 2002 was reported as 4470 tonnes U_3O_8, representing about 12% of world production. This is the longest running uranium mine of the three having commenced operations in 1980.

The regulatory regime at Ranger is perhaps one of the most complicated in the world involving both the Northern Territory and Australian Governments at the site level and on almost a day-to-day basis. In the cases of the other two mines the Australian Government's involvement is much more at arm's length.

Also in the Northern Territory is the Jabiluka Project. This is an underground prospect owned by ERA and located some 22 km to the north of their existing Ranger mine. Initial development of the Jabiluka project commenced in 1996 and some 2000 metres of underground workings were created. However, issues over final EIA approval for ERA's preferred development option, the permission of Aboriginal Traditional landowners and an undertaking by ERA not to run two mines concurrently resulted in the site being placed on long term care and mainte-

nance in late 2003. This program included the backfilling of the underground workings and removal of virtually all the above ground infrastructure.

Regulatory Regimes

In Australia, as previously stated, the regulation of mining activities lies within the jurisdiction of the States and Territories, particularly with reference to the issues of health and safety for the workforce. Environmental management issues are similarly regulated except in the Northern Territory where the Australian Government has an additional specialist group to oversee environmental matters for uranium mining. The Supervising Scientist Division of the Department of the Environment & Heritage comprises two branches with the common aim of ensuring that the environmental management of uranium mines within the Alligator Rivers Region (ARR) is of the highest standards and the environment remains protected from any adverse impacts as a consequence of mining. The two branches are the Office of the Supervising Scientist (OSS), which deals with matters of policy, supervision and audit in relation to environmental management at uranium mines within the ARR; and the Environmental Research Institute of the Supervising Scientist (***eriss***) which carries out research the areas of environmental radioactivity, ecosystem protection, hydrological and ecological processes and ecological risk assessment all in relation to uranium mining in the ARR.

Australian Government Legislation

The Australian Government has the power to regulate uranium mining through a number of instruments. The most significant seven are briefly described below:

- *Atomic Energy Act 1953*
  This Act established that ownership of all uranium minerals found in Australian territories is vested in the Australian Government. An authority established under s.41 of this Act provides for the Ranger uranium mine to operate. The prime importance of this Act is that attached to the s.41. Authority are the Environmental Requirements (ERs) which place environmental management obligations on the operators of the Ranger uranium mine. This act is administered by the Department of Industry, Tourism and Resources (DITR).
- *Environment Protection and Biodiversity Conservation Act 1999*
  This Act replaced the previous *Environment Protection (Impact of Proposals) Act 1974*. All authorities and approvals granted under the previous legislation are still valid. The former Act was the instrument under which all present uranium mines were originally approved and so the new Act is not retrospectively applied to those operations. Should there be any major changes to existing operations requiring a change in a current approval then the new Act would be triggered. The new Act (EPBC Act) is the source of the Australian Govern-

ment's legislation in respect of the mining, use and disposal of uranium. A list of six environmental issues of national importance includes "nuclear actions" amongst which are listed:

> *"(d) mining and milling of uranium ore*
> (f) de-commissioning or rehabilitating any facility or area in which an activity described in paragraph (a), (b), (c), (d), or (e) has been undertaken."

Clearly the mining of uranium is covered here. The main interest is that under the EPBC Act such activities may only proceed after approval has been given by the Minister. Such approval may only be granted after an environmental assessment has been made of the proposed action using an approved process and a satisfactory outcome obtained. This act is administered by the Department of the Environment & Heritage (DEH)

- *Nuclear Non-Proliferation (Safeguards) Act 1987.(DITR)*
  This legislation is to ensure the security of nuclear materials within Australia
- *Environment Protection (Alligator Rivers Region) Act 1978 (DEH)*
  This Act arose from the recommendations of the Ranger Uranium Environmental Inquiry held in 1976-1977. This Act provides for the administrative arrangements between the Australian and Northern Territory Governments which enable the Australian Government's oversight of uranium mining operations in the region. Also this Act establishes the Supervising Scientist and associated facilities. The Act also establishes two committees relevant to uranium mining activities within the region:
  - The Alligator Rivers Region Technical Committee (ARRTC) which is to review monitoring and research programs carried out in the region that are related to uranium mining; and
  - The Alligator Rivers Region Advisory Committee (ARRAC) which serves as a forum for information exchange on environmental issues in relation to uranium mining in the region; ARRAC also facilitates communication between all the major stakeholders including mine operators, Aboriginal Traditional Landowners, representatives from various elements of the community and the two governments.
- *Australian Radiation Protection and Nuclear Safety Act 1998*
  This Act established the Australian Radiation Protection and Nuclear Safety Agency (ARPANSA), the statutory body responsible for the protection of the health and safety of people and protection of the environment from the harmful effects of radiation. In the main this Act deals with the transportation and storage of uranium and associated products as well as general issues of radiation protection.
- *Aboriginal Land Rights (Northern Territory) Act 1976*
  This Act establishes the Northern Land Council as a statutory body to represent the interests of the Aboriginal traditional landowners. This is of significance as the uranium mines in the ARR are all on land that has been acknowledge as being traditionally owned by various Aboriginal groups.
- *Customs (Prohibited Exports) Regulations 1958 under the Customs Act 1901*

> Export of radioactive materials, including uranium concentrates, requires an export licence. As there is no domestic market for these products this is a very robust control mechanism over uranium mining. In 2000 these regulations were modified such that the Australian Government was enabled to attach conditions to export licences, including environmental conditions. The export of uranium products for all mines presently operating are subject to the Environmental Requirements issued under the previous *Environment Protection (Impact of Proposals) Act 1974*.

In addition to the laws there are also three Codes of Practice issued by ARPANSA which deal with various aspects of radiation protection for human health and the environment. All three have relevance to the uranium mining industry. These codes were originally introduced through the Environment Protection (Nuclear Codes) Act 1978 but have been revised from time to time and the current versions are:

- Code of Practice on the Management of Radioactive Wastes from the Mining and Milling of Radioactive Ores (1982) ["waste code"]
- Code of Practice on Radiation Protection in the Mining and Milling of Radioactive Ores (1987) ["health code']
- Code of Practice for the Safe Transport of Radioactive Substances (1982) ["transport code"]

The "waste code" and the "health code" are currently under revision. The two codes are being combined into one document. The working title is "*Code of Practice and Safety Guide for Radiation Protection and Radioactive Waste Management in Mining and Mineral Processing*" and it is anticipated that the final draft will be available for public consultation early in 2004 with final publication anticipated before the end of 2004.

ARPANSA also publishes a set of recommendations : "Recommendations for limiting exposure to ionising radiation (1995)" which in effect replaces the previous "transport code".

All these ARPANSA publications have a regulatory function as compliance with their provisions, in whole or in part, is required as conditions of Authorisations and licences issued by the Northern Territory and South Australian Governments respectively in relation to the mining of uranium.

All of the foregoing regulatory apparatus applies to uranium mines wherever they are located in Australia. In the following sections the additional legislation applicable in each of the two jurisdictions will be described.

The relationship between the Governments of Australia and the Northern Territory is defined by a set of Working Arrangements (WA) which clearly set down the areas of responsibility for each participant in the arrangement. Whilst the Northern territory Government is the regulator on a day-to-day basis the WA provide for the Australian Government to have the power to direct the NT Minister to a course of action if his proposed action is not in agreement with advice from the Supervising Scientist. The WA are currently in the process of being revised at the time of writing in 2004.

Northern Territory

Legislation and regulation

The Northern Territory government has the overall responsibility for the regulation of uranium mining within its jurisdiction, at the operational level. The activities are regulated primarily by the Department of Business, Industry and Resource Development (DBIRD) through administration of the *Mining Management Act 2001 (NT)*. This act deal with all the operational issues related to mining, apart from the issue of title to the site which is regulated through the *Mining Act 1982 (NT)*. The Act requires the mining company to produce a Mining Management Plan, at least annually, which contains the schedule of activities for the next 12 months. This schedule must include, *inter alia*, the monitoring programs proposed by the operator, reporting regimes, future development plans, details of management systems for health and safety issues and for environmental management and interpretation of previous environmental data.

In order to operate a uranium mine in the Northern Territory the mining company must have four valid authorisations:

1. An Authorisation to mine which has been granted in recognition of the operator having a Mine Management Plan (MMP) approved in accordance with the requirements of the Mining Management Act and any additional conditions specified by the NT Minister. In the specific case of uranium mining, the NT Minister must also consult with the Australian Government Minister and act in accordance with any advice provided by that Minister before issuing the Authorisation.
2. The operator must have either:
   - At Ranger -an Authority to mine issued under s.41 of the Atomic Energy Act (1953)
   - At Jabiluka – a Mineral lease issued under the *Mining Act (1982)*.
3. The operator must hold an export licence for radioactive material issued under the *Customs Act 1901* by the Minister for Industry, Tourism and Resources..
4. The operator must also have approval to export uranium from the relevant Australian Government Minister. At present this is the Minister for Resources, but in the future, for any new developments, it would be the Minister for the Environment.

Environmental management

The fact that both the Ranger mine and the Jabiluka prospect are located in "windows" surrounded by the World Heritage listed Kakadu National Park provides an explanation for the intense interest in environmental management at both sites. The close proximity of the Magela wetlands and the floodplains of the Alligator

River systems has led to the development of an intense regime of environmental monitoring and supervision for the mining operations. From the beginning the s.41 authority at Ranger was issued with 44 Environmental requirements (ERs) attached. A similar set of ERs was also found as attachments to the relevant NT legislation and an agreement to mine issued under s.44 of the *Aboriginal Land Rights Act (NT) 1976*. The ERs were in place for 26 years until the original s.41 Authority expired. The process of renewing that Authority provided an opportunity to change the ERs and the stakeholders took advantage of the situation to modify them in the light of advances in technology and more than 20 years operational experience. The revised list of 19 ERs cover the same range of issues but are less prescriptive and thus allow for "best practice" to be continuously improved rather than remain as a static prescription, as in some of the original ERs.

At Jabiluka the ERs are still the original set of 38 as the opportunity to update them has not yet arisen. However, should the project go ahead the expectation is that there would be an opportunity to revise the Jabiluka ERs to mirror the improved set in use at Ranger.

Monitoring

At the ERA sites there is an environmental monitoring program undertaken by the company, and approved by the regulator in consultation with major stakeholders. In addition there is a comprehensive check monitoring undertaken by the regulator and a basic independent monitoring program undertaken by the Supervising Scientist. Monitoring data are reported to the authorities monthly, or more frequently if required, for example in the event of any authorised water release. The whole monitoring program is discussed and interpreted, including analysis of trends, in a major report submitted annually. This report is required to be submitted within 6 weeks of the main creeks ceasing to flow during the dry season. This usually means reporting around 1 August each year, which is in time for the document to be discussed at the August meeting of the Alligator Rivers Region Advisory Committee (ARRAC), the prime forum for data exchange and discussion between stakeholders. ARRAC meets twice a year in August and December to discuss the data from the previous wet season and the preparations for the following wet season respectively.

Check monitoring data from the NTDBIRD are interpreted and reported every six months and are also discussed at the ARRAC meetings.

The data from the Supervising Scientist's monitoring program are published to a site on the internet each week, whilst the creeks are flowing. In addition the data are interpreted and discussed at the regular ARRAC meetings.

South Australia

Legislation and regulation

In South Australia the application of Australian Government regulation is broadly similar to that in the Northern Territory with the marked exceptions of the absence of the Supervising Scientist and any reference to the *Aboriginal Land Rights (NT) Act 1976.* There are two operating uranium mines. The in-situ leach mine at Beverley and the underground mine at Olympic dam. In both cases the mine operator is still required to possess two approvals from the Australian Government, as follows :

- An export licence for uranium issued under the *Customs Act 1901*
- An approval from the relevant Australian Government Minister to export uranium

Remaining legislative requirements arise from South Australian legislation and include :

- A licence to mine and mill radioactive ores issued under the *Radiation Protection and Control Act 1982 (SA)*
- A mining lease issued under the *Mining Act 1971 (SA)*
- Permits for all water wells drilled, issued through the *Water Resources Act 1997 (SA)*

The mine operator must also comply with requirements of other legislation which can have environmental implications including:

- Mines Works Inspection Act 1920 (SA)
- Radiation Protection and Control Act 1982 (SA)
- Environment Protection Act 1993 (SA)
- Dangerous Substances Act 1979 (SA)
- Occupational Health Safety & Welfare Act 1995 (SA)

In addition, for the Olympic Dam mine there is an over-arching piece of specific legislation, the *Roxby Downs (Indenture Ratification) Act 1982 (SA)* which governs many aspects of the operation. The indenture is primarily in place to provide security of tenure for the operator as well as protecting the interests of stakeholders including the State, the workers, the environment, the public at large and the local community. The indenture also protects financial interests of relevant parties through the setting of royalty rates for the various outputs from the mine. The indenture has the effect of modifying several state laws. In particular the operator has to apply to only one source for any permit, authorisation, licence etc related to the project - the Minister for Mines and Energy. There are special exemptions and conditions for the project issued under the *Noise Control Act 1977,* the *Aboriginal Heritage Act 1979* and the W*ater Resources Act 1981,* all SA legisla-

tion. These special conditions have also been applied to legislation which came later, including specifically *the Environment Protection Act 1993 (SA).*

The absence of any role for the Supervising Scientist means that the level of environmental supervision by the Australian Government is considered in some quarters to be less than at the mines in the Alligator Rivers Region. Under clause 11 of the Indenture the mine operator is required to obtain state government approval for an environmental management program, including an associated reporting regime, and the plan must be reviewed every three years. In addition the operator must provide an annual environmental interpretive report describing the outcomes of the pervious year's monitoring program as well as quarterly monitoring reports for submission to the quarterly meetings of the Environmental Radiation Review.

The formal involvement of the Australian Government at both the Beverley and Olympic dam mines is through membership of the stakeholder Consultative Committees. These are known as the Beverley Environment Consultative Committee (BECC) and the Olympic dam Environment Consultative Committee(ODECC). Both committees are required to meet very six months to review the environmental performance of the respective operations. The committees have no regulatory power but function primarily as review bodies.

As mentioned earlier, although there is an Environmental Protection Act in South Australia it is preceded by the Indenture in the case of operations at Olympic Dam. The EP Act is applicable to the Beverley operation and prescribes a general duty of care to the operator not to carry out activities that could result in pollution of the environment, all reasonable care and precautions having been taken. The Environment Protection Agency (EPA) is the authority for the issuing of licences in respect of discharges from mines including all gaseous discharges.

Conclusions

The environmental regulation of uranium mining in Australia is comprehensive at all three active minesites. The regulation involves both the Australian and State governments at differing levels depending on the locations. The most intensive regulation may be seen in the Alligator Rivers Region of the Northern Territory where the Australian Government has an oversight role but is also involved in routine environmental monitoring. The outcomes obtained in terms of environmental performance at all Australia's uranium mines is arguably as good as can be achieved through the implementation of best practice environmental management. The systems may be complex but the successful results speak for themselves.

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