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EXPLORATION EXTRACTION AND MILLING**

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INTRODUCTION

AREVA is at present the world's largest, integrated company in the nuclear cycle. It is an international company with a presence in over 30 countries. AREVA and affiliate companies have been involved in the construction of 103 of the world's 438 operating nuclear reactors and presently services more than 80% of this global fleet. AREVA's involvement in uranium exploration and mining globally has spanned more than 6 decades and thus, the company has a unique depth of experience in this sector.

AREVA (and its antecedents such as Afmeco) has been actively exploring the Australian continent since 1968. It has been involved with significant discoveries of uranium deposits during this time (Oobagooma in WA and Ben Lomond in QLD). AREVA resources Australia (ARA) has been based in Adelaide, South Australia (SA) since 2006 and is focussed 100% on uranium exploration in Australia. The Adelaide team has comprised a team of up to 15 geoscientists of Australian and French nationality/training. During the period 2006-2015 the company expended in excess of A\$50 million on grassroots exploration activities in SA, WA, NT and QLD. Of this, approximately \$30 million of this has been expended in South Australia. During this time the company has drill tested over 16 individual projects within a portfolio of up to 130 tenements, covering in excess of 40,000 square km of sedimentary basins. The main target has been ISR-amenable sandstone hosted "roll front" deposits of the Beverley/4 Mile type or Kazakhstan model.

AREVA has acquired a depth of experience in Mining Act process and regulatory regimes across four States of Australia during the past decade. This includes indigenous and non-indigenous land access and work approval processes in order to undertake exploration drilling programs. This paper describes some of ARA's return on experience during this phase of uranium exploration and makes recommendations for how further uranium exploration and mining might be encouraged, expanded and better facilitated within SA.

AREVA also presents some ideas on how it thinks South Australia may differentiate itself from other States of Australia to assist it in expanding its position as a leading global uranium exploration and mining destination. AREVA aspires to become a uranium miner in Australia and will maintain its presence in the country moving forward.

CONCLUSIONS and RECOMMENDATIONS

AREVA believes that South Australia to be a world class destination for uranium exploration and mining due to its mineral endowment and “mining-friendly” culture. The State’s geology is favourable for the occurrence of several styles of uranium deposits and much of the State is under-explored. That said there are several ways in which AREVA believes the State of South Australia could attract additional investment in uranium exploration and mining.

These are summarised in the following recommendations:

1. Ensure consistent and stable uranium mining policies across Government parties to provide long term investor confidence necessary for the development of uranium mines
2. Continue to promote mineral exploration through various State initiatives specifically targeting the discovery of uranium deposits such as
 - a. PACE co-funding
 - b. Pre-competitive targeted datasets (e.g. geophysics for IOCG-U or palaeochannel uranium deposits)
 - c. land releases in prospective areas
 - d. expanded research into deposit styles
3. Ensure turnover of exploration ground by not allowing companies to “freeze” exploration acreage by holding tenements without meeting commitments; promote opportunities
4. Streamline and assist explorers and miners to work through Government imposed processes and compliance red tape
5. Dedicated facilitation officers within Government who have KPIs based on tangible outcomes with companies seeking approvals for uranium exploration and mining
6. Provide granted exploration tenements which have land access pre-negotiated
7. Consider promoting uranium exploration opportunities on granted tenements held by miners/explorers not targeting uranium – or consider uranium-only tenements similar to petroleum titles

AREVA believes that South Australia is uniquely positioned to promote itself further as a world class, uranium-friendly exploration and mining jurisdiction. The company herein offers its expertise to the Royal Commission on any aspect of this submission at any time.

OPPORTUNITIES FOR NEW OR FURTHER EXPLORATION ACTIVITIES

Are there opportunities for new or further exploration activities directed at locating new mineral deposits, or to better understand existing deposits containing economic concentrations of uranium or thorium in South Australia? What specifically are those opportunities? What might understanding those opportunities be reasonably expected to reveal? What needs to be done to understand their potential more clearly?

There are almost certainly additional opportunities to locate economic deposits of uranium (U) within South Australia (SA). The state of South Australia is large and is comprised of favourable geology for a variety of U deposit styles. There remains significant potential for the discovery of additional resources around known deposits (brownfields); for example the Olympic Dam resource increases during the period 2005-2010, the Four Mile Northeast deposits recently announced by [Alliance Resources](#), which have world class resource potential and also at the [Carrapateena](#) copper-gold-uranium deposit where significant additional discoveries have been made by Oz Minerals at surrounding prospects such as Khamsin and Fremantle Doctor in recent years.

There are also significant opportunities for the discovery of new uranium deposits by grassroots exploration activities. These new, greenfield discoveries will most likely be located beneath the vast areas of alluvial and wind-borne cover sediments which blanket the geology of more than 60% of the land surface of SA. The deposit styles which AREVA considers most likely to be found are the IOCG-U and sediment-hosted, REDOX-styles, although AREVA itself will not pursue such deposit styles in the near future given the difficulty and expense required to targeting them.

Olympic Dam is the best example of IOCG-U known globally, however Prominent Hill and Carrapateena are also examples of this style of U deposit which have significant, unexploited uranium resources. There are other occurrences of IOCG-U mineralisation which have been identified whose uranium prospectivity may remain relatively untested (e.g. Vulcan Prospect, Tasman resources. Refer [SA Uranium Information Brochure M50, DSD](#)).

South Australia is host to a world class province for sediment-hosted, REDOX style deposits within the Frome Embayment. The Beverley and Four Mile deposits are the pedigree for this province with other well-known deposits and prospects already identified.

There is also the potential for the occurrence of unconformity-style uranium deposits in SA. The best examples of this class of deposits occur in the Athabasca Basin in Canada, e.g. Cigar Lake and McArthur River deposits. The Ranger and Jabiluka deposits in the Northern Territory of Australia are also examples of this style of deposit. This style of mineralisation is yet to be identified in SA, however the southern Gawler Craton and Stuart Shelf hosts favourable geology analogous to that of the Athabasca Basin. AREVA has, in the past attempted to target this style of deposit, however it abandoned these projects in favour of ISR-amenable targets due to the difficulty and expense required to target this deposit type.

1.2 ECONOMIC CONDITIONS NECESSARY FOR THE FINANCIAL VIABILITY OF NEW EXPLORATION ACTIVITIES

What are the economic conditions including those in resource markets that would be necessary for the financial viability of new exploration activities directed at locating uranium or thorium? Aside from economic conditions, how do factors such as access to investment, skills training, taxation, research and development, innovation and regulation, bear on decisions to invest in new activities? What is most important?

AREVA considers that the economic conditions required are where market demand exceeds supply (= higher price of uranium). This 'market risk', to some extent can be mitigated by targeting lower extraction

cost deposits. For example the extraction costs for hard rock uranium mining at Ranger in the Northern Territory, or Canada are much higher than the costs at ISR mining operations like Four Mile, in SA or in Kazakhstan. Hard-rock uranium mining in the current market is only economic for deposits of high grade, such as those in Canada (e.g. Cigar Lake and McArthur River) and those whose capital costs have already been repaid. Until uranium prices are approaching levels required to develop new mines, investment in exploration activities will remain suppressed. Luckily, SA has a good endowment of ISR-amenable deposits such as Beverley-Four Mile, with reasonable prospects of more deposits of this style being discovered in the coming years.

AREVA Resources Australia (AREVA) has expended in excess of A\$50M during the last ten years in the search for (mostly) ISR-amenable uranium deposits. This work has been undertaken in all uranium “friendly” States of Australia, including SA (approximately A\$30M). AREVA consciously took a decision to not explore for Olympic Dam-style (IOCG-U) deposits due to the high costs associated with exploration and exploitation of such deposits and the multi-commodity nature of them.

Beyond market conditions influencing exploration investment, the State of South Australia may be able to attract more investment in uranium exploration by ‘making’ SA a less expensive State to explore. AREVA considers Australia to be one of the most expensive countries in which to explore for uranium. The costs which make Australian exploration more expensive than other prospective countries include the following:

1. Very high labour costs (including the high cost of professionals)
2. Delay costs due to bureaucracy (regulation and compliance)
3. Delay costs associated with time taken to get on the ground to commence exploration programs due to Native Title and heritage agreement making, Non-indigenous landowner compensation agreement making
4. High costs and expectations of Aboriginal groups for exploration (equivalent expectations to mining)

In AREVA’s opinion it is access to land for exploration and mining which is most important. Without access to land and without ‘social licence’, no decision to mine uranium is conceivable.

1.3 ENCOURAGING FURTHER EXPLORATION

What might be necessary to encourage further exploration for uranium and thorium? What might be done to promote viability? Are existing government plans sufficient? Could support be provided in other ways and, if so, how could that be done most effectively? Is there a sufficient availability of information from exploration activities previously undertaken?

Several ideas and concepts are dot-pointed below in response to the question:

- Ongoing and increased State (e.g. PACE) co-funding for geophysics and drilling programs would encourage more active exploration, especially during market downturns like at the time of writing where companies (especially juniors) have problems raising capital to explore for uranium during the current market downturn.
- Pre-competitive targeted datasets (e.g. geophysics for IOCG-U or palaeochannel uranium) would also help promote SA’s prospectivity, particularly if there was post-survey value adding by geological experts. PACE co-funding could go hand in hand with areas/regions of the data releases.

- An enhanced understanding of the global geological framework of SA should be an ongoing part of the work by the State Geological Survey (as we believe it is). Continually improving data such as the depth to basement and interpreted basement geology are key to the generation of new targets and projects for uranium exploration.
- Exploration land releases in U-prospective areas, perhaps associated with the pre-competitive data releases.
- Consideration could be given to the creation of uranium-only exploration permits in order to reduce competition for ground. This concept may require additional regulations, but may free up significant areas of land, for example in the Bernagarie Ridge area of the Frome Embayment, west of Broken Hill (but still in SA) where uranium explorers are in competition with base and precious metal explorers.
- Along the same theme, the State may also consider promoting deals to explore and exploit uranium on tenures held by non-uranium explorers/miners.
- State funded research into uranium deposit styles with involvement from current or ex-industry geoscientists. This is one area where Australia as a whole is falling behind other countries such as France and Canada, both of whom have very strong uranium geology research units in various universities (e.g. CREGU, Nancy, France).
- One other way the State could promote opportunities to access prospective ground is by ensuring the 'turnover' of exploration ground. One way to do this is by not allowing companies to "sit" on tenements (for example tenements in the region of Four Mile or in the vicinity of Olympic Dam or other uranium-prospective regions which may have not been worked for many years). The State often grants an unofficial reprieve to companies, from reducing or dropping ground in a tenement package if expenditure has not been met in a given year; if the holder has a sufficiently valid excuse, such as having spent more than the minimum for an adjoining tenement. If the State were more strict and transparent with the application of the regulations, it would improve the confidence of explorers in their ability to acquire prospective ground and encourage new investment and competition.
- A very significant way that the State of SA could differentiate itself from other States is by streamlining the land access aspects of the exploration tenement process. The State of SA could consider Government control of land access processes so that granted exploration tenements are granted with all land access "included". The Government would be the lead stakeholder for negotiations during the application period and would not benefit in any way until the tenement is granted and on-ground activities commence. A revised, more predictable land access regime with fixed timelines, access to mediation and determination and preferably with fixed (and indexed) compensation amounts for various activities would be very attractive for explorers who all need to be able to budget time and limited funds. For example \$X per drill hole per week active, or \$Y per line km of geophysical survey.
- The present Department of State Development is one of the best in Australia to work with from a proponent's perspective. The Department of State Development's online delivery system for geoscience data and historic technical reports (SARIG) is one of the best in the country (and in fact,

the world) and certainly assists explorers in the generation of new projects. This should continue to improve and facilitate the data acquisition and interpretation for all proponents within SA.

- There is, however significant room to streamline and assist explorers and miners to work through Government imposed processes and compliance red tape (e.g. PEPRs). This could take the form of dedicated facilitation officers within Government who can assist proponents to achieve tangible outcomes whilst seeking approvals for uranium exploration as well as coordinate the various departments involved (e.g. water, environment, Native Title etc).

1.4 EXISTING PROVEN RESOURCES

Are there either existing proven uranium or thorium resources which might feasibly be developed? Where are they? What specifically needs to be done to develop these? How long would the development process take?

There are demonstrable uranium resources in the Beverley-4-Mile project area and those at Olympic Dam. At the time of writing the Four Mile (and Four Mile Northeast) resources are being held back from production due to a breakdown in the joint venture partnership (General Atomics and Alliance Resources), and possibly the low commodity prices. The uranium resources estimated at Olympic Dam are huge ([2,490,000 tonnes U₃O₈](#)) and will be developed over the coming decades in conjunction with the expansion of the mine there (refer to WMA website section on Olympic Dam at: <http://www.world-nuclear.org/info/Country-Profiles/Countries-A-F/Appendices/Australia-s-Uranium-Mines/>). The IOCG-U deposits at [Prominent Hill and Carrapateena](#) also contain significant proven uranium resources which are not presently exploited.

Should market conditions emerge with uranium prices above \$60-80 per pound, such mine expansions may conceivably take place quite quickly as these existing operations are capable of handling higher production rates than at present.

There are other uranium resources in SA which may become viable in a higher U-price market. These might include the Honeymoon deposit (Uranium One) and the nearby Junction Dam prospects (Marmota Energy). The table and map below (copied from the Department of State Development's 2015 booklet entitled [Uranium in South Australia](#)) lists the key, known resources in SA with the exception of the known resources at Prominent Hill and Carrapateena. Uranium production from these deposits may be feasible in the future subject to additional studies and improved market conditions.

OPERATING MINES

MINE	OPERATOR	JORC RESOURCE	U ₃ O ₈ RESOURCE (tonnes)	DEPOSIT TYPE
Olympic Dam*	BHP Billiton	9,550 Mt at 0.026%	2,483,000	Breccia
Beverley	Heathgate Resources	7.7 Mt at 0.27%	21,000	Sandstone
Beverley North	Heathgate Resources	2.2 Mt at 0.18%	4,000	Sandstone
Four Mile	Quasar Resources Alliance Resources	9.7 Mt at 0.33%	32,000	Sandstone
Honeymoon (Care & Maintenance)	Uranium One	4,192 Mt at 0.109%	4,571	Sandstone
TOTAL OPERATING MINES			2,544,571	

DEVELOPING PROJECTS

PROJECT	OPERATOR	JORC RESOURCE	U ₃ O ₈ RESOURCE (tonnes)	DEPOSIT TYPE
Junction Dam	Marmota Energy Ltd Teck, PlatSearch, etc.	4.36 Mt at 0.0437%	1,905 eU ₃ O ₈	Sandstone
Samphire	Uranium SA	64.5 Mt at 0.0230%	14,850 eU ₃ O ₈	Sandstone
Crocker Well	Sinosteel Corporation	18.84 Mt at 0.03%	5,290	Vein
TOTAL DEVELOPING PROJECTS			22,045	



1.5 DEVELOPING NEW MINE SITES OR EXPAND EXISTING SITES

What would be necessary to develop new mine sites or expand existing sites? To what extent are those factors affected by the ability to extract commercial resources other than uranium? What are the necessary factors that might stimulate an expansion in activity? What is the evidence that those factors have been relevant to an expansion in activities elsewhere?

Expansion of existing mine sites requires the right economic environment in the first instance. In the case of a uranium-only mining operation such as Four Mile, SA, expansion will be driven by market demand (U price increase). In the case of poly-metallic deposits such as Olympic Dam, or Carrapateena, the viability of expansion or development will also depend upon the economics of the principal minerals being mined; mostly copper. Streamlining the permits and approvals processes may also assist such expansions, as the time and cost of these processes are significant to feasibility (*pers. comm.* Heathgate Resources).

1.6 FACTOR INPUTS (INCLUDING SKILLS AND TRAINING, RESEARCH, EDUCATION AND INFRASTRUCTURE)

Does more need to be done now and in the future with factor inputs (including skills and training, research, education and infrastructure) which are relevant to decisions made to invest in new projects or to expand those that already exist? What capabilities and capacities would be required for the development of new projects? What is the evidence that any specific deficiency influences new investment? What needs to be done to address any deficiency and how would it be done?

The ongoing issue here is that uranium, like other commodities is cyclical. Uranium is also political and the 3 Mine Policy which was in place for approximately 30 years resulted in a huge loss of technical skills in uranium geoscience, mining, ore processing and radiation protection. During the uranium boom between 2005 and 2011, it was clear that Australia's 'pool' of skills in this field was lacking. AREVA attempted to recruit local geologists with the geoscience skillsets required to perform uranium exploration; but it became rapidly evident that few Australian geologists were suitably qualified in comparison to those from overseas (e.g. France). Consequently AREVA employed more than 50% of its geoscience team from overseas on 457 visas. Despite the recent boom in uranium exploration and mining in Australia, AREVA believes that the industry will yet again face difficulty in this area during the next upswing in the cycle. One way in which the State of SA could help avoid such skills shortages is to create a dedicated uranium geoscience and engineering faculty at an SA university. Such a school could ensure a supply of suitably qualified professionals to a future uranium mining industry.

1.7 INCREASED DEMAND FOR URANIUM IN THE MEDIUM AND LONG TERM

Is there a sound basis for concluding that there will be increased demand for uranium in the medium and long term? Would that increased demand translate to investment in expanded uranium production capacity in South Australia (bearing in mind other sources of supply and the nature of South Australia's resources?).

Reactor requirements, expressed in natural uranium equivalent, were about 66,000 metric tons of uranium in 2014 (source: WNA 2013), a slight increase from 2013 led in particular by demand from Asia (e.g. China), after declining from 2010 to 2013 due to the shutdown of Japanese and German reactors and the closure of some US reactors,.

Supply consists of:

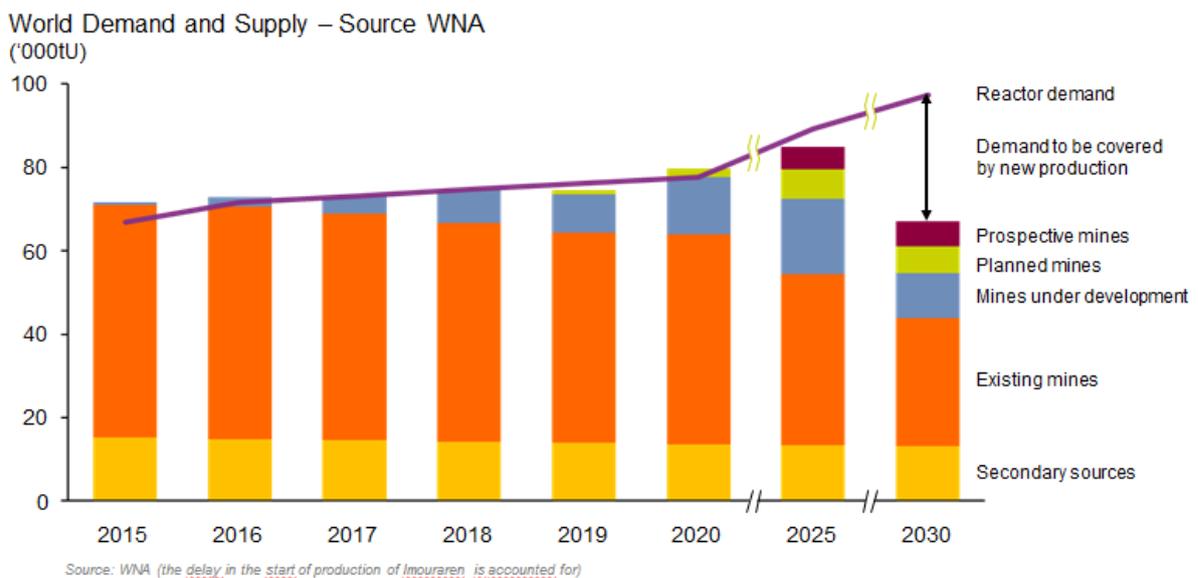
- mining production, which was around 56,000 metric tons of uranium, down from 2013 due to reduced production at existing mines and projects put under care and maintenance (e.g. Kayelekera, Malawi or Honeymoon, SA);
- secondary resources, consisting of highly enriched uranium (HEU) from dismantled Russian and US weapons, materials recovered from used fuel recycling, US Department of Energy uranium inventory market-out, the re-enrichment of tails and uranium from underfeeding. Despite the end in 2013 of the HEU program, in which AREVA participated for several years, secondary resources – including uranium from underfeeding – should continue to play a role in the market in the coming years.

The spot market, which represents about 15% of uranium supply, weakened in the summer of 2014 to \$28 per pound. It recovered in the fall, reaching \$44 per pound. These relatively low levels reflect an imbalance between supply and demand, currently offset by opportunistic purchases and inventory-in. The surplus of materials available on the market did not push to the signature of multiyear contracts in 2014, with the result that the average of long-term indicators stood at \$49.50 per pound at the end of 2014, compared with \$50 per pound at the end of 2013.

Since 2012, with the decline of market indicators, producers have announced numerous project postponements and the closure and/or mothballing of producing mines (e.g. Kayelekera in Malawi and Honeymoon in SA). This restructuring is expected to continue in the coming months.

Longer term, the market is still expected to grow, with demand 35% higher in 2025 than in 2014 according to the World Nuclear Association (WNA), in particular with the restart of the Japanese reactors and growing reactor requirements from the Chinese nuclear program. Rising demand is expected to raise market prices and enable new projects to be launched.

The latest data from the World Nuclear Association members report should be consulted for more detailed market information. The chart below presents a chart of uranium supply and demand for uranium beyond 2015 based on these data, indicating that additional uranium production will be required from approximately 2021.



Longer term, the demand for uranium will depend upon how quickly new reactor builds are rolled out by countries such as China, and India. Indeed, if countries go down the path decarbonisation of their energy sources and select the nuclear path, then demand may grow much more rapidly than presently predicted.

1.8 RISKS FOR THE HEALTH AND SAFETY OF WORKERS AND THE COMMUNITY

Would an expansion in extraction activities give rise to new or different risks for the health and safety of workers and the community? If so, what are those risks and what needs to be done to ensure they do not exceed safe levels?

No; the uranium mining-specific risks are mostly are centred on radiation exposure. These risks are well understood and are successfully managed by existing operations. Any expansion in the uranium extraction industry (mining) should have zero additional health and safety risks if they are managed in a responsible manner which existing laws and regulations ensure today.

1.9 INTERACTION BETWEEN THE INTERESTS OF EXPLORATION AND EXTRACTION ACTIVITIES AND OTHER GROUPS

Are the existing arrangements for addressing the interaction between the interests of exploration and extraction activities and other groups with interests such as landowners and native title holders suitable to manage an expansion in exploration or extraction activities? Why? If they are not suitable, what needs to be done?

The existing arrangements for managing the interests of mining companies, and indigenous and non-indigenous land holders are far from satisfactory for any of the parties involved. The processes through which the stakeholders engage are founded in legislation, and generally speaking, interaction between proponents and other stakeholders commences with a legalistic backdrop. Indigenous groups in particular, are often the subject of manipulation by their (legal or land council) representatives who often represent their own personal interests and beliefs above those of the group, and in doing so ‘stymie’ the process of genuine relationship building between proponents and indigenous groups. The same can happen with the representatives of non-indigenous landowners but less so. For example the penetrations of green groups such as Lock the Gate into areas where coal seam gas projects are proposed in the Eastern seaboard of Australia.

There is a significant opportunity for the State of SA to build a new land access regime which better addresses the genuine interests of all parties and at the same time removes the often excessive time delays (and costs) caused by these matters. One concept that the State may consider is not grant an exploration or a mining permit without providing the ability for the holder to undertake the activities that the licence purports to permit-immediately. That is, once an exploration tenement is granted, a company should be able to undertake activities contemplated under such a licence because all access agreements are in place. By way of example AREVA is of the understanding that an individual or company who purchases or leases land off the State for pastoral activities are permitted to undertake these activities immediately; so why is it not the same for exploration and mining companies who are granted permits and licences under the Mining Act? State-wide land access agreements which the proponents/stakeholders can simply sign onto are one possible solution, noting that these have been previously used with mixed success (e.g. Arabunna ILUA). AREVA believes that the State Government needs to be a more active stakeholder in all processes to do with land access.

AREVA believes that if SA can create and help facilitate fast and ‘fixed price’ land access that it would greatly increase SA ranking as an exploration destination.

1.10 ENVIRONMENTAL RISKS

Would a future expansion of exploration, extraction and milling activities create new environmental risks or increase existing risks? If so, are current strategies for managing those new risks sufficient? If not, in what specific respects? How would any current approach need to be changed or adapted?

No expansion of the exploration, mining or processing of uranium ores would inherently provide additional or increased environmental risks. AREVA considers that all of the environmental safeguards already built into existing State and Federal legislation are more than adequate to manage any environmental risks associated with increased activities in the uranium mining sector in SA.

1.11 RELEVANT LESSONS FOR THE CONTEMPORARY MANAGEMENT OF ENVIRONMENTAL IMPACTS THAT SHOULD BE LEARNED FROM PAST EXTRACTION AND MILLING PRACTICES

Given current techniques of extraction and milling and their regulation, what are the relevant lessons for the contemporary management of environmental impacts that should be learned from past extraction and milling practices?

AREVA defers to other, Australian miners with relevant local experience. AREVA, however, is able to and is more than willing to share its international experience on this subject should it be requested by the Royal Commission.

1.12 Economic activity benefits

If an expansion of exploration or extraction activities were viable, what would the estimated benefit be expected to be directly in those sectors, in terms of economic activity? Can growth in employment relating to the extraction or milling of uranium (alone or in conjunction with other commodities being extracted) be estimated? Is there evidence increased extraction and milling would create additional capabilities and capacities in related sectors? What are those sectors? What would their value be?

AREVA defers to more accurate, modelled data to be submitted by other party's on this question. It is a difficult task to predictively model employment etc for mines which do not exist yet and for deposits which remain undiscovered in regional areas. For example an underground mine has much different economic activity benefits to a large scale open cut mine. Until the deposits are identified, the locations known and the uranium market is more favourable, it is not a simple matter to accurately predict such benefits to an economy apart from direct royalties to the State of SA.

1.13 NEGATIVE IMPACTS ON OTHER SECTORS OF THE ECONOMY

Would an increase in extraction activities give rise to negative impacts on other sectors of the economy? Have such impacts been demonstrated elsewhere in Australia or in other economies similar to Australia?

AREVA does not believe there would be undue effect on other sectors of the SA economy. On the contrary, AREVA believes that other sectors of the economy should benefit from increased mining activities. Specifically support services would be needed for any new mining operation, especially if located in remote regions. AREVA has no examples from its global experience where other sectors of the economy have been significantly impacted by mining.