Submission to the Royal Commission into the Nuclear Fuel Cycle
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Executive summary

BHP Billiton welcomes the Royal Commission to explore South Australia’s involvement in the mining, enrichment, energy and storage phases for nuclear energy. We believe this is an important opportunity for the South Australian community to make informed decisions about the role of the nuclear industry in the State’s economic future, and we appreciate the opportunity to provide a submission.

BHP Billiton has had a long history in South Australia, and currently operates a world class copper, uranium, gold and silver asset at Olympic Dam in the State’s north. In FY2014, Olympic Dam produced approximately 184,000 tonnes of copper cathode, 4,000 tonnes of uranium oxide, 121,000 ounces of refined gold and 972,000 ounces of refined silver. In FY 2015 production was impacted following an electrical failure which caused a mill outage in January 2015.1

Olympic Dam has a strong track record in managing operational risks in relation to uranium extraction, transport, and waste management. We follow the World Nuclear Association uranium product stewardship principles, and comply with all state, national and international regulations governing the extraction, processing and transport of uranium.

The Company is proud of its contribution to the local, regional and State economy. In the 2014 financial year, we spent $450 million on contracts with South Australian businesses, of which $5.4 million was with Aboriginal-owned businesses. We also employed over 3,500 people at Olympic Dam and Adelaide, and contributed over $68 million in royalties to the State.2

BHP Billiton believes that the Royal Commission process is an excellent opportunity to understand and communicate the nuclear fuel cycle, and demonstrate the economic and social opportunities it presents.

In accordance with the Terms of Reference, BHP Billiton’s submission provides:

- An overview of our asset at Olympic Dam;
- Information on the uranium mining and milling process; and
- Suggested reforms that we believe will reduce barriers to entry to extraction and exploration of nuclear materials.

Our involvement in the Nuclear Fuel Cycle

BHP Billiton’s strategy is to own and operate large, long-life, low-cost, expandable, upstream assets diversified by commodity, geography and market. Olympic Dam is a core part of that portfolio.

Olympic Dam is the largest known deposit of uranium in the world and the largest producer of uranium in Australia. It is important to note that Olympic Dam is first and foremost a copper mine, and the economics of the project are primarily determined by copper production. The majority of uranium sales are made to electricity generating utilities principally in western Europe, North America and east Asia, typically sold under a mix of long-term and short-term contracts3.

As is described by the four issues papers, the nuclear fuel cycle follows a four staged process, starting with the exploration, extraction and milling of uranium ore into uranium oxide (or U$_3$O$_8$). The following stage includes conversion, enrichment, and fuel fabrication. Electricity generation comes next, after which the spent fuel is either reprocessed or disposed of at an appropriate location. As a

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1 In FY2015, Olympic Dam produced approximately 125,000 tonnes of copper cathode, 3,100 tonnes of uranium oxide, 104,000 ounces of refined gold and 724,000 ounces of refined silver.
2 More information can be found in our Environment and Protection Management Plan, see http://www.minerals.statedevelopment.sa.gov.au/mining/mines_and_quarries/olympic_dam
mining and resources company, BHP Billiton’s participation in the nuclear fuel cycle is limited to the production of uranium oxide, which is then transported to our customers who further process the product.

Consistent with our experience and the upstream focus of our portfolio, our submission will focus on Issues Paper 1: Exploration, Extraction and Milling. However, we also provide a short overview of our management of low level waste on site, in order to support Issues Paper 4: Management, Storage and Disposal of Waste.

A range of factors is important to the decision to invest in exploration for and extraction of mineral resources. However, government has an important role in fostering a positive environment for investment. We believe this Commission to be an important opportunity to seek changes that will reduce barriers to entry into uranium extraction and exploration.

We make two important recommendations:

1. **Reduction of Regulatory Complexity and Duplication:**
   - Environmental regulation in Australia is often unnecessarily complex, and there is significant duplication between State and Federal authorities in undertaking impact assessments and approvals.
   - Uranium extraction is subject to particularly high levels of regulation, in part due to the public perception that uranium mining is a particularly high risk activity.
   - In fact, uranium mining is well understood, and has a similar risk profile to the mining of other commodities. We are pleased to have the opportunity to share our experience of how we manage these risks, which we hope will provide an example of how economic benefits can be achieved without negative health, safety, environmental impacts.
   - BHP Billiton welcomes reforms to environmental regulation undertaken in recent years, particularly the development of ‘one stop shops’ for environmental approvals, and the move toward outcome-based assessments.
   - We recommend that the Commission considers the question of the removal of uranium mining from the list of Matters of National Environmental Significance in the Federal Government’s Environment Protection and Biodiversity Conservation Act.

2. **Better platforms for information sharing**
   - Access to geological data and learnings from earlier exploration or extraction activities can be an important factor in encouraging further investment.
   - BHP Billiton is proud to make its own contribution to these efforts, within the limits of commercial practicality, including sharing geological data with the State Core Library.
   - We believe there is an opportunity for Government to support a shared body of learnings from extraction and exploration in our sector, in order to lower barriers to entry. We recommend:
     - Expanding support for research to build a greater understanding of how uranium has been transported, precipitated, and potentially enriched in various geological provinces over time.
     - Expanded pre-competitive 4D mapping of the upper crust.
     - Further research into the broader economic challenges facing the extractives sector.
   - Information sharing should also include the broader community. As a participant in the nuclear fuel cycle, we believe in engaging transparently with stakeholders so that they can build an informed view of the sector and the key issues of our operations. At Olympic Dam we see the value of this open discussion through our weekly site tours. These tours are well
attended by interested members of the public, with over 1500 visitors in the past year. This allows people to see our project first hand, and ask questions directly of people working at a uranium mine, and is a valuable way for people to make up their own minds.

- This Royal Commission is an important contribution to the public debate, and there may be further benefits from ensuring ongoing access to trusted information about nuclear issues.
Response to Issues Paper 1: Exploration, Extraction and Milling

1.1 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 two types of uranium deposits in South Australia; primary and secondary. Uranium in the primary deposits is associated with other commodities such as copper, iron, gold, lead and zinc which occur in basement rocks. Basement is defined as the rocks underlying the Pandurra Formation or younger sedimentary sequences. Uranium in the sedimentary sequences is likely sourced from the basement rocks which have been subjected to geological processes (such as uplift, erosion, glaciation, heat and fluid circulation) post their original formation.

Uranium in secondary deposits is leached from the primary sources, and then transported in fluids along faults or other permeable zones (such as the contacts between units within the sedimentary sequences). It is then redeposited in basement rocks or the overlying younger sedimentary sequences. Uranium can be transported in fluids away from the primary sources for distances of a few millimetres up to possibly a few hundred kilometres.

Uranium occurs as U-bearing minerals (where U is a major element) and non-U minerals (where its concentration can vary from minor to trace levels). In the primary deposits, uranium occurs as uraninite, coffinite, brannerite but also in iron oxides (magnetite and hematite) and other alteration minerals such as chlorite, fluorite, sericite, carbonates, sulphates, apatite, Rare Earth Elements (REEs), feldspars, etc. In secondary deposits, uranium occurs as uraninite/pitchblende, coffinite, carnotite, uranophane, autunite, torbernite, etc.

There are opportunities for discovering new uranium bearing deposits by improving the scientific understanding of how uranium has been transported, precipitated, and potentially enriched in the various geological provinces in South Australia as a function of time. Specifically, the following questions may be worthy of further research:

- What are the ages of all tectonic events either in South Australia or near South Australia’s geographic borders which potentially lead to mobilisation of uranium within South Australia? This can be addressed by:
  - Dating uranium mineralisation within existing deposits (and drill core archived at the SA core library) and then correlating the ages with tectonic events regardless of the current perceptions of the near-field or far-field impacts of those tectonic events.
  - Re-examining all existing ages for rocks/minerals which have been determined by different isotopic systems but discarded due to ‘isotopic resetting’ and then correlating the ‘isotopic resetting’ ages with tectonic events.
- What are the ages/directions of regional scale fluid fluxes through the Pandurra formation? Was uranium deposited in the Pandurra at the time of deposition, or was the uranium added by a later fluid circulating event?
- What is the relationship between sub-vertical faults intersecting potential sub-horizontal fluid pathways, and the deposition of uranium?
- What are all of the potential uranium source rocks in South Australia? And what geological conditions (temperature and fluid chemistry) would be necessary to leach uranium from the source rocks?
- What are the geochemical vectors for primary and secondary uranium deposits?
1.2 What are the economic conditions including those in resources 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 investments, skills training, taxation, research and development, innovation and regulation, bear on decisions to invest in new activities? What is most important?

Exploration is an economically high risk activity. Fluctuations in the price of uranium, and to a lesser degree, market accessibility, drive the level of investment in uranium exploration. When investment funding in exploration is available, other factors become important. These include:

- Land access with fit-for-purpose regulations.
- Access to highly prospective uranium provinces.
- Innovative exploration methods/tools.
- New models of deposit formation.
- Access to high quality, pre-competitive exploration data.
- Availability of skilled professionals to conduct exploration activity.
- Exploration taxation incentives.

General investment in uranium mining may also be influenced by the cost of compliance with regulation. Under the current regulatory regime, BHP Billiton’s Olympic Dam operation complies with the following uranium related regulations:

**Commonwealth Government**
- Environment Protection and Biodiversity Conservation Act 1999 (EPBC Act)
- Nuclear Non-Proliferation (Safeguards) Act 1987
- Australian Radiation Protection and Nuclear Safety Act 1998
- Relevant Codes:
  - Code of Practice for the Safe Transport of Radioactive Material (2012)

**South Australian Government**
- Mining Act 1971
- Roxby Downs (Indenture Ratification) Act 1982
- Radiation Protection and Control Act 1982
- Radiation Protection and Control (Ionising Radiation) Regulations 2000
- Radiation Protection and Control (Transport of Radioactive Substances) Regulations 2003
- Criteria and Procedures for Recording and Reporting Incidents at SA Uranium Mines
- Codes of Practice under the National Directory for Radiation Protection (relevant regulatory authority for above).

BHP Billiton believes that public confidence in Australia’s legislative framework for environmental protection is vital, and we take our regulatory obligations very seriously. However, our experience suggests that some of the regulation described above is inefficient, and there is unnecessary duplication between State and Federal environmental regulation.

Regulation associated with uranium mining has gradually proliferated in Australia, often in response to public concerns about the perceived risks associated with uranium mining. However, the risks of mining and milling of uranium have in fact been demonstrated to be consistent with risks associated
with other mining processes⁴. A 2014 OECD review of the health and safety practices associated with uranium mining found:

“Societal expectations related to environmental protection and the safety of workers and the public evolved considerably as the outcomes of the early era of mining became apparent, driving changes in regulatory oversight and mining practices. Uranium mining is now conducted under significantly different circumstances, with leading practice mining the most regulated and one of the safest and environmentally responsible forms of mining in the world.”⁵

Safety performance at the Olympic Dam operation is comparable to other BHP Billiton sites across different commodities.

Olympic Dam adopts a conservative dose assessment methodology; as such all reported doses are considered an upper bound of exposure. The approach is considered conservative for several reasons: respiratory protection factors are not used in dose assessment, exposure duration considers all time on site (including time getting changed and traveling to and from work areas), dose conversion factors are based on the most conservative particle size (AMAD) and radionuclide within operational areas. More detailed information on dose assessment and monitoring can be found in Olympic Dam’s quarterly and annual radiation dose reports to the SA EPA.

Recognition that uranium mining is consistent with other forms of mineral extraction from a risk perspective should lead to the removal of some of the unnecessary and duplicative regulation that has accumulated in Australia – without any reduction in the overall level of protection for people or the environment.

Unnecessary or poorly designed regulation can have a significant dampening effect on investment. During the recent mining investment boom, BHP Billiton often experienced significant and costly delays in approvals for new projects, due to unnecessarily inefficient regulation.

As an example, the approval of the 2009 Expansion EIS saw Olympic Dam obtain two approvals with similar or duplicate conditions for a number of issues at both the Commonwealth and State level.

The Federal and South Australian environmental authorities have since made significant progress in reducing duplication by concluding bilateral agreements for ‘one stop shop’ environmental approvals. A ‘one stop shop’ agreement accredits the South Australian Government to conduct assessments in accordance with Commonwealth guaranteed standards of protection, with the two governments significantly reducing duplication of regulatory processes, while still protecting environmental standards. We also welcome recent progress by the Commonwealth Department of Environment in moving toward outcomes-based environmental impact assessments.

With respect to regulatory reform, BHP Billiton believes that removal or reform of the nuclear action trigger from the list of ‘Matters of National Environmental Significance’ (MNES) within the Commonwealth Environment Protection and Biodiversity Conservation (EPBC) Act would be an appropriate item for the Commission to consider.

The EPBC Act is the primary piece of Commonwealth Government environmental legislation designed to protect and manage matters of national environmental significance (NES). Any mining proposal, including uranium mining that potentially impacts on matters of NES must be referred for assessment under the EPBC Act. At present, the mining and milling of uranium ores is also captured under the nuclear provisions trigger of the Act, even though there may be no impact on matters of

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⁵ OECD, Managing Environmental and Health Impacts of Uranium Mining, (Nuclear Energy Agency, 2014)
NES when compared to a similar non-uranium project. This means that – despite the bilateral agreement – even minor changes to the environmental approvals for Olympic Dam requires scrutiny by both State and Commonwealth governments, inevitably leading to duplication and delays. There is no scientific basis for uranium mining to be defined as a matter of NES, and accordingly the Commission should consider whether its retention is appropriate. As a first step, there is a case for the Commonwealth Government to progress the recommendation made by the Productivity Commission in its review of regulatory burdens on the primary sector:

“The case for the continued treatment of uranium mining as a matter of national environmental significance – and therefore as a potential trigger for environmental assessments under the EPBC Act – should be reviewed. This review should be informed by a science-based assessment of the most up-to-date evidence of the inherent properties of uranium and any environmental, health and implications.”

Investment decisions are driven by a range of factors, of which regulatory burden is only one (albeit a significant one). However, a transparent and effective regulatory regime makes the decision to invest easier, and streamlining environmental assessments will allow South Australia to realise more of the economic opportunities from its geological wealth over the long term.

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1.3 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?

Discoveries are one of the best ways of ensuring continual exploration activity. However, exploration can also be encouraged through understanding the reasons for success and failure from previous exploration activities. Companies are likely to do this but will not always disseminate these learnings to the wider exploration community.

BHP Billiton recommends that government geologists consolidate learnings from historical exploration activities and add these summaries to the pre-competitive exploration data once an exploration licence is relinquished. These summaries should address whether the exploration activities enhanced the understanding of the geology of South Australia, or changed ideas about the geological conditions which lead to the formation of uranium deposits.

As most of the geology of South Australia is under cover\(^7\), exploration in South Australia (and throughout the world) is becoming increasingly difficult and expensive, and opportunities for deposit discoveries using historical exploration methods are increasingly rare. There is a significant need to map the upper crust in 4D so that the complete crustal architecture beneath known deposits is understood. Regional crustal mapping should then be conducted in highly prospective, underexplored areas to attract further exploration activities. Any new datasets which potentially support the development of new ways of thinking about deposit formation should be collected and made part of the pre-competitive exploration data packages.

For Olympic Dam specifically, initiatives that promote expanded exploration for copper will by extension also encourage expanded exploration for uranium. As we have outlined elsewhere in this submission, the nature of the ore body at Olympic Dam is such that our investments decisions will always be driven primarily by copper.

Finally, as noted above, simplification of regulatory requirements may make exploration more viable.

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

Olympic Dam is our only proved uranium reserve in South Australia, and is already in production.

\(^7\) In the case of Olympic Dam, this means that there is approximately 350m of unmineralised overburden which sits on top of the ore deposit. At Stuart Shelf, a similar unmineralised overburden, is approximately 400 - >1200m thick.
1.5 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?

In the Olympic Dam deposit, uranium is positively correlated with copper. There is also a very strong spatial association between Cu and U at all scales from 1 metre drill hole samples up to mining blocks (e.g. 5x5x10 metres and 30x30x15 metres).

- High Cu grades are typically associated with high U grades and vice-versa.
- Low Cu grades are typically associated with low U grades, and vice-versa.

At Olympic Dam, it is not possible to mine uranium separate from copper. Mineralogical data collected over the past 25 years also supports this. Copper sulphides and uranium minerals are intergrown at the micron scale. Such fine grained inter-growths occur across the entire deposit.

Mining at Olympic Dam occurs underground via mechanised sublevel open stope methods. Ore has never been mined at Olympic Dam via open pit mining. Ore is trucked to ore passes, and then transported to underground crushers via a rail system. Crushed ore (~145mm) is then hoisted up to the surface via two shafts. The crushed ore is conveyed to the surface stockpiles and stacker-reclaimer system.

The figure below depicts the processing flow sheet at Olympic Dam. The 2009 Draft Environmental Impact Statement (DEIS)\(^8\) provides more detailed descriptions of the process to extract Cu, U, Au, Ag from Olympic Dam ores and produce electro-refining and electro-winning copper cathode, uranium ore concentrate (UOC), along with gold and silver bullion.

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In South Australia, all known iron oxide Cu-Au (IOCG) deposits are actually IOCG-U deposits, meaning they contain U, albeit at different concentration levels. Hence copper sulphide concentrates produced from these deposits will contain U at different concentration levels. For transport purposes, a NORM (i.e. secular equilibrium) material is classified as radioactive if the activity is greater than 1 Bq/g per radionuclide. Unleached copper concentrates with activity less than 1 Bq/g per radionuclide can be transported as non-radioactive. However, this does not guarantee that a smelter will necessarily treat this concentrate. No further processing infrastructure (beyond the traditional grinding and copper flotation circuits) at the mine site is required because the Cu concentrates can be treated offsite from the mine.

If the Cu concentrate has an activity greater than 1 Bq/g per radionuclide, then it is classified as radioactive which requires further processing at the mine site. This entails the addition of capital-intensive infrastructure downstream from the copper grinding and flotation circuits. The high cost of capital infrastructure to treat copper sulphides at a mine site may cause a new deposit not to be developed or result in an existing operation not to expand its output capacity. Development of new, less capital-intensive extraction processes for treating radioactive Cu concentrates may lead to new deposits being brought into production or expansion of existing mines.
1.6 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 2009 DEIS for the proposed Olympic Dam major expansion identified a number of issues and limitations related to skills and training, social services and infrastructure. The issues identified would apply more generally depending on the scale of investment in new projects or expansion of existing projects. Issues identified include:

- Recruitment and retention of the required specialist skills.
- Attraction of workers from existing ventures, leading to greater competition for skilled workers.
- Capacity constraints in the business sector.
- The need for additional social services and facilities.

Of course there have been substantial changes in the Australian labour market since 2009, as the mining investment boom winds down.

These factors led to the identification of the need for a continuing emphasis on skills development and training. Additionally, the assessment identified that while direct and indirect business opportunities arise from additional investment, the scale and specialty of the goods and services required may extend beyond the capacity of many local companies. For further detail, refer to the DEIS.

Olympic Dam has recognised the importance of developing knowledge of uranium mining, its processes and risk management. As such, we have made contributions to a number of important academic projects in this area.

In collaboration with the South Australian Government and the University of Adelaide, we have established the Centre of Mining Excellence with the goal to identify and fund research opportunities to better understand technology options for development of uranium mining and processing in South Australia.

In addition, we provide a range of geological data to the State Core Library, and are in the process of developing an exploration program for Exploration Licences throughout the Stuart Shelf. We also make contributions to the Deep Exploration Cooperation Research Centre and the CSIRO and are in the process of working with the University of Adelaide to establish a Graduate Certificate in Radiation Management.
1.7 (a) Is there a sound basis for concluding there will be increased demand for uranium in the medium and long term?

According to the International Energy Agency (IEA)\(^9\) there are currently 437 operating nuclear power reactors in the world with 378 GWe capacity. In addition, there are currently 68 reactors under construction. This growing fleet of reactors is likely to generate additional demand for nuclear fuel. The IEA state in their 2014 World Energy Outlook (WEO) that nuclear capacity will increase to 624 GW in 2040, based on their central scenario. \(^1^0\)

(b) 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?)

In the long-run, additional supply of primary uranium will be required to meet the expected demand. With steady demand increases, the market deficit is expected to be filled by a range of potential projects located in Australia, Kazakhstan, North America and Africa.

It should be noted that the commercial return from Olympic Dam is driven primarily by copper production, together with a combination of commodity prices and other market factors and therefore increased demand for uranium may not in and of itself lead to increased investment in the Olympic Dam deposit.

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\(^9\) IAEA Power Reactor Information System (Last update on 2015-07-29).

\(^1^0\) IEA, World Energy Outlook 2014.
1.8. 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?

Expansion activities on their own would not result in new risks based on the current set of health and safety risks that must be managed in current mining activities. If new methods of mining and extraction were implemented, then as with any new methods, the specific health and safety risks for both the workers and local communities would need to be considered and addressed appropriately in line with the regulatory frameworks.

Existing methods of mining and associated risk management are well understood in relation to open pit mining, underground stoping and in-situ leach. Olympic Dam’s radiation-related health and safety performance demonstrates this.

It is important to reiterate that the risks associated with uranium mining are generally similar to the risks associated with any other form of mining.

1.9. 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?

BHP Billiton holds freehold, long term leasehold and other interests in the land (including occupational licences and exploration licences) on which the mine is situated, and much of the surrounding land. There is little in the way of competing commercial interests in the area (for example, there is no intensive farming which would be prevented by an expansion), so the impact of an expansion in that sense would be very minimal.

Given we have already undertaken an Environmental Impact Statement process for a major expansion (which includes social and economic, as well as strictly “environmental” considerations), we have already considered in detail and planned for, the likely impacts and how best to minimise and manage them.

In terms of native title, our existing arrangements include a commercial agreement called the Olympic Dam Agreement (ODA) between BHP Billiton and the Barngarla, Kokatha and Kuyani Aboriginal groups, and an Indigenous Land Use Agreement (ILUA) between the Kokatha Aboriginal Corporation, the State and BHP Billiton. These form the basis for BHP Billiton's relationship with the relevant groups. The arrangements, which include ongoing consultation, contemplate an expansion and are flexible enough to accommodate the interests of all parties.

BHP Billiton recognises the importance of its licence to operate at Olympic Dam and surrounding areas, and is committed to maintaining positive relationships with all stakeholders, making it well-placed to manage any future expansion.
1.10. 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?

The environmental risks associated with uranium mining (or any mining and processing activity) are determined by the location, method and other factors specific to the activity being considered. However, as discussed at 1.8, unless new methods of exploration, extraction or milling are used in future expansion, there would be no change to the existing environmental risks.

For Olympic Dam, our experience in dealing with environmental management and monitoring over more than 25 years has shown that risk and impact are well understood, and that current strategies for dealing with risk and impact are sufficient. This experience has also shown that the mining and milling of uranium ores has similar risk and impact to other mining activities and therefore does not warrant being considered a matter of national environmental significance that triggers the requirements of the EPBC Act.

1.11. 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?

Olympic Dam has over 25 years of experience in the management of environmental impacts associated with its operation, and the risks and impacts are well understood. Over that time, regulation and management of environmental impact has shifted from a more compliance-based approach to the more outcome-based contemporary model.

Outcome-based environmental management occurs through measurable standards and parameters (compliance criteria) that clearly demonstrate the achievement of environmental outcomes relating to potential environmental impacts. This approach provides for adaptive management and allows Olympic Dam to manage environmental impacts based on extensive accumulated environmental knowledge and experience.

Olympic Dam’s approach to outcome based environmental management is contained within its Environmental Protection and Management Program (EPMP) and the annual EPMP report against environmental outcomes and criteria\(^\text{11}\).

\(^\text{11}\) This report is available from: [http://www.bhpbilliton.com/home/society/regulatory/Pages/default.aspx#013_Copper](http://www.bhpbilliton.com/home/society/regulatory/Pages/default.aspx#013_Copper)
1.12 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 of 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?

An extensive analysis of the potential economic benefits, including the growth in employment and additional benefits, was incorporated in the 2009 DEIS for the proposed Olympic Dam expansion. While that analysis was specific to the potential benefits of that project, a number of general conclusions can be made.

An expansion of extraction activities can:

- Provide economic benefits through increases in Australian gross domestic product, gross state product and gross regional product.
- Increase the amount of royalties paid to the State from increases in production.
- Lead to higher private consumption of goods and materials in Australia, with a corresponding benefit through increased living standards.
- Provide for the development of human capital (i.e. a workforce of skilled professional and experienced tradespersons from which other mines and industries may benefit).
- Provide business opportunities.
- Create new full-time and short-term jobs.
Response to Issues Paper 4: Management, Storage and Disposal of Nuclear and Radioactive Waste

BHP Billiton’s experience with radioactive waste management and storage at Olympic Dam is limited to the storage of tailings and other low level contaminated materials generated during the treatment of ore. Tailings are the waste product stream from the metallurgical operations. They consist of a slurry of fine rock particles and acidic liquor (a solution consisting of water and sulphuric acid) from which the economically-recoverable minerals (copper, uranium, gold and silver) have been extracted.

The slurry is pumped to the tailings storage facility (TSF) where tailings solids settle and the tailings liquor is reclaimed for evaporation or re-use. The TSF is an engineered facility currently consisting of five TSF cells covering about 800 ha, which are used as primary storage for the tailings solids. The tailings are considered low level radioactive waste (LLRW) as some remnant uranium and uranium decay products remain after processing.

The overall radioactivity of the tailings is less than that of the ore that was treated. Other low level contaminated material generated during the treatment of ore consists predominantly of plant and equipment that has reached the end of its service life which is unable to be treated to remove radioactive materials to a level to allow recycling or disposal in a traditional waste disposal facility.

Environmental management of tailings and other low level contaminated material, including the requirements of the radioactive waste management plan, is integrated into the Olympic Dam environmental management system (EMS), an ISO 14001-certified set of policies, procedures and practices detailing the approach adopted at Olympic Dam to protect environmental values at the site. In the case of tailings, the program incorporates recent developments at an international level in the management of LLRW, with the overall aim to ensure that the waste is safely contained and controlled.

Olympic Dam now has over 25 years of operating experience dealing with the management and monitoring of tailings. Over that time, the TSF has been expanded and with each addition, improvements in design and management have been identified and implemented. Environmental monitoring continues to demonstrate the effective containment of tailings and no compromise of environmental values outside the immediate mining lease area as a result of tailings storage and management.

Tailings storage and management is common in mining operations throughout the world, and in this respect the management of tailings at Olympic Dam is no different to that of other BHP Billiton operations not involving uranium (e.g. copper or nickel), or indeed other mining operations worldwide. Given this similarity, the demonstrated level of environmental management and the low level of radioactivity involved, the treatment of tailings from uranium operations should be considered as akin to that of other metal mining operations. Correspondingly, it does not warrant being considered a matter of national environmental significance that triggers the requirements of the EPBC Act.

BHP Billiton does not handle or manage intermediate and high-level radioactive wastes. Nevertheless we understand that current thinking is toward long term storage rather than disposal, as it is foreseeable that the contained energy may be able to be harnessed in the future. Irrespective of whether storage or disposal is preferred, BHP Billiton considers that either option would be inconsistent with our core business of mining and the production of high quality copper and associated by-products at Olympic Dam.