SOUTH AUSTRALIA'S NUCLEAR FUEL CYCLE ROYAL COMMISSION ISSUES

- SUMMARY -

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Prepared on behalf of the Conservation Council SA
by Dr Jim Green, Friends of the Earth, Melbourne.

The SA Government's Nuclear Fuel Cycle Royal Commission will consider options for uranium enrichment, nuclear power, and proposals for South Australia to host an international high-level nuclear waste dump. The Royal Commission website is: www.nuclearrc.sa.gov.au

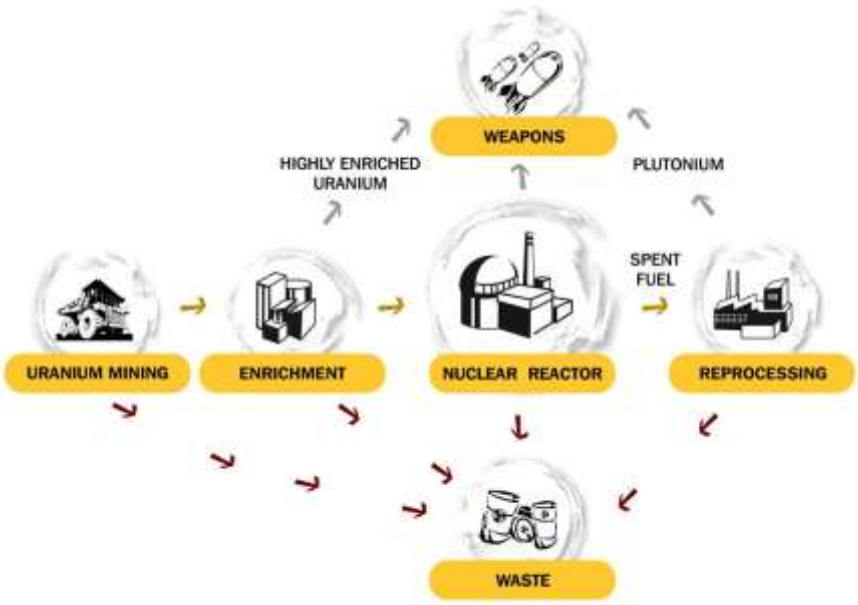
The Conservation Council of South Australia (Conservation SA) is the peak environment group in the state, representing around 50 non-profit environmental organisations.

Conservation SA does not support an expansion of South Australia's role in the nuclear cycle.

Uranium mining in SA has a history of very significant environmental impacts that show no signs of abating. The nuclear industry has caused suffering and displacement of Aboriginal communities over many decades, from the toxic legacy of Maralinga nuclear testing, uranium mining operations and attempts to impose unwanted nuclear waste dumps.

All forms of energy generation have some environmental impact. To determine the lowest impact options, we need to assess each technology across its entire life cycle. Unfortunately, this is rarely done. Emissions from the nuclear fuel cycle will increase as relatively high-grade uranium ores are mined out and are replaced by the mining of lower-grade ores. Nuclear power brings with it a range of unavoidable risks to public health and safety that other energy options simply do not. Nuclear is also a high-cost option that has never been viable without generous taxpayer support.

The Royal Commission provides an opportunity for all of the impacts of the nuclear fuel cycle to be assessed, and Conservation SA will be actively participating to ensure that it does. This document outlines a summary of our thinking. For more information see the full issues paper.



Key stages of the nuclear fuel cycle.

URANIUM MINING

From the mid-2000s until the Fukushima disaster in 2011, expectations of a significant global expansion of nuclear power drove a sharp increase in uranium exploration and the start-up of numerous mines. However nuclear power has maintained its long-standing pattern of stagnation. Some uranium mines have shut down, some are operating at a loss. The uranium price is lower than the average cost of production − and well below the level that would entice mining companies to invest capital in new projects.

Australia's uranium production of 5,000 tonnes in 2014 was the lowest for 16 years. The industry generates less than 0.2 per cent of national export revenue and accounts for less than 0.02 per cent of jobs in Australia.

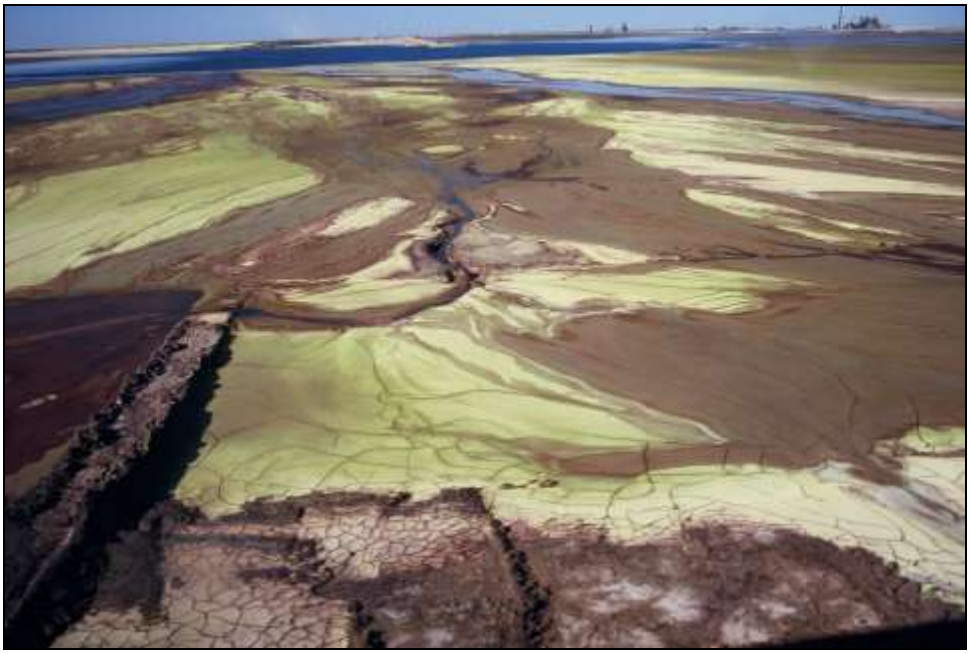
Governments and uranium companies routinely claim that 'strict' safeguards ensure peaceful use of Australian uranium. Those claims do not stand up to scrutiny. During his tenure as the Director-General of the International Atomic Energy Agency from 1997−2009, Dr. Mohamed El Baradei said that the Agency's safeguards system suffers from "vulnerabilities" and "clearly needs reinforcement"; that efforts to improve the system have been "half-hearted"; and that the safeguards system operates on a "shoestring budget ... comparable to that of a local police department".

The Royal Commission needs to consider the vital issues of nuclear safeguards and uranium export policy (e.g. sales to countries refusing to ratify the Comprehensive Test Ban Treaty). The Terms of Reference ask the Royal Commission to consider the risks associated with uranium mining yet the greatest risk − weapons proliferation − is not included in the relevant Issues Paper released by the Royal Commission.

The Royal Commission should investigate the repeated pattern of Aboriginal land rights and heritage protection laws being weakened or circumvented at the behest of the uranium industry. One example concerns the 1982 South Australian Roxby Downs Indenture Act, which sets the legal framework for the operation of BHP Billiton's Olympic Dam mine. The Act was amended in 2011 but it retains exemptions from the SA Aboriginal

Heritage Act. Traditional Owners were not even consulted. The SA government's spokesperson in Parliament said: "BHP were satisfied with the current arrangements and insisted on the continuation of these arrangements, and the government did not consult further than that."

A 2003 report by the federal Senate References and Legislation Committee found "a pattern of under-performance and non-compliance" in the uranium mining industry. It identified many gaps in knowledge and found an absence of reliable data on which to measure the extent of contamination from the uranium mining industry, and it concluded that changes were necessary "in order to protect the environment and its inhabitants from serious or irreversible damage". The Committee concluded "that short-term considerations have been given greater weight than the potential for permanent damage to the environment".



Radioactive tailings waste at Olympic Dam, with the processing plant in the background.

URANIUM ENRICHMENT

The establishment of a uranium enrichment industry in SA is being promoted as a way to 'value add' to uranium exports. However the 2006 Switkowski Review concluded that "there may be little real opportunity for Australian companies to extend profitably" into enrichment. Conditions are no more conducive to the establishment of an enrichment industry now than they were in 2006. Former World Nuclear Association executive Steve Kidd noted in July 2014 that "the world enrichment market is heavily over-supplied".

Proposals to expand South Australia's role in the nuclear fuel cycle would inevitably have weapons proliferation implications, regardless of intent:

- an enrichment plant could produce highly enriched uranium (which can be used in weapons);
- conventional uranium-fuelled power reactors routinely produce weapons-useable reactor grade plutonium and could be operated on a short operating cycle to produce weapon grade plutonium;
- a reprocessing plant could be used to separate plutonium from irradiated materials for weapons;

- importing spent nuclear fuel would necessarily mean acquiring plutonium (which makes up 1% of spent fuel).

FUEL LEASING

Fuel 'leasing' proposals could involve:
- uranium export, and the import and storage or disposal of high-level nuclear waste arising from the use of that uranium in power reactors overseas; or
- comprehensive 'front end' processes (uranium mining, conversion into uranium hexafluoride, enrichment, fuel fabrication) and 'back end' management of spent fuel (reprocessing and re-export, storage and/or disposal).

Among other problems and obstacles, the simpler of those options − uranium export and spent fuel take-back − would likely be unacceptable to at least some of Australia's major uranium customers. In its submission to the Switkowski Review BHP Billiton said: "BHP Billiton believes that there is neither a commercial nor a non-proliferation case for it to become involved in front-end processing or for mandating the development of fuel leasing services in Australia."

NUCLEAR POWER

A renaissance?

Despite the promotion of a nuclear power 'renaissance' over the past decade, the number of 'operable' power reactors fell from 443 to 437 in the 10 years to January 2015.

In 2014, worldwide nuclear capacity increased by 2.4 gigawatts (GW). Approximately 100 GW of solar and wind power capacity were installed in 2014, up from 74 GW in 2013.

The International Energy Agency said in its *World Energy Outlook 2014* report: "A wave of retirements of ageing nuclear reactors is approaching: almost 200 of the 434 reactors operating at the end of 2013 are retired in the period to 2040, with the vast majority in the European Union, the United States, Russia and Japan."

Cost

Nuclear power is subject to a 'negative learning curve' − it is becoming more expensive over time. Even the large-scale, standardised French nuclear power program has been subject to a negative learning curve.

Nuclear power is heavily subsidised. Earlier promises not to subsidise new reactors in the UK have been abandoned. Construction cost estimates for two planned large reactors at Hinkley Point in the UK range from A$30.6−46.8 billion (the higher figure including financing costs). The UK government is offering loan guarantees of A$19.3 billion. The UK government is also guaranteeing payment of A$173.30 for every megawatt-hour generated by the Hinkley Point reactors, fully indexed for inflation, for 35 years. For comparison, that guaranteed payment is 2.7 times greater than typical wholesale electricity purchase costs in Australia.

In addition to capital costs for reactors, the introduction of nuclear power in Australia would incur additional, very large start-up costs such as those associated with the acquisition of greenfield sites and the recruitment and training of a large workforce.

A response to climate change?

Nuclear power could at most make a modest contribution to climate change abatement. The Switkowski Review stated that the construction of 12 power reactors from 2025−2050 would reduce Australia's greenhouse emissions by just 8% relative to business as usual, assuming that nuclear power displaces coal. Emissions savings would be lower if the assumption is that nuclear power displaces gas.

Greenhouse emissions from renewable energy sources vary but are typically similar to nuclear power. If nuclear power displaces those renewable energy sources that are less greenhouse intensive than nuclear power, and/or the many energy efficiency measures which are less greenhouse intensive than nuclear power, nuclear power will result in increased greenhouse emissions.

Former US Vice President Al Gore said: "For eight years in the White House, every weapons-proliferation problem we dealt with was connected to a civilian reactor program. And if we ever got to the point where we wanted to use nuclear reactors to back out a lot of coal ... then we'd have to put them in so many places we'd run that proliferation risk right off the reasonability scale."

Next generation reactors?

The International Atomic Energy Agency states: "Experts expect that the first Generation IV fast reactor demonstration plants and prototypes will be in operation by 2030 to 2040." The Generation IV International Forum, which brings together 12 countries plus Euratom, states: "Depending on their respective degree of technical maturity, the first Generation IV systems are expected to be deployed commercially around 2030−2040."

Clearly the commercial deployment of Generation IV reactors is a significant way off. Moreover, it is doubtful whether the purported benefits of Generation IV reactors will be realised. Whether Generation IV concepts deliver on their potential depends on a myriad of factors, not just the resolution of technical difficulties. Moreover some of the 'new' concepts are not new. For example the history of 'fast neutron' reactors has been one of extremely expensive, underperforming and accident-prone reactors which have contributed to WMD proliferation problems.

POSSIBLE SITES FOR NUCLEAR POWER REACTORS

The Australia Institute identified possible sites for nuclear power plants in a 2007 report. Using a range of criteria, the report identified possible sites in several states including the following sites in SA: Mt Gambier / Millicent, Port Adelaide, Port Augusta, and Port Pirie.

NUCLEAR ACCIDENTS AND ATTACKS

In a 2010 paper, academic Benjamin Sovacool documented 99 accidents at nuclear power plants from 1952 to 2009 that resulted in the loss of human life and/or more than US$50,000 of property damage. Of the 99 accidents, 57 occurred since the Chernobyl disaster in 1986, and 56 were in the USA, refuting the notion that severe accidents are relegated to the past or to countries without modern US technology and oversight.

Claims that the safety of nuclear power is comparable to that of renewable energy sources do not stand up to scrutiny, for the following reasons (among others):

- Firstly, and most importantly, nuclear power is the only energy source with repeatedly-demonstrated connections to the proliferation of Weapons of Mass Destruction. Moreover, there are serious proliferation-related security risks such as military attacks on nuclear plants to prevent their use in support of a weapons program.
- Secondly, such claims ignore the long-term cancer death toll from major accidents, in particular Chernobyl and Fukushima. For Chernobyl, the World Health Organization estimates up to 9,000 excess cancer deaths in Belarus, the Russian Federation and Ukraine. Credible estimates of the Chernobyl cancer death toll across Europe range from 16,000 to 93,000. For Fukushima, the long-term cancer death toll will be in the thousands. Based on UN data on human radiation exposure, UK radiation biologist Dr Ian Fairlie estimates around 5,000 fatal cancers from Fukushima fallout.
- Thirdly, such claims ignore or downplay human radiation exposure from routine emissions from the nuclear fuel cycle. The United Nations Scientific Committee on the Effects of Atomic Radiation has estimated the collective effective dose to the world population over a 50-year period of operation of nuclear power reactors and associated nuclear fuel cycle facilities at two million person-Sieverts. Applying a risk estimate of 0.05−0.1 fatal cancers per person-Sievert gives a total of 100,000−200,000 fatal cancers.
- Fourthly, non-fatal impacts must be considered. For example, the relocation of 350,000 people in the aftermath of the Chernobyl disaster was associated with a great deal of trauma. Four years after the Fukushima disaster, around 80,000 people remain displaced specifically as a result of the nuclear accident.

Exposure to even low-level radiation is a health hazard. That is the position of all relevant expert bodies such as the United Nations Scientific Committee on the Effects of Atomic Radiation. As the the US National Academy of Sciences' Committee on the Biological Effects of Ionising Radiation states, "the risk of cancer proceeds in a linear fashion at lower doses without a threshold and … the smallest dose has the potential to cause a small increase in risk to humans."

One of the ruined Fukushima reactors.

RADIOACTIVE WASTE

The waste produced in nuclear reactors − called spent nuclear fuel − is orders of magnitude more radioactive than fresh uranium fuel. It takes around 200,000 years for the radioactivity of spent fuel to decline to that of the original uranium ore body.

Annually, nuclear power plants around the world produce about 12,000 tonnes of spent fuel and about 200,000 m^3 of low and intermediate level waste. About 350,000 tonnes of spent fuel have been produced in power reactors around the world. About one third of that amount has been reprocessed and the remainder is stored.

These are comparatively small amounts of waste compared to the mass or volume of wastes generated by coal-fired electricity plants. However, there are very large waste streams generated across the nuclear fuel cycle − for example the Olympic Dam mine generates 10 million tonnes of low-level tailings waste annually. Moreover, it is not the volume or mass of spent nuclear fuel that is of concern but its extreme toxicity, longevity, heat generation, and the fact that it contains plutonium which can be extracted for use in nuclear weapons.

Not a single repository exists anywhere in the world for the disposal of high level waste from nuclear power reactors. Only a few countries have identified a repository site. Sweden and Finland are the most advanced, with repositories under construction.

Worldwide, there is one deep underground repository for long-lived intermediate-level nuclear waste − the Waste Isolation Pilot Plant (WIPP) in the US state of New Mexico. In February 2014, a heat-generating chemical reaction ruptured one of the barrels stored underground at WIPP, and this was followed by a failure of the filtration system which was meant to ensure that radiation did not reach the outside environment. Twenty-two workers were exposed to low-level radiation, the total cost to fix up the problems will exceed $500 million, and WIPP will be shut for at least four years.

A safety analysis conducted before WIPP opened predicted that one radiation release accident might occur every 200,000 years. On the basis of real-world experience, that estimate needs to be revised upwards to over 13,000 accidents over a 200,000 year period.

A troubling aspect of the WIPP problems is that complacency and cost-cutting set in just 10−15 years after the repository opened.

AUSTRALIAN EXPERIENCES WITH RADIOACTIVE WASTE

In the late-1990s, the Australian government carried out a clean-up of the Maralinga nuclear test site. It was done on the cheap and many tonnes of plutonium-contaminated debris remain buried in shallow, unlined pits in totally unsuitable geology. The government said the Maralinga clean-up was 'world's best practice' even though it breached Australian standards for the management of long-lived nuclear waste. In 2011, a survey revealed that 19 of the 85 contaminated debris pits have been subject to erosion or subsidence.

From 1998−2004, the federal government attempted to impose a national radioactive waste repository in SA despite the clear opposition of the SA Parliament and the SA population. In 2003, the federal government used the Lands Acquisition Act 1989 to seize land for the dump. In the lead-up to the 2004 federal election, with the dump issue deeply unpopular, and the Federal Court having rejected the government's use of urgency provisions in the Lands Acquisition Act, the federal government decided to abandon the dump plan.

The federal government announced in 2005 that a national radioactive waste dump would be imposed in the Northern Territory. The government passed legislation allowing

the imposition of a nuclear dump with no Aboriginal consultation or consent. A small group of Traditional Owners supported the dump but a much larger group were opposed and some initiated legal action in the Federal Court challenging the nomination of the Muckaty site by the federal government and the Northern Land Council (NLC). The Federal Court trial finally began in June 2014. After two weeks of evidence, the NLC gave up and the federal government acceded to the NLC's request not to proceed with the Muckaty nomination. Federal Industry Minister Ian Macfarlane characterised the Muckaty process as a "disaster".

Former Chair of the Board of the Australian Nuclear Science and Technology Organisation, Ziggy Switkowski, has been promoting the construction of 50 nuclear power reactors in Australia. Over a 50-year lifespan, 50 reactors would:

- be responsible for 1.8 billion tonnes of low level radioactive tailings waste (assuming the uranium came from Olympic Dam).
- be responsible for 430,000 tonnes of depleted uranium waste.
- produce 75,000 tonnes of high level nuclear waste (approx. 25,000 cubic metres).
- produce 750,000 cubic metres of low level waste and intermediate level waste.
- produce 750 tonnes of plutonium, enough for 75,000 nuclear weapons.

Should SA accept high-level nuclear waste from overseas?

How much money might be made by taking nuclear waste from other countries? There is no precedent to base an estimate on. It is doubtful whether it would generate any more than a fraction of the revenue that some lobbyists claim it might. There are many constraints, such as the fact that some countries with significant nuclear power programs − such as Russia, France, and India − operate reprocessing plants so would be unlikely to want to send spent fuel to Australia. BHP Billiton's submission to the Switkowski Review states that the utilities to which it sells uranium "generally regard their spent fuel as an asset".

Prof. John Veevers from Macquarie University states: "Tonnes of enormously dangerous radioactive waste in the northern hemisphere, 20,000 kms from its destined dump in Australia where it must remain intact for at least 10,000 years. These magnitudes − of tonnage, lethality, distance of transport, and time − entail great inherent risk."

Some argue that Australia has a moral responsibility to accept the high-level nuclear waste arising from the use of Australian uranium in power reactors overseas. However the responsibility for managing nuclear waste lies with the countries that make use of Australian uranium. There are no precedents for Australia or any other country being morally or legally responsible for managing wastes arising from the use of exported fuels.