



# Submission to the SA Joint Select Committee on the Findings of the Nuclear Fuel Cycle Royal Commission

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## SUMMARY

*"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."*  
– Prof. John Veevers, Macquarie University<sup>1</sup>

Our organisations expressed deep reservations over the Royal Commission process, with particular concern over the Commission's pro-industry terms of reference and the pro-nuclear bias in the composition of the Royal Commission (e.g. a majority of the members of the Expert Advisory Committee were clearly partisan nuclear advocates).<sup>2</sup> We maintain that the Royal Commission's report is not a credible, even-handed report; instead it should be regarded as an advocacy document.<sup>3</sup> The report fails to demonstrate that a high level nuclear waste facility is practical or economic for SA, it downplays and ignores risks and uncritically presents arbitrary and highly optimistic forecasts of economic impacts.

The Royal Commission report fails to adequately reflect the clear international history of complexity, cost, contest and project failure in relation to radioactive waste management. This experience is of profound importance in framing any future discourse on this highly contested public policy arena. Our organisations believe that as a foundation document for framing and advancing any such discourse the Commission report is deeply deficient.

### **Importing waste before a repository is established**

No country has completed construction and begun operation of a high level nuclear waste repository – at a national, let alone an international level. Many countries have failed or in their attempts to establish a repository. Successive Australian governments have repeatedly failed in their efforts to establish a repository for low level waste and plans to establish an intermediate level waste repository were abandoned in 2004 when the National Store Committee was disbanded. Yet the Royal Commission proposed importing high level nuclear waste on the assumption that it will be possible to establish a high level nuclear waste repository. This is highly irresponsible and should be rejected by the Joint Select Committee.

The so-called 'Interim Storage Facility' is proposed to accumulate 50,000 tonnes of high level nuclear waste before a repository begins accepting waste. There is a significant risk that high level waste will be imported and will have to remain in 'interim' storage *ad infinitum* due to i) the lack of a repository, ii) the lack of a return-to-sender clause in contracts and iii) the inability to send the waste on to a third country.

### **International experience**

The Royal Commission insists that a nuclear waste storage and dumping business could be carried out safely. But would it be carried out safely? The Royal Commission ought to have considered evidence that can be drawn upon to help answer the question – but it failed to do so.

What sort of evidence might be considered? The experience of the world's one and only deep underground nuclear waste dump – the Waste Isolation Pilot Plan (WIPP) in the U.S. – is clearly

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<sup>1</sup> <http://web.archive.org/web/20120410062832/http://eps.mq.edu.au/media/veevers1.htm>

<sup>2</sup> 'A Critique of the South Australian Nuclear Fuel Cycle Royal Commission', December 2015, [www.foe.org.au/sites/default/files/RC-critique-16Dec2015-final.pdf](http://www.foe.org.au/sites/default/files/RC-critique-16Dec2015-final.pdf)

<sup>3</sup> [www.foe.org.au/sites/default/files/NFCRC-response-tent-findings-CCSA-ACF-FoE-18March2016-final\\_0.pdf](http://www.foe.org.au/sites/default/files/NFCRC-response-tent-findings-CCSA-ACF-FoE-18March2016-final_0.pdf)

relevant yet it was completely ignored in the Royal Commission's Tentative Findings report and receives one token paragraph in the Final Report. WIPP is a case study of a sharp decline in safety and regulatory standards over a short space of time ([www.foe.org.au/wipp](http://www.foe.org.au/wipp)). A chemical explosion in a nuclear waste barrel in February 2014 was followed by a failure of the filtration system, resulting in 22 workers receiving small doses of radiation and widespread contamination in the underground caverns. WIPP has been shut down for 2.5 years since the accident. Costs associated with the accident are likely to exceed US\$500 million.

The Royal Commission ignored the fundamental lesson from the WIPP fiasco – initially high safety and regulatory standards gave way to complacency, cost-cutting and corner-cutting in the space of just 10–15 years. The Royal Commission correctly notes that high level waste "requires isolation from the environment for many hundreds of thousands of years". How can we be confident that high safety and regulatory standards in SA would be maintained over centuries and millennia when WIPP shows that the half-life of human complacency, cost-cutting and corner-cutting is measured in years or at most decades?

The Royal Commission gives great weight to abstract, theoretical safety assessments while ignoring what is happening in the real world. It ignores clear and important examples of the spectacular mismatch between theoretical safety assessments and real-world experience. For example, a safety analysis conducted before WIPP opened predicted one radiation release every 200,000 years. Yet WIPP was open for just 15 years before the chemical explosion in February 2014.

There is no logical reason to believe that the SA government would perform any better than the U.S. government. On the contrary, there are good reasons to believe that nuclear waste management would be more difficult here given that the U.S. has vastly more nuclear waste technical and management expertise, experience and capacity than Australia.

The Royal Commission had little or nothing to say about other problems overseas, e.g. fires at radioactive waste repositories<sup>4</sup>, the current project to exhume 126,000 waste barrels from a dump in Germany following extensive water infiltration and corrosion, the liquid nuclear waste explosion at Mayak in the USSR, and many others.

Political decisions are reinforcing the selectivity of the Royal Commission. The leaders of the SA Labor and Liberal parties plan to visit the waste facility under construction in Finland (20 times smaller than that proposed for SA). Why aren't they visiting WIPP, or the German repository, or Mayak? Why aren't they visiting places whose names are synonymous with dangerous and hideously expensive nuclear waste mismanagement – Dounreay, Sellafield, Hanford, etc.? Why aren't they visiting the wine producers in France who took the operator of a nuclear waste dump to court in a failed attempt to have the dump shut down? The SA Joint Select Committee should recommend that the Premier and the Leader of the Opposition extend their overseas trip to visit the above-mentioned locations, or at the least to meaningfully engage with international critics and not merely advocates.

While ignoring the world's one and only existing deep underground nuclear waste dump (WIPP), the Royal Commission talks at length about deep underground repositories under construction in Finland and Sweden. According to the Royal Commission, those two countries "have successfully developed long-term domestic solutions" for nuclear waste. But in fact, neither country has completed construction of a repository let alone demonstrated safe operation over any length of time. After over 30 years Finland is still seven years away from first disposal of high level waste –

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<sup>4</sup> [www.foe.org.au/fire](http://www.foe.org.au/fire)

said to start in 2023. Sweden's Forsmark Geological Disposal Facility has not yet even been licensed to start construction and isn't planned to open until the late 2020s. Also both facilities are clearly focussed on addressing domestic nuclear waste arisings, not the far more complex international issues.

## **Mismanagement of radioactive waste in SA**

Just as the Royal Commission glossed over countless serious examples of nuclear waste mismanagement around the world, it also glossed over numerous problems in SA.

A radioactive waste repository at Radium Hill, for example, "is not engineered to a standard consistent with current internationally accepted practice" according to a 2003 SA government audit – yet there is no current intention to rectify the situation.

The Port Pirie uranium treatment plant is still contaminated over 50 years after its closure. It took a six-year community campaign just to get the site fenced off and to carry out a partial rehabilitation. As of July 2015, the SA government website states that "a long-term management strategy for the former site" is being developed.

Management of mine wastes has also been problematic. For example SA regulators failed to detect Marathon Resource's illegal dumping of radioactive materials in the Arkaroola Wilderness Sanctuary. The incident represents a serious failure of SA government regulation yet to the best of our knowledge there have been no legislative or regulatory changes to reduce the risks of a recurrence.

The 'clean-up' of nuclear waste at the Maralinga nuclear test site in the late 1990s provides no cause for comfort with an expansion of nuclear waste in SA:

- Nuclear engineer Alan Parkinson said of the 'clean-up': "What was done at Maralinga was a cheap and nasty solution that wouldn't be adopted on white-fellas land."
- Scientist Dale Timmons said the government's technical report was littered with "gross misinformation".
- Dr Geoff Williams, an officer with the Commonwealth nuclear regulator ARPANSA, said that the 'clean-up' was beset by a "host of indiscretions, short-cuts and cover-ups".
- Nuclear physicist Prof. Peter Johnston (now with ARPANSA) noted that there were "very large expenditures and significant hazards resulting from the deficient management of the project".

The Royal Commission claims that "South Australia has a unique combination of attributes which offer a safe, long-term capability for the disposal of used fuel". But instead it can be credibly argued that SA has a track record of mismanaging radioactive waste (Radium Hill, Maralinga, Port Pirie, Arkaroola, etc.) and no experience managing high-level nuclear waste.

If there was clear recognition of the mismanagement of radioactive waste in SA, coupled with remediation of contaminated sites, we might have some confidence that lessons have been learnt and that radioactive waste would be managed more responsibly in future. But there is no such recognition in the Royal Commission's report or from state or federal governments, and there are no plans to remediate contaminated sites. On the contrary, the plan is to make a bad situation much worse with the importation of vast amounts of international intermediate and high level nuclear waste.

As mentioned, successive Australian governments have repeatedly failed in their efforts to establish a repository for low level waste and an interim store (or deep geological repository) for intermediate level national waste – yet the current assumption is that it will be possible to establish

a repository for high level international nuclear waste. This assumption is not consistent with past experience and needs focussed interrogation.

### **A moral responsibility to import nuclear waste?**

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 given that Australia is a uranium exporting nation. But 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, or from the export of any other mineral products. The responsibility for managing nuclear waste lies with the countries that make use of Australian uranium.

One plausible scenario is uranium being mined on Aboriginal land regardless of Aboriginal opposition, and high level nuclear waste being dumped on Aboriginal land, again without consent. That scenario is immoral twice over.

Indeed we maintain that the most consistent ‘moral’ argument is that Australia seek to prevent the creation of further nuclear waste rather than attempt to facilitate its import and dumping.

### **Aboriginal Traditional Owners**

Our organisations hold serious concerns over past and continuing nuclear industry practices and impacts and the following comments highlight the often poor treatment of Aboriginal people by the nuclear/uranium industries in Australia and by governments pursuing or facilitating nuclear/uranium projects.

From evidence provided to the Royal Commission it is evident that a large majority of Aboriginal people oppose the plan to import intermediate and high level nuclear waste.<sup>5</sup>

The SA Government's handling of the Royal Commission process systematically disenfranchised Aboriginal people. The truncated timeline for providing feedback on draft Terms of Reference disadvantaged people in remote regions, people with little or no access to email and internet and people for whom English is a second language. This was compounded when the Commission was formulated as there was no translation of the draft Terms of Reference, and a regional communications and engagement strategy was not developed or implemented. Subsequent efforts by the Royal Commission to provide translators and to translate written material were highly selective, partial and simply inadequate. Aboriginal people repeatedly expressed frustrations with the Royal Commission process.

At a minimum, we call on the Joint Select Committee to develop and implement a strategy to facilitate Aboriginal participation in the Committee's inquiry, including holding hearings in regional and remote locations, and the provision of translators and translated written material. If this requires an extension of the timeline for the Committee's work, so be it.

The federal government tried but failed to impose a national nuclear waste dump on Aboriginal land in SA from 1998–2004, then tried but failed to impose a dump on Aboriginal land in the NT from 2005–14, and now the federal government appears to again be seeking to impose a dump on Aboriginal land in SA against the near-unanimous opposition of Adnyamathanha Traditional Owners.

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<sup>5</sup> [www.anfa.org.au/traditional-owners-statements/](http://www.anfa.org.au/traditional-owners-statements/)

At the federal level Labor and the Coalition both supported the National Radioactive Waste Management Act, which permits the imposition of a dump on Aboriginal land without any consultation with or consent from Aboriginal Traditional Owners (to be precise, the nomination of a site is not invalidated by a failure to consult or secure consent).

In SA, there is bipartisan support for the South Australian Roxby Downs Indenture Act. The Act was amended in 2011 but it retains indefensible exemptions from the SA Aboriginal Heritage Act. Traditional Owners were not even consulted about the amendments. 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."

As things stand, BHP Billiton must partially comply with an old version of the Aboriginal Heritage Act – a version that was never proclaimed. That extraordinary situation needs to be rectified. Moreover it sets an extremely poor precedent in the context of the proposal to import foreign nuclear waste.

## **Economics**

The Royal Commission – and the Jacobs MCM consultancy – base their economic calculations on an entirely arbitrary estimate as to how much waste might be imported. And their estimate of the price per tonne is highly questionable. Plausible estimates of tonnage and price per tonne result in economic losses as explained by Prof. Richard Blandy: "In fact, if South Australia's dump could only attract a quarter of the world's high level nuclear waste, at prices equal to Swedish or Finnish costs of construction (approximately A\$1.13m/tonne of heavy metal and A\$0.65m/tonne of heavy metal, respectively), our dump would lose money and would have a negative net present value."

The nuclear waste import proposal privileges short-term economic interests at the expense of the long-term interests of South Australians. Again this is neatly explained by Prof. Blandy: "We are bequeathing a stream of costs to our successor generations. They will be poorer as a result, and will have reason to curse their forebears for selfishly making themselves better off at their expense. The problem with the high level nuclear waste dump is the inescapable risk (the Royal Commission says that "it is not possible to know the geological and climatic conditions in the distant future") of severely adverse outcomes that we might be passing on to tens of thousands of future generations of South Australians. We should think of what we will leave to our descendants – and not do it."

The Royal Commission (and the Jacobs MCM consultancy) make some provision for cost overruns but nothing on the scale of the near-doubling of cost estimates evident in France and the UK:

- Estimates of the clean-up costs for a range of (civil and military) UK nuclear sites including Sellafield have jumped from a 2005 estimate of £56 billion (A\$97.6b) to over £100 billion (A\$174b).
- In 2005, the French government's nuclear waste agency Andra estimated the cost of a deep geological disposal facility at between €13.5 and €16.5 billion (A\$19.7–24.1 billion). In 2016, Andra estimates the cost of the facility at between €20 billion to €30 billion (A\$29.1–43.7 billion).

The promised 600 jobs associated with the nuclear waste project (once operations began) represent less than 0.1% of the 800,000 jobs presently in South Australia. According to the Australian Bureau of Statistics, there are 11,909,900 'employed persons' in Australia as of January 2016 – thus the nuclear waste storage/disposal project would increase the total by 0.005%.

If the nuclear waste project has even a marginal adverse impact on tourism, the jobs created in the nuclear waste project could be equalled by job losses in the tourism industry. According to the SA

Tourism Commission, 57,000 are employed in tourism in South Australia (direct and indirect). Thus a 1% reduction in the tourism industry would result in the loss of ~570 jobs, very similar to the 600 promised long-term jobs associated with the nuclear waste project. Visitor expenditure is estimated at \$5.7 billion annually, thus a 1% reduction would amount to \$57 million annually, or \$570 million per decade or \$5.7 billion over a 100-year period.

This negative economic impact has not been adequately identified or addressed across a range of potentially adversely exposed sectors including agricultural, wine and fisheries production.

### **Transport risks**

The SA Joint Select Committee might want to consider the implications of any proposal to abandon plans for dedicated, new infrastructure (e.g. port, rail) in favour of existing infrastructure. It should be noted that from 1999–2002 Pangea Resources initially envisaged dedicated infrastructure but as its plans advanced it increasingly favoured the use of existing infrastructure. A shift from dedicated to existing infrastructure would have significant implications for the economics of the project as well as public health and environmental risks.

The Royal Commission report states: "During the past 50 years, approximately 7000 international shipments of used nuclear fuel, including nine that have left Australia for reprocessing, have been undertaken. In this time, no accident involving a breach of the package and the release of its contents has occurred. The same record applies to international transport of high and intermediate level waste."

That claim is incorrect and is refuted by documented evidence provided to – and ignored by – the Royal Commission. For example a whistleblower sparked a major controversy over frequent excessive radioactive contamination of waste containers, rail cars, and trucks in France and Germany. International transport regulations for spent fuel shipments were constantly over a period of many years and this was done knowingly. Another example concerns the derailment of a train wagon carrying spent fuel in December 2013, 3 km from Paris, with testing by AREVA revealing a hotspot on the rail car.

Numerous other train derailments involving nuclear materials transport have been documented. It is unsettling to consider the multiple derailments on the Ghan train line in Australia in the relatively short period of time it has been in operation.

Transport incidents and accidents are routine in countries with significant nuclear industries. The case of the UK is pertinent. A UK government database contains information on 1018 events from 1958 to 2011 (an average of 19 incidents each year).

There were 187 events during the shipment of irradiated nuclear fuel flasks from 1958–2004 in the UK (an average of four per year):

- 33% involved excess contamination on the surface of the flask;
- 24% involved collisions and low speed derailments of the conveyance;
- 16% involved flask preparation faults, and loading/unloading faults;
- 13% involved excess contamination of conveyance;
- 11% involved faults with the conveyance; and
- the remainder included three cases involving fire on a locomotive with no damage to flasks.

The French nuclear safety agency IRSN produced a report summarising radioactive transport accidents and incidents from 1999–2007. The database lists 901 events from 1999–2007 – on

average 100 events annually or about two each week. The IRSN report notes that events where there is contamination of packages and means of transport were still frequent in 2007.

Potential costs of transport accidents: Spent fuel / high level nuclear waste transport accidents have the potential to be extraordinarily expensive. Dr. Marvin Resnikoff and Matt Lamb from Radioactive Waste Management Associates in New York City calculated 355–431 latent cancer fatalities attributable to a "maximum" hypothetical rail cask accident, compared to the US Department of Energy's estimate of 31 fatalities. Using the Department of Energy's model, they calculated that a severe truck cask accident could result in US\$20 billion to US\$36 billion in clean-up costs for an accident in an urban area, and a severe rail accident in an urban area could result in costs from US\$145 billion to US\$270 billion.

Transport and nuclear security: Nuclear engineer Dr John Large writes: "Movement of nuclear materials is inherently risky both in terms of severe accident and terrorist attack. Not all accident scenarios and accident severities can be foreseen; it is only possible to maintain a limited security cordon around the flask and its consignment; ... terrorists are able to seek out and exploit vulnerabilities in the transport arrangements and localities on the route; and emergency planning is difficult to maintain over the entire route."

A number of nuclear transport security incidents are listed in the body of this submission (section 3.8).

### **Security and proliferation risks**

As the Chernobyl disaster proved, dispersal of nuclear material from just one reactor core can have devastating national and international effects. The Royal Commission proposes that Australia accept an amount of nuclear waste that is more radioactive than the Chernobyl #4 reactor core by orders of magnitude. The proposed import of 138,000 tonnes of spent nuclear fuel equates to 6,900 reactor-years of nuclear waste generation (a single reactor produces approx. 20 tonnes of spent nuclear fuel per year).

Nuclear engineers Alan Parkinson and John Large have warned that Australia's proposed national radioactive waste facility would be attractive to terrorists wanting to make a 'dirty bomb', a radioactive weapon delivered by conventional means. The same risk applies to any comparable store of nuclear materials.

Historical examples of military attacks on nuclear plants include attacks and attempted attacks on reactors in Iraq, Iran, Israel and Syria. Those incidents were motivated by attempts to prevent weapons proliferation. Nuclear plants might also be targeted with the aim of widely dispersing radioactive material. High level nuclear waste stores in Australia might be targeted for both reasons.

Numerous security incidents at ANSTO's Lucas Heights site are noted in the body of this submission (section 3.7).

Importation of 138,000 tonnes of spent nuclear fuel would contain 1,380 tonnes of plutonium – sufficient to build approx. 138,000 nuclear weapons. Thus Australia, *regardless of intent*, would be far closer to a weapons capability than is currently the case and regional countries might therefore decide to take steps towards a weapons capability.

Claims that Australia would be making a contribution to global non-proliferation efforts by accepting foreign nuclear waste are highly questionable. Australia's acceptance of spent fuel would



add to the number of countries with large stockpiles of fissile material – in that sense it would contribute to proliferation risks, not to the resolution of those risks.

## **1. IMPORTING WASTE BEFORE A REPOSITORY IS ESTABLISHED**

The Royal Commission's proposal is to import waste before a high level waste repository is established. The so-called 'Interim Storage Facility' is proposed to accumulate 50,000 tonnes of high level nuclear waste before a disposal facility begins accepting waste (Jacobs MCM, Figure 2.1, Baseline spent fuel inventories, p.114).

However it cannot be assured or reliably assumed that it will be possible to establish a repository – many countries have failed and Australia has repeatedly failed in its efforts to establish a national repository for low level waste or an interim store or repository for intermediate level waste. Thus there is a significant risk that high level waste would be imported and would have to remain in 'interim' storage *ad infinitum* due to i) the lack of a repository, ii) the lack of a return-to-sender clause in contracts, and iii) the inability to send the waste on to a third country.

Even if the SA Government is willing to import nuclear waste before a repository is operational, it is doubtful whether state and federal regulators would consider it acceptable, or whether client countries would consider it acceptable. Moreover, winning public support for a nuclear port and nearby 'Interim Storage Facility' will be difficult in any circumstances, and considerably more difficult if a repository has not yet been established.

## **2. A MORAL RESPONSIBILITY TO IMPORT NUCLEAR WASTE?**

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. In fact and in practice, 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, or from the export of any other products.

If any moral responsibility lies with Australia, that responsibility arguably rests with the uranium mining companies (which are foreign-owned or majority foreign-owned) rather than with Australian citizens or federal or state governments. Such responsibility could be framed in 'cradle-to-grave' or life-cycle stewardship arguments of corporate social responsibility.

One plausible scenario is uranium being mined on Aboriginal land regardless of Aboriginal opposition, and high level nuclear waste being dumped on Aboriginal land, again without consent. That scenario is unethical twice over.

It is also argued that Australia has a moral responsibility to accept high level nuclear waste because Australia has more suitable geology than other countries, and/or a more stable political system. Those arguments rest on questionable assumptions. Australia is less tectonically stable than a number of other continental regions according to Dr Mike Sandiford.<sup>6</sup> On the basis of the flawed Maralinga clean-up, there is no reason to believe that a high level nuclear repository (or a waste-to-

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<sup>6</sup> ABC, 'Ask an Expert', [www.abc.net.au/science/expert/realexpert/nuclearpower/08.htm](http://www.abc.net.au/science/expert/realexpert/nuclearpower/08.htm)

fuel recycling project) would be carefully and responsibly managed in Australia, or that regulation would be rigorous and independent.

The Northern Territory Minerals Council has questioned whether Australia has an obligation to accept nuclear waste:<sup>7</sup>

*"In terms of the proposition of taking back nuclear waste, that should be viewed as an economic rather than a moral decision. I do not think that it follows, as some have said, that because we produce uranium we have a moral obligation to take back spent fuel rods and the like. The vast quantity of economic benefit is derived by those producing power and selling it down the track. The percentage we derive from selling the product is minuscule. If it makes economic sense, by all means look at it on that economic and scientific basis, but I do not think there is a moral obligation to do it."*

Likewise, Alan Layton from the Association of Mining and Exploration Companies said:<sup>8</sup>

*"The only observation I would make is that there is probably an argument that there is some safety in burying the wastes close to where the product is used, rather than transporting them. I am not certain about this notion that when we sell uranium we necessarily have to take back its wastes."*

It is argued that Australia would be making a contribution to global non-proliferation efforts by accepting nuclear waste from overseas. However it is not clear that non-proliferation efforts would be advanced as this would depend on many factors. Australia's acceptance of high-level nuclear waste would add to the number of countries with significant stockpiles of fissile material (because it contains plutonium) – in that sense it would contribute to proliferation risks, not to the resolution of those risks.

BHP Billiton's submission to the Switkowski Review stated:

*"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. ... There is no evidence that a change to current Australian Government policies to facilitate domestic enrichment, fuel leasing and high level waste disposal would lead to significant economic opportunities or reduce proliferation risks in the foreseeable future."*

### **3. PUBLIC HEALTH AND ENVIRONMENTAL RISKS**

#### **3.1 Geology / seismic risks**

Claims that Australia is the best place in the world for a nuclear waste dump on seismic criteria are not correct.

Dr Mike Sandiford from the School of Earth Sciences at University of Melbourne writes:<sup>9</sup>

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<sup>7</sup> House of Representatives – Federal Standing Committee on Industry and Resources, Dec 2006, 'Australia's uranium: Greenhouse friendly fuel for an energy hungry world', ch.12, [www.aph.gov.au/Parliamentary\\_Business/Committees/House\\_of\\_Representatives\\_Committees?url=isr/uranium/report.htm](http://www.aph.gov.au/Parliamentary_Business/Committees/House_of_Representatives_Committees?url=isr/uranium/report.htm)

<sup>8</sup> House of Representatives – Federal Standing Committee on Industry and Resources, Dec 2006, 'Australia's uranium: Greenhouse friendly fuel for an energy hungry world', transcript of hearings, 23 Sept 2005, [http://parlinfo.aph.gov.au/parlInfo/download/committees/commrep/8750/toc\\_pdf/4256-2.pdf;fileType=application%2Fpdf#search=%22committees/commrep/8750/0000%22](http://parlinfo.aph.gov.au/parlInfo/download/committees/commrep/8750/toc_pdf/4256-2.pdf;fileType=application%2Fpdf#search=%22committees/commrep/8750/0000%22)

<sup>9</sup> ABC, 'Ask an Expert', [www.abc.net.au/science/expert/realexpert/nuclearpower/08.htm](http://www.abc.net.au/science/expert/realexpert/nuclearpower/08.htm)

*"Australia is relatively stable but not tectonically inert, and appears to be less stable than a number of other continental regions. Some places in Australia are surprisingly geologically active.*

*"We occasionally get big earthquakes in Australia (up to about magnitude 7) and the big ones have tended to occur in somewhat unexpected places like Tennant Creek. The occurrences of such earthquakes imply that we still have much to learn about our earthquake activity. From the point of view of long-term waste disposal this is very important, since prior to the 1988 (M 6.8) quake, Tennant Creek might have been viewed as one of the most appropriate parts of the continent for a storage facility.*

*"Australia is not the most stable of continental regions, although the levels of earthquake risk are low by global standards. To the extent that past earthquake activity provides a guide to future tectonic activity, Australia would not appear to provide the most tectonically stable environments for long-term waste facilities. However, earthquake risk is just one of the 'geologic' factors relevant to evaluating long-term integrity of waste storage facilities, and other factors such as the groundwater conditions, need to be evaluated in any comprehensive assessment of risk."*

The SA State Emergency Services states: "Any part of Australia could experience an earthquake. There is no accepted method to predict earthquakes, however, some regions are more earthquake-prone than others. Parts of South Australia including Adelaide and the mid-north are earthquake hazard areas with a high potential for future earthquakes."<sup>10</sup>

### **3.2 Mismanagement of radioactive waste in SA: Maralinga, Port Pirie, Radium Hill, Arkaroola Wilderness Sanctuary, Olympic Dam, Beverley**

*"The disposal of radioactive waste in Australia is ill-considered and irresponsible. Whether it is short-lived waste from Commonwealth facilities, long-lived plutonium waste from an atomic bomb test site on Aboriginal land, or reactor waste from Lucas Heights. The government applies double standards to suit its own agenda; there is no consistency, and little evidence of logic."*

*– Nuclear engineer Alan Parkinson<sup>11</sup>*

A demonstrated ability to manage Australia's radioactive waste would be a necessary precursor to establishing some degree of confidence that Australia could manage foreign waste. Yet there have been repeated flawed and failed attempts to impose repositories in SA and the NT, and we believe the current attempt to site a national radioactive waste repository in the Flinders Ranges will also fail.

There are also many examples of the mismanagement of radioactive waste in SA that were largely ignored in the Royal Commission report. If there was clear acknowledgement of the mismanagement of radioactive waste in SA, coupled with remediation of contaminated sites, we might have some confidence that lessons have been learnt and that radioactive waste would be managed more responsibly in future. But there is scant recognition of the problems and no plans to remediate contaminated sites. On the contrary, the plan is to make a bad situation much worse with the importation of vast amounts of intermediate- and high-level nuclear waste.

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<sup>10</sup> [www.ses.sa.gov.au/site/community\\_safety/earthquake\\_information.jsp](http://www.ses.sa.gov.au/site/community_safety/earthquake_information.jsp) [accessed 31 July 2015]

<sup>11</sup> Alan Parkinson, 2002, 'Double standards with radioactive waste', *Australasian Science*, [www.foe.org.au/anti-nuclear/issues/oz/britbombs/clean-up](http://www.foe.org.au/anti-nuclear/issues/oz/britbombs/clean-up)

## Maralinga

The explosion of nuclear bombs at Maralinga in the 1950s has nothing to do with the current waste import proposal. However aspects of the Maralinga experience are highly relevant, as the Commission itself correctly notes. In particular, the 'clean-up' of nuclear waste at Maralinga in the late 1990s is relevant and it was a fiasco.<sup>12</sup> 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 – specifically, Australian standards preclude the shallow burial of long-lived waste.<sup>13</sup> Disturbingly, ARPANSA also promoted the fiction that the clean-up was 'world's best practice'.

The 'clean up' of Maralinga was badly mishandled because the government officials had little or no project management experience and little or no understanding of the technical risks, and because the federal government wasn't prepared to spend the money to carry out the clean-up properly.<sup>14</sup>

The scale of the incompetence associated with the Maralinga clean-up warrants emphasis. Nuclear engineer Alan Parkinson had this to say about senior government officials responsible for the Maralinga 'clean up':

*"Different members of the department's team (a) did not know what is meant by alpha radiation (plutonium-239, the main contaminant at Maralinga, emits alpha radiation), (b) thought that a milliSievert (a unit of radiation dose) could be converted to a picoCurie (a unit of radioactivity) and (c) stated that soda ash (an alkaline substance) would be neutralised by the limestone (another alkaline substance) at the site. The person who made the last statement also told a Senate committee that limestone is "rich in sodium and carbonate" with no mention of calcium (limestone is calcium carbonate). One of those people told me "When dealing with contractors, you should always seek compromises.""*

Parkinson said of the 'clean-up': "What was done at Maralinga was a cheap and nasty solution that wouldn't be adopted on white-fellas land."<sup>15</sup>

Scientist Dale Timmons said the government's technical report on the Maralinga clean-up was littered with "gross misinformation".<sup>16</sup>

Dr Geoff Williams, an officer with the Commonwealth nuclear regulator ARPANSA, said that the clean-up was beset by a "host of indiscretions, short-cuts and cover-ups".<sup>17</sup>

Nuclear physicist Prof. Peter Johnston (now with ARPANSA) noted that there were "very large expenditures and significant hazards resulting from the deficient management of the project".<sup>18</sup>

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<sup>12</sup> [www.foe.org.au/anti-nuclear/issues/oz/britbombs/clean-up](http://www.foe.org.au/anti-nuclear/issues/oz/britbombs/clean-up)

<sup>13</sup> [www.foe.org.au/sites/default/files/ParkinsonARPANSA2004.doc](http://www.foe.org.au/sites/default/files/ParkinsonARPANSA2004.doc)

<sup>14</sup> See section 1.9 of this submissions.

See also: [www.foe.org.au/anti-nuclear/issues/oz/britbombs/clean-up](http://www.foe.org.au/anti-nuclear/issues/oz/britbombs/clean-up)

See also: Alan Parkinson, 2015 submission to Nuclear Fuel Cycle Royal Commission, <http://nuclearrc.sa.gov.au/app/uploads/2015/08/Alan-Parkinson-12-06-2015.pdf>

<sup>15</sup> ABC-SA 774 Radio, August 2002

<sup>16</sup> <http://pandora.nla.gov.au/pan/30410/20090218-0153/www.geocities.com/jimgreen3/martac.html>

<sup>17</sup> [www.abc.net.au/radionational/programs/backgroundbriefing/maralinga-the-fall-out-continues/3466242](http://www.abc.net.au/radionational/programs/backgroundbriefing/maralinga-the-fall-out-continues/3466242)

<sup>18</sup> 2004, Submission to ARPANSA inquiry into proposed repository in SA, [www.foe.org.au/anti-nuclear/issues/oz/britbombs/clean-up](http://www.foe.org.au/anti-nuclear/issues/oz/britbombs/clean-up)

Prof. Johnston (and others) noted in a conference paper that Traditional Owners were excluded from any meaningful input into decision-making concerning the clean-up.<sup>19</sup> Traditional Owners were represented on a consultative committee but key decisions – such as abandoning vitrification of plutonium-contaminated waste in favour of shallow burial in unlined trenches – were taken without consultation with the consultative committee or any separate discussions with Traditional Owners.

Senator Nick Minchin said in a May 1, 2000 media release that: "As the primary risk from plutonium is inhalation, all these groups have agreed that deep burial of plutonium is a safe way of handling this waste." By "these groups" the Minister meant ARPANSA, the Maralinga Tjarutja and South Australian Government. The Minister's statement was false on two counts. Firstly, the burial of plutonium-contaminated debris is not 'deep' no matter how loose the definition – the soil cover was just five metres. Secondly, the Maralinga Tjarutja certainly did not agree to the decision to abandon ISV in favour of burial – in fact they wrote to the Minister disassociating themselves from the decision.<sup>20</sup>

The Senate passed resolutions condemning the clean-up on 21 August 2002 and 15 October 2003.<sup>21</sup>

If lessons were learnt from the Maralinga clean-up there might be some cause for optimism. However there is no evidence that lessons have been learnt. The clean-up of Maralinga in the late 1990s was the fourth clean-up but it is unlikely to be the last. Barely a decade after the clean-up, a survey revealed that 19 of the 85 contaminated waste pits have been subject to erosion or subsidence.<sup>22</sup>

## **Port Pirie**

The Port Pirie Uranium Treatment Complex was closed over 50 years ago in 1962.<sup>23</sup> Yet the site is still contaminated. Six uranium tailings dams and a rare earth extraction dam cover approximately 26 hectares.<sup>24</sup>

As of July 2015, the SA government website states that "a long-term management strategy for the former site" is being developed.<sup>25</sup> Likewise, June 2012 correspondence from the SA Department of Manufacturing, Innovation, Trade, Resources and Energy states: "The [Port Pirie] site assessment works were undertaken to inform the department in developing the long term planning and management of the sites. As a follow on from these works, the sites are actively monitored to provide additional information to assist with the ongoing development of management plans and potential remediation."

One unsavoury feature of Australia's nuclear history is the exposure of children to radiation at disused uranium mines and processing plants.<sup>26</sup> Port Pirie provides one such example: due to the

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<sup>19</sup> P.N. Johnston, A.C. Collett, T.J. Gara, "Aboriginal participation and concerns throughout the rehabilitation of Maralinga", presented at the Third International Symposium on the Protection of the Environment from Ionising Radiation, Darwin, 22-26 July 2002. See pp.349-56 in this PDF: [www-pub.iaea.org/MTCD/publications/PDF/CSP-17\\_web.pdf](http://www-pub.iaea.org/MTCD/publications/PDF/CSP-17_web.pdf)

<sup>20</sup> Senate Estimates, May 3, 2000.

<sup>21</sup> [www.foe.org.au/anti-nuclear/issues/oz/britbombs/clean-up](http://www.foe.org.au/anti-nuclear/issues/oz/britbombs/clean-up)

<sup>22</sup> [www.theage.com.au/national/maralinga-sites-need-more-repair-work-files-show-20111111-1nbpp.html](http://www.theage.com.au/national/maralinga-sites-need-more-repair-work-files-show-20111111-1nbpp.html)

<sup>23</sup> <https://australianmap.net/port-pirie>

<sup>24</sup>

[http://minerals.dmitre.sa.gov.au/mines\\_\\_and\\_\\_developing\\_projects/former\\_mines/port\\_pirie\\_treatment\\_plant/about\\_the\\_plant](http://minerals.dmitre.sa.gov.au/mines__and__developing_projects/former_mines/port_pirie_treatment_plant/about_the_plant)

<sup>25</sup> [http://minerals.dmitre.sa.gov.au/mines\\_\\_and\\_\\_developing\\_projects/former\\_mines/port\\_pirie\\_treatment\\_plant](http://minerals.dmitre.sa.gov.au/mines__and__developing_projects/former_mines/port_pirie_treatment_plant)

<sup>26</sup> For more information and references see <https://australianmap.net/overview/>

lack of fencing, the contaminated Port Pirie site was used as a playground by children for a number of years. The situation was rectified only after a six-year community campaign. Again, this lived experience provides no basis for confidence in what is currently being proposed in relation to international radioactive waste.

## **Radium Hill**

Academics Gavin Mudd and Mark Diesendorf summarise the substandard history of uranium mine rehabilitation in Australia (and their paper provides references to detailed supporting literature):<sup>27</sup>

*"In Australia, there is often a widely held belief that we have been successful in rehabilitating our legacy U projects – but invariably this view is held by those who have never visited these sites. In brief, the major Cold War-era U mines in Australia were the Mary Kathleen, Rum Jungle, Radium Hill-Port Pirie and the Upper South Alligator Valley, with the latter rehabilitated only in the 2000s (after the Coronation Hill saga) while all others were rehabilitated in the mid-1980s. Further small U projects were also developed at Pandanus Creek-Cobar 2, Fleur de Lys, George Creek, Brock's Creek and Adelaide River in the Northern Territory and Myponga in South Australia, though no substantive rehabilitation work is known for each site. The Nabarlek project, which operated from 1979 to 1988, was a 'modern U mine' and approved and operated under strict regulations and supervision, being rehabilitated in the mid-1990s. Other 'modern U mines' are still in operation at Ranger, Olympic Dam and more recently Beverley.*

*At present, there is no former U project in Australia which can be claimed as a successful, long-term rehabilitation case study – all still require ongoing monitoring and maintenance and some remain mildly to extremely polluting. While this may be rather surprising to many in the general mining industry, there is strong evidence to support such a view.*

A radioactive waste repository at Radium Hill "is not engineered to a standard consistent with current internationally accepted practice" according to a 2003 SA government audit. Yet there are no plans to rectify the situation.

## **Arkaroola Wilderness Sanctuary: – a serious failure of SA government oversight/regulation**

Marathon Resources was found guilty of illegally disposing of radioactive materials in the Arkaroola Wilderness Sanctuary.<sup>28</sup> Illegally dumped material included 22,800 calico bags containing drill cuttings, 16 steel and four plastic drums, 1500 empty plastic bags, folding seats, tyres, safety suits, aluminium trays, PVC pipes, oil and air filters, bottles and cans and polystyrene foam.

In addition, the Arkaroola Wilderness Sanctuary managers noted other problems with Marathon's activities at Mt Gee<sup>29</sup>:

- numerous hydrocarbon spills;
- Marathon's contractors allegedly stole 90,000 litres of rainwater;
- Marathon employee/s allegedly stole fluorite from the Mt Gee Geological Monument<sup>30</sup>; and
- the failure to follow safety procedures resulting in loss of wildlife.

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<sup>27</sup> Mudd, G M & Diesendorf, M, 2010, Uranium Mining, Nuclear Power and Sustainability - Rhetoric versus Reality. In "Sustainable Mining 2010 Conference", Australasian Institute of Mining and Metallurgy (AusIMM), Kalgoorlie, Western Australia, Australia, August 2010, pp 315-340.

<https://www.ausimm.com.au/publications/epublication.aspx?ID=5676>

Available from Gavin.Mudd@monash.edu

<sup>28</sup> <http://australianmap.net/mt-gee/>

<sup>29</sup> <http://australianmap.net/mt-gee/>

<sup>30</sup> <http://unknownsa.blogspot.com.au/2008/09/case-of-missing-minerals.html>

It is important to note that Marathon's illegal activities were uncovered by detective work by the managers of the Arkaroola Wilderness Sanctuary. Those activities were not detected by government regulators. If not for the detective work of the managers of the Arkaroola Wilderness Sanctuary, the activities might be continuing to this day. The saga represents a serious failure of the SA government's oversight of the uranium mining industry.

The SA Joint Select Committee should ascertain what steps have been taken to prevent a recurrence of problems such as those that arose with Marathon Resources and what regulatory and monitoring changes have been adopted in response to this situation. To the best of our knowledge, there have been no regulatory or legislative changes.

The Royal Commission report deals with this scandal in two sentences, noting that the "regulator required the company to undertake rectification works" but without noting that the regulator would know nothing of the illegal radioactive waste dumping if not for the detective work of non State parties.

### **3.3 Corporate governance – the case of General Atomics / Heathgate**

To the best of our knowledge the SA Government shown no interest in the corporate governance questions raised here – this sets a poor precedent and raises questions as to whether private-sector interests involved in the nuclear waste import project would be subject to adequate oversight.

Fortune Magazine details one of the controversies surrounding General Atomics' subsidiary Heathgate Resources' Beverley uranium mine in SA.<sup>31</sup> When uranium prices increased in the mid-2000s, the company was locked into long-term contracts to sell yellowcake from Beverley at earlier, lower prices. Heathgate devised plans to renegotiate its legally-binding contracts. Customers were told that production costs at Beverley were higher than expected, that production was lower than expected, and that a failure to renegotiate contracts would force Heathgate to file for bankruptcy. However former employees said that General Atomics (GA) CEO Neal Blue had allegedly directed Heathgate to increase its production costs. Customers were not told that bankruptcy was unlikely since GA had agreed to continue providing Heathgate with financial assistance. Two of Heathgate's Australian directors consulted an attorney who advised them that the plan could be considered a conspiracy to defraud. They left the company. Exelon, one of Heathgate's uranium customers, sued. The lawsuit was settled for about \$41 million. Because of the increased uranium price, Blue ended up well in front despite the cost of the settlement with Exelon – more than \$200 million in front by some estimates. Blue was unrepentant: "It made more sense to, in essence, just pay the fine."

The SA Joint Select Committee should determine what action if any the federal and SA governments took in response to allegations of corporate impropriety by General Atomics / Heathgate as detailed in Fortune Magazine.

### **3.4 Hazards associated with high level nuclear waste**

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<sup>31</sup> Barney Gimbel, 31 Oct 2008, 'The predator', Fortune Magazine, [www.foe.org.au/anti-nuclear/issues/oz/u/isl/blue](http://www.foe.org.au/anti-nuclear/issues/oz/u/isl/blue)

[http://money.cnn.com/2008/10/28/magazines/fortune/predator\\_gimbel.fortune/index.htm](http://money.cnn.com/2008/10/28/magazines/fortune/predator_gimbel.fortune/index.htm)

[http://archive.fortune.com/2008/10/28/magazines/fortune/predator\\_gimbel.fortune/index.htm](http://archive.fortune.com/2008/10/28/magazines/fortune/predator_gimbel.fortune/index.htm)

See also: Nick O'Malley and Ben Cubby, 30 July 2009, 'Arms maker behind uranium mine settled fraudulent pricing case', Sydney Morning Herald, [www.smh.com.au/national/arms-maker-behind-uranium-mine-settled-fraudulent-pricing-case-20090729-e11x.html](http://www.smh.com.au/national/arms-maker-behind-uranium-mine-settled-fraudulent-pricing-case-20090729-e11x.html)

Spent fuel / high level waste is extraordinarily radioactive and hazardous. It takes about 300,000 years for the radioactivity of spent fuel to decline to that of the original uranium ore.<sup>32</sup> For the high level waste stream from reprocessing (from which plutonium and uranium have been removed), it takes about 10,000 years for the radioactivity to decline to that of the uranium ore body.<sup>33</sup>

Writing in *Australian Geologist*, Professor John Veevers from Macquarie University notes the serious public health and environmental risks associated with a high level nuclear waste repository:

*"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."*<sup>34</sup>

Pangea-successor ARIUS notes some of the technical challenges:<sup>35</sup>

*"In general, repositories are held to stringent safety standards defined both internationally and by national radiation safety regulatory authorities. These standards require a high level of containment of the emplaced wastes, as even a small fraction returning to the biosphere can result in violating the standards. It must be demonstrated that repositories will continue to meet these standards for an extremely long time and national regulations often define different practical yardsticks and measures for different times in the future. This will require developing an unprecedented level of confidence in our ability to understand the long-term future performance of the repository system."*

In a detailed 2010 report, Dr Helen Wallace summarises numerous potential problems with deep geological storage of nuclear waste:<sup>36</sup>

- Corrosion of copper or steel canisters and overpacks.
- The effects of intense heat generated by radioactive decay, and of chemical and physical disturbance due to corrosion, gas generation and biomineralisation, could impair the ability of backfill material to trap some radionuclides.
- Build-up of gas pressure in the repository, as a result of the corrosion of metals and/or the degradation of organic material, could damage the barriers and force fast routes for radionuclide escape through crystalline rock fractures or clay rock pores.
- Poorly understood chemical effects, such as the formation of colloids, could speed up the transport of some of the more radiotoxic elements such as plutonium.
- Unidentified fractures and faults, or poor understanding of how water and gas will flow through fractures and faults, could lead to the release of radionuclides in groundwater much faster than expected.
- Excavation of the repository will damage adjacent zones of rock and could thereby create fast routes for radionuclide escape.
- Future generations, seeking underground resources or storage facilities, might accidentally dig a shaft into the rock around the repository or a well into contaminated groundwater above it.
- Future glaciations could cause faulting of the rock, rupture of containers and penetration of surface waters or permafrost to the repository depth, leading to failure of the barriers and faster dissolution of the waste.

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<sup>32</sup> <https://theconversation.com/the-case-for-nuclear-power-despite-the-risks-41552>

<sup>33</sup> Switkowski Review, 2006, Uranium Mining, Processing and Nuclear Energy Review, <http://pandora.nla.gov.au/tep/66043>

<sup>34</sup> J.J. Veevers, 'Disposal of British RADwaste at home and in antipodean Australia', <http://web.archive.org/web/20120410062832/http://eps.mq.edu.au/media/veevers1.htm>

<sup>35</sup> <http://nuclearc.sa.gov.au/app/uploads/2015/08/Arius-Association-13-07-2015.pdf>

<sup>36</sup> Dr Helen Wallace for Greenpeace International, Sept 2010, 'Rock Solid? A scientific review of geological disposal of high-level radioactive waste', [www.greenpeace.org/eu-unit/en/Publications/2010/rock-solid-a-scientific-review/](http://www.greenpeace.org/eu-unit/en/Publications/2010/rock-solid-a-scientific-review/)



- Earthquakes could damage containers, backfill and the rock.

Dr Wallace identifies the following unresolved issues:

- the high likelihood of interpretative bias in the safety assessment process because of the lack of validation of models, the role of commercial interests and the pressure to implement existing road maps despite important gaps in knowledge. Lack of (funding for) independent scrutiny of data and assumptions can strongly influence the safety case.
- lack of a clearly defined inventory of radioactive wastes, as a result of uncertainty about the quantities of additional waste that will be produced in new reactors, increasing radioactivity of waste due to the use of higher burn-up fuels, and ambiguous definitions of what is considered as waste.
- the question of whether site selection and characterisation processes can actually identify a large enough volume of rock with sufficiently favourable characteristics to contain the expected volume of wastes likely to be generated in a given country.
- tension between the economic benefits offered to host communities and long-term repository safety, leading to a danger that concerns about safety and impacts on future generations may be sidelined by the prospect of economic incentives, new infrastructure or jobs.
- potential for significant radiological releases through a variety of mechanisms, involving the release of radioactive gas and/or water due to the failure of the near-field or far-field barriers, or both.
- significant challenges in demonstrating the validity and predictive value of complex computer models over long timescales.
- risk of significant escalation in repository costs.

The UK group Nuclear Waste Advisory Associates published an Issues Register in 2010 listing 100 issues which need resolution before any kind of safety case can be made for deep geological disposal.<sup>37</sup> The register considers potential problems and data gaps in the following categories:

*Gases*

*Release of Hydrogen Gas*

*Radioactive Carbon – High Doses within Short Timescale*

*Site Considerations*

*Gases and the Site Selection*

*Availability of Necessary Site Data*

*Groundwater flow and transport*

*Gas/Groundwater Flow*

*Construction Issues*

*Mechanical Questions – Constructability issues*

*Worker Doses*

*The Waste Package and Repository Components*

*The Waste Package Itself*

*The Components of the Waste Facility*

*High Level Wastes*

*Clay*

*Interactions Between the Facility and the Surrounding Rock*

*Chemistry and Contamination Levels*

*Risk Predictions Not Reliable*

*Calculating Contamination Levels*

*Solubility of Chemicals holding Radionuclides*

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<sup>37</sup> Nuclear Waste Advisory Associates Issues Register, March 2010, [www.nuclearwasteadvisory.co.uk/wp-content/uploads/2011/06/NWAA-ISSUES-REGISTER-COMMENTARY.pdf](http://www.nuclearwasteadvisory.co.uk/wp-content/uploads/2011/06/NWAA-ISSUES-REGISTER-COMMENTARY.pdf)

*Oxygen*  
*Large Chemicals – 'Colloids'*  
*Behaviour in Natural Systems*  
*Containment in Alkaline System – cf Detriment to Clay*  
*'Ionic Strength' Effect – Salty Water*  
*Cellulose Breakdown Products + Solubility Increases*  
*Sorption*  
*Plutonium and Uranium-235 and Nuclear Energy*  
*Possible Impact Nuclear Energy Chain Reaction*  
*The Nuclear Weapon Dilemma*  
*Biota*  
*Living Things*  
*Microbes*  
*Timescales*

The UK Nuclear Decommissioning Authority has developed an Issues Register listing and discussing a large number of relevant issues that require consideration.<sup>38</sup>

A January 2015 article discusses recent debates regarding copper corrosion:<sup>39</sup>

*Corrosion*

*To illustrate the sorts of issues being raised by Rock Solid, NWAA and others, one of the many issues raised was a particular problem with copper corrosion which has been raised by some recent research.*

*The KBS-3V disposal concept using copper containers is one of the current disposal concepts under consideration by RWM, for High Level Waste/Spent Fuel (HLW/SF) in higher strength rock. (If the host rock for a DGR were clay then the Swiss NAGRA concept would be used and the German system if the host rock were salt).*

*Both SKB in Sweden and Posiva in Finland have selected the KBS-3V disposal concept as their reference design for use in a spent fuel repository. The KBS-3V disposal concept has been developed over a period of nearly four decades. In this concept, vertical copper canisters are used to store spent fuel, in vertical deposition holes. Adjacent to the canister Bentonite clay would be used to contain the canisters and retard any potential radionuclide migration. Bentonite is also used to backfill the deposition tunnels.*

*The copper canisters are supposed to be corrosion resistant, but in July 2009 Hultquist et al published research which suggested that a copper wall thickness of one metre would be required for long-term (100,000 years) durability. It is not clear how such a wall thickness would be either logistically or economically achievable. (6)*

*The Swedish NGO, MKG explains that after the emplacement of the canisters and clay the oxygen in the repository is quickly consumed by bacteria and chemical processes. The fundamental assumption in the KBS method is that very little corrosion takes place in an oxygen-free environment. The canister walls are 5 centimetres thick and only a millimetre or two of the copper is supposed to corrode in a million years.*

*Now new research shows that once copper begins to corrode, the process can proceed quickly through so-called pitting, which gives pox-mark indentations in the surface. The risk of pitting has led critical researchers to fear that the copper canisters may start to leak after only some hundreds of years — instead of after hundreds of thousands of years.*

*In November 2009 after various papers by Hultquist et al, the Swedish Council for Nuclear Waste, an independent scientific committee which advises the Government, organised a*

<sup>38</sup> [www.nda.gov.uk/rwm/issues/navigating-your-way-around-the-issues-register/](http://www.nda.gov.uk/rwm/issues/navigating-your-way-around-the-issues-register/)

<sup>39</sup> [www.no2nuclearpower.org.uk/nuclearnews/NuClearNewsNo70.pdf](http://www.no2nuclearpower.org.uk/nuclearnews/NuClearNewsNo70.pdf)

workshop. The conclusions of the expert panel invited to comment on the issues raised were not categorical. The Council states that:

"...mechanisms of copper corrosion in oxygen-free water must be investigated experimentally to determine whether corrosion of copper by hydrogen evolution can take place in pure, deionized, oxygen-free water and in groundwater with bentonite." (7)

Then in 2011 the Swedish Radiation Safety Authority (SSM) published research which in principal reproduced parts of Hultquist et al. Exposure of copper in pure anoxic water (depleted of dissolved oxygen) resulted in a measureable gas production rate. The most obvious explanation for the results in this work is consequently that corrosion of copper occurs in pure anoxic water. (8)

In 2012 SSM explained that the copper canisters will need to meet to two completely different environments over the life of the geological disposal facility;

- an initial period of several hundreds of years when copper is exposed to gaseous corrosion
- and then a period when it is exposed to aqueous corrosion

From a corrosion point of view the first 1000 years are the most critical for the copper canister since pure, or phosphorus alloyed copper, is not designed to cope with corrosion at elevated temperatures. The outer copper surface temperature is expected to reach 100°C within some decades after closure of the repository and then slowly cool down to around 50°C after 1000 years.

SSM criticises SKB for only looking at oxygen when assessing gaseous corrosion. It says "This simple model has no scientific support since several corrosive trace gases, such as sulphurous and nitrous compounds, operates together with water molecules (moisture) and the corrosion product consists mostly of oxides and hydroxides derived from water molecules. These trace gases are known to have an accelerating effect on copper corrosion. Any corrosion model describing the gaseous copper corrosion period must therefore be based on experimental data." (9)

In 2013, SSM commissioned Hultquist and others to carry out further research. This indicated that corrosion of copper in anoxic water involves a mechanism in which hydrogen atoms present in water molecules form hydrogen gas which partly dissociate and diffuse into the copper metal as hydrogen atoms. (10)

In September 2014 SKB submitted a progress report to SSM on Copper Corrosion. SKB now admits that theoretically copper can corrode in anoxic water and that there are indications that the process does occur on the surface. But SKB claims that the corrosion stops very soon after starting and that hydrogen measured over longer time-scales comes from inside the copper and not from a continued corrosion process. Unfortunately SKB had no evidence to support this assertion. And according to microbiologist Karsten Pedersen in Gothenburg, who carried out the study for SKB, it is possible to interpret the results in different ways. (11) SKB claimed that it was now scientifically proven that even if copper can react with oxygen-free water, this is only a short-lived surface effect. Hence, the corrosion process will not be a threat to the long-term safety of the planned repository for spent nuclear fuel at Forsmark. This ongoing scientific debate on just one of many unresolved issues surely raises a question-mark over whether it will ever be possible to produce an adequate robust safety case in order to proceed with burying nuclear waste underground.

6. "Water Corrodes Copper" G. Hultquist et al [July 2009 – (online)] *Catal Lett* (2009) 132: 311–316: Received: 29 June 2009 – Accepted: 19 July 2009 (Published online: 28 July 2009) Springer Science+Business Media, LLC 2009

[http://www.mkg.se/uploads/Water\\_Corrodes\\_Copper\\_-\\_Catalysis\\_Letters\\_Oct\\_2009\\_-\\_Hultquist\\_Szakalos\\_et\\_al.pdf](http://www.mkg.se/uploads/Water_Corrodes_Copper_-_Catalysis_Letters_Oct_2009_-_Hultquist_Szakalos_et_al.pdf)

7. Nuclear Waste State-of-the-Art Report 2010 — Challenges for the Final Repository Program, Swedish Council for Nuclear Waste, Stockholm, 2010.

<http://www.government.se/sb/d/574/a/150543> (quoted in *Managing Spent Fuel from Nuclear*

*Power Reactors: Experience and Lessons from Around the World, IPFM, September 2011*

<http://www.fissilematerials.org/library/rr10.pdf>

8. 2011:34 *Evolution of hydrogen by copper in ultrapure water without dissolved oxygen*, by Richard Becker and Hans-Peter Hermansson

<http://www.stralsakerhetsmyndigheten.se/Publikationer/Rapport/Avfall-transport-fysiskt-skydd/2011/201134/>

9. *Technical Note: Corrosion of Copper Canister 2012:17, SSM*

<http://www.stralsakerhetsmyndigheten.se/Publikationer/Rapport/Avfall-transport-fysiskt-skydd/2012/201217/>

10. 2013:07 *Corrosion of copper in distilled water without molecular oxygen and the detection of produced hydrogen*, G. Hultquist, M.J. Graham, O. Kodra, S. Moisa, R. Liu, U. Bexell and J.L. Smialek. <http://www.stralsakerhetsmyndigheten.se/Publikationer/Rapport/Avfall-transport-fysiskt-skydd/2013/201307/>

11. *Swedish Radio 3rd Oct 2014*

<http://sverigesradio.se/sida/artikel.aspx?programid=406&artikel=5981167>

### 3.5 Overseas examples of nuclear waste (mis)management

There are no operating repositories for high level nuclear waste. The one and only deep geological repository for intermediate level waste – the Waste Isolation Pilot Plant in the USA – has been a spectacular failure. It is discussed in detail below.

**Finland and Sweden** are the countries most advanced with deep geological repository projects. Plans for new reactors in Finland are being complicated by the inability of the proposed repository to accommodate any additional waste. Posiva Oy, a joint venture between TVO and Fortum, plans a deep geological repository on Olkiluoto Island but those plans do not include accommodation for spent fuel from any new plants such as the one proposed by the Fennovoima consortium. Posiva, TVO and Fortum have repeatedly said they will not accept Fennovoima as a partner. Posiva President Reijo Sundell said in 2012: "We're not trying to be nasty. But the simple fact is that there is not enough room. We can't expand the site under the sea. We can't create another deeper level because then it might not withstand the pressure of an ice age. And we can't build a shallower level because the underground water there is saltier and therefore more corrosive."<sup>40</sup> Making the Olkiluoto bedrock repository bigger to accommodate waste from additional reactors would cost about 200 million euros, whereas building a separate facility would cost far more.<sup>41</sup>

The Royal Commission claimed that Finland and Sweden "have successfully developed long-term domestic solutions" for nuclear waste. But in fact, neither country has completed construction of a repository let alone demonstrated safe operation over any length of time. After over 30 years Finland is still seven years away from first disposal, scheduled for 2023. Sweden's Forsmark Geological Disposal Facility has not been licensed to start construction and isn't planned to open until the late 2020s.

Plans for a high level waste repository at Yucca Mountain in Nevada, **USA**, were abandoned in 2009. Over 20 years of work was put into the repository plan, and over A\$10 billion spent. The repository plan was controversial and subject to scandals including one involving the falsification of safety data in relation to groundwater modelling. Studies found that Yucca Mountain could not meet the existing radiation protection standards in the long term and subsequent moves by the US

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<sup>40</sup> 24 Jan 2012, 'Posiva: No room for Fennovoima waste in nuclear cave', [http://yle.fi/uutiset/posiva\\_no\\_room\\_for\\_fennovoima\\_waste\\_in\\_nuclear\\_cave/5295682](http://yle.fi/uutiset/posiva_no_room_for_fennovoima_waste_in_nuclear_cave/5295682)

<sup>41</sup> [www.world-nuclear.org/info/Country-Profiles/Countries-A-F/Finland/](http://www.world-nuclear.org/info/Country-Profiles/Countries-A-F/Finland/)

Environmental Protection Agency to weaken radiation protection standards generated controversy.<sup>42</sup>

Some of the problems dealing with radioactive waste in the US are summarised by Pangea-successor ARIUS: "USA: politics has heavily influence[d] the hugely expensive and as yet unsuccessful repository projects. Unrealistic setting of target dates by politicians led to unnecessary pressures on technical work, failure to meet deadlines and loss of confidence in the implementer (USDOE). Political dealings then led to a poorly justified selection of Yucca Mountain in Nevada and further political deals then led to the multi-billion project there being declared as not workable by the present administration."<sup>43</sup>

There is no end in sight to **Japan's** efforts to establish a repository for high-level nuclear waste. The Nuclear Waste Management Organisation was set up in October 2000 by the private sector to progress plans for disposal. Municipalities were invited to indicate whether they were interested in hosting a repository. Only the town of Toyo in western Japan indicated interest – but the town's application was quickly withdrawn after the local population expressed strong opposition. Now, the Japanese government intends to use a top-down approach, identifying "scientifically promising locations" first and then discussing options with local governments. The new policy was approved by Cabinet in May 2015. The revised policy does not specify a timeframe for building a repository. The cost of building a repository is estimated at ¥3,500 billion.<sup>44</sup>

The Science Council of Japan has criticized the government for being "irresponsible toward future generations" by seeking to restart reactors without a decision on a waste disposal site. The council says that finding a site will be difficult "given that public trust in the government, power companies and scientists has been lost" because of the Fukushima disaster.<sup>45</sup>

**Germany's** efforts to manage nuclear waste have been littered with controversy, scandals, and technical failures – a salutary lesson for Australia given that Germany has far more nuclear experience and expertise than Australia. One of the technical failures is the Asse repository for low- and intermediate-level waste. Water intrusion has caused great damage and plans are being developed to exhume 126,000 barrels of waste. The exhumation will be technically challenging and possibly hazardous, it will cost between €4 billion and €10 billion, and it could take up to 30 years.<sup>46</sup>

Two pictures of the Asse repository in Germany:

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<sup>42</sup> Nuclear Information & Resource Service, [www.nirs.org/radwaste/yucca/yuccahome.htm](http://www.nirs.org/radwaste/yucca/yuccahome.htm)

<sup>43</sup> <http://nuclearrc.sa.gov.au/app/uploads/2015/08/Arius-Association-13-07-2015.pdf>

<sup>44</sup> WNA, Japan's Nuclear Fuel Cycle, updated May 2015, [www.world-nuclear.org/info/Country-Profiles/Countries-G-N/Japan--Nuclear-Fuel-Cycle/](http://www.world-nuclear.org/info/Country-Profiles/Countries-G-N/Japan--Nuclear-Fuel-Cycle/)

<sup>45</sup> 22 Feb 2015, 'Editorial: Nuclear waste disposal problem', [www.japantimes.co.jp/opinion/2015/02/22/editorials/nuclear-waste-disposal-problem/](http://www.japantimes.co.jp/opinion/2015/02/22/editorials/nuclear-waste-disposal-problem/)

<sup>46</sup> Michael Fröhlingdorf, Udo Ludwig and Alfred Weinzierl, 21 Feb 2013, 'Abyss of Uncertainty: Germany's Homemade Nuclear Waste Disaster', [www.spiegel.de/international/germany/germany-weighs-options-for-handling-nuclear-waste-in-asse-mine-a-884523.html](http://www.spiegel.de/international/germany/germany-weighs-options-for-handling-nuclear-waste-in-asse-mine-a-884523.html)



The protracted and unsuccessful efforts to manage nuclear waste in the **UK** are detailed in the submission to the Royal Commission written by Jean McSorley.<sup>47</sup> Failures include unsuccessful efforts to establish a high level waste repository, reprocessing failures (e.g. THORP), the unsuccessful SMP MOX plant, a stockpile of 100+ tonnes of civil plutonium, etc.

The explosion of a liquid high level nuclear waste tank at Chelyabinsk in the **Soviet Union** on 29 September 1957 is the worst accident involving nuclear waste.<sup>48</sup> It led a "significant release of radioactive material to the environment" according to the International Atomic Energy Agency. It was rated Level 6 ('Serious Accident') on the 7-point International Nuclear Event Scale. Liquid high level wastes were stored in underground steel tanks in concrete trenches, surrounded by coolers. Failure to repair a cooling system in one of the tanks led to an increase in temperature and eventually – after about one year – to a chemical explosion. The contamination was "very serious" according to Soviet scientists; the total release was of the order of 740,000 terabecquerels (20 megacuries) with about 90% deposited in the immediate area and 10% widely dispersed. The accident resulted in long-term contamination of more than 800 sq kms, primarily with caesium-137 and strontium-90; this area is referred to as the East-Ural Radioactive Trace. Over 10,000 people were evacuated in the 18 months following the accident. Over 1,000 sq kms of land in Chelyabinsk province and Sverdlovsk province were removed from agricultural use. Soviet scientists noted that clean-up measures were "inadequately effective" and produced "comparatively poor results". Nevertheless, all but 220 sq kms were returned to agricultural use between 1961 and 1978. It is estimated that direct exposure to radiation from the accident caused at least 200 long-term cancer deaths – although other estimates put the figure significantly higher and others significantly lower.

### 3.6 WIPP – chemical explosion in the world's only deep geological repository

No deep underground repositories for high level nuclear waste exist, however 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.

<sup>47</sup> [www.foe.org.au/sites/default/files/McSorley-9MB-FoEA-ACF-CCSA-22-07-2015-NFCRCsubmission-inc-attachments-9MB.pdf](http://www.foe.org.au/sites/default/files/McSorley-9MB-FoEA-ACF-CCSA-22-07-2015-NFCRCsubmission-inc-attachments-9MB.pdf)

<sup>48</sup> [www.bellona.org/articles/articles\\_2008/kyshtym\\_memorial](http://www.bellona.org/articles/articles_2008/kyshtym_memorial)  
[www.iaea.org/Publications/Documents/Infcircs/Others/inf368.shtml](http://www.iaea.org/Publications/Documents/Infcircs/Others/inf368.shtml)  
[www.johnstonsarchive.net/nuclear/radevents/1957USSR1.html](http://www.johnstonsarchive.net/nuclear/radevents/1957USSR1.html)  
 'Soviets Tell About Nuclear Plant Disaster; 1957 Reactor Mishap May Be Worst Ever', 'The Washington Post', R. Jeffrey Smith, 10 July 1989  
[http://en.wikipedia.org/wiki/Kyshtym\\_disaster](http://en.wikipedia.org/wiki/Kyshtym_disaster)  
[www.fas.org/news/russia/1995/fbust037\\_95011.htm](http://www.fas.org/news/russia/1995/fbust037_95011.htm)  
[www.iaea.org/Publications/Factsheets/English/ines.pdf](http://www.iaea.org/Publications/Factsheets/English/ines.pdf)

On 5 February 2014, a truck hauling salt caught fire at WIPP. Six workers were treated at the Carlsbad hospital for smoke inhalation, another seven were treated at the site, and 86 workers were evacuated. A March 2014 report by the US Department of Energy identified the root cause of the fire as the "failure to adequately recognize and mitigate the hazard regarding a fire in the underground." In 2011, the Defense Nuclear Facilities Safety Board, an independent advisory board, reported that WIPP "does not adequately address the fire hazards and risks associated with underground operations."<sup>49</sup>

In a separate incident, on 14 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 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.<sup>50</sup>

A US government report blamed the barrel rupture and radiation release on the operator and regulator of WIPP, noting their "failure to fully understand, characterize, and control the radiological hazard ... compounded by degradation of key safety management programs and safety culture."<sup>51</sup>

A safety analysis conducted before WIPP opened predicted that one radiation release accident might occur every 200,000 years.<sup>52</sup> 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. Earl Potter, a lawyer who represented Westinghouse, WIPP's first operating contractor, said:<sup>53</sup>

*"At the beginning, there was an almost fanatical attention to safety. I'm afraid the emphasis shifted to looking at how quickly and how inexpensively they could dispose of this waste." Likewise, Rick Fuentes, president of the Carlsbad chapter of the United Steelworkers union, said: "In the early days, we had to prove to the stakeholders that we could operate this place safely for both people and the environment. After time, complacency set in. Money didn't get invested into the equipment and the things it should have."*

Complacency and cost-cutting set in just 10–15 years after WIPP opened. The half-life of plutonium-239, one of the components in the WIPP waste, is 24,100 years.

The following articles provide more information:

*One deep underground dump, one dud*

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<sup>49</sup> 6 June 2014, 'Fire and leaks at the world's only deep geological waste repository', Nuclear Monitor #787, [www.wiseinternational.org/node/4245](http://www.wiseinternational.org/node/4245)

<sup>50</sup> 27 Nov 2014, 'New Mexico nuclear waste accident a 'horrific comedy of errors' that exposes deeper problems', *The Ecologist*, [www.theecologist.org/News/news\\_analysis/2642182/new\\_mexico\\_nuclear\\_waste\\_accident\\_a\\_horrific\\_comedy\\_of\\_err\\_ors\\_that\\_exposes\\_deeper\\_problems.html](http://www.theecologist.org/News/news_analysis/2642182/new_mexico_nuclear_waste_accident_a_horrific_comedy_of_err_ors_that_exposes_deeper_problems.html)

<sup>51</sup> US Dept of Energy, Office of Environmental Management, April 2014, 'Accident Investigation Report: Phase 1: Radiological Release Event at the Waste Isolation Pilot Plant on February 14, 2014', <http://energy.gov/em/downloads/radiological-release-accident-investigation-report>

<sup>52</sup> Matthew Wald, 29 Oct 2014, 'In U.S. Cleanup Efforts, Accident at Nuclear Site Points to Cost of Lapses', [www.nytimes.com/2014/10/30/us/in-us-cleanup-efforts-accident-at-nuclear-site-points-to-cost-of-lapses.html](http://www.nytimes.com/2014/10/30/us/in-us-cleanup-efforts-accident-at-nuclear-site-points-to-cost-of-lapses.html)

<sup>53</sup> Patrick Malone, 14 Feb 2015, 'Repository's future uncertain, but New Mexico town still believes', [www.santafenewmexican.com/special\\_reports/from\\_lanl\\_to\\_leak/repository-s-future-uncertain-but-new-mexico-town-still-believes/article\\_38b0e57b-2d4e-5476-b3f5-0cfe81ce94cc.html](http://www.santafenewmexican.com/special_reports/from_lanl_to_leak/repository-s-future-uncertain-but-new-mexico-town-still-believes/article_38b0e57b-2d4e-5476-b3f5-0cfe81ce94cc.html)

*Nuclear Monitor #801, 9 April 2015*

[www.wiseinternational.org/nuclear-monitor/801/one-deep-underground-dump-one-dud](http://www.wiseinternational.org/nuclear-monitor/801/one-deep-underground-dump-one-dud)

*New Mexico nuclear waste accident a 'horrific comedy of errors' that exposes deeper problems*  
27 Nov 2014, *The Ecologist*

[www.theecologist.org/News/news\\_analysis/2642182/new\\_mexico\\_nuclear\\_waste\\_accident\\_a\\_horrific\\_comedy\\_of\\_errors\\_that\\_exposes\\_deeper\\_problems.html](http://www.theecologist.org/News/news_analysis/2642182/new_mexico_nuclear_waste_accident_a_horrific_comedy_of_errors_that_exposes_deeper_problems.html)

### **3.7 SECURITY AND PROLIFERATION RISKS**

The Royal Commission asserts that nuclear security risks are "manageable and well-managed". This is a very broad assertion, particularly in the current global security context and scant evidence is provided to justify the assertion.

The Royal Commission's Final Report notes that terrorist attack scenarios are conceivable and a rocket attack has the greatest potential to cause a release of radiation (Appendix L – Transport risk analysis).

As the Chernobyl disaster proved, dispersal of nuclear material from just one reactor core can have devastating national and international effects. The Royal Commission proposes that Australia accept an amount of nuclear waste that is more radioactive than the Chernobyl #4 reactor core by *orders of magnitude*. The proposed import of 138,000 tonnes of high level waste equates to 6,900 reactor-years of nuclear waste generation (a single reactor produces approx. 20 tonnes of spent nuclear fuel per year).

Nuclear engineers Alan Parkinson and John Large have warned that Australia's proposed national radioactive waste facility would be attractive to terrorists wanting to make a 'dirty bomb', a radioactive weapon delivered by conventional means. The same risk applies to any comparable store of nuclear materials. Security risks associated with the proposal to import very large amounts of intermediate and high level waste would be far greater than the risks associated with the proposed national facility – because the radioactive inventory is orders of magnitude greater.

One of the security risks associated with plans to import foreign spent nuclear fuel / high level nuclear waste is that waste must be secured not just for years, decades or even centuries, but millennia. Thus there is a body of literature about how future generations might be warned about radiological hazards, long after warning signs have disappeared, engineered and geological barriers have been compromised, etc.<sup>54</sup>

The IAEA summarises problems associated with nuclear theft, smuggling and other such illicit activities:<sup>55</sup>

*"From January 1993 to December, 2013, a total of 2477 incidents were reported to the ITDB by participating States and some non-participating States. Of the 2477 confirmed incidents, 424 involved unauthorized possession and related criminal activities. Incidents included in this category involved illegal possession, movement or attempts to illegally trade in or use nuclear material or radioactive sources. Sixteen incidents in this category involved high enriched uranium (HEU) or plutonium. There were 664 incidents reported that involved the theft or loss of nuclear or other radioactive material and a total of 1337 cases involving other*

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<sup>54</sup> See for example Scott Beauchamp, 24 Feb 2015, 'How to Send a Message 1,000 Years to the Future', [www.theatlantic.com/technology/archive/2015/02/how-to-send-a-message-1000-years-to-the-future/385720/](http://www.theatlantic.com/technology/archive/2015/02/how-to-send-a-message-1000-years-to-the-future/385720/)

<sup>55</sup> [www-ns.iaea.org/security/itdb.asp](http://www-ns.iaea.org/security/itdb.asp)



*unauthorized activities, including the unauthorized disposal of radioactive materials or discovery of uncontrolled sources."*

### **Attacks on nuclear plants**

Historical examples of military strikes on nuclear plants include the following:

- Israel's destruction of a research reactor in Iraq in 1981.
- the United States' destruction of two smaller research reactors in Iraq in 1991.
- attempted military strikes by Iraq and Iran on each other's nuclear facilities during the 1980-88 war.
- Iraq's attempted missile strikes on Israel's nuclear facilities in 1991.
- Israel's bombing of a suspected nuclear plant in Syria in 2007.

Most of the above examples have been motivated by attempts to prevent weapons proliferation. Nuclear plants might also be targeted with the aim of widely dispersing radioactive material. High level nuclear waste stores in Australia might be targeted for both reasons.

### **Incidents at ANSTO's Lucas Heights site**

Incidents at ANSTO's Lucas Heights site in southern Sydney include the following<sup>56</sup>:

- 1983: nine sticks of gelignite, 25 kg of ammonium nitrate (usable in explosives), three detonators and an igniter were found in an electrical substation inside the boundary fence. A detonator was set off but did not detonate the main explosives. Two people were charged.
- 1984: a threat was made to fly an aircraft packed with explosives into the HIFAR reactor – one person was found guilty of public mischief.
- 1985: after vandalism of a pipe, radioactive liquid drained into Woronora river, and this incident was not reported for 10 days. In 1986 an act of vandalism resulted in damage to the sampling pit on the effluent pipeline.
- 2000: in the lead-up to the Sydney Olympics, New Zealand detectives foiled a plot to attack the Lucas Heights reactor by Afghan sympathisers of Osama bin Laden.
- 9 October 2001: NSW and Federal police conducted a search following a bomb threat directed at ANSTO.
- December 2001: Greenpeace activists easily breach security at the front gate and the back fence of Lucas Heights, some activists scale the reactor while another breaches the 'secure air space' in a paraglider.
- October 2003: French terror suspect Willy Brigitte deported from Australia and held on suspicion of terrorism in France. He was alleged to have been planning to attack the reactor and to have passed on bomb-making skills to two Australians.
- November 2005: multiple coordinated arrests of terrorist suspects in Sydney and Melbourne. Court documents reveal the Lucas Heights reactor was a potential target. Three of the eight alleged members of the Sydney terror cell had previously been caught near the reactor facility by police in December 2004, each alleged to have given different versions of what they had been doing.
- November 2005: a reporter and photographer were able to park a one-tonne van for more than half an hour outside the Lucas Heights back gate, protected by a simple padlock able to be cut with bolt-cutters, 800 m from the reactor. The Australian reported: "The back door to one of the

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<sup>56</sup> Tilman Ruff, 2006, 'Nuclear Terrorism', EnergyScience Coalition Briefing Paper #10, [www.energyscience.org.au/FS10%20Nuclear%20Terrorism.pdf](http://www.energyscience.org.au/FS10%20Nuclear%20Terrorism.pdf)

nation's prime terrorist targets is protected by a cheap padlock and a stern warning against trespassing or blocking the driveway."<sup>57</sup>

- A man facing terrorism charges in 2007 had purchased five rocket launchers allegedly stolen from the army. According to a witness statement, the accused purchaser said "I am going to blow up the nuclear place", an apparent reference to Lucas Heights.<sup>58</sup>

Repeated incidents and threats to ANSTO's Lucas Heights nuclear facility are alarming in and of themselves, and an expansion of Australia's role in the nuclear industry would pose far greater security risks (especially given the nature of the materials envisaged in expansion plans).

### **Insider threats**

Matthew Bunn and Scott Sagan discuss the problem of insider threats in a paper – 'A Worst Practices Guide to Insider Threats: Lessons from Past Mistakes' – which forms part of a larger project on insider threats under the Global Nuclear Future project of the American Academy of Arts and Sciences.<sup>59</sup> A recent example was the apparent insider sabotage of a diesel generator at the San Onofre nuclear plant in the United States in 2012; the most spectacular was a 1982 incident in which an insider placed explosives directly on the steel pressure vessel head of a nuclear reactor in South Africa and detonated them – thankfully the plant had not yet begun operating. All known thefts of plutonium or highly enriched uranium appear to have been perpetrated by insiders or with the help of insiders. Similarly, most of the sabotage incidents that have occurred at nuclear facilities were perpetrated by insiders.

Bunn and Sagan look at past disasters caused by insiders and draw from them 10 lessons about what not to do. The lessons are as follows:

- #1: Don't assume that serious insider problems are NIMO (Not In My Organization)
- #2: Don't assume that background checks will solve the insider problem
- #3: Don't assume that red flags will be read properly
- #4: Don't assume that insider conspiracies are impossible
- #5: Don't rely on single protection measures
- #6: Don't assume that organizational culture and employee disgruntlement don't matter
- #7: Don't forget that insiders may know about security measures and how to work around them
- #8: Don't assume that security rules are followed
- #9: Don't assume that only consciously malicious insider actions matter
- #10: Don't focus only on prevention and miss opportunities for mitigation

### **'Material Unaccounted For' at Sellafield**

The hazards associated with nuclear reprocessing were highlighted in April 2005 with the revelation of an accident at the THORP reprocessing plant at Sellafield. A broken pipe led to the leaking into a containment structure of 83,000 litres of a highly radioactive liquor containing dissolved spent nuclear fuel. The leakage went undetected for at least eight months. The accident was classified as Level 3 ('serious incident') on the 7-point International Nuclear Event Scale and British Nuclear Group Sellafield Limited was fined 500,000 pounds plus costs after pleading guilty to three serious, prolonged breaches of its licence conditions.

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<sup>57</sup> Jonathan Porter, 19 Nov 2005, 'Nuclear site left exposed at the back door', *The Australian*.

<sup>58</sup> Sally Neighbour, 2 July 2007, 'Nations linked by blood and Islam', *The Australian*.

Charles Ferguson, 9 Jan 2007, 'Nuclear risk could be an inside job', [www.smh.com.au/news/opinion/nuclear-risk-could-be-an-inside-job/2007/01/08/1168104921045.html](http://www.smh.com.au/news/opinion/nuclear-risk-could-be-an-inside-job/2007/01/08/1168104921045.html)

<sup>59</sup> Matthew Bunn and Scott Sagan, April 2014, 'A Worst Practices Guide to Insider Threats: Lessons from Past Mistakes', Occasional Paper, American Academy of Arts & Sciences, [www.amacad.org/content/publications/publication.aspx?d=1425](http://www.amacad.org/content/publications/publication.aspx?d=1425)

What is significant about the THORP leakage is not the small environmental and health risk it posed but the fact that the liquid spill contained 160 kgs of plutonium – enough to build 15-20 nuclear weapons – yet the loss went undetected for at least eight months.

The UK Health and Safety Executive concluded: "An underlying cause was the culture within the plant that condoned the ignoring of alarms, the non-compliance with some key operating instructions, and safety-related equipment which was not kept in effective working order for some time, so this became the norm. In addition, there appeared to be an absence of a questioning attitude, for example, even where the evidence from the accountancy data was indicating something untoward, the possibility of a leak did not appear to be considered as a credible explanation until the evidence of a leak was incontrovertible."<sup>60</sup>

In short, an inadequate culture, inadequate structures/processes to detect and respond to the problem in a timely manner - and all this in a country with far greater nuclear expertise and experience than Australia.

### **Proliferation issues**

Some waste forms – in particular spent fuel – might be accessed for fissile material for nuclear weapons – by national governments or sub-national groups. Moreover, should Australia accept foreign spent fuel, Australia would have sufficient weapons-useable plutonium to build many weapons. Typically, one tonne of spent fuel contains around 10 kgs of plutonium, and 10 kgs of 'reactor grade' plutonium is sufficient to build one weapon. Thus, importation of 138,000 tonnes of spent nuclear fuel would contain 1,380 tonnes of plutonium – sufficient to build approx. 138,000 nuclear weapons. Thus Australia, *regardless of intent*, would be far closer to a weapons capability than is currently the case and regional countries might therefore decide to take steps towards a weapons capability. A counterargument is that Australia already has a fissile material production capability due to the operation of the OPAL research reactor. However the plutonium production capability of the OPAL reactor is not known but is presumably small (as was the case with the previous HIFAR reactor) and certainly minuscule in comparison to the 1,380 tonnes of plutonium mentioned above.

It is sometimes argued that Australia would be making a contribution to global non-proliferation efforts by accepting foreign nuclear waste. For example a Lowy Institute article states that Australia's acceptance of foreign spent fuel / nuclear waste would "reinforce non-proliferation objectives".<sup>61</sup> However it is not clear that non-proliferation efforts would be advanced as this would depend on many factors. Australia's acceptance of spent fuel would add to the number of countries with significant stockpiles of fissile material – in that sense it would contribute to proliferation risks, not to the resolution of those risks.

BHP Billiton's submission to the Switkowski Review stated:<sup>62</sup>

*"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***

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<sup>60</sup> UK Health and Safety Executive report:

<http://web.archive.org/web/20081126075501/www.hse.gov.uk/nuclear/thorpreport.pdf>

See also [www.whitehavennews.co.uk/news/Thorpe-N-leak-alarms--ignored-d43b046a-acb6-4687-bc93-5c9622ca71eb-ds](http://www.whitehavennews.co.uk/news/Thorpe-N-leak-alarms--ignored-d43b046a-acb6-4687-bc93-5c9622ca71eb-ds)

<sup>61</sup> John Tilemann, 13 Feb 2015, 'SA's Royal Commission into nuclear energy: Let's talk about waste', [www.lowyinterpreter.org/post/2015/02/13/Australias-nuclear-future-Building-on-Maralinga-and-Olympic-Dam.aspx?COLLCC=934222631&](http://www.lowyinterpreter.org/post/2015/02/13/Australias-nuclear-future-Building-on-Maralinga-and-Olympic-Dam.aspx?COLLCC=934222631&)

<sup>62</sup> [http://web.archive.org/web/20070830182528/www.pmc.gov.au/umpner/submissions/223\\_sub\\_umpner.pdf](http://web.archive.org/web/20070830182528/www.pmc.gov.au/umpner/submissions/223_sub_umpner.pdf)

*leasing services in Australia. ... There is no evidence that a change to current Australian Government policies to facilitate domestic enrichment, fuel leasing and high level waste disposal would lead to significant economic opportunities or reduce proliferation risks in the foreseeable future." (emphasis added)*

### 3.8 TRANSPORT RISKS

The scale of the proposed transports – 138,000 tonnes of high level waste and 390,000 cubic metres of intermediate level waste – is unprecedented. Globally, high level nuclear waste shipments amount to 80,000 tonnes in a 45-year period since 1971.<sup>63</sup>

The Royal Commission's Final Report notes that "if a cask was lost at sea and was irrecoverable, there is a potential for some members of the public consuming locally sourced seafood to receive a very small dose of radiation".

The Royal Commission report states: "During the past 50 years, approximately 7000 international shipments of used nuclear fuel, including nine that have left Australia for reprocessing, have been undertaken. In this time, no accident involving a breach of the package and the release of its contents has occurred. The same record applies to international transport of high and intermediate level waste."

This claim is incorrect and is refuted by documented evidence provided to – and ignored by – the Royal Commission.<sup>64</sup>

For example:

**Germany – a nuclear 'cartel of liars':** A whistleblower supplied the WISE-Paris NGO with information which sparked a major controversy over frequent excessive radioactive contamination of waste containers, rail cars, and trucks.<sup>65</sup> Nuclear waste shipments from German nuclear reactor sites to reprocessing plants in the UK and France were banned, and transport within France was suspended, in the aftermath of the controversy. WISE-Paris summarised the controversy:<sup>66</sup>

*There are two scandals, both unprecedented. The first lies in the fact that for 15 years the nuclear industry – power plants, transport companies, plutonium factories and nuclear safety institutes in France, Germany, Switzerland and the UK at least – have managed to hide the fact that the international transport regulations for spent fuel shipments have been constantly violated, up to levels exceeding several thousand times the limit. This is all the more stunning as the original recommendation stems from the industry friendly, heavily pro-nuclear International Atomic Energy Agency (IAEA) in Vienna.*

*The second scandal derives from the fact that the French nuclear safety authority DSIN has been aware of the problem since autumn 1997, agreed with the French nuclear industry representatives over the wording of a mere "cleanliness problem", and kept silent until a journalistic investigation brought the story to light. The safety authority neither informed its*

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<sup>63</sup> World Nuclear Association, "Transport of Radioactive Materials", Sept 201), [www.world-nuclear.org/information-library/nuclear-fuel-cycle/transport-of-nuclear-materials/transport-of-radioactive-materials.aspx](http://www.world-nuclear.org/information-library/nuclear-fuel-cycle/transport-of-nuclear-materials/transport-of-radioactive-materials.aspx); and Jacobs MCM, p.152.

<sup>64</sup> [www.foe.org.au/sites/default/files/NFCRC%20submission%20FoEA%20ACF%20CCSA-FINAL-AUGUST-2015.pdf](http://www.foe.org.au/sites/default/files/NFCRC%20submission%20FoEA%20ACF%20CCSA-FINAL-AUGUST-2015.pdf)

[www.foe.org.au/sites/default/files/NFCRC-response-tent-findings-CCSA-ACF-FoE-18March2016-final\\_0.pdf](http://www.foe.org.au/sites/default/files/NFCRC-response-tent-findings-CCSA-ACF-FoE-18March2016-final_0.pdf)

<sup>65</sup> WISE-Paris, Plutonium Investigation, No.6, May-June 1998, [www.wise-paris.org/index.html?english/ournewsletter/6\\_7/contents.html](http://www.wise-paris.org/index.html?english/ournewsletter/6_7/contents.html) and

[www.wise-paris.org/english/ournewsletter/6\\_7/no6\\_7.pdf](http://www.wise-paris.org/english/ournewsletter/6_7/no6_7.pdf)

<sup>66</sup> [www.wise-paris.org/index.html?english/ournewsletter/6\\_7/editorial.html&english/frame/menu.html](http://www.wise-paris.org/index.html?english/ournewsletter/6_7/editorial.html&english/frame/menu.html)

*ministers nor its foreign counterparts and, of course, nor did it inform the public. Worse, when the story broke, the authority played the role of the tough transparent State control agency finally cleaning up ... without actually taking any kind of regulatory or disciplinary consequences, while downplaying health consequences and the persistent outrageous violation of regulations.*

*The risk seems rather high that people have been exposed to significant levels of radiation over the period the contaminated transports have crossed countries. Worse, hot particles have been spread into the environment along rail tracks and roads. People might actually continue to get contaminated presently and for a long time to come.*

French Environment Minister Dominique Voynet said: "Beyond the level of contamination, I'm shocked by the fact that as soon as one asks some simple questions to the operators, one realises that this has been going on for years, that the three companies questioned (EDF, Transnucléaire, COGEMA) were perfectly aware of it and that they have not said anything."

In Germany, an opinion poll found that 72% of respondents thought that further nuclear waste shipments would be "irresponsible". The opinion poll found a dramatic increase in opposition to nuclear power, with 76% of respondents supporting the idea of a law to phase out nuclear power. The police trade union speaker Konrad Freiberg called the nuclear industry a "cartel of liars" which "has driven democracy against the wall".

**Here is another example which refutes the Royal Commission's incorrect claim:** 23 December 2013: A rail freight wagon carrying nuclear waste was derailed at a depot in Drancy, 3 km northeast of Paris. The wagon carried spent fuel from the Nogent nuclear power plant destined for AREVA's reprocessing plant at La Hague in Normandy. Although no leakage of radiation was measured at the accident location, the Nuclear Safety Authority (ASN) reported that subsequent testing by AREVA revealed a hotspot on the rail car that delivered a dose of 56 microsievert. An investigation into the origin of the contamination is underway.<sup>67</sup>

**Here is another example which refutes the Royal Commission's incorrect claim:** A serious nuclear transport incident occurred in the UK in 2002.<sup>68</sup> AEA Technology was fined £250,000 for the incident during a 130-mile truck journey. A highly radioactive beam was emitted from a protective flask as it was driven across northern England and it was "pure good fortune" that no-one was dangerously contaminated, Leeds Crown Court was told. The problem arose when a plug was left off a specially-built 2.5-tonne container carrying radioactive material on a lorry. Staff used the wrong packaging equipment and failed to carry out essential safety checks before the radioactive cobalt-60 (decommissioned cancer treatment equipment) was transported from West Yorkshire to Cumbria. The court heard the 8mm-wide beam of radiation escaped through the bottom of the flask, pointing directly into the ground, throughout the three-hour road journey. Had the beam travelled horizontally, anyone within 280 metres would have been at risk of contamination from a beam of gamma rays up to 1000 times more powerful than a "very high dose rate". Radiation experts from the Health and Safety Executive said that anyone exposed to the beam could have exceeded the legal dose within seconds and suffered burns within minutes. One scientist estimated that someone standing a metre from the source and in the direct path of the rays

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<sup>67</sup> International Panel on Fissile Materials, 21 Jan 2014, [http://fissilematerials.org/blog/2014/01/nuclear\\_train\\_accident\\_in.html](http://fissilematerials.org/blog/2014/01/nuclear_train_accident_in.html)

<sup>68</sup> UK Health and Safety Executive, 2006, 'Transport case prompts HSE reminder on the importance of radiation protection controls', [www.hse.gov.uk/press/2006/e06017.htm](http://www.hse.gov.uk/press/2006/e06017.htm)

See also: 'Firm fined £250,000 over radioactive leak', *The Scotsman*, 21 February 2006, <http://news.scotsman.com/topics.cfm?tid=112&id=267752006>

See also: 'Toxic truck leak a radiation near-miss', 22 February 2006, [www.theaustralian.news.com.au/common/story\\_page/0,5744,18231965%5E2703,00.html](http://www.theaustralian.news.com.au/common/story_page/0,5744,18231965%5E2703,00.html)

would have been dead in two hours. The judge, Norman Jones, QC, said staff at the firm had acted in a "cavalier and somewhat indifferent" manner with a "degree of arrogance" towards their duties. He said the risk from the leak had been "considerable". In addition to the fine, he ordered the company to pay more than £150,000 in costs to the UK Health and Safety Executive.

No doubt there are other examples of dangerous transport accidents involving spent fuel / high level waste. The Royal Commission failed to carry out the necessary research, ignored information provided to it in submissions and repeated false industry claims regarding nuclear transport.

It should be noted that there have been **other train derailments** involving nuclear waste. For example, a train carrying three casks with about 180 tons of high-level radioactive waste derailed near Apach (France) on 3 February 1997. The waste was on its way from the nuclear power plant in Lingen (Germany) to Sellafield, UK, for reprocessing. The train was going at about 30 kilometres per hour, and the casks did not turn over. The incident was not a unique event. On 15 January 1997 a nuclear fuel cask derailed in front of the German nuclear power plant at Krümmel during a track change, and on 3 February 1997 the engine driver of a nuclear waste transport from Krümmel suffered from a faint.<sup>69</sup>

Transportation of nuclear waste by rail from a port to a storage/disposal site is proposed by Pangea-successor and others. Thus it is notable that there have been **numerous train derailments in Australia** over the past decade. Some examples are noted here:

- 12 December 2006 – Northern Territory – another derailment on the Adelaide to Darwin railway. Two locomotives and 11 carriages of the Ghan were derailed 130 kms south of Darwin when the train and a road-train collided. A 50-year-old female passenger was in a critical but stable condition while three others were being treated for less serious injuries. Great Southern Railways said it could take five days to clear the railway.<sup>70</sup>
- A serious derailment occurred on 27 December 2011, when a Darwin bound train carrying copper concentrate (with trace uranium, 0.008%) from the Prominent Hill mine derailed into the Edith River northwest of Katherine. Floodwaters from a recent cyclone caused the river crossing to flood and wash out. It was estimated that 1200 tonnes of copper concentrate spilled into the Edith River when 13 carriages overturned into the river. More carriages derailed but did not overturn, and debris from carriages was recovered up to 5km down stream. The company exporting the copper, OZ Minerals, had been operating under an exemption to the Australian Code for the Transport of Dangerous Goods, granted by SafeWorkSA and NT WorkSafe. Instead of being transported in sealed containers, the copper was simply in metal tubs with tarpaulin covering.<sup>71</sup>

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<sup>69</sup> WISE News Communiqué #467, February 28, 1997

Die Tageszeitung (FRG) February 5, 1997

Greenpeace press release February 4, 1997

<sup>70</sup> 'Crash sparks calls for Adelaide to Darwin rail line probe', <http://theaustralian.com.au/national-affairs/crash-sparks-calls-for-adelaide-to-darwin-rail-line-probe/story-fn59niix-1226390639315>

'Nuke warning in Ghan crash', 13 December 2006, [www.news.com.au/couriermail/story/0,23739,20925432-5010960,00.html](http://www.news.com.au/couriermail/story/0,23739,20925432-5010960,00.html)

'Investigations begin into Ghan derailment', 13 December 2006,

<http://abc.net.au/news/australia/nt/alice/200612/s1810195.htm>

<sup>71</sup>

<http://news.smh.com.au/breaking-newsnational/nt-rail-line-remains-cut-after-floods-20111228-1pcf.html>

AAP, April 18, 2012 – 'Pacific Highway site 'clear' of radioactive waste, Roads Minister Duncan Gay says'

'Radioactive transport accident New South Wales 1980', [antinuclear.net/2012/04/18/radioactive-transport-accident-new-south-wales-1980/](http://antinuclear.net/2012/04/18/radioactive-transport-accident-new-south-wales-1980/)

ATSB, 2012 - Australian Transport Safety Bureau, "Derailment of freight train 7AD1 at Edith River near Katherine, NT", [atsb.gov.au/publications/investigation\\_reports/2011/rair/ro-2011-019.aspx](http://atsb.gov.au/publications/investigation_reports/2011/rair/ro-2011-019.aspx)

- 2012, June 7 – Northern Territory – train derailment. A Pacific National freight train carrying 6000 tonnes of manganese derailed in the NT blocking the railway and stranding 240 Ghan passengers in Alice Springs as the track was blocked. Some reports had the derailment near Alice Springs, others 60 kms north of Tennant Creek and others much closer to Muckaty land which is being targeted for a national radioactive waste facility. Muckaty traditional owner, Penelope Phillips from the Wirntiku group, said the train derailment raises concerns about the safety of transporting radioactive material. "I think it's an omen to people, to let them know to stop trying to talk about that Muckaty waste coming to the country, whether it's by rail or train," she says. Cat Beaton from the Environment Centre NT raised concerns about plans to use the train line to transport 1.2 million tonnes of copper/uranium concentrate annually from the Olympic Dam mine in SA to the Port of Darwin.<sup>72</sup>
- On 25 November 2012, 14 carriages of a freight train bound for Adelaide were overturned near Cadney Park in South Australia, and other carriages derailed. Strong winds were the cause of the accident which caused "significant damage" to containers and carriages, and damaged 300m of track.

**UK:** Transport incidents and accidents are routine in countries with significant nuclear industries. The case of the UK is pertinent. A UK government database – RAdioactive Material Transport Event Database (RAMTED) – contains information on 1018 events from 1958 to 2011 (an average of 19 incidents each year).<sup>73</sup> Of 806 incidents in the UK between 1958–2004, 2.3% (19 incidents) resulted in individual whole-body doses over 1 mSv, or extremity doses over 50 mSv. There were 187 events during the shipment of irradiated nuclear fuel flasks from 1958–2004 in the UK<sup>74</sup> – 23% of the total number of 806 recorded incidents:

- 33% involved excess contamination on the surface of the flask;
- 24% involved collisions and low speed derailments of the conveyance;
- 16% involved flask preparation faults, and loading/unloading faults;
- 13% involved excess contamination of conveyance;
- 11% involved faults with the conveyance; and
- the remainder included three cases involving fire on a locomotive with no damage to flasks

**Canada:** Since 2010, more than one truck in seven carrying radioactive material has been pulled off the road by Ontario ministry of transportation inspectors for failing safety or other requirements.<sup>75</sup> The information is contained in a notice filed with a panel studying a proposal to establish a radioactive waste repository near Kincardine. The notice states that since 2010,

<sup>72</sup> NT News, [www.ntnews.com.au/article/2012/06/08/306471\\_ntnews.html](http://www.ntnews.com.au/article/2012/06/08/306471_ntnews.html)

Train derailment fuels Muckaty fears, 8 June 2012, [www.abc.net.au/local/stories/2012/06/08/3521295.htm](http://www.abc.net.au/local/stories/2012/06/08/3521295.htm)

Freight train derails in NT, 8 June 2012, <http://news.ninemsn.com.au/national/8480633/freight-train-derails-in-nt>

<http://news.ninemsn.com.au/national/8480633/freight-train-derails-in-nt>

<sup>73</sup> Some recent annual reviews of transport incidents in the UK are posted at

<http://webarchive.nationalarchives.gov.uk/20140722091854/www.hpa.org.uk/Publications/Radiation/CRCEScientificAndTechnicalReportSeries/>

Some earlier annual reviews are posted at:

<http://webarchive.nationalarchives.gov.uk/20140722091854/www.hpa.org.uk/Publications/Radiation/HPARPDSeriesReports/>

The most recent annual review is as follows: M.P. Harvey and A.L Jones, Aug 2012, 'HPA-CRCE-037 - Radiological Consequences Resulting from Accidents and Incidents Involving the Transport of Radioactive Materials in the UK – 2011 Review', [www.hpa.org.uk/Publications/Radiation/CRCEScientificAndTechnicalReportSeries/HPACRCE037/](http://www.hpa.org.uk/Publications/Radiation/CRCEScientificAndTechnicalReportSeries/HPACRCE037/)

<sup>74</sup> J.S. Hughes, D. Roberts, and S.J. Watson, July 2006, 'Review of Events Involving the Transport of Radioactive Materials in the UK, from 1958–2004, and their Radiological Consequences',

[http://webarchive.nationalarchives.gov.uk/20140714084352/www.hpa.org.uk/webc/HPAwebFile/HPAweb\\_C/1194947346295](http://webarchive.nationalarchives.gov.uk/20140714084352/www.hpa.org.uk/webc/HPAwebFile/HPAweb_C/1194947346295)

<sup>75</sup> John Spears, 15 Nov 2013, 'Trucks with radioactive cargo fail inspections',

[www.thestar.com/business/2013/11/15/trucks\\_with\\_radioactive\\_cargo\\_fail\\_inspections.html](http://www.thestar.com/business/2013/11/15/trucks_with_radioactive_cargo_fail_inspections.html)

Ministry of Transportation – Undertaking #61: [www.ceaa-acee.gc.ca/050/documents/p17520/95562E.pdf](http://www.ceaa-acee.gc.ca/050/documents/p17520/95562E.pdf)

inspectors examined 102 trucks carrying "Class 7 Dangerous Goods (Radioactive material.)" Of those, 16 were placed "out-of-service," which means the vehicle "must be repaired or the violation corrected before it is allowed to proceed." Violations included: faulty brake lights; "load security" problems; flat tires; false log; damaged air lines; and a driver with no dangerous goods training. In other cases, trucks were allowed to proceed but were slapped with enforcement actions for problems with hours of service; annual inspection requirement; missing placards; exceed gross weight limit; speed limiter; overlength combination; overheight vehicle; vehicle registration / insurance. In total, 25 of the 102 inspections – nearly one in four – resulted in the vehicle being placed out-of-service and / or enforcement action taken against the operator of the vehicle.

**France:** In 2008, the French nuclear safety agency IRSN produces a report summarising radioactive transport accidents and incidents from 1999–2007. The IRSN manages a database listing reported deviations, anomalies, incidents and accidents (known in a generic way as "events") relating to transport. The database lists 901 events from 1999–2007 – on average 100 events annually or about two each week. The IRSN report notes:<sup>76</sup>

- Events where there is contamination of packages and means of transport were still frequent in 2007.
- The number of events related to a defect in package stowing was significant, as was the number involving shocks on packages during handling. "Analysis of these two types of event reveals failures of information or training of the operators."
- "A number of events have been induced by human error in conditioning the radioactive contents of the packages, leading to significant consequences on the safety of the package. In particular, the incident with the highest level of gravity on the INES scale since 1999 (an incident which occurred on 27th December 2001 at Roissy airport during transit between Sweden and the United States) is linked to an error in packaging iridium capsules in the package, which led to their displacement in a portion of the cavity without radiation protection."
- "Finally, efforts should continue to prevent losses of packages and, if necessary, to find the lost packages quickly in order to avoid significant risks to uninformed persons in the event of unsupervised opening of these packages."

**USA:** In the eight years from 2005 to 2012, 72 incidents involving trucks carrying radioactive material on US highways caused US\$2.4 million in damage and one death, according to the Transportation Department's Pipeline and Hazardous Materials Safety Administration.<sup>77</sup>

**Potential costs of transport accidents:** Spent fuel / high level nuclear waste transport accidents have the potential to be extraordinarily expensive. Dr. Marvin Resnikoff and Matt Lamb from Radioactive Waste Management Associates in New York City calculated 355–431 latent cancer fatalities attributable to a "maximum" hypothetical rail cask accident, compared to the US Department of Energy's estimate of 31 fatalities. Using the Department of Energy's model, they calculated that a severe truck cask accident could result in US\$20 billion to US\$36 billion in clean-up costs for an accident in an urban area, and a severe rail accident in an urban area could result in costs from US\$145 billion to US\$270 billion.<sup>78</sup>

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<sup>76</sup> IRSN (France), 21 October 2008, 'Information report: Incidents in transport of radioactive materials for civil use: IRSN draws lessons from events reported between 1999 and 2007', [www.irsn.fr/EN/publications/technical-publications/Documents/IRSN\\_ni\\_transports\\_analysis\\_20081021.pdf](http://www.irsn.fr/EN/publications/technical-publications/Documents/IRSN_ni_transports_analysis_20081021.pdf)  
[www.irsn.fr/EN/Library/Documents/IRSN\\_ni\\_transports\\_analysis\\_20081021.pdf](http://www.irsn.fr/EN/Library/Documents/IRSN_ni_transports_analysis_20081021.pdf)  
[www.irsn.fr/EN/Pages/home.aspx](http://www.irsn.fr/EN/Pages/home.aspx)

<sup>77</sup> Anna M. Tinsley, 15 April 2012, 'Radioactive waste may soon travel on DFW highways', <http://web.archive.org/web/20130504150446/www.star-telegram.com/2012/04/15/3884220/radioactive-waste-may-soon-travel.html>

<sup>78</sup> 7 July 2000, [www.state.nv.us/nucwaste/news2000/nn10719.htm](http://www.state.nv.us/nucwaste/news2000/nn10719.htm)



## Waste transport

A few examples of accidents and incidents involving the transport of radioactive waste are noted here.

September 2002: A truck carrying nuclear waste from Idaho to the Waste Isolation Pilot Plant in New Mexico, USA, ran off Interstate 80 in Wyoming. The driver said he felt ill and attempted to pull over, but he blacked out before he made it to the roadside. The truck crossed the median, headed across the westbound lane and left the road. The accident was the second in less than two weeks. On Aug. 25, a truck bound for the WIPP plant near Carlsbad was hit by an alleged drunk driver. Nobody was injured and no contaminants were released in either accident, WIPP officials said.<sup>79</sup>

23 December 2013: A rail freight wagon carrying nuclear waste was derailed at a depot in Drancy, 3 km northeast of Paris. The wagon carried spent fuel from the Nogent nuclear power plant destined for AREVA's reprocessing plant at La Hague in Normandy. Although no leakage of radiation was measured at the accident location, the Nuclear Safety Authority (ASN) reported that subsequent testing by AREVA revealed a hotspot on the rail car that delivered a dose of 56 microsieverts. An investigation into the origin of the contamination is underway.<sup>80</sup>

1976, Kentucky, USA: Six drums containing radioactive waste burst open after they rolled off tractor-trailer trucks in Ashfield, Kentucky, USA. Two drivers were slightly injured. When the highway was cleaned, checks indicated radioactivity.<sup>81</sup>

3 February 1997 – High-level nuclear waste transport derails. A train carrying three casks with about 180 tons of high-level radioactive waste derailed near Apach (France). The waste was on its way from the nuclear power plant in Lingen (Germany) to Sellafield, UK, where it is to be reprocessed. The train was going at about 30 km per hour, and the casks did not turn over. The incident was not a unique event. On 15 January 1997 a nuclear fuel cask derailed in front of the German nuclear power plant at Krümmel during a track change, and on 3 February 1997 the engine driver of a nuclear waste transport from Krümmel suffered from a faint.<sup>82</sup>

16 January 2014: A driver abandoned his stricken car at a level crossing moments before it was dragged 300 metres down a railway track by an empty nuclear waste train. The train is used to take spent nuclear fuel to Sellafield but, as it was returning to Cheshire, was empty.<sup>83</sup>

## Sea transport

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<sup>79</sup> AP, 9 Sept 2002, 'WIPP truck runs off highway in Wyoming', [http://lubbockonline.com/stories/090902/upd\\_075-3941.shtml](http://lubbockonline.com/stories/090902/upd_075-3941.shtml)

<sup>80</sup> International Panel on Fissile Materials, 21 Jan 2014, [http://fissilematerials.org/blog/2014/01/nuclear\\_train\\_accident\\_in.html](http://fissilematerials.org/blog/2014/01/nuclear_train_accident_in.html)

<sup>81</sup> Legislative Research Service Paper, Parliamentary Library, Canberra

<sup>82</sup> WISE News Communique #467, February 28, 1997

Die Tageszeitung (FRG) February 5, 1997

Greenpeace press release February 4, 1997

<sup>83</sup> CORE Briefing, 15 Jan 2014, [www.corecumbria.co.uk/newsapp/pressreleases/pressmain.asp?StrNewsID=331](http://www.corecumbria.co.uk/newsapp/pressreleases/pressmain.asp?StrNewsID=331)  
[www.lancasterguardian.co.uk/news/nuclear-waste-train-in-50mph-smash-1-6376671](http://www.lancasterguardian.co.uk/news/nuclear-waste-train-in-50mph-smash-1-6376671)

Morning Star, 16 Jan 2014, [www.morningstaronline.co.uk/a-e91c-Level-crossing-crash-exposes-dangers-of-nuclear-trains](http://www.morningstaronline.co.uk/a-e91c-Level-crossing-crash-exposes-dangers-of-nuclear-trains)

Lancaster Guardian, 16 Jan 2014, [www.lancasterguardian.co.uk/news/nuclear-waste-train-in-50mph-smash-1-6376671](http://www.lancasterguardian.co.uk/news/nuclear-waste-train-in-50mph-smash-1-6376671)

In May 2013, fire damaged the Atlantic Cartier ship carrying nine tons of uranium hexafluoride while it was in the Port of Hamburg. (According to some reports the ship was also carrying 11.6 tons of uranium oxide.) The uranium hexafluoride was destined for the Areva-owned uranium enrichment plant at Lingen, Lower Saxony. Authorities said containers with dangerous substances were promptly removed from the ship. Firefighters took 16 hours to douse the fire, with a shortage of extinguishing agent in the region hampering their efforts. Five fire-fighting boats and 296 fire-fighters were involved. Only 500 metres from the burning ship, around 35,000 people were involved in a civic event – they were not warned about the potential hazards and they were not directed to move away.<sup>84</sup>



*The Atlantic Cartier in Hamburg.*

July 2002: UK destroyer HMS Nottingham ran aground on the submerged but well-charted Wolf Rock near Lord Howe Island. A 50 metre hole is torn down the side of the vessel from bow to bridge, flooding five of her compartments and nearly causing her to sink.<sup>85</sup>

A 2001 report, 'A Review of Aspects of the Marine Transport of Radioactive Materials', by visiting UK-based marine pollution expert Tim Deere-Jones, revealed confusion about which Australian State or Commonwealth agency would take responsibility for an at-sea nuclear accident. It found that up to eight different agencies could be involved in an emergency that would probably involve State emergency personnel who lack nuclear emergency equipment or training. The report found that the Pacific Nuclear Transport Ltd (PNTL) ships, Pacific Pintail and Pacific Teal, which travelled close to the Australian coast via the Tasman Sea, and the Bougeunais, which carried nuclear waste from Sydney, did not meet the highest safety standards.<sup>86</sup>

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<sup>84</sup> Martyn Lowe, 25 Aug 2013, 'Next Destination – Antwerp', [www.theproject.me.uk/?p=492](http://www.theproject.me.uk/?p=492)

Maritime Bulletin, 17 May 2013,

[www.news.odin.tc/index.php?page=view/article/416/Fire-on-ro-ro-Atlantic-Cartier-could-spark-explosions-and-radioactive-contamination-Hamburg](http://www.news.odin.tc/index.php?page=view/article/416/Fire-on-ro-ro-Atlantic-Cartier-could-spark-explosions-and-radioactive-contamination-Hamburg)

The Local, 17 May 2013, [www.thelocal.de/national/20130517-49777.html](http://www.thelocal.de/national/20130517-49777.html)

May 2013, <http://rt.com/news/hamburg-radioactive-ship-fire-464/>

Fairplay, 22 May 2013,

[www.fairplay.co.uk/login.aspx?reason=denied\\_empty&script\\_name=/secure/display.aspx&path\\_info=/secure/display.aspx&articlename=dn0020130522000014](http://www.fairplay.co.uk/login.aspx?reason=denied_empty&script_name=/secure/display.aspx&path_info=/secure/display.aspx&articlename=dn0020130522000014)

<sup>85</sup> [www.mapw.org.au/files/2009-06-29\\_fact-sheet\\_Nukeships-BW.pdf](http://www.mapw.org.au/files/2009-06-29_fact-sheet_Nukeships-BW.pdf)

[https://en.wikipedia.org/wiki/HMS\\_Nottingham\\_%28D91%29](https://en.wikipedia.org/wiki/HMS_Nottingham_%28D91%29)

<sup>86</sup> Greenpeace, 15 March 2001, 'Australia not prepared for a nuclear accident at sea'

Edwin Lyman, (then) Scientific Director at the Nuclear Control Institute, wrote in a 1999 paper:<sup>87</sup>

*"Recently, the IAEA has demonstrated an alarming lack of interest in the enforcement of its own regulations. For example, the IAEA standards for external contamination of shipping casks were found last year to have been routinely violated all over Western Europe for a decade or longer, by factors of up to ten thousand. One of the contributing factors was a design flaw that made adequate decontamination of some shipping casks very difficult. However, instead of reviewing the standards that permitted these casks to be licensed, it took no action. This merely reinforced the attitude which led to the problem in the first place – a pervasive belief on the part of shippers that IAEA standards were unnecessarily stringent and could be ignored. The public has no way of knowing how many other aspects of the existing regulations are treated in such a cavalier fashion. ...*

*The shipping packages now used to transport large quantities of radioactive material (RAM) by sea are designed to meet a set of performance requirements known as "Type B" standards, which are defined in the IAEA's transport standards, the most recent of which are the "Regulations for the Safe Transport of Radioactive Material" (1996 edition). Most notably, the standards require that Type B packages withstand a series of drop tests from a height of 9 meters, followed by an 800 degrees C fire for thirty minutes, without significant breach of the containment. For packages containing large inventories of RAM, an immersion test in water at 200 meters' depth for one hour is required.*

*These standards were originally developed for land-based modes of transport, and questions have arisen regarding their adequacy for packages used for sea shipments, which may be subject to more severe accident conditions, including more energetic collisions, long-duration, high-temperature fires and long-term immersion or immersion at greater depths. The IAEA's response to this issue has been two-fold. First, it argues that although accident conditions that occur aboard ships may be more severe than the Type B testing regimen, the actual accident environment experienced by a RAM package most likely would be less severe. Second, it claims that Type B packages have substantial safety margins built into them, so that even if they experience more severe conditions than they were designed to withstand they will "fail gracefully" rather than abruptly.*

*There is scant evidence, however, for either of these assumptions. ...*

*Recent evidence indicates that the long-term public health consequences of a severe accident during the sea transport of highly radioactive materials could be comparable to those resulting from a loss-of-containment accident at a nuclear reactor. On the other hand, the shippers of RAM and regulatory authorities are unable to provide convincing arguments that the risk of such an accident is negligible. Therefore, the safety case for these shipments has not been made."*

## **Atlantic Osprey**

Pangea-successor ARIUS proposed dedicated ships being used to transport nuclear waste to Australia, meeting the strictest standards. In reality, there is a history of sub-standard ships being used to transport nuclear materials. For example, the Atlantic Osprey, owned by the UK Nuclear Decommissioning Authority, was used to transport nuclear materials until it was retired in late 2013.<sup>88</sup>

It was an old converted car ferry, lacking the safety and security attributes of other nuclear cargo carriers. A 2010 assessment by NDA-subsiary International Nuclear Services of the Atlantic Osprey conceded the reduced 'public acceptance and political credibility' of transporting Category

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<sup>87</sup> Edwin Lyman, October 1999, 'The Sea Shipment of Radioactive Materials: Safety and Environmental Concerns', [www.nci.org/e/el-malaysia.htm](http://www.nci.org/e/el-malaysia.htm)

<sup>88</sup> [www.world-nuclear-news.org/WR-Final-voyage-for-Atlantic-Osprey-2208147.html](http://www.world-nuclear-news.org/WR-Final-voyage-for-Atlantic-Osprey-2208147.html)

1 nuclear material on the ship, and admitted that reservations about the Atlantic Osprey's continued use for Category 1 cargoes had been expressed by France's safety authority.<sup>89</sup>

In 2002, an engine fire broke out on the Atlantic Osprey while it was crossing the Manchester Ship Canal, although there was no nuclear material on board at the time.<sup>90</sup> The ship experienced engine failures, fires and cases of drifting at sea.<sup>91</sup>

## UK report

The Atlantic Osprey has been taken out of service but questions remain about the adequacy of ships still being used for nuclear transports. The UK Nuclear Free Local Authorities noted in 2014: "In the example of the Atlantic Cartier, it was transporting significant amounts of uranium hexafluoride ... but also other dangerous chemicals, explosive materials and cars for export. Last year it was involved in a major fire, where a significant radioactive emergency incident was only narrowly avoided in Hamburg Port, Germany. Less than four months later the vessel was back in operation, delivering and unloading at UK ports such as Liverpool. This is despite a long list of safety concerns<sup>92</sup> on the vessel that had been identified over the past few years."<sup>93</sup>

Launching a detailed Policy Briefing written by independent marine pollution consultant Tim Deere-Jones, the Nuclear Free Local Authorities' recommendations included:<sup>94</sup>

- ships carrying dangerous cargoes into any port should be issued with a public notice about the potential dangers which they might cause;
- any ship carrying radioactive materials should have regular fire inspections;
- any ship which fails to pass such tests should be prevented from sailing;
- the ship owners and the ship management should be held legally responsible for any breach of these regulations;
- any ship carrying radioactive materials should be subject to a new set of rigorous fire and safety standards regulations;
- international shipping regulations are changed so that no radioactive materials can be transported on any ships which carry either explosives, or highly inflammable liquid gases.

Tim Deere-Jones said:

*"It is evident from my ongoing research that the safety of the majority of maritime transports of radioactive materials through European waters cannot be guaranteed. The regulations covering such transports are generally little better than those covering "non-radioactive" cargos. The UK National Marine Pollution Plan, in common with many other National Plans, contains no specific plan for response to maritime radiological incidents. European Port and Local Authorities, Emergency Responders and Government Agencies appear similarly poorly prepared for reaction to such events. In order to forestall a serious maritime radiological accident, I fully support the NFLA call for improvements to the management of such shipments*

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<sup>89</sup> November 2012, 'Yet more 'intolerable risk' as Sellafield MOX fuel awaits shipment to Germany', [www.corecumbria.co.uk/newspapp/pressreleases/pressmain.asp?StrNewsID=310](http://www.corecumbria.co.uk/newspapp/pressreleases/pressmain.asp?StrNewsID=310)

<sup>90</sup> Treacy Hogan, 28 March 2002, 'Protests after fire on Sellafield nuclear waste ship', [www.unison.ie](http://www.unison.ie)

<sup>91</sup> Safe Energy E-Journal, No.57, December 2012, [www.no2nuclearpower.org.uk/documents/SAFE\\_ENERGY\\_No57.pdf](http://www.no2nuclearpower.org.uk/documents/SAFE_ENERGY_No57.pdf)

<sup>92</sup> NFLA media release, 28 August 2013, [www.nuclearpolicy.info/docs/news/NFLA\\_Atlantic\\_Cartier\\_concerns.pdf](http://www.nuclearpolicy.info/docs/news/NFLA_Atlantic_Cartier_concerns.pdf)

<sup>93</sup> Nuclear Free Local Authorities, 4 March 2014, 'NFLA publishes marine nuclear materials transportation briefing which raises concerns over emergency procedures for lower level mixed material vessel shipments', [www.nuclearpolicy.info/docs/news/NFLA\\_nuclear\\_marine\\_transport\\_briefing.pdf](http://www.nuclearpolicy.info/docs/news/NFLA_nuclear_marine_transport_briefing.pdf)

<sup>94</sup> Nuclear Free Local Authorities, 4 March 2014, 'NFLA publishes marine nuclear materials transportation briefing which raises concerns over emergency procedures for lower level mixed material vessel shipments', [www.nuclearpolicy.info/docs/news/NFLA\\_nuclear\\_marine\\_transport\\_briefing.pdf](http://www.nuclearpolicy.info/docs/news/NFLA_nuclear_marine_transport_briefing.pdf)

*and for both Nation States and the International Maritime Organisation to tighten the current lax international regulations.*"<sup>95</sup>

## **Parida ship fire**

In October 2014, a ship carrying radioactive waste which was set adrift in the North Sea after it caught fire caused the evacuation of the nearby Beatrice oil platform, part-owned by Ithaca Energy. The MV Parida was transporting six 500-litre drums of cemented radioactive waste from Scrabster in northern Scotland to Antwerp, Belgium, when the fire broke out in one of its funnels. The blaze was put out by the ship's crew. Meanwhile 52 workers were airlifted off the oil platform as a precaution in case the drifting MV Parida struck it. The ship was subsequently towed to a secure pier at the Port of Cromarty Firth by a commercial operator, despite the Aberdeen coastguard sending two emergency tugs to assist. The cargo was reportedly undamaged. The waste was from the Dounreay experimental nuclear power plant.<sup>96</sup>

Angus Campbell, the leader of the Western Isles Council, said the Parida incident highlighted the need for a second coastguard tug in the Minch. "A ship in similar circumstances on the west coast would be reliant on the Northern Isles-based ETV [emergency towing vessel] which would take a considerable amount of time to get to an incident in these waters."<sup>97</sup>

## **Nuclear transport security**

Hirsch et al. summarise some of the security risks associated with the transport of nuclear materials:<sup>98</sup>

*During transport, radioactive substances are a potential target for terrorists. Of the numerous materials being shipped, the following are the most important:*

- 1. Spent fuel elements from nuclear power plants and highly active wastes from reprocessing (high specific inventory of radioactive substances)*
- 2. Plutonium from reprocessing (high radiotoxicity, particularly if released as aerosol)*
- 3. Uranium hexafluoride – uranium has to be converted into this chemical form in order to undergo enrichment (high chemical toxicity of released substances, resulting in immediate health effects in case of release).*

*Since the amounts transported with one shipment are about several tonnes at most, the releases to be expected will be smaller by orders of magnitudes than those that result from attack of a storage facility – even if the transport containers are severely damaged. On the*

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<sup>95</sup> Nuclear Free Local Authorities, 4 March 2014, 'NFLA publishes marine nuclear materials transportation briefing which raises concerns over emergency procedures for lower level mixed material vessel shipments', [www.nuclearpolicy.info/docs/news/NFLA\\_nuclear\\_marine\\_transport\\_briefing.pdf](http://www.nuclearpolicy.info/docs/news/NFLA_nuclear_marine_transport_briefing.pdf)

<sup>96</sup> Andrew Snelling, 9 Oct 2014, 'Oil rig evacuated after radioactive fire', [www.energynewspremium.net/StoryView.asp?storyID=826936500&section=General+News&sectionsourc=s63&aspdsc=yes](http://www.energynewspremium.net/StoryView.asp?storyID=826936500&section=General+News&sectionsourc=s63&aspdsc=yes)

NFLA / KIMO, 8 Oct 2014, 'NFLA and KIMO call for urgent inquiry into Parida nuclear waste transport fire off the Moray Firth', [www.nuclearpolicy.info/docs/news/NFLA\\_KIMO\\_Parida\\_incident.pdf](http://www.nuclearpolicy.info/docs/news/NFLA_KIMO_Parida_incident.pdf)

West Highland Free Press 26 July 2014, [www.whfp.com/2014/07/25/concern-over-nuclear-waste-shipments/](http://www.whfp.com/2014/07/25/concern-over-nuclear-waste-shipments/)

16 Oct 2014, 'Call for safety review following ship fire', [www.fia.uk.com/en/information/details/index.cfm/call-for-safety-review-following-ship-fire](http://www.fia.uk.com/en/information/details/index.cfm/call-for-safety-review-following-ship-fire)

World Nuclear News, 8 Oct 2014, [www.world-nuclear-news.org/WR-Dounreay-ready-to-assist-fire-investigation-08101401.html](http://www.world-nuclear-news.org/WR-Dounreay-ready-to-assist-fire-investigation-08101401.html)

<sup>97</sup> Herald, 30 July 2014 [www.heraldscotland.com/news/home-news/plans-for-radioactive-waste-by-sea-are-criticised.24898732](http://www.heraldscotland.com/news/home-news/plans-for-radioactive-waste-by-sea-are-criticised.24898732)

<sup>98</sup> Helmut Hirsch, Oda Becker, Mycle Schneider and Antony Froggatt, April 2005, 'Nuclear Reactor Hazards: Ongoing Dangers of Operating Nuclear Technology in the 21st Century', report prepared for Greenpeace International, [www.greenpeace.org/international/press/reports/nuclearreactorhazards](http://www.greenpeace.org/international/press/reports/nuclearreactorhazards)

*other hand, the place where the release occurs cannot be foreseen, as attacks can occur, in principle, everywhere along the transport routes. Those routes often go through urban areas; for example at ports or during rail transport. Thus, releases can take place in densely populated regions, leading to severe damage to many people, even if the area affected is comparatively small.*

Nuclear engineer Dr John Large writes:

*"Movement of nuclear materials is inherently risky both in terms of severe accident and terrorist attack. Not all accident scenarios and accident severities can be foreseen; it is only possible to maintain a limited security cordon around the flask and its consignment; ... terrorists are able to seek out and exploit vulnerabilities in the transport arrangements and localities on the route; and emergency planning is difficult to maintain over the entire route."*<sup>99</sup>

### **Examples of nuclear transport security incidents**

In 1998, Greenpeace protesters easily boarded a ship carrying highly radioactive waste. A Panama Canal Commission (PCC) memo, obtained through a Freedom of Information Act request, found that "communication, command and control ... was dysfunctional" when the Greenpeace protesters boarded the ship as it entered the Panama Canal. The PCC report noted that patrol boats had failed to spot the Greenpeace launch and that the ship's crew had thought the demonstrators to be security personnel boarding the ship. Greenpeace and the Nuclear Control Institute noted: "Had the ship been boarded by a group of well-armed attackers instead of peaceful demonstrators, its cargo would have been in grave jeopardy, with potentially catastrophic consequences for the people of Panama. Given the shippers' frequently professed concerns about security, we were astonished to discover how thoroughly inept and ineffective were the security arrangements at the Panama Canal. In fact, essential elements of the security system did not work."<sup>100</sup>

Tom Bielefeld discusses an incident in Mexico in 2014:<sup>101</sup>

*At 1:30 a.m. on December 2, gunmen forced two truck drivers who had taken a nap at a gas station on the outskirts of Mexico City to surrender their vehicle. The thieves took off with the truck's heavy and hazardous cargo: a decommissioned teletherapy unit that was once used for cancer treatment and still contained a small capsule of highly radioactive material. The capsule's contents – some 3,000 curies of cobalt-60 – made it a "category 1" radiation source, the most dangerous of five categories defined by the IAEA to rank radioactive materials according to the risk they pose to people working with them. Taken out of their shielding containers, category-1 sources can kill anyone who is exposed to them at close range for a few minutes to an hour.*

*Two days later, the police found the radioactive capsule abandoned in a corn field. Although someone had extracted the capsule from its shielding (and likely received an unhealthy radiation dose in the process), there were no immediate reports of serious injuries and no contamination found in the area nearby. Thus the consequences of this incident appeared to be less grave than in two earlier cases – in Brazil in 1987, and in Thailand in 2000 – when*

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<sup>99</sup> Quoted in UK Nuclear Free Local Authorities, May 2016, "Briefing: Nuclear security concerns – how secure is the UK civil nuclear sector?", [www.nuclearpolicy.info/wp/wp-content/uploads/2016/05/A258\\_NB145\\_Nuclear\\_Security\\_concerns.pdf](http://www.nuclearpolicy.info/wp/wp-content/uploads/2016/05/A258_NB145_Nuclear_Security_concerns.pdf)

<sup>100</sup> 22 Dec 1998, 'Major Security Breach at Panama Canal revealed as the next nuclear waste shipment looms', [www.nci.org/pr/pr122298.htm](http://www.nci.org/pr/pr122298.htm)  
Panama Canal Commission's Director of Safety, Environment and Security, 1998, 'Pacific Swan Greenpeace Incident', [www.nci.org/seatrans.htm](http://www.nci.org/seatrans.htm)

<sup>101</sup> Tom Bielefeld, 23 Jan 2014, 'Mexico's stolen radiation source: It could happen here', <http://thebulletin.org/mexico%E2%80%99s-stolen-radiation-source-it-could-happen-here>

*unsuspecting scavengers who dismantled old radiotherapy machines exposed themselves and their families to very high doses of radiation. Four of the exposed people died in Brazil, and three in Thailand, and more were seriously injured. The cost of cleanup and recovery for their communities was substantial.*

*Officials, especially in the United States, were relieved that the stolen Mexican capsule did not end up with terrorists, who could have used it to build a "dirty bomb." Even though many planning scenarios predict that such a bomb would probably cause few radiation-related deaths, its economic impact could be disastrous.*

...

*Perhaps the most worrisome lesson of the Mexican incident and the other ones above is this: If hapless truck-jackers can steal high-activity sources by accident, a well-organized terrorist group could certainly do so in a planned operation.*

Transport of uranium ore from the Bagjata mine to the Uranium Corporation of India Limited (UCIL) processing plant was suspended after an ore-laden truck was torched by Maoists on 7 May 2014.<sup>102</sup> Fifteen armed people pulled the driver down from the vehicle and then set it ablaze. The Maoists had reportedly been demanding permanent jobs for locals as compensation for acquisition of their land in Bagjata. About 150 families were displaced to make way for the Bagjata mine and had not been compensated. "If such violent activities continue to recur time and again, we apprehend it wouldn't be easy for us to function here," a senior UCIL official said.

July 2006 – Scotland – reporter plants fake bomb on train carrying nuclear waste: An investigation was underway after a newspaper reporter planted a fake bomb on a train carrying nuclear waste. The journalist from the *Daily Mirror* claimed he had wandered up to the unattended wagons at a north-west London depot. The reporter said his only ID as a rail worker was a fluorescent orange jacket and hard hat, on sale at any builders' merchants. "This was not a one-off. It was the tenth time I had wandered freely into the depot," he said. The rail company had already been criticised for "serious lapses" – the government's Office for Civil Nuclear Safety outlined serious failings in supervision at the sidings in 2005.<sup>103</sup>

March 2009 – An overseas company had made several shipments of nuclear fuel feedstock to another country, calling into a UK port en route. The company forged a UK approval document, and further investigation revealed that two other shipments had taken place with suspect UK approvals.<sup>104</sup>

13 April 1981 – Brisbane, Australia: A panel van carrying infectious and radioactive waste and a quantity of the pesticide 245T was stolen in Brisbane. Police said it contained one drum of radioactive waste, six drums of infectious waste and a quantity of 245T.<sup>105</sup>

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<sup>102</sup> [www.dnaindia.com/india/report-maoists-set-truck-carrying-uranium-for-ucil-ablaze-1986317](http://www.dnaindia.com/india/report-maoists-set-truck-carrying-uranium-for-ucil-ablaze-1986317)  
<http://timesofindia.indiatimes.com/city/ranchi/Suspension-of-ore-transportation-hits-uranium-work-at-UCIL/articleshow/34961281.cms>

<http://timesofindia.indiatimes.com/city/ranchi/Frequent-threats-from-rebels-worry-UCIL-officials/articleshow/29483709.cms>

<sup>103</sup> Tom Parry, 22 July 2006, 'N-TRAIN FIRM RAPPED BEFORE OVER SECURITY EXCLUSIVE', [www.mirror.co.uk/news/tm\\_objectid=17428696%26method=full%26siteid=94762%26headline=n%2dtrain%2dfirm%2drapped%2dbefore%2dover%2dsecurity-name\\_page.html](http://www.mirror.co.uk/news/tm_objectid=17428696%26method=full%26siteid=94762%26headline=n%2dtrain%2dfirm%2drapped%2dbefore%2dover%2dsecurity-name_page.html)

'Probe after reporter plants fake bomb on nuclear train', *The Scotsman*, 21 July 2006, <http://news.scotsman.com/uk.cfm?id=1061462006>

<sup>104</sup> M. Harvey and A. Jones, 2011, 'Radiological Consequences Resulting from Accidents and Incidents Involving the Transport of Radioactive Materials in the UK – 2010 Review', HPA-CRCE-024, [www.hpa.org.uk/Publications/Radiation/CRCEScientificAndTechnicalReportSeries/HPACRCE024/](http://www.hpa.org.uk/Publications/Radiation/CRCEScientificAndTechnicalReportSeries/HPACRCE024/)

<sup>105</sup> *Courier Mail* 14/4/81

On 17 October 2001, then ANSTO CEO Helen Garnett said that claims "that security is wanting at the Lucas Heights Science and Technology Centre ... is far from the truth."<sup>106</sup> Exactly two months later, several dozen Greenpeace protesters clambered over the spent fuel storage building and the reactor, while a paraglider enjoyed the scenery from ANSTO's 'secure' airspace.

In Canada, the Nuclear Safety Commission listed 17 cases from 2005 to 2013 in which radioactive materials were stolen from vehicles, or in which the vehicle itself was stolen with a radiation source in the trunk. Five of these cases involved radiography cameras, all of which were eventually recovered.<sup>107</sup>

About 330 kilograms of weapons-grade uranium in the form of naval fuel was stolen from a US plant in the 1960s. Multiple cases of naval HEU thefts were also reported in Russia in the early 1990s.<sup>108</sup>

According to Mark Gaffney, author of *Dimona: the Third Temple* (1989), Israel smuggled nuclear technology (triggers, known as krytrons) out of the US, and hijacked a ship on the high seas loaded with uranium ore.<sup>109</sup>

### **Nuclear transport security: US reports**

A March 2014 report by the James Martin Center for Nonproliferation Studies found that in 2013, there were 153 cases where authorities in 30 countries lost control of some of their radiological and nuclear materials.<sup>110</sup> Most cases (141) involved materials that are radioactive but not usable in nuclear weapons. In about half of cases, the report blamed the loss of the materials on "negligence" by the people handling them. In 29% of the cases, the materials were lost or stolen during transit. The report states:

*Nearly one-third of all documented incidents in 2013 (29 percent) involved material in transit. Of the 30 reported thefts of material, 57 percent involved transportation, while 15 percent of the 73 losses did.*

*Incidents that occurred in transport are further classified as either "movement," in which the device was in a moving vehicle (28 incidents); or "stationary" (14 incidents), in which the vehicle was not in motion at the time of the incident. Notably, all stationary incidents were thefts.*

*The most publicized incident in 2013 was a theft during movement. On December 2, 2013, gunmen near Mexico City forced the drivers of a truck transporting a decommissioned cancer therapy machine to abandon their vehicle. The machine contained an encapsulated Category 1 cobalt-60 source (reportedly about 3,000 curies), thus posing serious safety and security concerns. Mexican authorities appealed to the public for help locating the truck and its contents, while also alerting the thieves to the dangerous nature of the radioactive material sealed inside the device. Two days later, police recovered the material in a cornfield, with the truck nearby.*

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<sup>106</sup> Australian Financial Review, letter.

<sup>107</sup> Tom Bielefeld, 23 Jan 2014, 'Mexico's stolen radiation source: It could happen here', <http://thebulletin.org/mexico%E2%80%99s-stolen-radiation-source-it-could-happen-here>

<sup>108</sup> Sébastien Philippe, 4 Sept 2014, 'Bringing law to the sea: safeguarding the naval nuclear fuel cycle', <http://thebulletin.org/bringing-law-sea-safeguarding-naval-nuclear-fuel-cycle7418>

See also:

Victor Gilinsky and Roger J. Mattson, 17 April 2014, 'Did Israel steal bomb-grade uranium from the United States?', <http://thebulletin.org/did-israel-steal-bomb-grade-uranium-united-states7056>

<sup>109</sup> Mark H. Gaffney, 'Obama Plays Hardball with Israel?', [www.informationclearinghouse.info/article40994.htm](http://www.informationclearinghouse.info/article40994.htm)

<sup>110</sup> Nuclear Threat Initiative / James Martin Center for Nonproliferation Studies, March 2014, 'CNS Global Incidents and Trafficking Database: 2013 Annual Report', [www.nti.org/media/pdfs/global\\_trafficking\\_report.pdf?\\_id=1395275964](http://www.nti.org/media/pdfs/global_trafficking_report.pdf?_id=1395275964)



*Since thefts of materials in transit are of particular policy interest, the database further classifies thefts into additional subcategories, possibly illuminating areas of security vulnerability. First, thefts during transit are sub-classified as "stolen from vehicle" (11 incidents); "stolen with vehicle" (2 incidents); "stolen from individual" (2 incidents); or "unknown" (2 incidents).*

*An example of a "stolen from vehicle" incident was reported on February 4, 2013, in Phoenix, Arizona, where an individual broke into a locked steel box bolted to the bed of a truck parked outside a private home and stole a density gauge. There is no proof that the individual was aware of what he was stealing; many such crimes appear to be thefts of opportunity.*

*One "stolen with vehicle" incident occurred on November 18, 2013, when an individual stole a truck carrying a density gauge while the truck was parked outside of a home. As in most cases classified as "stolen with vehicle," it appears that the individual targeted the vehicle without being aware of its contents.*

*In one "stolen from individual" incident, an individual was riding a passenger train and carrying a portable industrial X-ray device. At one point, the individual noticed the device was missing and reported it stolen.*

*Thefts during transit are also sub-classified according to whether the material stolen was attended or unattended when the theft occurred. The material was attended at the time of the theft in only three of the 17 thefts during transit. In the remaining 14 incidents, the material had been left unattended when the theft occurred. ...*

*Policy Implication 5: Focusing on Security for Materials in Transit*

*Increased policy emphasis should be given to how to improve security for radioactive materials in transit. National regulatory policies differ. In some cases, new regulatory requirements or guidelines may be useful.*

*However, simple improvements to end-user training and awareness could also significantly decrease the number of incidents occurring in transit.*

*In most countries, once a device containing radioactive material is licensed for use, there appears to be little regulation governing its transportation and storage (this is particularly true of IAEA Category 3, 4, and 5 sources). In the United States, while radioactive sources must be locked into vehicles while in transit, regulations do not prohibit leaving sources in an unattended vehicle. Incident data for 2013, which includes multiple thefts from parked vehicles, suggests the possible need for additional regulation of radioactive materials while in transit, such as requiring that materials not be left unattended for lengthy periods in areas where there is general public access.*

*Many of the incidents that occurred during transport reflect simple negligence, and could easily have been avoided (e.g., incidents in which a licensee forgot to secure a source, and the source fell off the truck while in transit). Such incidents reinforce Key Finding 4, concerning the need to improve nuclear security training for personnel working with radioactive materials.*

Harvard University's Tom Bielefeld, a physicist specialising in nuclear security and nonproliferation research, wrote in *The Bulletin of the Atomic Scientists* in 2014 about nuclear transport security issues in the USA:<sup>111</sup>

*For transport security, the active involvement of all stakeholders is of particular importance. On the road, there are fewer technical protection measures available than inside buildings, so security depends even more on the people in charge: the drivers. They must be vigilant and prepared. This is primarily the responsibility of their bosses, who, in turn, must be able to rely on adequate rules and specific guidance from the regulator. Businesses must also be able to count on responsive state agencies and law enforcement. The federal government can set financial incentives to invest in better security. It is also in a unique position to provide the*

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<sup>111</sup> Tom Bielefeld, 23 Jan 2014, 'Mexico's stolen radiation source: It could happen here', <http://thebulletin.org/mexico%E2%80%99s-stolen-radiation-source-it-could-happen-here>

other parties with the information necessary to better understand the nature of the threats they might be facing. Here are some specific recommendations for the various parties involved in transport security:

- *The NRC must further strengthen its regulations. Given the scale of damage that a "dirty bomb" could cause, it's difficult to understand why there are still no armed escorts required for category-1 transports. A real-time location-tracking system should be mandatory, not just for vehicles transporting category-1 sources, but also for those with category-2 sources. Similarly, the requirement for drivers to identify "safe havens" for rest stops, before their trip begins, should be extended to category-2 transports.*
- *The states could do a lot more, too. Those that do not yet require armed escorts for category-1 transports should implement such a policy soon – and not wait for the NRC to change its rules. And if there is one lesson from the Mexican incident for the states, it's that all of them should be proactive when it comes to helping licensees identify secure parking areas.*
- *The companies themselves play the main role in protecting radioactive sources. They need to be aware that someone might be after their cargo. Drivers, in particular, must be trained to follow security protocols, avoid risky situations, and respond appropriately should they come under attack. Managers should equip their trucks with low-cost security systems—such as GPS tracking systems, duress buttons, or vehicle disabling devices—even when they are not legally required to do so.*
- *Improving transport security remains an urgent matter for all parties involved, but the NRC and the states must pave the way – and quickly. In addition to the measures outlined above, a new program should be initiated in which experts from government and industry work together to develop better security concepts for sources in transit.*

**Nuclear transport security: March 2014 Nuclear Security Summit.** Only five states – Japan, France, South Korea, the UK and the USA – endorsed a statement on nuclear transport security risks. Commitments include adopting the recommendations of the yet-to-be published IAEA 'Implementing Guide on the Security of Nuclear Material in Transport', and "consider[ing] mutually exchanging information on physical protection and the security of other radioactive materials ... in order to capture good practices and lessons learned." Harvard University's Matthew Bunn said the transportation gift basket "is as weak as dishwasher," and he took exception to its suggestion that "the security record of civilian transport of nuclear materials has been excellent" historically. "It used to be legal to send plutonium by regular mail," Bunn noted, "and the industry complained loudly when the [U.S. Nuclear Regulatory Commission] started requiring any armed guards at all."<sup>112</sup>

### 3.9 REGULATION

The SA government's demonstrated inability to adequately monitor and robustly regulate the uranium industry should rule out any deeper involvement in the nuclear industry including the nuclear waste import proposal. Examples include:

- The FoI revelation in 2013 that the radiation plans for Olympic Dam were more than 15 years out of date, with the SA Environment Protection Authority acknowledging that an update was

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<sup>112</sup> Douglas P. Guarino, 26 March 2014, 'Nations Pledge to Follow Security Guidelines for 'Dirty Bomb' Material', [www.nti.org/gsn/article/nations-pledge-follow-security-guidelines-dirty-bomb-material/](http://www.nti.org/gsn/article/nations-pledge-follow-security-guidelines-dirty-bomb-material/)  
Joint Statement: [www.nss2014.com/sites/default/files/documents/joint\\_statement\\_on\\_transport\\_security\\_final.pdf](http://www.nss2014.com/sites/default/files/documents/joint_statement_on_transport_security_final.pdf)  
[www.whitehouse.gov/the-press-office/2014/03/25/fact-sheet-enhancing-security-maritime-supply-chain-gift-basket](http://www.whitehouse.gov/the-press-office/2014/03/25/fact-sheet-enhancing-security-maritime-supply-chain-gift-basket)

(long) overdue.<sup>113</sup> If not for the FoI application and the surrounding publicity, the radiation plans would likely be more than 17–18 years out of date and counting.

- The failure to detect the illegal dumping of radioactive materials in the Arkaroola Wilderness Sanctuary (discussed previously).

The comments below consider the federal nuclear regulator, the Australian Radiation Protection and Nuclear Safety Agency (ARPANSA), with a focus on problems that could be redressed.

The federal government undermined ARPANSA's independence by allowing the then Chief Executive of ANSTO, Helen Garnett, to sit on panel which interviewed applicants for the position of CEO of ARPANSA. When asked to comment on that process at a public meeting in March 1999, ANSTO's then Communications Manager John Mulcair said he thought Garnett's involvement was indefensible.

Then ARPANSA CEO John Loy said in a 17 April 2000 media release that the Maralinga clean-up was "world best practice" although it clearly was not; for example shallow burial of plutonium in unlined trenches certainly would not be tolerated in the UK or the USA. ARPANSA officials made suggestions about options for managing contaminated debris – such as encasement with concrete – which were simply dropped when the Department and its consultants proposed cheaper, inferior options. The contaminated debris has been buried just a few metres below grade in an unlined trench. Shallow burial of long-lived waste does not even comply with Australian standards let alone qualify as 'world best practice'.<sup>114</sup> Given that ARPANSA was willing to echo government fallacies in relation to the nuclear waste project at Maralinga in SA, there is legitimate concern that ARPANSA may experience pressure to do the same in relation to future nuclear proposals in SA including national or international waste repositories or stores, or nuclear fuel cycle facilities. We acknowledge that there has been a significant and welcome change of leadership, senior personnel and organisational culture within ARPANSA since this time but the experience remains.

Nuclear engineer Alan Parkinson wrote "The newly formed Australian Radiation Protection and Nuclear Safety Agency (ARPANSA) also has not performed particularly well in its first major assignment – the Maralinga project."<sup>115</sup>

Then ARPANSA CEO John Loy repeatedly stated that a reactor construction licence would not be granted unless progress was made towards the establishment of a store for long-lived intermediate-level waste (LLILW). Yet a reactor construction licence was issued by ARPANSA, and later a reactor operating licence, without a LLILW store being in place, and without firm plans in place towards the establishment of a store, and with very little or no progress towards a final disposal site and facility for LLILW.

The 2005 Australian National Audit Office report was critical of ARPANSA.<sup>116</sup> It said:

- The Regulatory Branch's operational objectives and activities are numerous, vary considerably in scope, are not prioritised, and are insufficiently specific to be clear or assessable.

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<sup>113</sup> Miles Kemp, 7 July 2013, 'Radiation leak plan 15 years out of date', The Advertiser, [www.adelaidenow.com.au/business/olympic-dam-mine-radiation-leak-plan-15-years-out-of-date/story-fni6uma6-1226675659296](http://www.adelaidenow.com.au/business/olympic-dam-mine-radiation-leak-plan-15-years-out-of-date/story-fni6uma6-1226675659296)

<sup>114</sup> Alan Parkinson, DEST National Radioactive Waste Repository - A Second Round Submission to ARPANSA, 25/2/04. [www.foe.org.au/sites/default/files/ParkinsonARPANSA2004.doc](http://www.foe.org.au/sites/default/files/ParkinsonARPANSA2004.doc)  
See also Alan Parkinson, "Maralinga: The Clean-Up of a Nuclear Test Site", *Medicine and Global Survival*, Volume 7, Number 2, February 2002. [www.ipnw.org/pdf/mgs/7-2-parkinson.pdf](http://www.ipnw.org/pdf/mgs/7-2-parkinson.pdf)

<sup>115</sup> Submission to the Senate Select Committee for an Inquiry into the Contract for a New Reactor at Lucas Heights, September 2000.

<sup>116</sup> [www.foe.org.au/sites/default/files/Audit%20Office%20-%20ARPANSA.pdf](http://www.foe.org.au/sites/default/files/Audit%20Office%20-%20ARPANSA.pdf)

- [O]verall management of conflict of interest is not sufficient to meet the requirements of the ARPANS Act and Regulations. ... Potential areas of conflict of interest are not explicitly addressed or transparently managed.
- The bulk of license assessments – some 75 per cent – were made without the support of robust, documented procedures.
- ARPANSA does not monitor or assess the extent to which licensees meet reporting requirements. The ANAO found that there had been under-reporting by licence holders.
- ARPANSA has reported only one designated breach to Parliament. This is notwithstanding that there have been a number of instances where ARPANSA has detected non-compliance by licensees.

The Australian National Audit Office's overall conclusions were as follows:

- The ANAO concluded that improvements are required in the management of ARPANSA's regulatory function. While initial under-resourcing impacted adversely on regulatory performance, ARPANSA's systems and procedures are still not sufficiently mature to adequately support the cost-effective delivery of regulatory responsibilities.
- In particular, deficiencies in planning, risk management and performance management limit ARPANSA's ability to align its regulatory operations with risks, and to assess its regulatory effectiveness.
- As well, procedures for licensing and monitoring of compliance have not been sufficient, particularly as a licence continues in force until it is cancelled or surrendered. Current arrangements do not adequately support the setting of fees in a user-pays environment, nor ARPANSA's responsibilities for transparently managing the potential for conflict of interest.

Since 2007 ARPANSA has been drawn into an unseemly process regarding incidents and accidents at ANSTO's Lucas Heights site and its treatment of whistleblowers. ARPANSA issued two contradictory reports on the issue, leading the Minister to establish an inquiry into ARPANSA. The ABC reported in July 2011: "The Health Department's audit and fraud control branch has been investigating how ARPANSA handled allegations of safety breaches and bullying at the nation's only nuclear reactor in Sydney. Whistleblowers had alleged ARPANSA was too close to the Australian Nuclear Science and Technology Organisation (ANSTO), which runs the Lucas Heights research facility. The whistleblowers claimed that safety reports were being compromised. The Health Department review also questioned ARPANSA's impartiality."<sup>117</sup>

In 2011, the then Parliamentary Secretary for Health and Ageing, Catherine King, announced a review into ARPANSA's regulatory powers following the receipt of an independent audit by the Audit and Fraud Control Branch of the Department of Health and Ageing into ARPANSA's handling of two safety incidents at ANSTO in September 2007 and August 2008. The audit found that while the incidents were investigated and concluded at the time, there was a lack of consistency in evidence and transparency in the handling of one of the incidents.<sup>118</sup>

The ABC reported: "Australia's nuclear industry regulator, ARPANSA, is under review over its handling of safety breaches at the nation's only nuclear reactor. Last year, ABC 1's Lateline revealed allegations of serious safety and operational breaches at the Lucas Height's reactor in Sydney, which were later backed up by Australia's workplace regulator, Comcare. A departmental investigation was launched by Science Minister Kim Carr last month, but now a party to that

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<sup>117</sup> [www.abc.net.au/news/stories/2011/07/07/3264086.htm](http://www.abc.net.au/news/stories/2011/07/07/3264086.htm)

See also: [www.abc.net.au/news/stories/2011/03/30/3178186.htm](http://www.abc.net.au/news/stories/2011/03/30/3178186.htm)

See also: [www.foe.org.au/ansto-whistleblower-saga-2007-ongoing](http://www.foe.org.au/ansto-whistleblower-saga-2007-ongoing)

<sup>118</sup> Catherine King, 7 July 2011, Media Release: 'Review of Regulatory Powers of the Australian Radiation Protection and Nuclear Safety Agency'.

investigation – ARPANSA – is itself under review. The Chief Auditor is investigating how ARPANSA handled the original allegations of safety breaches and bullying at the nuclear site. ARPANSA last year released two conflicting reports on the claims at the Lucas Heights facility."<sup>119</sup>

## 4. ABORIGINAL TRADITIONAL OWNERS

### 4.1 Introduction

Our organisations hold serious concerns over past and continuing nuclear industry practices and impacts and the following comments highlight the often poor treatment of Aboriginal people by the nuclear/uranium industries in Australia and by governments pursuing or facilitating nuclear/uranium projects.

Most of the issues discussed here are either current or they are recent history. There are patterns of mistreatment that would likely be exacerbated by the current waste dumping proposals.

### 4.2 SA Government / Royal Commission

The plan to turn SA into the world's nuclear waste dump has been met with near-unanimous opposition from Aboriginal people.<sup>120</sup>

The Aboriginal Congress of SA, comprising people from many Aboriginal groups across the state, endorsed the following resolution at an August 2015 meeting:<sup>121</sup>

*"We, as native title representatives of lands and waters of South Australia, stand firmly in opposition to nuclear developments on our country, including all plans to expand uranium mining, and implement nuclear reactors and nuclear waste dumps on our land. ... Many of us suffer to this day the devastating effects of the nuclear industry and continue to be subject to it through extensive uranium mining on our lands and country that has been contaminated. We view any further expansion of industry as an imposition on our country, our people, our environment, our culture and our history. We also view it as a blatant disregard for our rights under various legislative instruments, including the founding principles of this state."*

SA Premier Jay Weatherill said in March 2015: "We have a specific mandate to consult with Aboriginal communities and there are great sensitivities here. I mean we've had the use and abuse of the lands of the Maralinga Tjarutja people by the British when they tested their atomic weapons."<sup>122</sup>

Yet the SA Government's handling of the early stages of the Royal Commission process systematically disenfranchised Aboriginal people. The truncated timeline for providing feedback on draft Terms of Reference disadvantaged people in remote regions, people with little or no access to email and internet, and people for whom English is a second language. This was compounded when the Commission was formulated as there was no translation of the draft Terms of Reference, and a regional communications and engagement strategy was not developed or implemented.

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<sup>119</sup> ABC, 30 March 2011, 'Nuclear regulator investigated over safety review', [www.abc.net.au/news/stories/2011/03/30/3178186.htm](http://www.abc.net.au/news/stories/2011/03/30/3178186.htm)

See also: [www.emfacts.com/2011/07/arpansa-being-investigated-for-improper-relationship-with-nuclear-agency/](http://www.emfacts.com/2011/07/arpansa-being-investigated-for-improper-relationship-with-nuclear-agency/)

See also: ABC, 8 July 2011, 'Nuclear regulator 'too close' to ANSTO', [www.abc.net.au/news/stories/2011/07/07/3264086.htm](http://www.abc.net.au/news/stories/2011/07/07/3264086.htm)

<sup>120</sup> [www.anfa.org.au/traditional-owners-statements/](http://www.anfa.org.au/traditional-owners-statements/)

<sup>121</sup> <http://nuclearrc.sa.gov.au/app/uploads/2016/03/Native-Title-Representative-10-09-2015.pdf>

<sup>122</sup> [www.abc.net.au/worldtoday/content/2015/s4200643.htm](http://www.abc.net.au/worldtoday/content/2015/s4200643.htm)

The Premier's powerful words were not reflected in the Commission's actual practice.

Aboriginal people have repeatedly expressed frustrations with the Royal Commission process. One example (of many) is the submission of the Anggumathanha Camp Law Mob:

*"Why we are not satisfied with the way this Royal Commission has been conducted:*

*Yaiinidlha Udnyu ngawarla wanggaanggu, wanhanga Yura Ngawarla wanggaanggu? – always in English, where's the Yura Ngawarla (our first language)?*

*The issues of engagement are many. To date we have found the process of engagement used by the Royal Commission to be very off putting as it's been run in a real Udnyu (whitefella) way. Timelines are short, information is hard to access, there is no interpreter service available, and the meetings have been very poorly advertised. Engagement opportunities need to be fair and equitable (readily available to all people) and the Native Title interest is no more important than the wider community. A closed and secretive approach makes engagement difficult for the average person on the street, and near impossible for Aboriginal people to participate."*

The Royal Commission made some efforts to overcome its early deficiencies – such as the appointment of a (non-Aboriginal) regional engagement officer and some limited efforts to translate written material. However it would be fair to summarise the attitudes of very many Aboriginal people by saying that the Royal Commission's efforts have been too little, too late.<sup>123</sup>

The following ABC article addresses some of these concerns:

***SA nuclear royal commission: Indigenous voices lost because of 'difficult' JP requirement, community leader says***

*Nicola Gage, ABC, 22 May 2015, [www.abc.net.au/news/2015-05-22/sa-nuclear-royal-commission-barrier-indigenous-voices/6490160](http://www.abc.net.au/news/2015-05-22/sa-nuclear-royal-commission-barrier-indigenous-voices/6490160)*

*Indigenous voices will not be heard in South Australia's royal commission into the nuclear fuel cycle because the process is "too difficult", a prominent Aboriginal woman claims.*

*The commission is examining the potential for an expansion of SA's role in the nuclear industry, including whether a nuclear power station or nuclear waste dump should be built. Meetings have been held in Adelaide as well as the state's far north, including in the APY Lands and Coober Pedy.*

*Karina Lester, whose father Yami was affected by nuclear testing at Maralinga in the 1950s, said residents were told they would need a Justice of the Peace (JP) to sign any submissions before they would be accepted.*

*She said many communities did not have a JP, making it "very difficult for people".*

*"For example my father, 27 kilometres west from Marla Bore, (he) doesn't drive, wouldn't have a JP on hand, and would probably need to travel down to Coober Pedy," Ms Lester said.*

*"But he certainly has a story to tell and certainly would love to have input into the royal commission."*

*Ms Lester said a number of people at remote meetings did not speak English and she was frustrated because some, including a gathering at the Umoona community, did not include interpreters.*

*"I think they were a little bit confused," she said.*

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<sup>123</sup> Relevant submissions to the Royal Commission include the following:

Frank Young (Amata community member); Mike Williams, Mimili Community; Anangu Pitjantjatjara Yankunytjatjara; Bobby Brown; James Brown; Campbell Law; Kurna; Anggumathanha Camp Law Mob; Kokatha Aboriginal Corporation; Frank Young.

Submission from Representatives of Native Title Parties: Antakirinja Matu Yankunytjatjara Aboriginal Corporation; Dieri Aboriginal Corporation RNTBC; Irrwanyere Aboriginal Corporation RNTBC; Narungga Nations Aboriginal Corporation; Nauo Native Title Claimants; Ngadjuri Nation Aboriginal Corporation; Yankunytjatjara Native Title Aboriginal Corporation (YNTAC); Yandruwandha Yawarrararrka Traditional Land Owners Aboriginal Corporation. Separate Native Title Representative submission dated 10 September 2015.

*"They haven't simplified the talk to the community and straight away you will get disengagement when it's a language that's not understood by the general community."*  
*Ms Lester said many Aboriginal people had become disengaged with the process. She wanted oral submissions to be accepted to stop people walking away.*

*"They have a story, let them tell their story," Ms Lester said.*

*"The commission needs to now find ways and means of how they can go and gather those stories."*

*Conservation Council of South Australia chief executive officer Craig Wilkins said there were huge barriers stopping Aboriginal people from participating.*

*"Requiring a member of the public to travel to a JP and swear an oath in front of them before they can lodge a submission is a highly unusual, unnecessary and a surprising restriction that will stop people getting involved," he said.*

*"If they are concerned about fake or spam submissions, all they need is for individuals to self declare and sign a coversheet.*

*"To be forced to swear an oath in front of a JP just to have your say is simply not necessary."*  
*The commission has hired a regional engagement officer to work with Aboriginal communities.*

*It said it would do everything in its power to ensure indigenous voices were heard.*

#### **Commission opening old wounds, community executive says**

*Yalata chief executive Greg Franks said discussions about the nuclear fuel cycle was opening old wounds for many people affected by the Maralinga nuclear testing.*

*"Every time issues come up regarding nuclear energy and in particular nuclear bombs, it is still a raw wound with many people in community, particularly the older ones," he said.*

*Yami, in his 70s, claims to have been blinded from nuclear testing at Maralinga in the 1950s.*

*"He was out there as a young man or a young boy on country, when the black mist rolled north of where the tests took place," Ms Lester said.*

*"There was a camp, people started getting very sore in their eyes, people started to get rashes on their skin.*

*"He lost his sight overtime from those tests so he's now blind and we are reminded everyday on how it's affected the family."*

*Mr Franks said many Aboriginal people were confused about how to make sure their voices were heard.*

*"The first language of the community is Pitjantjatjara so the formal structures around having to make submissions, doing things online, formal signoffs by JPs for example, although there is one here in community, they are difficult things to do," he said.*

*"They're barriers for getting people to provide good feedback."*

### **4.3 Proposed national nuclear waste dump in the Flinders Ranges**

From 1998–2004, the Australian federal government tried but failed to impose a national nuclear waste dump on Aboriginal land in South Australia. The government's subsequent attempt to impose a dump on Aboriginal land in the Northern Territory also failed. Now the Australian government has embarked on its third attempt to establish a nuclear waste dump and it has decided to once again try to impose a dump on Aboriginal land in SA despite clear opposition from Traditional Owners.

The latest proposal is for a dump in the spectacular Flinders Ranges, 400 km north of Adelaide in SA, on the land of the Adnyamathanha Aboriginal Traditional Owners.

The proposed dump site is adjacent to the Yappala Indigenous Protected Area (IPA).<sup>124</sup> "The IPA is right on the fence – there's a waterhole that is shared by both properties," says Yappala Station resident and Adnyamathanha Traditional Owner Regina McKenzie. The waterhole – a traditional women's site and healing place – is one of many archeological and culturally significant sites in the area that Traditional Owners have registered with the SA government over the past six years.

Two Adnyamathanha associations – Viliwarinha Aboriginal Corporation and the Arnggumthanha Camp Law Mob – wrote in November 2015 statement: "We don't want a nuclear waste dump here on our country and worry that if the waste comes here it will harm our environment and muda (our lore, our creation, our everything). We call on the federal government to withdraw the nomination of the site and to show more respect in future."<sup>125</sup>

The SA Labor Government has shown little interest in supporting the near-unanimous opposition of Adnyamathanha Traditional Owners to the proposed dump (in striking contrast to previous support for the Kupa Piti Kungka Tjuta). The SA Liberal Party Opposition has shown no interest. Both major parties at the federal level have shown little interest.

The following article comments on the SA Labor Government's indifference:

***SA Premier silent while Flinders Ranges threatened***

Regina McKenzie, 6 May 2016

<http://indaily.com.au/opinion/2016/05/06/premier-silent-while-flinders-ranges-threatened/>

#### **4.4 Dumping on South Australia, 1998–2004**

The current Flinders Ranges proposal isn't the first time that Aboriginal people in SA have faced the imposition of a nuclear waste dump. In 1998, the federal government announced its intention to build a nuclear waste dump near the rocket and missile testing range at Woomera.

The proposed dump generated such controversy in South Australia that the federal government hired a public relations company. Correspondence between the company and the government was released under Freedom of Information laws. In one exchange, a government official asked the PR company to remove sand-dunes from a photo to be used in a brochure. The explanation provided by the government official was that: "*Dunes are a sensitive area with respect to Aboriginal Heritage*". The sand-dunes were removed from the photo, only for the government official to ask if the horizon could be straightened up as well.<sup>126</sup>

Aboriginal groups were provided with little genuine choice in relation to signing 'Heritage Clearance Agreements' consenting to test drilling of short-listed sites for the proposed dump.<sup>127</sup> The federal government made it clear that if consent was not granted, drilling would take place anyway. Aboriginal groups were put in an invidious position. They could attempt to protect specific cultural sites by engaging with the federal government and signing agreements, at the risk of having that engagement being misrepresented as consent for the dump; or they could refuse to engage in the process, thereby having no opportunity to protect cultural sites. Aboriginal groups did participate in Heritage Clearance Agreements, and as feared that participation was repeatedly misrepresented by the federal government as amounting to Aboriginal consent for the dump.

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<sup>124</sup> [www.indigenous.gov.au/new-indigenous-protected-area-creates-opportunities-for-yappala-community](http://www.indigenous.gov.au/new-indigenous-protected-area-creates-opportunities-for-yappala-community)

<sup>125</sup> [www.foe.org.au/sites/default/files/Adnyamathanha%20statement%2027%20Nov%202015.pdf](http://www.foe.org.au/sites/default/files/Adnyamathanha%20statement%2027%20Nov%202015.pdf)

<sup>126</sup> [www.foe.org.au/anti-nuclear/issues/oz/nontdump/mw](http://www.foe.org.au/anti-nuclear/issues/oz/nontdump/mw)

<sup>127</sup> See statements from Dr Roger Thomas and others in: 25 Feb 2004, ARPANSA inquiry public hearing, <http://web.archive.org/web/20040610143043/http://www.arpansa.gov.au/reposit/nrwr.htm>



In 2002, the Federal Government tried to buy-off Aboriginal opposition to the dump. Three Native Title claimant groups – the Kokatha, Kuyani and Barngala – were offered A\$90,000 to surrender their native title rights, but only on the condition that all three groups agreed.<sup>128</sup> The government's offer was refused.

In 2003, the federal government used the Lands Acquisition Act 1989 to seize land for the dump. Native Title rights and interests were extinguished with the stroke of a pen. This took place with no forewarning and no consultation with Aboriginal people.

The government's approach to 'consultation' with Aboriginal people was spelt out in a document leaked in 2002. The document states: "*Tactics to reach Indigenous audiences will be informed by extensive consultations currently being undertaken ... with Indigenous groups.*" In other words, sham 'consultation' was used to fine-tune the government's pro-dump propaganda.

#### **4.5 'Radioactive Ransom': Dumping on Muckaty Traditional Owners**

Following the failure of the attempt to impose a national radioactive waste dump in SA, the Howard government announced in July 2005 that the Northern Territory would host a national radioactive waste dump, like it or not. This decision was in clear conflict with commitments given during the 2004 federal election.

A toxic trade-off was part of this story from the start. The nomination of the Muckaty site in the NT was made with the promise of a compensation package of a mixture of cash and increased service provision valued at \$12 million. Traditional Owner Kylie Sambo objected to this 'radioactive ransom': "I think that is a very, very stupid idea for us to sell our land to get better education and scholarships. As an Australian we should be already entitled to that."

The Howard government passed legislation – the Commonwealth Radioactive Waste Management Act<sup>129</sup> – overriding the Aboriginal Heritage Act and the Aboriginal Land Rights Act, and allowing the imposition of a nuclear dump with no Aboriginal consultation or consent.

The federal Labor Party voted against the Commonwealth Radioactive Waste Management Act, with Labor parliamentarians describing it as "extreme", "arrogant", "draconian", "sorry", "sordid", and "profoundly shameful". At its 2007 national conference, Labor voted unanimously to repeal the legislation. Yet after the 2007 election, the Labor government passed legislation – the National Radioactive Waste Management Act (NRWMA)<sup>130</sup> – which was almost as draconian and still permitted the imposition of a nuclear dump with no Aboriginal consultation or consent (to be precise, the nomination of a site was not invalidated by a failure to consult or secure consent).

A small group of Traditional Owners supported the dump but a much larger group were opposed<sup>131</sup> and some initiated legal action<sup>132</sup> 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 federal government acceded to the NLC's request not to proceed with the Muckaty nomination.<sup>133</sup> The

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<sup>128</sup> [www.theage.com.au/articles/2003/05/16/1052885400359.html](http://www.theage.com.au/articles/2003/05/16/1052885400359.html)

<sup>129</sup> [www.legislation.gov.au/Details/C2006C00710](http://www.legislation.gov.au/Details/C2006C00710)

<sup>130</sup> [www.legislation.gov.au/Details/C2012A00029](http://www.legislation.gov.au/Details/C2012A00029)

[www.foe.org.au/anti-nuclear/issues/oz/nontdump/feb2010](http://www.foe.org.au/anti-nuclear/issues/oz/nontdump/feb2010)

<sup>131</sup> [www.beyondnuclearinitiative.com/](http://www.beyondnuclearinitiative.com/)

<sup>132</sup> [www.abc.net.au/lateline/content/2012/s3452671.htm](http://www.abc.net.au/lateline/content/2012/s3452671.htm)

<sup>133</sup> [www.theguardian.com/commentisfree/2014/jun/19/muckaty-nuclear-dump-defeat-is-a-huge-victory-for-aboriginal-](http://www.theguardian.com/commentisfree/2014/jun/19/muckaty-nuclear-dump-defeat-is-a-huge-victory-for-aboriginal-)

announcement came just days before the NLC and government officials were due to take the stand to face cross-examination. As a result of their surrender, the NLC and the government did not have to face cross-examination in relation to numerous serious accusations<sup>134</sup> raised in the first two weeks of the trial – including claims that the NLC rewrote an anthropologists' report.<sup>135</sup>

#### 4.6 The uranium industry and Aboriginal people

In viewing any moves to expand the nuclear in Australia it is important to note that the uranium industry has a track record of stripping Aboriginal people of their land rights and heritage and legal protections. 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 uranium mine in SA. The Act was amended in 2011 but it retains exemptions from the SA Aboriginal Heritage Act. Traditional Owners were not even consulted during the period of the most recent amendments. 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."<sup>136</sup>

Aboriginal land rights and heritage protections are repeatedly stripped away whenever they get in the way of uranium mining interests:

- As mentioned, the Olympic Dam mine is partially exempt from the SA Aboriginal Heritage Act.
- Sub-section 40(6) of the Commonwealth's Aboriginal Land Rights Act exempts the Ranger uranium mine in the NT from the Act and thus removed the right of veto that Mirarr Traditional Owners would otherwise have enjoyed.<sup>137</sup>
- NSW legislation exempts uranium mines from provisions of the NSW Aboriginal Land Rights Act.<sup>138</sup>
- The Western Australian government is in the process of gutting the WA Aboriginal Heritage Act 1972 at the behest of the mining industry, including the systematic deregistering of Aboriginal Heritage Sites.<sup>139</sup>

None of those exemptions is defensible. No attempt has ever been made to justify why the heritage protections and land rights legislation should be weakened at the behest of the uranium industry or why uranium mining should be exempted from land rights legislation.

## 5. ECONOMICS

### 5.1 Introduction

We recommend the following literature to the SA Joint Select Committee and suggest that the authors be approached to provide evidence to the Committee (if not already):

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australia

<sup>134</sup> <http://beyondnuclearinitiative.com/blog>

<sup>135</sup> [www.theage.com.au/federal-politics/political-news/indigenous-land-owners-accuse-lawyer-of-manipulating-nuclear-waste-storage-report-20140604-39jk8.html](http://www.theage.com.au/federal-politics/political-news/indigenous-land-owners-accuse-lawyer-of-manipulating-nuclear-waste-storage-report-20140604-39jk8.html)

<sup>136</sup> [http://hansard.parliament.sa.gov.au/pages/loaddoc.aspx?e=2&eD=2011\\_11\\_24&c=26](http://hansard.parliament.sa.gov.au/pages/loaddoc.aspx?e=2&eD=2011_11_24&c=26)

<sup>137</sup> <http://web.archive.org/web/20130425181741/www.mirarr.net/duress1.htm>

<sup>138</sup> [www.parliament.nsw.gov.au/prod/parlment/nswbills.nsf/131a07fa4b8a041cca256e610012de17/f82a7f63ed98b020ca2579a500209b70?OpenDocument](http://www.parliament.nsw.gov.au/prod/parlment/nswbills.nsf/131a07fa4b8a041cca256e610012de17/f82a7f63ed98b020ca2579a500209b70?OpenDocument)

<sup>139</sup> <http://blakandblack.com/2012/06/27/amendments-to-was-aboriginal-heritage-act-a-mining-industry-friendly-high-jacking/>

Mia Pepper, 19 April 2015, 'Radioactive racism in the Wild West – WA takes aim at remote communities', <http://thestringer.com.au/radioactive-racism-in-the-wild-west-wa-takes-aim-at-remote-communities-10123>

- Australia Institute, March 2016, 'Digging for Answers', [www.tai.org.au/sites/default/files/P222A%20Digging%20for%20answers%20-%20SA%20Nuclear%20Royal%20Commission%20Submission%20FINAL.pdf](http://www.tai.org.au/sites/default/files/P222A%20Digging%20for%20answers%20-%20SA%20Nuclear%20Royal%20Commission%20Submission%20FINAL.pdf)
- Prof. Richard Blandy, 7 June 2016, 'How a high-level nuclear waste dump could lose money', <http://indaily.com.au/business/analysis/2016/06/07/how-a-high-level-nuclear-waste-dump-could-lose-money/>
- Prof. Richard Blandy, 23 Feb 2016, 'Nuclear waste dump confounds cost-benefit analysis', <http://indaily.com.au/business/analysis/2016/02/23/nuclear-waste-dump-fails-the-cost-benefit-test/>

Prof. Blandy, Adjunct Professor in the Business School at the University of South Australia, explains how the headline figures promoted by the Royal Commission mask a more complex picture:<sup>140</sup>

*"In the summary of its report, the royal commission says that a high level waste dump "could generate more than \$100 billion income in excess of expenditure over the 120-year life of the project (or \$51 billion discounted at 4 per cent)". Note that the report says "could", not "would".*

*"But, in Appendix J, the report says that "applying a commercial pre-tax discount rate of 10 per cent the net present value of profits to the State would amount to \$11.5 billion". This is a big reduction from the headline number in the summary of \$100 billion.*

*"Also in Appendix J, the report says the commission undertook sensitivity analysis of the value of the dump if less of the world market for used fuel were captured and the price was lower. The royal commission concluded that: "Under these scenarios, the project achieved lower profits than the baseline scenario, but remained highly viable."*

*"On the page following that statement, Figure J.6 shows that at a price for dumped nuclear fuel equal to Swedish costs of constructing a nuclear waste dump, and assuming half or more of the world's available high level nuclear waste came to South Australia, the dump would have a net present value of profits of about \$5 billion.*

*"At a world price for dumped nuclear fuel equal to Finnish costs of constructing such a dump, the dump would have a net present value of profits of only about \$2.5 billion.*

*"In fact, if South Australia's dump could only attract a quarter of the world's high level nuclear waste, at prices equal to Swedish or Finnish costs of construction (approximately A\$1.13m/tonne of heavy metal and A\$0.65m/tonne of heavy metal, respectively), our dump would lose money and would have a negative net present value."*

Prof. Blandy goes on to question the Royal Commission's 'willingness to pay' estimate in his June 2016 article.<sup>141</sup>

Prof. Blandy's February 2016 article (also submitted to the Royal Commission) explains the concepts of 'net present value' and 'intergenerational discount rate' and he explains how the Royal Commission's proposal privileges South Australians in the short-term at the expense of many future generations. Put simply, Prof. Blandy writes:

*"We are bequeathing a stream of costs to our successor generations. They will be poorer as a result, and will have reason to curse their forebears for selfishly making themselves better off at their expense. The problem with the high level nuclear waste dump is the inescapable risk (the Royal Commission says that "it is not possible to know the geological and climatic conditions in the distant future") of severely adverse outcomes that we might be passing on to*

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<sup>140</sup> Prof. Richard Blandy, 7 June 2016, 'How a high-level nuclear waste dump could lose money', <http://indaily.com.au/business/analysis/2016/06/07/how-a-high-level-nuclear-waste-dump-could-lose-money/>

<sup>141</sup> Prof. Richard Blandy, 7 June 2016, 'How a high-level nuclear waste dump could lose money', <http://indaily.com.au/business/analysis/2016/06/07/how-a-high-level-nuclear-waste-dump-could-lose-money/>

*tens of thousands of future generations of South Australians. We should think of what we will leave to our descendants – and not do it.*"<sup>142</sup>

We note important points in a briefing paper by independent environmental analyst David Noonan:<sup>143</sup>

- Taking the prudent step of ensuring that there is an agreed licensed geological disposal site before importing any waste results in a 40% reduction in project Net Present Value.
- Claimed 'Initial Cost Outlays' of \$2.4 billion over 10 years (Royal Commission Final Report p.103-104) are premised on a baseline business case for a coastal location for above ground nuclear waste storage, some 5-10 km from a Nuclear port (Final Report p.290 & Table J.1; Jacobs Exec Summary p.5, p.136 and 167, p.196-198). An inland location with a required lengthy rail line increases storage capital and operating costs by approx. \$1 billion (Jacobs, Scenarios modelled p.196-198, and Table 3.3 Capital costs of configuration scenarios).
- The Royal Commission's Final Report (p.290) is based on "combined" siting at one location for high level waste disposal at 500m depth AND for intermediate level waste disposal at 200 m depth (Jacobs p.5 and p.196-198). Prudent planning requires a budget for "stand-alone" geological disposal facility costs, a \$9.6 billion increase on reported capital costs (Jacobs p.198 Configuration Scenario 1 versus Configuration Scenario 4).
- The Final Report and Finding 91 assumes a cost estimate of circa \$1.05 million per tonne for storage and disposal of high level nuclear waste in SA (total cited project costs of \$145 billion divided by 138 000 tonnes of high level waste). That is well short of the estimate of \$1.3–1.4 million (US \$1.0 million) per tonne in experienced nuclear countries with a national siting program. If the \$1.4 million figure turns out to be accurate, total costs of \$145 billion would increase by approx. 25% or around \$36 billion.
- Jacobs further assume that client countries will pay \$1.75 million per tonne as well as additional costs for waste preparation, transport and shipping (Exec Summary p.3-4), and storage casks costs (p.63 & p.75), totalling approx. \$0.35 million per tonne. The actual cost to client countries is approx. \$2.1 million per tonne of high level waste. Client countries are assumed to be willing to pay some 50 per cent higher than direct geological disposal costs of \$1.3–1.4 million per tonne in experienced nuclear countries with ongoing disposal programs. In effect, client countries are also assumed to be willing to pay up to double the claimed cost estimate for high level nuclear waste storage and disposal in SA at \$1.05 million per tonne.

In short, the expectation that clients will pay \$2.1 million per tonnes seems unrealistic. Alternative, cheaper options would likely be preferred – either domestic or regional disposal programs, or a commercial venture offering preferable rates.

## **5.2 National policies / possible customer countries**

No country has ever imported spent nuclear fuel or high-level nuclear waste as a commercial venture (other than the import of spent fuel for reprocessing). For that reason, and others, it is impossible to assess how many countries (and nuclear utilities) might be interested in sending spent fuel or high level nuclear waste to Australia for storage and/or disposal.

The Royal Commission gave little or no attention to some obvious difficulties. For example:

- If waste import does prove to be profitable Australia might face competition and the ambitious revenue projections would become even less plausible.

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<sup>142</sup> Prof. Richard Blandy, 23 Feb 2016, 'Nuclear waste dump confounds cost-benefit analysis', <http://indaily.com.au/business/analysis/2016/02/23/nuclear-waste-dump-fails-the-cost-benefit-test/>

<sup>143</sup>

[www.foe.org.au/sites/default/files/Noonan%20No%20Profit%20in%20Nuclear%20waste%20Brief%20July2016.pdf](http://www.foe.org.au/sites/default/files/Noonan%20No%20Profit%20in%20Nuclear%20waste%20Brief%20July2016.pdf)

- It might make sense for potential customer countries to send ALL their intermediate and high level nuclear waste; it would make little sense to send just a fraction of the waste to Australia (or another country) since the remainder would require domestic disposal.

There may be countries that would be willing to send nuclear waste to Australia for storage and/or disposal but there are many reasons why countries may choose other options:

- Countries which have no spent fuel or high level waste or intermediate level waste
- Countries (or companies/utilities) that would consider it irresponsible to entrust nuclear waste to a country that has very little or no experience or demonstrated competence – or a proven track record of incompetence and project non-delivery e.g. the Maralinga 'clean up' and repeated failure to establish a site for a national repository.
- Countries (or companies/utilities) that would consider it unethical to send nuclear waste to Australia given the demonstrated pattern of Aboriginal land rights and legal and heritage protections being sacrificed in order to advance radioactive waste repository projects (e.g. the extinguishment of Native Title rights and interests to advance the planned national repository in SA; and legislation allowing the imposition of a radioactive waste repository in the NT with no Aboriginal consultation or consent). Aboriginal people are overwhelmingly opposed to the plan to import nuclear waste<sup>144</sup> and have begun seeking international support.<sup>145</sup>
- Countries that are pursuing spent fuel reprocessing would seem unlikely candidates (see below).
- Countries (or companies/utilities) that would consider it unethical or inappropriate to send nuclear waste to Australia given the inevitability of deep community division.
- Countries that see spent fuel as a military asset (as it contains weapons-useable plutonium).
- Countries that are advancing domestic or regional disposal plans.

Of course, a vast majority of the world's countries (~160/194) have not operated power reactors and do not have spent fuel or high level nuclear waste stockpiles. Some of these countries do however have stockpiles of long lived waste from medicine, industry or research requiring disposal.

Countries with reprocessing plants (or which send spent fuel overseas for reprocessing) are presumably not interested in sending spent fuel to Australia; though some might consider sending the high level waste stream from reprocessing to Australia. However ARIUS, the successor to Pangea, notes that "reprocessing nations are likely to take care of their own wastes".<sup>146</sup>

The IAEA summarises the situation with reprocessing in its 'Nuclear Technology Review 2015':<sup>147</sup> "In 2014, about 10 000 t HM were discharged as spent fuel from all NPPs. The total cumulative amount of spent fuel that has been discharged globally is approximately 380 500 t HM, of which about 258 700 t HM are stored in facilities at either at-reactor or away-from-reactor sites. Less than a third of the cumulative amount of spent fuel discharged globally has already been reprocessed. In 2014, the global commercial reprocessing design capacity, spread across five countries (France, India, Japan, the Russian Federation and the United Kingdom), was about 4800 t HM per year. However, not all this capacity is operational."

Some countries are planning new or expanded reprocessing facilities, such as Russia's RT-2 reprocessing plant which is expected to be operational by 2021.<sup>148</sup>

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<sup>144</sup> [www.anfa.org.au/traditional-owners-statements/](http://www.anfa.org.au/traditional-owners-statements/)

<sup>145</sup> [www.anfa.org.au/sign-the-declaration/](http://www.anfa.org.au/sign-the-declaration/)

<sup>146</sup> <http://nuclearrc.sa.gov.au/app/uploads/2015/08/Arius-Association-13-07-2015.pdf>

<sup>147</sup> IAEA, July 2015, Nuclear Technology Review 2015, [www.iaea.org/About/Policy/GC/GC59/GC59InfDocuments/English/gc59inf-2\\_en.pdf](http://www.iaea.org/About/Policy/GC/GC59/GC59InfDocuments/English/gc59inf-2_en.pdf)

<sup>148</sup> IAEA, July 2015, Nuclear Technology Review 2015, [www.iaea.org/About/Policy/GC/GC59/GC59InfDocuments/English/gc59inf-2\\_en.pdf](http://www.iaea.org/About/Policy/GC/GC59/GC59InfDocuments/English/gc59inf-2_en.pdf)

BHP Billiton's submission to the Switkowski Review stated:<sup>149</sup>

*"We strongly doubt the acceptability of any government or commercially imposed requirement to lease fuel, as distinct from acquiring uranium, to our major customers, all of whom are highly respected utilities in countries with which Australia has rigorous safeguards agreements, and who have choices about where to acquire their U3O8. These utilities generally regard their spent fuel as an asset – a resource for future reprocessing to produce more fuel input."*

The EU Council Directive 2011/70/Euratom legally binds EU Member States to establish and maintain a spent fuel and radioactive waste management policy, and states that Each EU Member State shall have ultimate responsibility for managing the spent fuel and radioactive waste generated in it.<sup>150</sup>

South Korea has been actively lobbying for some years for the relaxation of a prohibition on reprocessing and may wish to pursue that path rather than sending spent fuel to another country.

Other countries are pursuing domestic repository projects and would therefore be unlikely to want to send spent fuel or high level waste to Australia. That would apply to the countries with the most advanced repository projects – Sweden, Finland and France. It might also apply to countries such as Canada, which is progressing plans for a low and intermediate level waste repository near Lake Huron and is slowly progressing plans for a high level waste repository.

China has plans for reprocessing and a domestic repository. The IAEA states:

*"China foresees geological disposal needs deriving from the reprocessing of 140 000 tonnes of spent fuel from a fleet of 48 reactors. Disposal is to be sited in either a crystalline or a sedimentary host formation, and construction of the first underground research facility (URF) is planned in the Beishan area. The results expected from this URF will contribute to informing future decisions on deep geological disposal implementation."*

### **5.3 Possible revenue**

The assumption that client countries will pay for Australia to store and dispose of 138,000 tonnes of high level waste and 390,000 cubic metres of intermediate level waste has no grounding in real-world analysis. It is arbitrary. As Jacobs MCM states (Feb. 2016, Conclusions for dry storage Interim Storage Facility, p.77): "At the present stage of analysing the International repository option, all of the assumption related to cost and revenues are dominated by the rather subjective judgement of how much of the world's spent fuel would land in Australia."

Little can be said about possible revenue from accepting nuclear waste given that there are no precedents for a commercial venture of this nature, and no way of knowing how many countries might be interested in sending waste to Australia, how much waste would be involved, etc.

Pangea planned to transport 75,000 tonnes of spent fuel over 40 years. Pangea-successor ARIUS states that commonly quoted potential prices for accepting spent nuclear fuel for disposal are in the order of US\$1M/ton.<sup>151</sup> That figure is a long way short of the revenue per tonne arbitrarily assumed by the Royal Commission.

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<sup>149</sup> [http://web.archive.org/web/20070830182528/www.pmc.gov.au/umpner/submissions/223\\_sub\\_umpner.pdf](http://web.archive.org/web/20070830182528/www.pmc.gov.au/umpner/submissions/223_sub_umpner.pdf)

<sup>150</sup> IAEA, July 2015, Nuclear Technology Review 2015,

[www.iaea.org/About/Policy/GC/GC59/GC59InfDocuments/English/gc59inf-2\\_en.pdf](http://www.iaea.org/About/Policy/GC/GC59/GC59InfDocuments/English/gc59inf-2_en.pdf)

<sup>151</sup> <http://nuclearrc.sa.gov.au/app/uploads/2015/08/Arius-Association-13-07-2015.pdf>

Other figures are not only arbitrary but absurd – in particular, analyses which add up all the revenue that could be generated at each stage of a nuclear fuel leasing program without grounding that analysis in the reality that a number of relevant markets (e.g. conversion, enrichment, fuel fabrication) already have substantial excess capacity. Details are provided in our August 2015 submission to the Royal Commission and we commend this document to the Committee's attention.<sup>152</sup>

Some nuclear proponents believe that spent nuclear fuel is a "multi-trillion dollar asset"<sup>153</sup> – because it can be processed for reuse as reactor fuel – at the same time they often also hold the conflicting belief that countries will pay "tens of billions of dollars"<sup>154</sup> to relieve themselves of this "multi-trillion dollar asset". However, to the extent that countries regard spent fuel as an asset, they likely will:

- not be willing to send it to Australia;
- offer to sell spent fuel to Australia rather than paying Australia to take it; or
- they may pay Australia to take spent fuel but they will pay less to the extent that spent fuel is considered an asset.

## 5.4 Costs

Nuclear waste disposal cost estimates can nearly double in a decade:

- Estimates of the clean-up costs for a range of (civil and military) UK nuclear sites including Sellafield have jumped from a 2005 estimate of £56 billion (A\$97.6b) to over £100 billion (A\$174b).<sup>155</sup>
- In 2005, the French government's nuclear waste agency Andra estimated the cost of a deep geological disposal facility at between €13.5 and €16.5 billion (A\$19.7–24.1 billion).<sup>156</sup> In 2016, Andra estimates the cost of the facility at between €20 billion to €30 billion (A\$29.1–43.7 billion).<sup>157</sup>

The Royal Commission (and the Jacobs consultancy) make some provision for cost overruns but nothing on the scale of the near-doubling of cost estimates evident in France and the UK.

We note that Jacobs Project Manager / Consultant Tim Johnson has informed the Joint Select Committee that "total expenditure prior to the decision to proceed and sign contracts with client countries is likely to be from around AUD300 million to in excess of AUD600 million, depending on the timing of the decision to proceed within year six."<sup>158</sup>

And Jacobs note the potential for initial outlays in the billions: "Under the cash-flow assumptions of the baseline, where no revenues ahead of delivery are assumed (a deliberately conservative assumption), there is an initial outlay of AUD 2.4 billion (real) in net terms."<sup>159</sup>

The proposed high level nuclear waste repository would cost some tens of billions of dollars. Plans

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<sup>152</sup> See pp.90-100 [www.foe.org.au/sites/default/files/NFCRC%20submission%20FoEA%20ACF%20CCSA-FINAL-AUGUST-2015.pdf](http://www.foe.org.au/sites/default/files/NFCRC%20submission%20FoEA%20ACF%20CCSA-FINAL-AUGUST-2015.pdf)

<sup>153</sup> <http://decarbonisesa.com/2012/02/22/a-matter-of-waste-latest-in-the-sacome-series/>

<sup>154</sup> <http://theconversation.com/royal-commission-into-nuclear-will-open-a-world-of-possibilities-37363>

<sup>155</sup> Jonathan Leake, 9 Dec 2012, 'Nuclear cleanup to take 120 years and cost £100bn', [www.thesundaytimes.co.uk/sto/news/uk\\_news/National/article1173042.ece](http://www.thesundaytimes.co.uk/sto/news/uk_news/National/article1173042.ece)

<sup>156</sup> World Nuclear News, 18 Jan 2016, 'Minister sets benchmark cost for French repository', [www.world-nuclear-news.org/WR-Minister-sets-benchmark-cost-for-French-repository-1801165.html](http://www.world-nuclear-news.org/WR-Minister-sets-benchmark-cost-for-French-repository-1801165.html)

<sup>157</sup> Geert De Clercq, 12 Jan 2016, 'EDF sinks to all-time low as nuclear waste cost estimate soars', <http://uk.reuters.com/article/edf-nuclear-waste-idUKL8N14W2RO20160112>

<sup>158</sup> Letter to Joint Standing Committee, 5 July 2016.

<sup>159</sup> (Jacobs, Paper 5, sec 4.4, Cash flow profile for the baseline, p.205.)

for a high level waste repository in Japan may be comparable: the estimated cost is ¥3,500 billion (A\$44.1 billion).<sup>160</sup> As mentioned above, current estimates of the cost of a deep geological disposal facility in France range from A\$29.1–43.7 billion.

Other relevant facilities with substantial costs include: repositories for low and intermediate level waste as well as high level waste; purpose-built ships; a dedicated sea terminal in Australia to provide port facilities; a dedicated rail system for transport from a port inland to a repository site; and support and maintenance facilities for the ships, rail locomotives, rolling stock and transport packages.

ARIUS (the successor to Pangea) states: "Depending on the chosen location, road, rail or port facilities may already exist. For a large repository project, however, it could be preferable and affordable to implement dedicated facilities."<sup>161</sup> ARIUS goes on to say: "This also increases the "added-value" of the project to Australia." However, dedicated facilities would obviously add significantly to the costs rather than the "added-value".

The SA Joint Select Committee might want to consider the implications of any proposal to abandon plans for dedicated, new infrastructure (e.g. port, rail) in favour of existing infrastructure. It should be noted that from 1999–2002 Pangea Resources initially envisaged dedicated infrastructure but as its plans advanced it increasingly favoured the use of existing infrastructure. A shift from dedicated to existing infrastructure would have significant implications for the economics of the project as well as public health and environmental risks.

The Royal Commission states: "In the event of a major nuclear accident, adverse impacts on the tourism, agriculture and property sectors could potentially be profound." (Finding 155, Impacts on Other Sectors). Costs associated with an accident – response/remediation costs, and "the need to abandon a site and move to an alternative site" (Jacobs MCM, p.32) – are not considered by Jacobs MCM or the Royal Commission.

## **5.5 Decommissioning, closure and remediation costs**

The Royal Commission's Tentative Findings Report proposed that funds (a 'Reserve Fund') for nuclear decommissioning, closure and remediation would not begin to accrue for some decades after the project ... and some decades after the first import of nuclear waste: "...for a fund to start in year 45, which would generate about A\$32 billion by year 83 to apply to the closure and ongoing monitoring of facilities." (Finding 93b, p.19; Jacobs MCM, p.206-207)

Funds need to be set aside at the start of the project, not when it is well advanced. According to the Jacobs MCM / Royal Commission proposal and timeline, South Australia is proposed to have taken ownership and liability for some 100,000 tonnes of high level nuclear waste by Project Year 45 (Jacobs Executive Summary, p.4-5 and Figure 3). To countenance hosting such a contaminating and complex waste stream with no assured financial provision for its management is reckless. There is a very real risk here of massive and inter-generational cost shifting and a continuing and uncapped financial burden on future SA state governments and taxpayers.

The Royal Commission's Final Report (p.100-101) cites an alternative scenario whereby funding for the Reserve Fund would begin to accrue from Project Year 11. The SA Joint Select Committee should recommend the accrual of funds from Project Year 11 rather than Year 45.

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<sup>160</sup> [www.world-nuclear.org/info/Country-Profiles/Countries-G-N/Japan--Nuclear-Fuel-Cycle/](http://www.world-nuclear.org/info/Country-Profiles/Countries-G-N/Japan--Nuclear-Fuel-Cycle/)

<sup>161</sup> <http://nuclearrc.sa.gov.au/app/uploads/2015/08/Arius-Association-13-07-2015.pdf>



Jacobs MCM (p.210-211) states that: "Funds must also be set aside for many hundreds of years of ongoing monitoring of these underground sites." Jacobs MCM (Introduction, p.11) refers to "perpetual site monitoring and safety assurance beyond its operational life" after closure, but does not appear to make provision for centuries (or millennia) of monitoring – the Reserve Fund declines to a balance of approx. \$1 million in Project Year 120 (Jacobs MCM, p.207).

Jacobs MCM (Site monitoring and post closure surveillance, p.185) also states: "The period of the post-closure surveillance phase is essentially open ended, and a period of 1 000 years is reflective of essentially perpetual monitoring activity." Further, the Royal Commission's Final Report (p.101) identifies "an annum surveillance allowance of \$550 000 for 1,000 years" to monitor nuclear facilities. But monitoring (and remediation of problems as they arrive) will be required for many thousands of years. The Royal Commission notes that high level nuclear waste "requires isolation from the environment for many hundreds of thousands of years".

## 5.6 Jobs

Prof. Blandy notes that the promised 600 jobs (once operations began) is very small compared with 800,000 jobs presently in South Australia (<0.1%).<sup>162</sup>

According to the Australian Bureau of Statistics, there are 11,909,900 'employed persons' in Australia as of January 2016. Thus the nuclear waste storage/disposal project would increase the total by 0.005%.

According to the SA Tourism Commission, 57,000 people are employed in tourism in South Australia (direct and indirect).<sup>163</sup> Thus a 1% reduction in the tourism industry would result in the loss of ~570 jobs, almost identical to the 600 promised long-term jobs associated with the nuclear waste project. Visitor expenditure is estimated at \$5.7 billion annually, thus a 1% reduction would amount to \$57 million annually, or \$570 million per decade or \$5.7 billion over a 100-year period.

This negative economic impact has not been adequately identified or addressed across a range of potentially adversely exposed sectors including agricultural, wine and fisheries production.

## 5.7 Impacts on other sectors

The Royal Commission's Tentative Findings report asserts that there "is no compelling evidence from any international experience that the development of nuclear facilities in South Australia would adversely affect other economic sectors, provided those facilities are operated safely and securely."

There's no need to go overseas to see impacts on other sectors. Examples abound in Australia. For example:

- Contamination around the former uranium mine at Rum Jungle restricts potential uses of the land and has sometimes restricted use of the Rum Jungle South Recreation Reserve. Despite some \$20 million of rehabilitation works, the site remains a major source of extreme acid and metalliferous drainage to the Finnis River, as well as other ongoing problems including erosion, weed invasion, site security and so on. In November 2010, the Rum Jungle South Recreation Reserve was closed due to low-level radiation in the area – the Department of

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<sup>162</sup> Prof. Richard Blandy, 23 Feb 2016, 'Nuclear waste dump confounds cost-benefit analysis', <http://indaily.com.au/business/analysis/2016/02/23/nuclear-waste-dump-fails-the-cost-benefit-test/>

<sup>163</sup> SA Tourism Commission, [www.tourism.sa.gov.au/assets/documents/At\\_A\\_Glance\\_March\\_16.pdf](http://www.tourism.sa.gov.au/assets/documents/At_A_Glance_March_16.pdf)

Resources advised the local council to shut down the reserve as a precautionary measure. Presumably fishing of the Finniss River has been restricted because of contamination from mine toxins. The most recent federal budget included an \$11 million allocation to assist with rehabilitation planning, bring to \$18 million the amount committed to this since 2009. The Northern Territory Department of Mines has estimated that operationalising the final plan will take eight years and a further \$200 million of public funds.

- A contaminated site near Kalgoorlie is unavailable for alternative uses – and poses an ongoing security / public health problem. In 2012, damage to a security gate allowed children to enter the contaminated site, where more than 5,000 tonnes of tailings from the Yeelirrie uranium deposit were buried in the 1980s. BHP Billiton said it would improve security.
- The legacy of multiple uranium mines and two mills in the Upper South Alligator Valley in the Northern Territory has likely restricted tourism and other potential uses of the land.
- The controversial Hunters Hill site in Sydney has been disruptive for local residents and one wonders what impact the saga has had on local property prices.
- The Port Pirie uranium processing site is off limits for recreational and other uses. Six uranium tailings dams and a rare earth extraction dam cover approximately 26 hectares.<sup>164</sup> A later plan for a rare earths mine was abandoned and the decision to abandon the mine proposal is likely to have been influenced by residual contamination from uranium processing (contamination certainly motivated community opposition to the proposed mine).
- BHP Billiton's water take from the Great Artesian Basin for the Olympic Dam mine (the company is licensed to take up to 42 million litres daily) has impacted the Mound Springs (see the references listed in section 1.10 of our original submission) and made them less attractive as a tourist drawcard.
- BHP Billiton's water take also competes with local pastoral operations. In August 2014 *The Australian* reported that pastoralist Shane Oldfield from Clayton Station blames BHP Billiton for a local drop in the level of Basin water, requiring the operation and maintenance of pumps which adversely impact on an already marginal operation.<sup>165</sup>

If the Royal Commission was so minded, it could easily have found hundreds of examples of nuclear fuel cycle facilities overseas impacting on other sectors, and the Commission's apparent unwillingness to acknowledge the problem is unacceptable. A number of examples are listed in section 1.13 of our original submission<sup>166</sup> to the Royal Commission – but those examples are just the tip of the iceberg. To restate just one example here, abandoned uranium mines and exploration sites in the U.S.<sup>167</sup> cumulatively represent a serious public health and environmental hazard, and contamination restricts both actual and potential uses of land and water resources.

The Royal Commission's Tentative Findings report notes that in the event of a major nuclear accident, adverse impacts on the tourism, agriculture and property sectors could potentially be profound. It should further note that nuclear accidents have no respect for state or national boundaries; for example the impacts of Chernobyl led to severe, decades-long restrictions on primary industries across Europe. Total direct and indirect costs of the Fukushima disaster will be

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[http://minerals.dmitre.sa.gov.au/mines\\_\\_and\\_\\_developing\\_projects/former\\_mines/port\\_pirie\\_treatment\\_plant/about\\_the\\_plant](http://minerals.dmitre.sa.gov.au/mines__and__developing_projects/former_mines/port_pirie_treatment_plant/about_the_plant)

<sup>165</sup> Sarah Martin, 9 Aug 2014, 'BHP Billiton's thirst triggers an outback water fight', [www.theaustralian.com.au/national-affairs/state-politics/bhp-billitons-thirst-triggers-an-outback-water-fight/story-e6frgczx-1227018481754](http://www.theaustralian.com.au/national-affairs/state-politics/bhp-billitons-thirst-triggers-an-outback-water-fight/story-e6frgczx-1227018481754)

See also Michael Owen, 21 Sept 2009, 'Corporate abuse' hits Great Artesian Basin, [www.theaustralian.news.com.au/story/0,25197,26101722-5013404,00.html](http://www.theaustralian.news.com.au/story/0,25197,26101722-5013404,00.html)

<sup>166</sup> [www.foe.org.au/sites/default/files/NFCRC%20submission%20FoEA%20ACF%20CCSA-FINAL-AUGUST-2015.pdf](http://www.foe.org.au/sites/default/files/NFCRC%20submission%20FoEA%20ACF%20CCSA-FINAL-AUGUST-2015.pdf)

<sup>167</sup> [www.cleantuptheminest.org](http://www.cleantuptheminest.org)

around US\$500 billion according to a study by the American Society of Mechanical Engineers.<sup>168</sup> A comparable accident would not only destroy the South Australian economy, it would have profoundly adverse economic (and other) impacts at a national level.

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<sup>168</sup> American Society of Mechanical Engineers, June 2012, 'Forging a New Nuclear Safety Construct: The ASME Presidential Task Force on Response to Japan Nuclear Power Plant Events', [www.asme.org/getmedia/73081de8-e963-4557-9498-f856b56dabd1/Forging\\_a\\_new\\_nuclear\\_safety\\_construct.aspx](http://www.asme.org/getmedia/73081de8-e963-4557-9498-f856b56dabd1/Forging_a_new_nuclear_safety_construct.aspx)