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SUBMISSION IN RESPONSE TO

THE ROYAL COMMISSION INTO THE NUCLEAR FUEL CYCLE

ISSUES PAPER 4

"MANAGEMENT, STORAGE, AND DISPOSAL OF NUCLEAR AND RADIOACTIVE WASTE"

22 July 2015

INTRODUCTION

Friends of the Earth Adelaide calls for a national Commission or comparable public inquiry to determine the best storage solution for Australia's existing nuclear waste. The terms of reference of the Nuclear Fuel Cycle Royal Commission make it an inappropriate body to consider this issue, because the focus is on "feasibility" as an economic enterprise rather than on "best solution" from a scientific and public acceptability perspective. Also, Australia's nuclear waste problem is national and cannot be solved by an inquiry conducted by a single state.

Friends of the Earth Adelaide opposes an international nuclear waste dump in Australia on broad safety and environmental grounds. The risk of accident or terrorism during the transport and storage of nuclear waste is too high. Furthermore, nuclear waste is the responsibility of the country that generated it. There is a danger that perverse incentives and moral hazards will arise if countries operate nuclear power plants in the belief that they can dump the nuclear waste overseas. If countries are unable to safely dispose of their nuclear waste, they should stop generating it. They should not be encouraged to defer or deflect the problem on the grounds that another country will take the problem off their hands.

High level nuclear waste needs to be safely stored for tens of thousands of years. For people and the environment to remain safe from high level nuclear waste, the waste containment vessels and security infrastructure would need to be secured over the vast life of a proposed dump. It is unlikely that this can be guaranteed to occur safely according to plan in a remote location for many thousands of years. For these reasons, this submission argues that there is no safe solution to the problem of nuclear waste, so generation of nuclear waste should cease.

> "Disposal in deep, stable geological formations usually several hundreds of metres below the surface is generally recognised as the most appropriate option for High Level Waste. "— p6, ANSTO, 2011, Management of Radioactive Wastes in Australia

While there have been several attempts to create a suitable repository globally, there are no currently operating repositories due to technical, political and community opposition reasons.

It is impossible to foresee what as-yet-unknown uses might be invented several generations hence for the geologically stable deposits which proponents of long-term storage of nuclear waste see as ideal dump sites. Given the resource industry's continuing and unfailing interest in extracting useable substances from the Earth's crust is highly probable that these places will become the target for future exploration and 'development'. The general public outrage when contemporary discoveries are made of toxic materials dumps created by previous generations is a reasonable indicator of how future generations would consider our actions if we merely 'left' radioactive poisons. We could, of course, label them - but how we might do that in ways that we can guarantee will be intelligible to future generations is problematic.

In addition, we have no demonstrably reliable idea for how long nuclear waste containment vessels will maintain their capacity to keep nuclear materials separate from each other, and other elements of the bio-geosphere.

The following is Friends of the Earth Adelaide's response to questions 4.5 through 4.10 of Issues Paper 4.

These questions presuppose that the objective is to find a way to enable the establishment of a nuclear waste dump. We reject this premise and believe the way the questions are formulated biases the inquiry. We therefore respond as much to the underlying assumptions behind the questions as to the questions themselves.

4.5 What are the specific models and case studies that demonstrate the best practice for the establishment, operation and regulation of facilities for the storage or disposal of nuclear or radioactive waste? What are the less successful examples? Where have they been implemented in practice? What new methods have been proposed? What lessons can be drawn from them?

The nuclear industry refers to the holding place of its waste as a "repository". "Repository" is a euphemism, so this submission will use the more understandable term "waste dump". We can indicate that, for most practical purposes, a 'repository' is a place humans put something they're going to return to collect later, not where they put 'stuff' for which they have no further use. The term has been co-opted by the nuclear industry and its supporters. Our use of the term 'waste dump' is not because we want to be difficult, but because we'd like the nuclear industry to use language that is, as we have said, more accurate - and a good deal more honest.

Worldwide the nuclear industry describes the levels of nuclear waste it produces as low, intermediate and high level.

LOW AND INTERMEDIATE LEVEL NUCLEAR WASTE FROM AUSTRALIAN SOURCES

Australia currently produces low and medium level nuclear waste which is stored at the location it is generated. Friends of the Earth Adelaide calls for a national Commission or comparable public inquiry to audit the amount, type and locations of the country's nuclear waste, and determine the best storage solution from the perspective of sound science and public acceptability.

The Olympic Dam mine at Roxby Downs in SA produces 10 million tonnes of low level nuclear waste from the mining and milling of uranium ores. This includes tails (finely crushed, solid residues from ore milling), tailings from ore processing, and radon gas. There are numerous recorded examples of problems with tailings dams including leaks, spills and dam collapses[1]. The current system of storing low level radioactive waste in open, above ground tailings dams is unacceptable.

Friends of the Earth Adelaide call upon the Royal Commission to use its coercive powers to compel BHP-Billiton to produce full and accurate details of accidents, leaks and dam collapses to assist in correcting deficiencies in their process to ensure the safety of humans and environments. Corrective actions will then be able to inform future mining expansion and nuclear waste disposal proposals under investigation by this Royal Commission.

HIGH LEVEL NUCLEAR WASTE

Australia currently does not produce high level waste but this would change if nuclear power was introduced. High level nuclear waste is the most toxic type of nuclear waste and currently the world's high level nuclear waste is stored above ground. This poses great risks, leaving the waste exposed to floods, terrorism, earthquakes, climate change and human error.

The time frame for safely containing radioactive waste can range from 10,000 to 1,000,000 years[2]. It would be impossible to ensure the safe containment of high level waste over such enormous periods of time. It would be highly irresponsible to bury the waste deep underground and abandon it without providing continuous security to safeguard it from misuse or intentional use by people of criminal/political intent such a terrorists, over the thousands of years it remains dangerous. The time frame involved is longer than human beings have existed. This demonstrates the irresponsibility of generating the waste in the first place.

After sixty years of the nuclear industry there are still no facilities to permanently store high level radioactive nuclear waste (spent fuel or reprocessed fuel) in the world. Only Finland has begun constructing a facility for its own high level nuclear waste disposal, while Sweden has selected a site but not yet commenced construction[3].

A high level nuclear waste dump entails a severe risk of harm to workers should accidents and leaks occur. There is a real, possibility of containment vessel failure over the generations for which they need to maintain safe storage of nuclear materials. Recent experience of nuclear 'incidents' tells us that governments and industries cut corners over any projects requiring long-term competent monitoring and response. We suggest that future generations of humans will behave in similar ways, since there is no reliable source of assurance to the contrary. So, 'incidents' will occur. People handling nuclear wastes will be endangered, probably damaged. The nuclear industry has no intention, or possibility, of ensuring that this does not happen or, if/when it does happen, of caring for the people and communities affected.

A summary of problems with deep geological storage of nuclear waste is provided in Table 1, quoted from a comprehensive and scientifically credible analysis by Greenpeace: "Rock Solid? A scientific review of geological disposal of high-level radioactive waste"[4].

TABLE 1 TECHNICAL & FINANCIAL PROBLEMS WITH DEEP GEOLOGICAL STORAGE

- Copper or steel canisters and overpacks containing spent nuclear fuel or high-level radioactive wastes could corrode more quickly than expected.

- 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.

- Earthquakes could damage containers, backfill and the rock.

Although computer models of such phenomena have undoubtedly become more sophisticated, fundamental difficulties remain in predicting the relevant complex, coupled processes (including the effects of heat, mechanical deformation, microbes and coupled gas and water flow through fractured crystalline rocks or clay) over the long timescales necessary. In particular, more advanced understanding and modelling of chemical reactions is essential in order to evaluate the geochemical suitability of repository designs and sites. The suitability of copper, steel and bentonite as materials for canisters, overpacks and backfill also needs to be reassessed in the light of developing understanding of corrosion mechanisms and the effects of heat and radiation.

Unless and until such difficulties can be resolved, a number of scenarios exist in which a significant release of radioactivity from a deep repository could occur, with serious implications for the health and safety of future generations. In this light, the existence in a number of countries of 'road maps' for the implementation of deep disposal, and the rejection of other options, do not automatically mean that deep disposal of highly radioactive wastes is safe.

At present, the following issues remain unresolved and have implications for policy development:

- 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. There is additional tension between endorsement of deep disposal as a potentially 'least bad' option for existing wastes, and nuclear industry claims that deep repositories provide a safe solution to waste disposal and so help to justify the construction of new reactors

- 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.

AUSTRALIAN SITUATION

For many years governments have been looking for a single location within Australia to store Australia's low level and intermediate level nuclear waste. Whenever a location has been proposed it has met with fierce opposition from local people as well as people from all around Australia.

Despite the failure to date to find a location for Australia's own nuclear waste, some people have proposed setting up an international nuclear waste dump in SA for other countries to send us their nuclear waste for a fee. However, Australia currently does not accept any kind of hazardous waste for "final disposal"[5]. In view of the discussion in this submission, we fail to see why a special exception should be made for nuclear waste, which is one of the most dangerous and controversial forms of waste.

Nevertheless, to address the theoretical feasibility of such a project, no country has ever imported high level nuclear waste with the aim of commercial permanent storage, so there is currently no publicly available evidence to base estimates of revenue should any country agree to send its waste to Australia for permanent disposal. There is no evidence to determine if dump fees would be profitable once expensive infrastructure for transport, storage and security had been paid for, and the terms of this Royal Commission insist upon verifiable facts and evidence. The OECD's Nuclear Energy Agency says it is impossible to gauge the future costs of storage sites, because each country's geography is different and there are no previous projects to serve as examples. Therefore, as no facts are available, no economic models can meaningfully or accurately predict the profitability or otherwise of hosting an international nuclear waste dump[6].

An argument is sometimes made that Australia has a moral responsibility to accept the high-level nuclear waste arising from the use of Australian uranium in power reactors overseas. This argument is disingenuous. The responsibility for managing nuclear waste lies with the countries that use 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. Furthermore, the nuclear waste in question is about a million times more radioactive than the uranium exported and contains a toxic cocktail of radioactive isotopes that were not in the exported uranium. The argument also overlooks the fact that the people who would bear the burden of the nuclear waste are not the same people who reaped the profits from the export, and in most cases the mining was carried out against their will. So the "moral responsibility" argument is clearly morally bankrupt.

LESS SUCCESSFUL EXAMPLES OF NUCLEAR WASTE DUMPS

Over 30 countries have established shallow nuclear waste dumps for low and short-lived intermediate level waste. The USA has closed three of these dumps due to environmental problems and accidents. Farmers in the Champagne region of France have taken legal action in relation to a leaking nuclear waste dump. In Germany, all 126,000 barrels of nuclear waste already placed in a nuclear dump are being removed because of water infiltration over a twenty years period. Serious questions are being asked about the containment ability of Finland and Sweden's high level nuclear waste[7].

AUSTRALIA – ATTEMPTS AT DUMPING NUCLEAR WASTE

A vast area around Maralinga in the north of SA was contaminated by UK nuclear bomb tests in the 1950s, and remains an off limits "prohibited area" today over 50 years later. The Australian government made an attempt to "clean up" the SA Maralinga nuclear test site in the late 1990s. The "clean up" was not performed correctly, and many tonnes of plutonium-contaminated debris remain buried in shallow, unlined pits in totally unsuitable geology. This inadequate attempt at a clean-up breached Australian standards for the management of long-lived nuclear waste. Despite this evidence, the government attempted to claim that the Maralinga clean-up was 'world's best practice'. In 2011, a survey revealed that 19 of the 85 contaminated debris pits have been subject to erosion or subsidence and no attempt to correct this has been made to date[7].

USA – ATTEMPTS AT A NUCLEAR WASTE DUMP

Worldwide there is only one dump for long-lived intermediate level nuclear waste: the Waste Isolation Pilot Plant (WIPP), a single deep underground dump in the US state of New Mexico. This dump has already experienced one serious accident resulting in exposure of 22 workers to radiation and exposure of the environment costing more than $500 million to repair. The dump will be shut down for 4 years to achieve this. During the set-up phase there was extreme attention paid to safety but this did not last long and complacency and cost-cutting set in[8]. The occurrence of a fundamental safety problem after such a short period of time demonstrates the unreliability of safety assessments that are supposed to be valid for periods of tens of thousands to millions of years.

GERMANY – ATTEMPTS AT NUCLEAR WASTE DUMPS

Nuclear waste dump problems have been encountered in two locations in Germany. Radioactive nuclear waste leaked from the former mining pit Asse II in Lower Saxony and was not reported for 20 years. A salt mine used for deep geological dumping in Morseleben Lower Saxony is in a state of collapse[9].

FINLAND AND SWEDEN - ATTEMPTS AT NUCLEAR WASTE DUMPS

Finland has been building a deep 450m underground spent fuel dump for some years in the granite bedrock. The containment technology to be used has been developed by Sweden and involves the rods being encased in copper containers, then packed into absorbent bentonite clay that swells when wet, which seals off the package from corrosive elements. A Swedish nongovernmental organization working on nuclear waste, MKG has serious questions about the ability of the containment material to last for 100,000 years. They question whether not only oxygen but also water molecules could react directly with the copper surface and cause it to degrade[6].

4.6 What are the security implications created by the storage or disposal of intermediate or high level waste at a purpose-built facility? Could those risks be addressed? If so, by what means?

There are serious public health, safety and environmental risks associated with a high level nuclear waste dump. There is no way to 100% prevent any escape of nuclear materials during transport via sea, rail or road, and the risk of terrorism during transport is serious.

Any high level nuclear waste dump site must be built to last for many thousands of years. There is no precedent for a human built structure that has lasted and maintained its structural integrity for that amount of time. Waste containment materials and security infrastructure will inevitably decay over the vast time frames that the waste will be dangerous, so responsible stewardship means provisions must be made to ensure the waste remains as safe and secure as possible.

It would be profoundly unfair to foist this safety, security, environmental and terrorism risk on the existing or future Australian population, both from the perspective that those who bear the burden would generally be different from those who reap any perceived benefits, and also from the perspective of inter-generational equity.

Technical experts agree that there is huge risk associated with handling and storing radioactive waste. For example, respected professor John Veevers from Macquarie University wrote in Australian Geologist *"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."*[10]

There are countries and terrorist groups who will resort to illegal activities to obtain nuclear material for violent purposes. The International Atomic Energy Agency (IAEA) has received information that shows *"a persistent problem with the illicit trafficking in nuclear and other radioactive materials, thefts, losses and other unauthorized activities"*[11].

The International Atomic Energy Agency's Incident and Trafficking Database notes there have been 1,266 incidents reported by 99 countries over the last 12 years, including 18 incidents involving Highly Enriched Uranium or plutonium trafficking[12].

4.7 What are the processes that would need to be undertaken to build confidence in the community generally, or specific communities, in the design, establishment and operation of such facilities?

> *"The greatest minds in the nuclear establishment have been searching for an answer to the radioactive waste problem for fifty years, and they've finally got one: haul it down a dirt road and dump it on an Indian reservation". Winona LaDuke*[13]

The wording of question 4.7 presupposes that the objective is to establish and operate these facilities and that the public needs to be educated to accept them. This is characteristic of the nuclear industry's 'deficit model' approach to the public, where ordinary citizens are seen as ignorant and lacking a 'correct understanding'.

The South Australian public has already demonstrated its opposition to a nuclear waste dump. It has already made a decision based on scientific facts about the health, safety and environmental risks. In response to this public opposition, in 2000 South Australian Liberal Premier John Olsen prohibited International and key National nuclear wastes in SA. Nuclear waste proposals before this Royal Commission are, therefore, illegal in SA. Under the "*Nuclear Waste Storage Facility (Prohibition) Act 2000"*, the import, transport, storage and disposal of any wastes derived from nuclear reactors, or uranium enrichment plants, or from the conditioning and reprocessing of spent nuclear fuel, is prohibited. The construction and operation of such nuclear waste facilities is against the law in our State. The Objects of this important Act are: "*to protect the health, safety and welfare of the people of South Australia and to protect the environment in which they live by prohibiting the establishment of certain nuclear waste storage facilities in this State."*

South Australian Labor Premier Mike Rann extended this legislation in 2002, successfully protecting SA's interests, and defeating Prime Minister John Howard's imposition of a National nuclear waste dump, which was against the law and the will of the people of SA.

International nuclear waste would be a national issue in the jurisdiction of the Federal government and subject to the Customs Act. International and National nuclear waste facilities have been made illegal in Western Australia, in South Australia, the Northern Territory and Queensland over the period 1999 to 2007 which demonstrates the enormous public desire for Australia to remain free of an international nuclear waste dump.

SA	NUCLEAR WASTE STORAGE FACILITY (PROHIBITION) ACT 2000 No. 68 of 2000; An Act to prohibit the establishment of certain nuclear waste storage facilities in South Australia; and for other purposes
NT	Northern Territory of Australia Nuclear Waste Transport, Storage and Disposal (Prohibition) Act 2004
WA	The Western Australia NUCLEAR WASTE STORAGE AND TRANSPORTATION (PROHIBITION) ACT 1999
QLD	The Queensland Nuclear Facilities Prohibition Act 2007

Since the announcement of the Royal Commission there has been a concerted effort by Rupert Murdoch's newspaper "The Advertiser" to encourage South Australians to embrace an expansion of the nuclear industry. Despite this, a survey undertaken in March 2015 reported that 70% of South Australians polled indicated they were opposed to an expansion of the nuclear industry[14].

A significant number of South Australian Aboriginal people are opposed to the nuclear industry and do not want expanded mining, an enrichment plant, nuclear power station or nuclear waste dump on their traditionally owned land or on any other land in SA. A meeting of Aboriginal people from all over the north of SA in Port Augusta on 16 May 2015 agreed unanimously on the public statement below (Appendix 1) and announced the start of a nuclear free campaign, as reported in The Advertiser in May 2015.

"Statement from a community meeting held in Port, Augusta, on Saturday 16 May 2015 to discuss The Royal Commission Into The Nuclear Fuel Cycle

"South Australian Traditional Owners say NO!

"We oppose plans for uranium mining, nuclear reactors and nuclear waste dumps on our land.

We call on the SA Royal Commission to recommend against any uranium mining and nuclear projects on our lands.

"We call on the Australian population to support us in our campaign to prevent dirty and dangerous nuclear projects being imposed on our lands and our lives and future generations.

"Endorsed by members from the following groups, present at the Port Augusta meeting: Kokatha, Kokatha---Mirning, Arabunna, Adnyamathanha, Yankunytjatjara---Pitjanjatjara Antikirinya---Yunkunytjatjara, Kuyani, Aranda, Western Aranda Dieri, Larrakia, and Wiradjuri.

"The meeting was also attended by non---Aboriginal people from Adelaide, Ceduna, Port Pirie, Port Augusta, Peterborough, Alice Springs and Melbourne".

FACTS ON THE ATTEMPT TO IMPOSE A WASTE DUMP ON AUSTRALIA

International consortium Pangea Resources secretly operated from the late 1990s to 2002, attempting to promote and establish an international high level nuclear waste dump in Australia. Pangea eventually gave up on its proposal due to overwhelming public opposition. Its existence was not known publicly until the leak of the Pangea corporate video[15].

The Australian federal government attempted to impose a national radioactive waste dump in SA from 1998–2004, despite the clear opposition of the SA Parliament and the SA population. The federal government used the Lands Acquisition Act 1989 to seize land for the dump in 2003. The dump issue was deeply unpopular with the public, and the Federal Court rejected the government's use of urgency provisions in the Lands Acquisition Act. The federal government decided to abandon the SA dump plan in the lead-up to the 2004 federal election[7].

The federal government then announced in 2005 that a national radioactive waste dump would be imposed in the Northern Territory. The federal government passed legislation allowing a nuclear waste dump to be imposed in the NT with no Aboriginal consultation or consent. A large group of Traditional Owners opposed the dump, and some initiated legal action in the Federal Court challenging the nomination of the Muckaty site by both the federal government and the Northern Land Council (NLC). The Federal Court trial began in June 2014 and after two weeks of evidence, the NLC decided to stop the proceedings, and the federal government decided not to proceed with the Muckaty nomination[7].

All the above examples clearly demonstrate the deep-rooted public opposition to a nuclear waste dump in South Australia and elsewhere in Australia. The government, the nuclear industry and their supporters should cease forthwith their campaign of wearing down public resistance by a process of attrition. In regard to Australia's existing nuclear waste, a national Commission or comparable public inquiry should be established to determine the best solution from the perspective of science and public acceptability. As for international waste, it is the responsibility of the country that generated it. No further consideration should be given to establishing an international nuclear waste dump in Australia.

4.8 Bearing in mind the measures that would need to be taken in design and siting, what risks for health and safety would be created by establishing facilities to manage, store and dispose of nuclear or radioactive waste? What needs to be done to ensure that risks do not exceed safe levels? Can anything be done to better understand those risks?

There would be unacceptable risks to the health and safety of Australian people, animals and vegetation along the transport route and at the storage site of waste materials were facilities to be established to dump nuclear waste.

HEALTH AND SAFETY RISKS

It is scientifically proven that exposure to high doses of radiation can cause serious harm or death. Animal studies have shown that treatment of an animal with radioactive materials can cause cancer and experience from exposure to nuclear weapons and radiation accidents shows that a 5 sievert dose is usually fatal for humans. Studies have also calculated that the lifetime risk of dying of cancer from a single radiation dose of 0.1 sievert is 0.8% and that the risk increases by 0.8% for each additional 0.1 sievert increment[16]. There is dispute about the impact of radiation doses below 0.1 sievert, but the mainstream scientific position supports the linear no-threshold model for cancer. The executive summary of the comprehensive BEIR VII[17] report states as follows:

"The Committee judged that the linear no-threshold model (LNT) provided the most reasonable description of the relation between low dose exposure to ionizing radiation and the incidence of solid cancers that are induced by ionizing radiation" (p. 6)

In regard to leukemia, an authoritative recent report[18], based on an international cohort of over 300,000 radiation-monitored workers representing over 8 million person-years, concludes that their study *"provides strong evidence of positive associations between protracted low-dose radiation exposure and leukaemia"* (p. 276).

Despite this evidence, nuclear advocates have gone out of their way to trivialise the risks of exposure to low levels of radiation. In response to the Fukushima disaster, US advocacy group, Physicians for Social Responsiblity, criticised press reports that implied there is a safe threshold for ionizing radiation exposure[19]: *"As the crisis in Japan goes on, there are an increasing number of sources reporting that 100 mSv (millisieverts) is the lowest dose at which a person is at risk for cancer. Established research disproves this claim. According to the National Academy of Sciences, there are no safe doses of radiation. Decades of research show clearly that any dose of radiation increases an individual's risk for the development of cancer."*

Associate Professor Tilman Ruff of University of Melbourne's Nossal Institute for Global Health and International Physicians for the Prevention of Nuclear War says there may be a threshold for some effects of radiation, but not for cancer[19]."*There is unfortunately a continuing tirade of statements by self-interested parties and some official agencies ... implying a threshold for radiation exposure below which there are no adverse consequences*."

The unscientific nature of the claims of these "self-interested parties" is clear when one considers two key principles: the principle that lack of proof of harm is not proof of no harm, and the precautionary principle. Where a significant body of research suggests that low doses of radiation are harmful, in view of the inherent difficulty of finding epidemiological proof for causes of common medical conditions, it is disingenuous to demand absolute proof before taking protective action. Bearing in mind the latency period for cancers and the two above mentioned principles, claims by nuclear proponents that there have been no deaths from radiation resulting from the Fukushima nuclear accident are further evidence of the unscientific self-interested nature of the industry. It is not that nuclear proponents are not aware of these principles. It is rather that their purpose is propaganda, instead of science and public health protection.

In this regard, the permitted radiation dose for workers involved in radioactive industries has steadily decreased over time as more safety information has become available. The permitted dose was set at 500 millisieverts per year in 1934, reduced to 150 mSv in 1950, reduced again to 50 mSv in 1956, and reduced again to 20 mSv (averaged over five years) in 1991. The current internationally recognised limit for members of the public is just 1 mSv. However the response of the Japanese government to the Fukushima nuclear accident has been to deny the science and relax the standards, rather than to take responsibility. This has been done without the consent of the public in order to limit its own liability and the liability of Tokyo Electric Power Company.

Based on the above discussion, the question is whether it is possible to guarantee that the full process from transport to storage to final disposal of radioactive waste can be conducted without releasing radioactivity into the environment over time frames from tens of thousands to millions of years. There are currently no long-term high-level nuclear waste dumps in the world, so it is not possible to base forward projections on health and safety on factual evidence. But from the track record of nuclear dumps for lower-level nuclear waste, it is clear that it is impossible to guarantee that facilities will perform according to design. As discussed in section 4.5, there is only one medium level nuclear waste dump in the USA, the Waste Isolation Pilot Plant (WIPP) in New Mexico. This has already experienced a serious accident which exposed workers to radiation and will shut the plant down for 4 years. Two nuclear waste dumps in Germany have experienced serious problems and nuclear waste from Maralinga in SA has not been disposed of properly. It is, therefore, impossible to assure the health and safety of workers and communities at a nuclear waste dump site, communities along the transport route, and future generations who may be exposed to radioactivity that can find its way into the biosphere through all sorts of pathways.

TERRORISM RISKS

As described in section 4.6 there are countries and terrorist groups who resort to illegal activities to obtain nuclear materials for violent purposes. The International Atomic Energy Agency's Incident and Trafficking Database notes there have been 1,266 incidents reported by 99 countries over the last 12 years, including 18 incidents involving Highly Enriched Uranium or plutonium trafficking. Nuclear waste is vulnerable to terrorism during both transport and storage. Even if it is not reprocessed to extract nuclear weapons-usable material, high level nuclear waste can be made into 'dirty' bombs. "Dirty bombs" are conventional bombs which spread nuclear waste over a wide area, or disperse nuclear waste by plane or helicopter[20].

4.9 Bearing in mind the measures that would need to be taken in design and siting, what environmental risks would the establishment of such facilities present? Are there strategies for managing those risks? If not, what strategies would need to be developed? How would any current approach to management need to be changed or adapted?

It is not possible to ensure there would be no risk to the environment surrounding a nuclear waste dump and along the nuclear waste transport route. As described in 4.5 it is impossible to contain nuclear waste for a period of over 10,000 years with the degradation of containment systems in a remote location for that extreme length of time. There are many pathways through which radioactivity could find its way into the biosphere and through which human beings could be exposed to radiation[4].

As described in section 4.5, there have been problems with waste disposal at Maralinga in SA, the WIPP facility in the USA and two sites in Germany, and given the time frames that nuclear waste needs to be stored it is very unlikely there won't be future accidents.

South Australia is the second most earthquake prone of the Australian states with around 3-4 tremors every day. From experience in the Flinders Ranges it would appear that the earthquakes are scattered widely and do not cluster along the faults. It is therefore considered that although the next major event may occur on a known fault line, there is also a real probability it will occur elsewhere[21].

Underground and above ground water is also at risk from accidents in transport and storage.

4.10 What are the risks associated with transportation of nuclear or radioactive wastes for storage or disposal in South Australia? Could existing arrangements for the transportation of such wastes be applied for this purpose? What additional measures might be necessary?

As described in section 4.8 it is not possible to ensure there would be no risk to safety and the environment along the transport route from the source of the nuclear waste to the dump. Accidents happen whether transport is by ship, truck or train. A military escort by ship, train or truck during transportation can reduce the risk of terrorism but cannot eliminate it. There are unacceptable and unpreventable risks from accident, theft and terrorism involved in transporting nuclear waste. Furthermore, the type of measures required to reduce the risks (bearing in mind that the risks cannot be eliminated) give rise to another category of risk, namely a risk to democratic freedoms, due to military-style security and reduced access to information.

In October 2014 there was an accident with the transport of uranium oxide at Outer Harbor in SA. The shipping container containing drums of uranium oxide slipped and emergency services and the Environmental Protection Agency had to be called to attend. As there were no safe handling facilities at Outer Harbor, the shipping container had to be taken back to Olympic Dam to be opened and assessed. This highlights the fact that emergency services personnel are not equipped to deal with a spillage of radioactive material, especially if it occurs in a populated area. Residents' and emergency personnel's health and safety would be at risk in case of accident, and property could become severely contaminated[22].

CONCLUSION

Based on the above discussion, Friends of the Earth Adelaide calls for a national Commission or comparable public inquiry to be set up to determine the best storage solution solution for Australia's existing waste. As for international nuclear waste, it is the responsibility of the country that generated it and we oppose an international dump hosted in Australia on broad safety, environmental and risk of terrorism grounds.

Friends of the Earth Adelaide also calls upon the Royal Commission to use its coercive powers to obtain compel BHP-Billiton to produce full and accurate details of accidents, leaks and dam collapses in order to inform the Royal Commission on the best practice way to ensure the safety of humans and the environment from existing nuclear waste in South Australia.

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APPENDIX 1

Statement from the community meeting held in Port, Augusta, on Saturday 16 May 2015 to discuss the Royal Commission Into The Nuclear Fuel Cycle.