MANAGEMENT, STORAGE AND DISPOSAL OF NUCLEAR AND RADIOACTIVE WASTE

Potential Impacts on SA Economy
Submission to the Nuclear Fuel Cycle Royal Commission
For
Prospect Local Environment Group Inc – PLEG Inc
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1. What this submission will cover
Due to the wide ranging nature of the Nuclear Fuel Cycle Royal Commission it is proposed not to address all items. Rather this submission will cover what is perceived as the most likely outcome and potential threat to the SA community, the establishment of a Nuclear Waste Facility in SA. As such the submission addresses Issues Paper 4 and responds to Questions 4.5 - 4.10.

The principle term of reference for the Royal Commission that this submission will address is:

The feasibility of establishing facilities in South Australia for the management, storage and disposal of nuclear and radioactive waste from the use of nuclear and radioactive materials in power generation, industry, research and medicine (but not from military uses), the circumstances necessary for those facilities to be established and to be viable, the risks and opportunities associated with establishing and operating those facilities.

However, the primary focus of the submission is the potential economic impact and cost to manage and maintain a purpose built facility for medium and high level waste in SA.

Executive Summary
This submission is based on a report by Synapse Energy Economics, entitled Real Cost of Cleaning up Nuclear Waste, Full cost accounting of clean up options for the West Valley Nuclear Waste Site (2008 USA). The Synapse Energy Economics study was funded by New York State (NYS) Legislature - Administered by NYS Dept of Environment and Conservation.

The figures from the above report have been adapted for SA conditions and costed at 2015 rates in Australian Dollars (AUD). The disposal of nuclear waste particularly medium and high level waste is a major issue, however the questions that we need to address are: what is the real cost of the nuclear waste? where should it be located? who will pay? and how can it be stored safely for 200,000 years?

This analysis of key documents has found that there is no defined market or price for nuclear waste that the countries who have nuclear power facilities are on the whole disposing of their own nuclear waste. The disposal of nuclear waste and clean up of poor practices has left a terrible legacy in many counties who have nuclear power, while nuclear accidents such as Fukashima have led to wholesale closure of the industry. Due to the life of nuclear waste remaining radioactive for over 200,000 years the cost of storage of waste is extraordinary if a full cost accounting approach is taken.

The analysis of the Synapse Energy Economics (2008) leads to the conclusion that a minimum an accounting period of 1,000 years needs to be used to determine the
cost. The estimated cost in Australian Dollars is over $18.7 billion (table 3) for the establishment and maintenance of one facility, which would only accommodate a small portion of the USA's nuclear waste. There are simply not the funds to responsibly establish such a facility in Australia. In addition, most models for nuclear waste are looking at funding the waste storage facility for 50 - 200 years. Even in this time frame there is a significant sovereign risk that a country will cease to exist or cease to honour such long term and expensive contracts.

Should South Australia build such a facility, other countries in Africa, Asia or an existing nuclear power generator may seek to open similar facilities and undercut the SA facility on price per tonne. This would result in a race to the bottom which would undermine proposed safety and security measures and leave us with a true nuclear dump that would in the long term be very expensive to clean up when the inevitable nuclear spillages occur.

While the hazard of terrorists stealing high level nuclear waste is an obvious risk, the primary risk is a failure to invest in infrastructure, which would enable a one in 50 year rain event to breach the facility. This may result in spreading of nuclear waste across the site and into adjacent pastoral leases, mining facilities or towns.

We can be left holding the baby and have a nuclear legacy for over 200,000 years. This period is eight times longer that this continent has been occupied by humans. It is therefore inconceivable that we will be able to care for and manage nuclear waste for that period.

The future is not nuclear, the future is renewable energy. SA could establish such a facility and find that it simply has the legacy of the waste while other energy sources such as wind, solar and battery storage of that power become the global norm. This will have a negative impact on the SA Economy. Who wants to go to Kazakhstan today? The legacy of Soviet nuclear tests and waste dumps in Kazakhstan does not endear it to tourism or clean green food developments and opportunities.

The maximum employment at the facility is estimated to be 77 people (Synapse: 2008 pg 63) at an annual cost of AUD$15.4 million. Surely we could spend nearly $15 million in a more productive way and without leaving SA with an $18.7 billion legacy. It makes the State Bank disaster of $3 billion (1993) look like a good financial decision.

The submission is based on a full cost accounting method over a 1,000 year period as per figure 1. The economic model used for this analysis is illustrated in figure 2 below.
Fig 1 Provision for 1,000 years

- Waste
- Legacy
- 200,000 years

Fig 2 Economic model

- Sovereign Risk
  Will overseas government default?

- Revenue
  50 years
  Who pays 950 years?

- Risk
  Competition
  1/50 y Flood
  Contamination
  Transportation
  Legal

- Government Liability
  Insurance premium up
  Tax Increase

- Medium - High Nuclear Waste Facility

- Terrorism
- Tourism
- Qualitative Risk
- Reputation
- Clean Food

PLEG Response to Nuclear Fuel Cycle Royal Commission 2015
Prospect Local Environment Group (PLEG)

PLEG was established in 2006 by former members of the Prospect Nuclear Free Zone Campaign (1983-1985). It was formed to actively engage with local residents, environmental experts, other community groups and Prospect Council to achieve positive environmental outcomes for our community.

One of our initiatives over the last 4 years has been the establishment of Prospects first Community garden, (Prospect Community Garden). PLEG regularly holds public meetings on issues relating to climate change. Members of the group have been involved in environmental issues in the area for the past 35 years. The group regularly receives support from the City of Prospect. PLEG supports this submission on Nuclear Waste.

Indeed, the first public meeting held by PLEG attracted over 200 people to hear Dr Helen Caldicott in 2006 talk on Nuclear Power in response to the Ziggy Switkowski enquiry.

2. Nuclear Fuel Cycle and Nuclear Waste

The waste produced in nuclear reactors – called spent nuclear fuel takes around 200,000 years for the radioactivity of spent fuel to decline to that of the original uranium ore body.

Not a single repository exists anywhere in the world for the disposal of high level waste from nuclear power reactors. Only a few countries to date have identified a repository site. A typical power reactor produces about 30 tonnes of spent nuclear fuel annually (Green: 2015 pg 59).

3. Outline of potential impacts of a Medium to High Level Nuclear Waste Repository

The Commonwealth Minister for Industry and Science called for voluntary nominations for a low level Nuclear Waste Repository. The process closed 5 May 2015. Only those sites which have met the strict criteria will be considered for short-listing. In South Australia Arcoona Station near Woomera has been mentioned. (http://www.radioactivewaste.gov.au/ 8 6 2015)
A low level radioactive waste facility is being considered in Spain at El Cabrils. An image of the proposed facility is above and could be similar to the proposed facility in South Australia, but would accommodate medium and high level waste and possibly low level waste.

The facility has two platforms for the disposal of low level radioactive waste and another with a specific structure for very low level waste. In addition, the facility has the infrastructure required for the treatment and conditioning of wastes for disposal.

**Time**

As medium level nuclear has a half-life of 200-250,000 years, the key question is how the waste would be safely stored, when no human civilisation has lasted longer than a few thousand years in the case of China. Even in China it has been torn by wars, rebellions and revolution in that period.

The mechanical solutions such as walls, barriers, drainage ditches, will need to be adequate to control waste leakage at the site if wastes are interred onsite over long periods of time. There is a need for government and institutional continuity, adequate budget and personnel, and flawless design of the control mechanisms.

In an analysis of remediation and storage of nuclear waste at the West Valley facility west of New York the Synapse Energy Economics, Clean up Feasibility study adopted a 1,000 year period to account for the cost of storage and clean-up of waste at that facility (Synapse: 2008 pg 81). This benchmark, while inadequate has been adopted for this submission into the feasibility of establishing a medium to high level nuclear waste storage facility in South Australia.
In the USA the federal Nation Regulatory Commission requires, the US Department of the Environment (DOE) to show that remediation and storage requirements can be met for at least 1,000 years, and perhaps as many as 10,000 years into the future (Synapse: 2008 Pg 131).

Spillovers and Macroeconomic effects
Large scale accidents can have consequences throughout the economy. Uncertainty and anxiety can result from even small scale nuclear accidents. Uncertainty shocks may be one source of a loss of confidence generally in the domestic economy, which can have widespread macroeconomic consequences. Fear of contamination and fear of contaminated products can lead to a drop in export demand, especially for clean green food, which the State Government is claiming to be an economic opportunity. An example of the impact of a nuclear accident is on tourist numbers coming to Japan, which dropped sharply after the earthquake and nuclear accident on 11th March 2011 (see figure 3) and have been slow to recover. Indeed Japan may be suffering today from the Kazakhstan effect where people simply don’t want to go near a county or an area with a nuclear legacy.

Figure 3. Visitor Numbers to Japan, 2009-2011. Source: JNTO
(Munro: ND pg 10)

A similar effect to the Port Arthur massacre in 1996 has been documented. It was estimated that the shooting resulted in a loss of 130,000 visitor nights to the Tasmanian economy in 1996 resulting in a loss of $15.6 million (AEMHS: ND) Using the Reserve Bank of Australia inflation calculator the impact in 2014 terms is $24.8 million. For the purposes of this analysis it has been estimated that a minor nuclear
accident that will have a reputation impact will occur every 25 years. Over a 1,000 year period this equates to 40 incidents. As such the impact on reputation of minor nuclear accidents is the $AUD 992 million. This impact does not take into account the potential impact of an accident on our clean green food image and the potential loss of export dollars.

**Likely Market for Nuclear Waste**

There is no precedent to base an estimated price for nuclear waste. It is doubtful whether it would generate any more than a fraction of the revenue that some lobbyists claim. There are many constraints, such as the fact that some countries with significant nuclear power programs – such as Russia, France, and India – operate reprocessing plants so would be unlikely to want to send spent fuel to Australia.

Some nuclear proponents believe that spent nuclear fuel is a "multi-trillion dollar asset" (Green: 2008 pg 68) because it can be processed for reuse as reactor fuel – and they also believe that countries will pay "tens of billions of dollars"(Green: 2008 pg 68) to relieve themselves of this multi-trillion dollar asset.

The Nuclear Fuel Cycle Royal Commission issues paper 4 on page 7 stated that there is **USD$28 billion set aside in their Nuclear and radioactive waste fund.** This however does not state if these funds are allocated to the clean up of existing sites. The West Valley site has a budget requirement of between USD$10 - $27 billion to clean up the site (see table 2). Indeed this USD$28 billion figure is not properly referenced by the Royal Commission. It is understood that "royalties" from the nuclear waste are a prime incentive behind the efforts to establish a nuclear waste facility. As such it could be seen to be misleading to use this unsubstantiated figure especially in a Discussion Paper which is meant to help set the parameters of the debate.

**Jobs**

The Synapse Energy Economics, study estimated that such a facility would require four full-time site managers. It estimates that 77 workers are required to support these four managers (Synapse: 2008 pg 63).

The estimated cost of managing such a facility in USD is $9.5 million (2005) per annum, as detailed in Table 1. This results in a cost per person of USD$124,427 which when considered with on costs, cars and superannuation is a reasonable. When inflated to 2015 dollars and converted to Australia Dollars the wages bill is then estimated to be AUD$15.4 million per annum, just to manage the facility safely.
4. Risks of Nuclear Waste Repository

Prof. John Veevers from Macquarie University wrote in the Australian Geologist in August 1999, an international high-level nuclear waste dump would pose serious public health and environmental risks: "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." (Green: 2008 pg 69)

There are social as well as technical dimensions to risk assessments. The “clean-up” of the Maralinga nuclear bomb test site in the late 1990s provides a test of Australia's capacity to safely manage nuclear waste. The “clean-up” was done on the cheap and many tonnes of debris contaminated with kilograms of plutonium remain buried in shallow, unlined pits in totally unsuitable geology.

Nuclear engineer and whistleblower Alan Parkinson said: "What was done at Maralinga was a cheap and nasty solution that wouldn't be adopted on white-fellas land." An officer with the Commonwealth nuclear regulator said in a leaked email that the “clean-up” was beset by a "host of indiscretions, short-cuts and cover-ups" (Green: 2008 pg 64).

Barely a decade after the Maralinga “clean-up”, a survey revealed that 19 of the 85 contaminated debris pits had been subject to erosion or subsidence. The half-life of plutonium-239 is 24,100 years (Green: 2008 pg 64).

The propensity to "do things on the cheap in SA combined with the potential isolation of the facility, will lead to two high risks. Risk from poor construction standards at the facility and terrorism.

Australia is not the only country where nuclear waste dumping is promoted as the solution to the poverty and disadvantage experienced by Aboriginal people. North American indigenous activist Winona LaDuke told the 2006 Indigenous World Uranium Summit:

"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" (Green: 2008 pg 58).

The US state of New Mexico is host to the world's only deep geological repository – the Waste Isolation Pilot Plant (WIPP), which stores long-lived intermediate-level military waste. WIPP is currently closed because of a fire and radiation leaks earlier this year.

When WIPP opened in 1999, the DOE estimated the risk of a radiological contamination incident to be one chance in 10,000 per year or less. But there has
already been a radiological contamination incident in the first 15 years of operation. At the current rate, there will be 670 radiological contamination incidents over a 10,000 year period (Green: 2008 pg 59).

**Risk of Nuclear Terrorism**
Nuclear power is the only energy source with multifaceted and repeatedly-demonstrated connections to the proliferation of Weapons of Mass Destruction.

The risk is that high grade waste can be readily used in a “dirty” nuclear bomb by terrorists. If this kind of waste is to be sorted then a high level of security at the site will be essential. As such the proposed 77 people to manage the site may be an underestimate of the real cost to secure and manage the site.

**Legal Risks**
The US DOE require nuclear plants to safely dispose of the waste and the Yucca Mountain site was seen as a national nuclear waste repository and the Bush Administration had supported it. However, the Obama administration has required DOE to withdrawn the Yucca Mountain license application “with prejudice,” meaning that it could not be resubmitted in the future. This was supported by the state of Nevada (Holt: 2015 pg 12).

If this can happen with such a large project in the USA it could also happen here. Indeed, Mike Rann the former Premier of SA strongly and successfully blocked a nuclear waste proposal in the Federal Court in 2004. Any new nuclear waste facility in SA would face a similar legal jeopardy.

**Site and Transportation**
It is assumed that the site for such a facility would be in the North of South Australia. One site mentioned is Arcoona station near Woomera. Other options could be an abandoned mine shaft at Roxby or nearby at Andamooka. The most logical way to transport the waste would be via ship to Port August and then road to Woomera.
Insurance Cost Increase
Peter Zweifel et al, 2005 conduct a 500 person contingent valuation study in Switzerland on willingness to pay for insurance against a nuclear disaster. Their major finding is that, residents were willing to pay (on average) $2,280 for full insurance at zero distance from nuclear power plants, with mean willingness to pay estimates falling by $24 per km to zero at a distance of 95 km (Munroe: ND pg 11).

Port August had a population in 2012 of 14,425 (ABS) and approximately 6,000 Households. Roxby Downs in 2012 has a population of 4,932 (ABS) and approximately 1,700 Households. Both towns had 827 businesses (ABS 2012) and a total of 7,700 households.

It could be assumed that at least 25% of households and businesses take out insurance of an additional $200 per year, to cover for the event of a small scale nuclear accident, most likely in the transportation of the waste. The economic impact would be over half a million dollars per annum. This has been factored into the economic model. There may also be a negative impact on property prices as proposed in the Swiss valuation analysis above. However, the potential negative impact on property prices has not been factored into the model.

Weather
The northwest Australian coastline between Broome and Exmouth is the most cyclone-prone region of the entire Australian coastline, having the highest frequency of coastal crossings. On average about five tropical cyclones occur during each tropical cyclone season over the warm ocean waters off the northwest coast between 105 and 125°E. On average about two cyclones cross the coast, one of which is severe (http://www.bom.gov.au/cyclone/climatology/wa.shtml 8 6 2015)

In SA these large rain events often occur after a tropical low drifts over the northwest of the State. This event can bring a large scale downpour. In the event of a one in 50 or one in hundred year downpour, localised flooding could cause a spread of the nuclear waste. The Bureau of Meteorology note one such event this year when it stated “heavy falls of up to 120mm have already occurred in the north of the state, in what they have described as the state’s heaviest rainfall event in 30 years”. (Advertiser 10th Jan 2015)

Sovereign Risk
There are 15 countries that have active nuclear power programs. Most of the waste is being stored close to the power generation sites or on site. However, by 2020 most of those countries are proposing some form of national or regional waste facility (World Nuclear Association: 2015).

Not all of these countries are politically or economically stable. Should Australia enter into a contract to take waste from one of these countries the sovereign risk may not necessarily be in the first 20 years or even 50 years. But there will surely be a problem with those counties ability to pay over a 1,000 year period. An upfront payment for 1,000 year contract is highly unlikely.
It is therefore unlikely that SA will be able to get the waste producer to pay for the full cost of the waste. It is even more unlikely that if a country does default that we will be able to send the nuclear waste back.

6. Economic Costs
How much money might be made by taking nuclear waste from other countries? There is no precedent to base an estimate on. It is doubtful whether it would generate a fraction of the projected revenue. There are issues surrounding very long periods of time: continuity of governments and stewardship, language and warnings, ethical issues associated with leaving an enormous hazard and responsibility to future generations, and appropriately estimating and valuing future costs, as well as irreversible and irreparable harm (Synapse: 2008 Page 75).

BHP Billiton's submission to the Switkowski Review states that the utilities to which it sells uranium "generally regard their spent fuel as an asset".(Green: 2015 pg 23)

Full Cost Accounting and Valley West
The Valley West analysis undertaken by Synapse Energy Economics has based its clean up and storage estimations on a full-cost accounting analysis for five alternative options out to 1,000 years. This is an attempt to more accurately compare and assess the real costs of nuclear waste. However, by no means does this mean that the radioactive waste stored would be considered safe at the end of 1,000 years.

The study evaluated two clean up Alternatives:
• Waste Excavation Alternative 1: Total exhumation of the wastes, off-site disposal, followed by complete site release for unrestricted use; and

The Valley West site is complicated by three additional elements:
1. The Site had been poorly managed (common in the case of nuclear waste facilities) and required a clean up of contaminated soil at a cost of between US$ 2.3 billion and US$37 million, dependent on the options (Table 1).
3. A catastrophic event of contaminated water leaking into the Great Lakes USD$14.4 billion has been calculated in option Alternate 2A.

For the purposes of the model it is proposed to use option 5 in Table 2 aka Alternative 2A (Buried Waste no catastrophic release) and none of the above three elements apply to this option. Table 2 lists the options used in the Valley West report by Synapse Energy Economics.

The site must be maintained into perpetuity. In this case, perpetuity is not a dozen years, or even two or three generations—the radioactive waste buried in Northern
SA would have to be monitored, tracked, and maintained in place for tens of thousands of years.

The total costs of this analysis must be taken as a whole, undiscounted cost. In standard capital investments, a discount rate is applied to account for future interest earnings. The discount rate for a 1000-year analysis has been determined to be zero or close to zero (Synapse: 2008 pg 82).

**Institutional controls definition**

The term “institutional controls” to refer to both legal and physical barriers, required to safely manage the site. As legal controls, that help minimize the potential for human exposure to contamination need to be in place. These include land deeds, control of landownership or lease, and access to property. Physical controls are built infrastructure to reduce potential human exposure to contamination, such as containment features, walls, erosion barriers, pools, fences, and so forth.

**Amount of Nuclear Waste**

This submission will not seek to quantify the amount of waste to be potentially stored at any particular facility. However, Table 1 below is the estimated waste at the Valley West the Facility in NYS.

<table>
<thead>
<tr>
<th>Table 1 Waste Volume at Valley West USA</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Total Waste at West Valley</strong></td>
</tr>
<tr>
<td></td>
</tr>
<tr>
<td></td>
</tr>
<tr>
<td>Mixed Toxic Waste</td>
</tr>
<tr>
<td>363,000</td>
</tr>
<tr>
<td>10,279</td>
</tr>
<tr>
<td>Low level</td>
</tr>
<tr>
<td>163000</td>
</tr>
<tr>
<td>4615</td>
</tr>
<tr>
<td>Low level</td>
</tr>
<tr>
<td>200,000</td>
</tr>
<tr>
<td>5663</td>
</tr>
<tr>
<td>Low level</td>
</tr>
<tr>
<td>2,400,000</td>
</tr>
<tr>
<td>67,960</td>
</tr>
<tr>
<td>Total</td>
</tr>
<tr>
<td>88,517</td>
</tr>
</tbody>
</table>

(Synapse: 2008 pg 41-43)

This equates to over half a million - 44 gallon drums. These drums would cover a 50 hectare site equivalent to 23 Melbourne Cricket Grounds.

In addition, there are 1,250,000 pounds of vitrified solid glass, which was high level waste or over 500,000 kg of waste.

At West Valley USA there is also 25,000 litres of high level radioactive liquid waste which equates to about 100,000 litres of waste (Synapse: 2008 pg 43).

**Cost of Waste**

In the United States, some 60,000 tons of nuclear waste have already been produced, and existing reactors add some 2,000 metric tons of spent fuel annually.
Citigroup states: "The capital cost of nuclear build has actually risen in recent decades in some developed markets, partly due to increased safety expenditure, and due to smaller construction programmes (i.e. lower economies of scale). Moreover the 'fixed cost' nature of nuclear generation in combination with its relatively high price (when back end liabilities are taken into account) also places the technology at a significant disadvantage; utilities are reluctant to enter into a very long term (20+ years of operation, and decades of aftercare provisioning) investment with almost no control over costs post commissioning, with the uncertainty and rates of change currently occurring in the energy mix." (Green: 2015 pg 32)

It was estimated that the Yucca Mountain program planned would cost USD$96.2 billion in 2007 dollars from the beginning of the program in 1983 to repository closure in 2133 (Holt: 2015 pg 28). The USA is currently exploring other options. But if they are having problems with disposal of their own waste, why would SA step into address their intractable issues. Indeed, it is likely that other alternatives including renewal energy solutions will be mature over the next 10 - 20 years and the need for a nuclear waste facility will be reduced.

**Detailed Costing in West Valley USA and adaption to SA**

The Synapse Energy Economics - *Real Cost of Cleaning up Nuclear Waste*, *Full cost accounting of clean up options for the West Valley Nuclear Waste Site* (USA) was, Funded by New York State Legislature and administered by NYS Dept of Environment and Conservation. The key costing table for the project is in Table 2 below.
### Table 2 Synapse Energy Economics - Real Cost of Cleaning up Nuclear Waste 2008

**Table ES-1: Full Cost Accounting for Alternatives 1 and 2 (2005 draft DEIS) and modified Alternatives 1A and 2A, with and without a catastrophic release in year 500.**

<table>
<thead>
<tr>
<th>Closure Procedure</th>
<th>Alternative 1</th>
<th>Alternative 1A</th>
<th>Alternative 2</th>
<th>Alternative 2A</th>
</tr>
</thead>
<tbody>
<tr>
<td>Waste Management Area Closures</td>
<td>4,001,064,000</td>
<td>3,914,031,906</td>
<td>1,275,097,000</td>
<td>1,275,098,430</td>
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<tr>
<td>Contaminated Soil Cleanup</td>
<td>2,290,360,000</td>
<td>1,669,194,382</td>
<td>37,309,000</td>
<td>1,469,464,760</td>
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<tr>
<td>Leachate Treatment Facility</td>
<td>114,288,000</td>
<td>114,288,449</td>
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<td>-</td>
</tr>
<tr>
<td>Container Management Facility</td>
<td>889,511,000</td>
<td>889,511,867</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Dry Cask Storage Area</td>
<td>-</td>
<td>-</td>
<td>92,846,038</td>
<td>92,846,038</td>
</tr>
<tr>
<td>Institutional Controls Installations</td>
<td>-</td>
<td>-</td>
<td>62,205,060</td>
<td>394,354,222</td>
</tr>
<tr>
<td>Ongoing Costs (cumulative over analysis period)</td>
<td>-</td>
<td>-</td>
<td>369,450,000</td>
<td>9,580,561,999</td>
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<tr>
<td>Final Status Survey</td>
<td>-</td>
<td>-</td>
<td>3,480,000</td>
<td>3,479,670</td>
</tr>
<tr>
<td>Waste Disposal Costs</td>
<td>3,321,700,000</td>
<td>3,321,700,000</td>
<td>177,700,000</td>
<td>177,700,000</td>
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<tr>
<td>Water Replacement Cost</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>14,445,386,239</td>
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<tr>
<td>Unavailable Land Lost Revenue</td>
<td>-</td>
<td>-</td>
<td>9,523,216</td>
<td>78,477,945</td>
</tr>
</tbody>
</table>

**Total Costs**

- Total Fixed Costs: $10,617,945,000
- Annual Costs over Analysis Period: $9,910,249,818
- Analysis Period (years): 73
- Total Costs over Analysis Period: $10,617,945,000

**Conversion of West Valley costs from $USD to $AUD with 10 years inflation**

<table>
<thead>
<tr>
<th>Expenditure Items</th>
<th>Total Fixed Cost $USD</th>
<th>21.1% US inflation</th>
<th>Cost in US 2015</th>
<th>Conversion to $AUD</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dry Cask Storage</td>
<td>92,846,038</td>
<td>19,590,514</td>
<td>112,436,552</td>
<td>149,570,393</td>
</tr>
<tr>
<td>Institutional Controls / Admin &amp; Physical Constructions</td>
<td>394,354,222</td>
<td>83,208,740</td>
<td>477,562,962</td>
<td>635,285,224</td>
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<tr>
<td>Ongoing costs</td>
<td>9,580,951,999</td>
<td>2,021,580,871</td>
<td>11,602,532,870</td>
<td>15,434,441,714</td>
</tr>
<tr>
<td>Total</td>
<td>$16,219,297,331</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

PLEG Response to Nuclear Fuel Cycle Royal Commission 2015
### Table 3 Cost of Establishing and maintaining a Nuclear Waste Facility in Northern SA

<table>
<thead>
<tr>
<th>Expenditure Items</th>
<th>Total Fixed Cost</th>
<th>Annual Cost 1,000 year</th>
<th>Total Life Cycle Cost</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dry Cask Storage</td>
<td>149,570,393</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Institutional Controls / Admin &amp; Physical Constructions</td>
<td>635,285,224</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Ongoing costs</td>
<td>16,219,297</td>
<td>16,219,297,331</td>
<td></td>
</tr>
<tr>
<td>Rent &amp; Economic Loss - Arcoona/Roxby/Andamooka</td>
<td>175,000,000</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Reputation Damage Tourism &amp; Food</td>
<td>992,000,000</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Insurance Increase for Business &amp; Households</td>
<td>511,600,000</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>2,463,455,617</strong></td>
<td><strong>16,219,297,331</strong></td>
<td><strong>18,682,752,948</strong></td>
</tr>
</tbody>
</table>

Rounded: AUD $18.7 Billion

Adapted for SA conditions - from *Real Cost of Cleaning up Nuclear Waste (2008)*

This model in Table 3 is based on option 5 in Table 2 or Alternative 2A (Buried Waste no catastrophic release).

This model does not take into consideration a major lapse in security or a major catastrophic spillage, which could be caused by a failure to invest in infrastructure with a one in 50 year rain event spreading nuclear waste across the site and into adjacent pastoral leases, mining facilities or towns.

The source study for West Valley in the USA has considered a nuclear accident options. An additional $1.5 billion has been allocated in Table 2 (West Valley USA) to the soil contamination clean up option. This has not been incorporated into the SA Nuclear Waste Facility model in Table 3.

The total cost for the establishment and long term management of the SA Nuclear Waste Facility model is in Table 3. The figures in Table 2 have been calculated in USD based on 2005 assumptions. Table 2 A converts these figures into 2015 AUD. The cumulative inflation rate in the USA in the last 10 years is 21.1%.

The total cost or liability to SA of the Nuclear Waste Facility is AUD$18,682,752,948 for the 1,000 year accounting period. This figure of $18.7 billion is conservative as it does not take into account the cost of remediation from a major nuclear accident or the reputation damage from such an accident.
7. Summary

The full cost accounting methodology based on the Synapse Energy Economics report of the disposal of nuclear waste at West Valley in New York State results in a potential cost of the facility if established in SA, costing in the order of AUD $18.7 billion.

This would result in an economic time bomb for the State of South Australia and become an unacceptable burden for future generations, resulting in a massive debt and a shocking legacy that will damage the reputation of the State well into the future.

The facility could be paid for and built by foreign interests and may result in a positive economic benefit for the first 10 or even 20 years. However, the experience of the nuclear industry over that last 60 years has been one of over-promising jobs and results and under-provisioning for waste. Indeed, the administration of nuclear waste sites has often been incompetent and is likely to result in accidents and spillage.

When the first 20 or 50 year contract comes up for renewal, there is a high sovereign risk. Will the county or entity still be in existence e.g. the USSR no longer exists as a legal entity? As we already have the waste why would a country once reconstituted or devolved seek to continue to pay millions of dollars to SA.

It is clear that all costing and Cost Benefit Analysis of the project need to be undertaken in a 1,000 year time frame at a minimum. The West Valley Nuclear Waste report (2008) has used a Full Cost Accounting methodology.

This methodology and the 1,000 year accounting period is a minimum period that needs to be used when assessing the feasibility of establishing such a facility in SA.

The 1,000 year accounting period is too short as the high level waste is radioactive for over 200,000 years. The analysis here has also not factoring in the impact on our reputation from a major nuclear accident or the clean up cost from such an accident. This accident may occur in the first five years of establishing such a facility or on 500 years. Nevertheless, the threat of a major nuclear accident in the transportation of the waste or during its storage is real and should also be assessed.

The reputation damage to the State, especially in the areas of tourism and clean green food has only been briefly assessed and could be much more than has been stated here. The potential cost of AUD $18.7 billion with additional risks is an unacceptable risk for the State Government to entertain further.
The establishment of a Quandong farm or Date Palm farm in regional SA is more likely to create jobs and provide long-term wealth to SA than a nuclear waste facility.

SA is facing difficult economic headwinds, but we have excellent assets and a great environment and a united community. The development of a nuclear waste facility will degrade our core assets and divide the community, hardly a good platform for economic growth.

8. Recommendations

1. A Full Cost Accounting methodology is essential to assess the future viability of a Nuclear Waste Facility.
2. All potential risks including Reputation Risks and Sovereign Risk needs to be factored into this assessment.
3. A minimum of a 1,000 year accounting period in essential.
4. The market for nuclear waste needs to be thoroughly assessed.
5. Based on the findings of this submission it is not feasible to have a nuclear waste facility in SA due to the high cost and long term liability and risk.
9. Bibliography and References

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