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South Africa's Impending Nuclear Plans

"I think that the amount of money that has been allocated for the nuclear build is not a thumb-suck, and we don't actually think that is the end amount, but we believe that it is the beginning,"

Energy Minister Dipuo Peters

1. Introduction

The demand for energy continually increases with South Africa's developing population and economy. Nuclear power has been touted as one of the solutions to meet this ever-increasing demand especially as, according to its proponents, it generates electricity in an environmentally responsible manner. South Africa's only nuclear power plant, Koeberg, situated 30km north of Cape Town, consists of two Pressurized Water Reactors better known as EPR units. Each unit has a capacity of 920 megawatts (MW) and is cooled by sea-water. In this system, water inside a pressurised reactor is heated up by uranium fuel in the reactor. High temperature, high pressure water is then passed through a heat-exchanger to a secondary water system in which steam is produced, which in turn drives turbines that generate electricity. Plans for future plants of this type are underway.

According to the 2012 national budget review, South Africa plans to build three new nuclear power plants, comprising six reactors, which will provide 9 600MW of power by 2029. The proposed sites are, once again, Koeberg; Bantamsklip on the southern Cape coast about seven kilometres from Pearly Beach; and Thyspunt in the Eastern Cape, near Cape St Francis. The decision to pursue the nuclear option is based on the 2010 Integrated Resource Plan (IRP), which called for planning to identify the lowest-cost methods of meeting electricity demand by considering all resources, including energy efficiency measures. The IRP envisages 9 600 MW of new nuclear capacity to be completed between 2023 and 2030.[1]

This briefing paper aims to highlight some of the key considerations and debates around the expansion of nuclear power in South Africa. However, government's proposals are still subject to public participation processes, environmental impact assessments and, no doubt, potential litigation. The fact that the finance minister made no reference in his budget speech to the anticipated expenditure of at least R300 billion has added to uncertainty around government's intentions. It is thus not possible to state with any certainty if, when or where these plants will be built, or what they will ultimately cost.

2. The Costs of Nuclear Power

Quantifying the costs of nuclear power is difficult, especially as the extremely long construction periods require a projection into the future. However, a starting point is to separate the costs into the following components:

- The *construction cost* of building the plant.
- The *operating cost* of running the plant and generating energy.
- The cost of *decommissioning* the plant.

2.1. Construction costs

Construction expenses dominate the cost of nuclear power. Although it is claimed that third

generation power plants are both substantially cheaper and faster to construct than the second generation power plants now in operation throughout the world, the R300 billion allocation is an enormous sum by any standards, and would constitute our biggest infrastructure project to date. However, even at this early stage it seems likely that R300bn will not be enough. In November 2011, the CEO of the Nuclear Energy Corporation of SA (Necsa), Rob Adam, refuted claims that it would cost the country R1 trillion to build three nuclear power plants with two reactors each. In an address to Parliament's Portfolio Committee on Energy, Mr Adam stated that a 1 600 MW nuclear reactor "would cost around R50 billion, and so the total cost of the programme would not amount to more than R400 billion at the top".[2]

2.1.1. Construction cost over-runs

Stephen Thomas, a professor at the University of Greenwich's business school, has warned of a 'Flamanville scenario', referring to the serious cost and time over-runs that have plagued the construction of a nuclear power station in Flamanville, in north-western France. Construction time has stretched to nine years instead of six, and costs have doubled. If similar problems occurred in South Africa, and with the expense of financing the increased expenditure, total construction costs could reach R1.4 trillion, according to Professor Thomas. Of course, as is invariably the case in debates around nuclear power, other 'experts' provide very different figures. Thus, Professor Philip Lloyd of the Cape Peninsula University of Technology has calculated a likely cost of between R322 and R380 billion, and regards Prof Thomas's figures as far too high. Clearly, though, such a project must be approached very cautiously: if something were to go wrong and the country had to start borrowing money on the open market to fund the overruns, the project would get very expensive very quickly.[3]

2.2. Operating costs

These costs are much easier to quantify and verify, as they relate directly to the profitability of the utilities which operate them. Any discrepancies are soon discovered through accounting audits. Companies that operate the USA's nuclear power reactors have made excellent profits over the last five years, and it can be argued that the US nuclear power industry has at last lived up to the promise made in the 1970s to produce electricity reliably and cheaply. Once the reactors are commissioned, they begin to pay back their construction and financing costs, although other costs, such as fuel and maintenance, then enter the picture. In this regard, reliability is an important factor because the less reliable a reactor, and the more down-time it experiences, the higher the cost per unit of electricity that it produces.

2.3. Decommissioning costs

According to the United Nations Environment Programme, 138 civilian nuclear reactors have been shut down in 19 countries; however, full decommissioning has been completed for only 17 of them. Decommissioning is a complex process that takes many years.[4] The US industry's average cost for decommissioning a reactor is $300 million, while the French and Swedish nuclear industries expect decommissioning costs to be 10%-15% of the construction costs and budget this into the price charged for electricity. On the other hand, British decommissioning costs have been projected to be around one billion Pounds per plant[5]. Funds for decommissioning should be accumulated from revenues during the lifetime of the plant but, once again, projecting what it will cost to decommission a plant in 30 years' time is extremely difficult; such costs must therefore be regarded as indeterminate.[6]

3. Funding for South Africa's nuclear plans

As mentioned above, the construction of three nuclear power stations will be South Africa's biggest infrastructural project to date. Although many questions remain unanswered as to where the money for funding the project will come from, it is likely that much of it will be in the form of loans from the IMF or the World Bank, and that Eskom will issue its own bonds. In recent years there has been a trend of overspending on many infrastructure projects in this country: the football world-cup stadiums and the Gautrain come to mind. One wonders whether this will be the case again, and if it happens that more money is needed while the project is in progress, where will the money be found?[7]

It is also worth noting the recent controversy around the new toll roads in Gauteng. These were paid for mostly through bonds issued by the SA National Roads Agency (SANRAL), a parastatal much like Eskom. Now that public pressure has resulted in the implementation of tolling being

delayed, it is unclear how SANRAL intends to meet the payments due on its bonds, and this has already led to at least one ratings agency expressing concern. The last thing South Africa can afford is to have its international credit rating seriously downgraded. Eskom will have to think long and hard about this method of financing, especially as consumers (whether reasonably or not) are becoming more and more disgruntled with the rising cost of electricity.

4. Impacts

4.1. Economic impact

The Nuclear Energy Agency states that there are a number of ways the economy will be impacted as a result of the country's expanding nuclear programme. Enhanced productivity, fossil fuel price capping, and electricity price stability are envisaged, along with intellectual capital gains, improved terms of trade, currency appreciation and enhanced economic growth. On the negative side, there will be direct effects on natural resources in terms of physical damage and environmental losses, while any problems with cost over-runs could have a knock-on effect on SA's international borrowing costs.

Perhaps the greatest short-term impact, though, will come in the form of job-creation during the construction phase. According to Rosatom, the Russian state atomic energy company, about 3 000 people would be employed in the construction of a power-station, while around 900 staff would be required for operational and maintenance purposes. Furthermore, there would be an employment multiplier effect of up to 5 000 jobs connected to each plant, ranging from equipment-suppliers to services such as schools and clinics.[8]

Even allowing for a degree of exaggeration in these figures, there is no doubt that the construction of a nuclear power plant, and its access and distribution infrastructures is a massive civil engineering undertaking, and that it would have a marked impact on employment levels in the local area.

4.2. Environmental impact

Some of the main benefits of using nuclear energy are that greenhouse gasses are largely avoided and that it is a continuous source of energy. That being said, in the past 40 years the world has seen three serious nuclear accidents (Three Mile Island, USA; Chernobyl, Ukraine; and Fukushima, Japan) and the severe environmental consequences of these incidents cannot be ignored.

Closer to home, a public meeting to discuss the Revised Draft Environmental Impact Report for the Bantamsklip site was held in the coastal town of Gansbaai on 23 May 2011. Numerous community members in attendance raised concerns about the effect the proposed nuclear plant would have on the sea water, kelp and abalone in their respective communities, as seawater fish farming (mariculture) is their main source of income. The abalone harvesting industry alone is estimated to be worth R250 million. The community's concerns came as a result of indications that the use of sea water to cool the reactors might lead the water temperature in the immediate vicinity to rise as much as 12 degrees, a factor that would prevent seaweed from growing. In essence, people were arguing that local livelihoods should not have to be sacrificed in the cause of delivering electricity to users in other parts of the country.[9]

4.3. Health impacts

The impact of potential nuclear plant breakdowns on public health, in particular due to radiation exposure for people living near plants, has been a key concern for governmental agencies and civilians alike. According to a report entitled *The True Cost of Nuclear Energy,* published by Greenpeace, even though working at nuclear power plants entails severe occupational health risks, many workers in South Africa's nuclear industry claim that they were not told about the risk of radiation contamination and chemical exposure, and were never given safety training or protective clothing. The report asserts that in some cases, they were not legally authorised to work in radiation areas but were told to deal with 'clean-ups'. Black unskilled workers, in particular, had no idea of the substances with which they worked. Some had been retrenched before they fell seriously ill, while those who suffer from the consequences of their occupation continue to battle on for compensation.

To date more than 500 seriously-ill former workers at Necsa's Pelindaba complex have sought occupational health compensation. As the body of evidence grows, nuclear workers at Koeberg nuclear power station near Cape Town

and at the Vaalputs nuclear waste dump site in Namaqualand in the Northern Cape have also sought clarity on the causes of their illnesses. But many current nuclear workers are fearful of losing their jobs and are reluctant to come forward. The allegations that many former Pelindaba employees were suffering from illnesses caused by radiation and chemical exposure led Earthlife Africa, together with the South African History Archive (SAHA) at Wits University, and an independent occupational health doctor, Dr Murray Coombs, to embark on a health study of former Pelindaba workers. Dr Coombs finalised his report in late 2006, finding that of the 208 people he had examined, almost 40% were suffering probable occupation-related illnesses ranging from respiratory diseases, like lung cancer, asthma and lung fibrosis, to dermatological conditions. Each of his diagnoses was backed up by the company's own records where these could be obtained. Dr Coombs concluded in his report that an investigation into occupational diseases for ex-Necsa workers was valid and necessary.[10]

4.4. Other impacts

The aforementioned Greenpeace report also noted that, similarly to elsewhere in the world, South Africa has yet to develop a solution to the problem of high-level nuclear waste. This is highlighted by the decision to bury our low and intermediate level waste at Vaalputs in the desert Namaqualand region, which some consider to have been one of the more sinister acts of the apartheid regime. In deciding where it would be safest to deposit Koeberg's waste, the state-owned Atomic Energy Corporation (AEC), which became the Nuclear Energy Corporation of South Africa (Necsa) in 1999, prescribed a 50 km exclusion zone for 'white' municipalities, but the indigenous Nama people who live in the Vaalputs area were neither consulted nor included in the buffer zone. To make matters worse, in 2009 a National Nuclear Regulator official publicly admitted to an International Atomic Energy Agency conference that the Vaalputs technology was outdated and ageing. The communities in the area rely on boreholes to survive and to water their flocks of goats, and are constantly worried about contamination because of the veil of secrecy that surrounds the Vaalputs operation. Some former workers at Vaalputs have openly voiced their criticism of the waste dump's operations, citing increases in contaminated water as well as leaks in drums containing nuclear waste.[11]

Proper education of civilians living near nuclear power plants should be provided to enhance both their ability to respond appropriately to a disaster and their understanding of potential long-term risks of cancer from radiation exposure from a major accident. Poor public communication before and after the Chernobyl and Fukoshima accidents led to delayed evacuation and the ingestion of contaminated food and water. In both cases, numerous civilians chose to stay in their homes and continued consuming food that was potentially tainted with radioactive fallout. While the precise health effects attributed to nuclear accidents are constantly debated, the importance of properly educating citizens who live close to a nuclear power plant must be emphasized.[12]

5. Advantages and Disadvantages

By way of summary, some of the main pros and cons in the debate around nuclear energy are the following:

5.1. Advantages

- Almost zero greenhouse-gas and sulphur emissions from the plant itself.
- The plants almost never experience problems apart from human error, which is a rare occurrence.
- A small amount of fuel creates large amounts of energy.
- Vast amounts of energy are generated from a single power plant.
- A truckload of uranium is equivalent in energy to 10 000 truckloads of coal (assuming the uranium is fully utilized).
- As a comparison, a nuclear-powered aircraft carrier can circle the globe continuously for 30 years on its original fuel while a diesel-fuelled carrier has a range of only about 3000 miles before having to refuel.[13]
- Uranium is present in vast quantities in the earth's crust, guaranteeing fuel for the foreseeable future.

5.2. Disadvantages

- Nuclear plants are very expensive to build, maintain and decommission.
- Breeder reactors yield products that could potentially be stolen or diverted and turned into atomic weapons.

- Waste products are dangerous and need to be carefully stored for long periods of time. The spent fuel is highly radioactive and has to be carefully stored for centuries. No fail-safe method of waste storage or disposal has yet been devised.
- In the event of an accident, a nuclear power plant can be dangerous to its surroundings and employees. Clean-ups after spillages or leaks are very costly.
- There exist safety concerns if the plant is not operated correctly or conditions arise that were unforeseen when the plant was developed. This was the case at the Fukushima plant in Japan where the core melted down following an earthquake and tsunami; the plant was not designed to handle such an event despite the world's strongest earthquake codes.
- Mishaps at nuclear plants can render hundreds of square miles of land uninhabitable and unsuitable for any use for years, decades or longer, and kill off entire river systems. [14]
- Although the plant itself has low emissions, the carbon-footprint associated with mining, processing and enriching uranium, transporting the ore, and dealing with the waste, is huge. Likewise, much uranium mining is in the form of open-cast mines, which tend to have major environmental impacts.

6. Conclusion

Major decisions such as those regarding which technological option to select when creating additional electricity generating capacity are primarily based on an evaluation of the comparative costs of the options available. It can be said, however, that most of the time these costs do not fully reflect the broader impacts of the given energy choice on the economy and society at large. It is for these reasons that governments need to take a wider view of the potential economic, environmental, health and social impacts when choosing whether to adopt or abandon nuclear technology.

Finally, it must be noted, again, that the currently-envisaged programme, even at the most conservative estimate, will involve a sum roughly ten times larger than the initial price of the notorious arms deal announced 13 years ago. The chances of the 'nuclear power deal' being similarly drenched in lies and corruption are somewhat less, since it is likely that one major supplier/contractor will win the overall construction tender. But only *somewhat* less; with R300 billion in the budget there can be no doubt that the politically-connected, the tenderpreneurs and crooks of every sort will gather.

It would be wise, therefore, for government to appoint an independent oversight team, with investigative powers, to watch over every step of the process. It is unfortunately not enough to rely on the internal mechanisms of government departments, tender boards, etc. They have shown themselves either incapable of eliminating corruption, or actively involved in perpetuating it.

Whether we can afford nuclear power from the point of view of the environment, the enormous cost, or the question of sustainability, is debatable. What is quite certain is that we cannot afford another 'arms deal' feast of corruption, broken promises and non-accountability.

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[6] http://nuclearinfo.net/Nuclearpower/WebHomeCostOfNuclearPower
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