

**New Policy Developments and Challenges
For Radioactive Waste Management
In South Africa - 9549**

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ABSTRACT

South Africa has one nuclear power station, Koeberg, which is located in the Western Cape Province near Cape Town. The power station has two units which deliver approximately 1 800 MW of electricity to the national grid.

With a current total electricity generating capacity of some 37 000 MW_e, Eskom, the state-owned power utility generates and supplies electricity to both its local industrial and residential customers some 96% of the country's electricity needs. This equals more than half of the electricity generated in Africa. Eskom also supplies electricity to some of the country's neighbouring states on long-term power purchase agreements. More than 90% of South Africa's electricity is generated from coal, while nuclear generation accounts for only 6% of total electricity generating capacity.

Due to increased economic growth, rapid industrialization, and the utility's mass electrification program, the demand for power in South Africa currently outstrips supply capacity. This, despite the position of the 1998 White Paper on Energy Policy, which called for energy security achievement through diversification of our primary energy resources. The White Paper also advocated an increase in electricity generating capacity, and predicted a shortfall in supply capacity by 2007, if this was not done. The following slide presents this situation (Slide 2: Courtesy of PBMR company). As a result, Eskom has embarked on a massive program to upgrade and expand its generation capacity to supply electricity to the country. This includes plans to spend some R343-billion over a period of five years to fund the construction of new generation power stations, with the first due to come on stream in 2013. The plan purports to double total capacity to some 80 000 MW_e by 2026.

In the light of this generation capacity expansion program, Eskom issued bids for the construction of two nuclear power stations, Nuclear One and Nuclear Two. Bids have been received from AREVA and the US-based Westinghouse company for the turnkey supply of these projects. In order to further stem the tide of the country's current acute energy crisis, Eskom has awarded construction contracts for two large coal-fired stations – the R31,5 billion Kusile Power Station (formerly known as the 'Bravo Project') to be built near Emalahleni in Mpumalanga by 2017, and the Medupi Power Station in Lephalale, Limpopo Province. Medupi, the first new power station to be constructed in more than 20 years, is the second power station in the area after Matimba, and will cost about R80 billion. In 2007, Eskom also marked the official opening of two new open cycle gas turbine (OCGT) power stations in the Western Cape Province. The three Simunye plants, Grootvlei, Komati and Camden, are currently also being returned to service by the utility.

The country's 2007 *Nuclear Energy Policy and Strategy* advocates the promotion of uranium exploration and mining, as well as the construction of new nuclear power infrastructure in the drive to

expand nuclear generating capacity. The policy position also calls for the country's involvement in the complete nuclear fuel cycle. However, due to the current global financial meltdown, the nuclear expansion program has been recently halted by Eskom, citing economic reasons for the decision.

South Africa is currently looking at investment in GEN III+ plant designs for the near future. This is driven by the following attractive features of these designs: modular construction, evolutionary design, passive safety features, less waste generation, and cost effectiveness. Of relevance to my topic for this morning is the fourth point: less waste generation - the new more efficient reactors will generate less waste over their design life ([slide 3](#)). There is absolutely no point or merit in discussing strategies on waste management and handling if we do not first find ways and means to minimize the waste in the first place.

Looking forward to the future, there are currently vibrant international efforts to research and introduce Generation IV nuclear reactor designs which have promising features to help tackle the problem of high-level nuclear wastes, while also offering process heat for industrial applications. Gen IV reactors are a set of theoretical nuclear reactor designs currently being researched.

In 2002, ten countries - Argentina, Brazil, Canada, France, Japan, Republic of Korea, *South Africa*, Switzerland, the UK and the USA - joined together to form the Generation IV International Forum (GIF) to develop future-generation nuclear energy systems. A Document titled '*A Technology Roadmap for Generation IV Nuclear Energy Systems*' was published in December 2002 by the US DOE Nuclear Energy Research Advisory Committee. Most of these reactors are however generally not expected to be available for commercial construction before 2030, with the exception of the Very High Temperature Reactor (VHTR) known as the Next Generation Nuclear Plant (NGNP) to be completed around 2021([slides 4&5](#)). As is the case with the GEN III+ systems, the primary goals of GEN IV reactors are improved nuclear safety; improved proliferation resistance; minimization and waste generation; and cost reduction ([slide 6](#)). Three major mission interests were identified by GIF for the GEN IV reactors: electricity generation; process heat applications such as hydrogen production, CTL, SMR, desalination, oil sands; and actinide management in HLW's ([slide 7](#)).

Extended Nuclear Fuel Cycle for Improved Waste Management Policy Formulation Challenges

The foregoing gives a snapshot of the tasks that lie ahead in the objective to find effective and lasting solutions for the management and disposal of high level wastes. In South Africa, the 2005 National Policy and strategy on Radioactive Waste Management advocates a position whereby a hierarchical approach is adopted for the handling and management of spent fuel and HLW's, which allows for both the direct disposal option as well as the reprocessing option ([slides 8&9](#)). The state-owned power utility Eskom is actively investigating the latter option, and has also conducted extensive studies to compare direct disposal versus reprocessing costs.

Allow me to briefly share with you some of the developing research trends regarding the advanced nuclear fuel cycle that South Africa is actively investigating currently. These are central to the task of identifying sound policy strategies and subsequently formulating effective intervention measures and options for the management of HLW's and spent fuel. The application and deployment of these will naturally depend on the successful development and deployment of the Gen IV systems. The long-term hazard of radioactive waste is a subject of continued discussion and public concern worldwide. By using the partitioning of the minor actinides (Np, Am, Cm) and transmutation of the long-lived fission products, the radiotoxicity of the HLW can be reduced.

Partitioning separates the short-lived fission products (mainly Cs₁₃₇ and Sr₉₀) from the long-lived ones (mainly the minor actinides) using chemical and electrochemical methods. Transmutation changes long-

lived fission products (I_{129} , Tc_{99} , Zr_{93} and Cs_{135}) to short-lived or stable non-radioactive fission products, by neutron bombardment using fast reactors and Accelerator-Driven Systems (ADS) in the Advanced Nuclear Fuel Cycle. The Idaho National Engineering and Environmental Laboratory (INEEL) and the DOE's Advanced Fuel Cycle Initiative (AFCI) have done some studies and published some of their findings in this regard. The Initiative considers methodologies for the removal of the actinides, and reduction of long-lived fission products (LLFP's) and the short-lived fission products (SLFP's) from the waste (Slides 10-15, slides 11-13 *courtesy* of INEEL).

A comprehensive effort is currently being made by Eskom to investigate and recommend to government the best option for the management of spent fuel from Koeberg, which is currently being stored at-reactor in spent fuel pools (slides 16&17). These options include long-term storage; waste minimization through reprocessing; fuel-leasing or take-back options; and consideration of international, multinational and regional facilities that we are going to hear about so much at this Conference this morning (slide 18).

Policy Implementation Challenges: Spent Fuel Management Framework

Policy formulation is but the beginning of a long road towards effective policy implementation and the achievement of a successful set of activities that are required for the implementation of sound strategies for the management of spent fuel and HLW's. Unless careful thought is given to the critical cross-cutting issues that impact on the overall policy formulations and implementation strategies, a successful and cost-effective regime for spent fuel and HLW management cannot be achieved.

Policy framework issues that must be taken into account involve such modalities as principles; legislation; institutional responsibilities; definition and classification of nuclear wastes. Policy implementation 'tools' or 'enabling infrastructure' would involve considerations such as principles; formal waste management implementation structures; funding considerations; and a smart implementation process (slide 19).

Policy Option Evaluation Mechanisms

Additional thought needs to be given to the mechanisms for evaluating the proposed spent fuel and HLW options. These would for instance involve: framework construction; guiding principles; and framework features (slides 20&21).

CONCLUSION (slide 22)

- Spent fuel and HLW are long-lived and radiotoxic. We need to find lasting solutions to manage them safely
 - Deep geological repositories have as yet to be constructed, licensed and commissioned. None exist so far
 - International, regional and national solutions must be sought (eg small user countries sharing facilities for repositories, where national policies allow)
 - Techniques and methodologies are available for making an informed choice of spent fuel options
 - Public confidence will be achieved by developing convincing long term plans for spent fuel and HLW management
 - We need clear and unambiguous policy guidelines and strategies that will address the challenges
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