THE MANAGEMENT OF SPENT FUEL FROM NUCLEAR POWER REACTORS LEARNING FROM THE PAST, ENABLING THE FUTURE: A STRATEGY/CONTEXT FOR THE REPUBLIC OF SOUTH AFRICA

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Abstract

The management of spent fuel from nuclear power reactors still pose a great challenge with varying competing management and disposal strategies. It is indeed a challenge to talk about the management of spent fuel without considering the main issues of its association with nuclear weapons, and the bitter legacy left by the major nuclear accidents at Chernobyl and Fukushima. However, it is encouraging to know that the lessons learned from the past have motivated scientists and engineers to design modern nuclear reactors with systems to maintain cooling in case the primary coolant is lost. This extended abstract presents the management of spent fuel and the role of the National Radioactive Waste Disposal Institute (NRWDI) in South Africa.

1. INTRODUCTION

South Africa as a founding member state of the International Atomic Energy Agency (IAEA) holds the principle that radioactive waste shall be managed in a manner that is safe for human health and the environment. The principles for such are outlined in the radioactive waste management policy and strategy of South Africa [1]. The authority for the disposal and storage of all radioactive waste classes, including nuclear spent fuel vests with the Minister of Energy in terms of the Nuclear Energy Act [2]. South Africa is a contracting party to the IAEA Joint Convention on the Safety of Spent Nuclear Fuel Management (SFM) and Safety of Radioactive Waste Management ("the Joint Convention").

The NRWDI is a South African state-owned entity mandated by government for professional radioactive waste management and disposal under the NRWDI act no. 53 of 2008 [3]. This mandate is currently carried out by the Nuclear Energy Corporation of South Africa (NECSA). The radioactive waste disposal facility which is the asset of NRWDI is Vaalputs. The NRWDI responsibilities as stated in the act are as follows:

- Long term management of all classes of radioactive waste, including the disposal, on a national basis
- Operation of the Vaalputs repository
- Develop criteria for accepting and disposing all classes of radioactive waste
- Manage, operate and monitor operational radioactive waste disposal facilities
- Site, design and construct new disposal and related facilities as required
- Define and conduct research and development aimed at finding solutions for long-term management of all classes of radioactive waste.
- Provide information on all aspects of radioactive waste disposal to the public in general
- Maintain a national radioactive waste database.

2. MANAGEMENT OF SPENT FUEL IN SOUTH AFRICA

There are two major generators that produce spent fuel in South Africa, namely, the Koeberg nuclear power reactor (ESKOM) and the SAFARI 1 research reactor at NECSA. South Africa spent fuel is currently stored in dry and wet authorised storage facilities on-site. The spent fuel from Koeberg power station is stored in the reactor pools and also in dry storage spent fuel casks. The spent fuel at the SAFARI 1 reactor at NECSA is stored in a dry storage facility (Pipe Store) at Thabana and also on reactor pools on-site in Pelindaba. However, it must be noted that the Policy and Strategy clearly indicate that the long-term storage of spent fuel on-site at these facilities

is not sustainable. South Africa has therefore through the policy proposed the following strategies to be investigated and established for the safe management of spent fuel;

— Long term above-ground storage in an off-site authorised Centralised Interim Storage Facility (CISF)
— The process of reprocessing, conditioning and recycling
— Transmutation, and
— Deep geological repository

Transmutation is excluded due to economic challenges associated with the technology. South Africa is aware of international developments under the technology.

Currently there are two major options for the long-term management of spent fuel:

(a) The "open fuel cycle or once-through fuel cycle", where the fuel is used once and is then regarded as being spent and declared radioactive waste for subsequent direct disposal, or
(b) The closed or twice-through fuel cycle: the recycling option where the used fuel is reprocessed to recover unused uranium and plutonium for eventual recycling in light water reactors, closing the fuel cycle.

South Africa has not yet concluded which strategy (open or closed cycle) it will pursue. Regardless of the chosen Spent Fuel Strategy, the following technical outcomes are inevitable:

— Centralized Long-Term Off-site Storage Facility is required by 2025
— Deep Geological Repository is required by 2065

The establishment of a deep geological repository is not only a technical issue. To be successful, a deep geological repository needs to be technical sound, socially acceptable, environmentally responsible and economically feasible. The acceptability of the deep geological repository will involve adjustments between societal, institutional, economic and political drivers. In the end, public acceptance may be the deciding factor on whether any repository project will be implemented or not!

ACKNOWLEDGEMENTS

I greatly appreciate the assistance, encouragement, comradeship and support of colleagues from the National Radioactive Waste Disposal Institute. This work was supported by funding from International Atomic Energy Agency (IAEA) under Grant reference No. CN-272; EVT 1803899.

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