SOUTH AFRICA

a) National framework for management of spent fuel and radioactive waste

The cornerstone of South Africa's approach to addressing radioactive waste management issues is the Radioactive Waste Management Policy and Strategy for the Republic of South Africa. The strategic intent of this Policy and Strategy is to ensure a comprehensive radioactive waste governance framework by formulating, in addition to nuclear and other applicable legislation, a policy and implementation strategy in consultation with all role-players and stakeholders. The scope of the South African Policy and Strategy on radioactive waste management relates to all types of radioactive waste with the exception of operational radioactive liquid and gaseous effluent discharges, which are permitted to be routinely released into the environment under the authority of the relevant regulators: National Nuclear Regulator (NNR) or the Directorate Radiation Control (RADCON) in the Department of Health.

In accordance with the Policy and Strategy, final disposal is regarded as the ultimate step in the radioactive waste management process, although a stepwise waste management process is acceptable. Long-term storage of specific types of waste, such as high-level waste, long-lived waste and high activity disused radioactive sources, may be regarded as one of the steps in the management process. In the South African context, nuclear fuel that has been irradiated in a nuclear reactor is called "used fuel" instead of "spent fuel". Pending the outcome of current investigations into possible reprocessing of the used fuel to extract radioactive isotopes for further use, used fuel is not classified as radioactive waste. Rather than being in its final form for disposal, used fuel is considered to still contain useful material. In terms of the Radioactive Waste Management Policy and Strategy of the Republic of South Africa, ownerless radioactive waste (radioactive waste where the generator no longer exists or cannot be identified by reasonable means or does not have the resources to manage such waste) is the responsibility of government.

In practice, the following hierarchy of waste management options shall be followed where practicable:

- Waste avoidance and minimisation;
- Reuse, reprocessing and recycling;
- Storage and
- Conditioning and final disposal.

Waste classification:

- HLW – Heat-generating radioactive waste with high, long and short-lived radionuclide concentrations;
- LILW-LL – Radioactive waste with low or intermediate short-lived radionuclide and intermediate long-live radionuclide concentrations;
- LILW-SL – Radioactive waste with low or intermediate short-lived radionuclide and/or low long-lived radionuclide concentrations;
- VLLW – Radioactive waste containing a very low concentration of radioactivity;
- NORM-L – Potential radioactive waste containing low concentrations of NORM;
- NORM-E – Radioactive waste containing enhanced concentrations of NORM.

b) National legal and regulatory framework

The South African legislative framework on nuclear energy dates back to 1948, when the predecessor of the present South African Nuclear Energy Corporation, namely the Atomic Energy Board, was established in terms of the provisions of the Atomic Energy Act. Over the years, this Act was amended to keep pace with developments in nuclear energy. The establishment of the Nuclear Installations Act, which came into force in 1963, made provision for the licensing of nuclear installations by the Atomic Energy Board.

At present, the nuclear sector in South Africa is mainly governed by the Nuclear Energy Act, 1999 and the National Nuclear Regulator Act, 1999, which provides the South African National Nuclear Regulator (NNR) with a mandate to establish and enforce national standards in the areas of radiological health, safety and environmental protection. The National Nuclear Regulator is responsible for exercising regulatory control over the safety of nuclear installations, radioactive waste, irradiated nuclear fuel and the mining and processing of radioactive ores and minerals. The NNR's primary function is to protect workers and members of the public from the harmful effects (i.e. nuclear damage) arising from exposure to ionizing radiation.

The National Radioactive Waste Disposal Institute (NRWDI), established by the promulgation of the National Radioactive Waste Disposal Institute Act, 2008, is responsible for the management and disposal of radioactive waste on a national basis.

c) Radioactive waste management, decommissioning and spent fuel strategy

Waste generators will contribute to the fund, based on the radioactive waste classes and volumes produced. The fund is aimed at ensuring sufficient provision for the long-term management of radioactive waste, and includes the following:

- Funding for disposal activities;
- Funding for research and development activities, including investigations into waste management/disposal options;
- Funding of capacity-building initiatives regarding radioactive waste management; and
- Funding for other activities related to radioactive waste management.

Legislation for the establishment of a National Radioactive Waste Management Fund was developed and is currently undergoing legal review by the State Law Advisor.

At present, the following disposal options are implemented in South Africa:

- Above ground, disposal in engineered facilities for the bulk of mining waste.
- Near surface disposal of Low and Intermediate Level Waste (LILW) at the Vaalputs National Radioactive Waste Disposal Facility in the Northern Cape Province.

In Vaalputs the low and intermediate-level waste is disposed in shallow landfill trenches. The National Radioactive Waste Repository operated by Necsa and situated about 600 km north of Cape Town. Although the state financed the initial development costs of the site, the waste producers (Eskom and Necsa) pay fees, based on the amount of radioactive material sent to Vaalputs.

Used fuel is currently stored in authorised facilities on the generator's site. Two mechanisms, namely dry and wet storage, are currently in use in South Africa.

Used fuel from the Koeberg Nuclear Power Station (KNPS) is currently stored in authorised used fuel pools on site, as well as in casks designed and constructed for dry storage of used fuel. It is recognised that the current storage capacity at KNPS is finite and limited. Due to a need to increase the energy output at KNPS, the KNPS operating organisation, Eskom, implemented a revised fuel management strategy. This has required that some used fuel be stored in a checkerboard configuration within the used fuel pool, thereby reducing the available storage capacity of the used fuel pools. Eskom is also considering extending the operating lifetime of the two units at KNPS, beyond 40 years and this means also that the options to expand the used fuel storage capacity at KNPS are under consideration.

The used fuel from the SAFARI-1 Research Reactor, at the Necsa Pelindaba site, is initially stored in the reactor pool for at least two years to facilitate cooling, prior to it being transferred to the Thabana Pipe Store – an authorised dry storage facility on the Pelindaba site. This facility comprises subsurface sealed stainless steel storage pipes. These pipes are positioned in boreholes that are lined with normal borehole lining and cement piping for possible acid neutralisation. The pipe openings are shielded with a lead plug and are sealed with an airtight flange. The pipes are kept under pressure of an inert gas. For security and safety purposes, the facility is enclosed in a shed-like structure.

Decommissioning is currently taking place in the following areas:

- Decommissioning and associated waste management of Necsa's two former enrichment plants (the Y and Z plants), as well as the former conversion plant (U plant) and associated facilities, are undertaken by Necsa itself and the financing is carried by the state through the annual state allocation of operational funds.

- Decommissioning of disused mine equipment (primarily in the gold, copper, phosphate and mineral sands operations) are currently being undertaken. The mining companies finance the decommissioning costs themselves and subcontract the operations out to specialised agencies.

Decommissioning of the Koeberg nuclear power station is currently scheduled for after 2035. Financial provision for the decommissioning and used fuel management has been accumulating on a monthly basis since commercial operations of the installation started in 1984. Management at Eskom and South African Nuclear Energy Corporation is responsible for determining the financial resources necessary to meet legal responsibilities through the budgeting programme, including adequate funding for the management of used fuel and the disposal of intermediate and low-level waste. Similar arrangements are in place for the mines.

Table 1 Radioactive Waste In Storage (including spent fuel that is considered waste)

Route Waste Class	Processed /Unprocessed	Total Current Volume (m3)	Estimated Disposal Volume (m3)	Distribution (%)							Planned Disposal Route (if known)
				RO	FFE	RP	NA	DF	DC/ RE	ND	
All Classes											
HLW		0,25		100							
LILW-LL		870		100							
LILW-SL		7800+10944,4		100							
LLW	Processed	588294	1532975	100							
VLLW		5500+1559,83		100							

NEWMDB waste origin type codes:
RO – reactor operations
FFE – fuel fabrication & enrichment
RP – fuel reprocessing
NA – nuclear applications
DF - defence
DC/RE - decommissioning & remediation
ND - Not Determined

Table 2 Radioactive Waste Disposed (as disposed volume)

Waste Class	Processed (not)	Total Volume (m3)	Distribution (%)							Disposal Route Used
			RO	FFE	RP	NA	DF	DC/RE	ND	
All Classes										
LILW-SL		13882	100							

Table 3 Spent fuel in Storage (MTHM)

Type	Current Amount (NPP) Used fuel assemblies	Current Amount (Research Reactors) Spent Fuel Elements
Total Spent Fuel Storage	2117	1042
Wet storage (AR)	2005	175
Wet storage (AFR)		
Dry storage (AR)	112	867
Dry storage (AFR)		
Total spent fuel held in storage for other countries (amounts also included above)		

Table 4 Spent fuel sent for reprocessing (in the country or sent to another country) (MTHM)

Type	Current Amount (NPP)	Current Amount (Research Reactors)
Total amount Spent Fuel sent to Reprocessing (in your country)		
Total amount Spent Fuel sent to Reprocessing (in another country)		
Total amount of Spent Fuel received from another country for reprocessing and recycling		
Total amount of Spent Fuel (MTHM) or radioactive waste (cubic metres) returned to country of origin for storage/disposal		

Table 5 Example of a translation matrix (from NEWMDB) that can be used for transition from a national classification system to IAEA classification

National Waste Classification Name	VLLW	LILW-SL	LILW-LL	HLW
VLLW	100	0	0	0
LILW-SL	0	100	0	0
LILW-LL	0	0	100	0
HLW	0	0	0	100

Table 6 Waste management facilities

Type	Planned	Construct.	Commiss.	In Operation	Shutdown	Decomm.	Other	Total
Spent Fuel Storage	0	0	0	4	0	0	0	4
Spent Fuel Reprocessing and Recycling	0	0	0	0	0	0	0	0
Spent Fuel Conditioning	0	0	0	0	0	0	0	0
Spent Fuel disposal	0	0	0	0	0	0	0	0
Waste processing	0	0	0	12	0	0	0	12
Waste storage	0	0	0	23	0	0	0	23
Waste	0	0	0	1	0	0	0	1

disposal								

Table 7 Summary of major sources of waste

Type	Planned	Construct	Commiss.	In Operation	Shutdown	Decomm.	Other	Total
Research reactors	0	0	0	1	0	1	0	2
Nuclear Power reactors	0	0	0	2	0	0	0	2
Spent Fuel Reprocessing and Recycling	0	0	0	0	0	0	0	0
Other	0	0	0	0	0	0	0	0

Table 8 Future prospects

Type	Current amount	Estimated Current amount when prepared for disposal	Current Disposal Capacity	Total forecast at 2030	Disposal Capacity 2030	Total forecast at 2050	Disposal Capacity 2050
Spent Fuel Storage							
Wet storage (AR)							
Wet storage (AFR)							
Dry storage (AR)							
Dry storage (AFR)							
Total amount Spent fuel sent to Reprocessing and Recycling							
Total amount Spent fuel disposed							
Waste in storage							
Waste							

disposal							