SOUTH AFRICAN NATIONAL REPORT ON THE COMPLIANCE TO OBLIGATIONS UNDER THE JOINT CONVENTION ON SAFETY OF SPENT FUEL MANAGEMENT AND ON THE SAFETY OF RADIOACTIVE WASTE MANAGEMENT

SUBMISSION TO
THE SEVENTH REVIEW MEETING OF THE CONTRACTING PARTIES
OCTOBER 2020

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ACKNOWLEDGEMENT

The South African National Nuclear Regulator (NNR) acknowledges the support and co-operation of the South African Department of Mineral Resources and Energy (DMRE), the South African Health Products Regulatory Authority (SAHPRA), the South African Nuclear Energy Corporation (Necsa), Eskom, National Radioactive Waste Disposal Institute (NRWDI), iThemba Labs and the South African Mining Sector in the preparation of this report.

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EXECUTIVE SUMMARY

Recognising the importance of the safe management of spent nuclear fuel and radioactive waste, the international community agreed on the necessity of adopting a convention with the objective of achieving and maintaining a high level of safety, worldwide, in the management of spent nuclear fuel and radioactive waste.

This was the origin of the Joint Convention on the Safety of Spent Fuel Management and on the Safety of Radioactive Waste Management (the "Joint Convention"), which was adopted on 5 September 1997 and entered into force on 18 June 2001.

The Joint Convention established an international peer review process among Contracting Parties and makes provision for incentives for nations to take appropriate steps to bring their nuclear activities into compliance with general safety standards and practices.
Since the entry into force of the Joint Convention, there has been six Review Meetings held at the International Atomic Energy Agency (IAEA) Headquarters in Vienna. The Seventh Review Meeting is scheduled for the period 22 May – 04 June 2021.

The Republic of South Africa acceded to the Joint Convention on 15 November 2006, and it's obligations under the convention entered into force on 13 February 2007. The First South African National Report was presented at the Third Review Meeting of the Contracting Parties under the Joint Convention in Vienna, Austria, during May 2009. This Fifth South African National Report is an update of the previous National Reports, prepared in 2008, 2011, 2014 as well as 2017, and documents used fuel and radioactive waste management safety in the Republic of South Africa. It also incorporates additional information and responses to questions raised at the Sixth Review Meeting of the Contracting Parties.

A comprehensive national legal and regulatory infrastructure ensures the safety of spent fuel and radioactive waste management. The report describes the policies and management practices related to used fuel* and radioactive waste management in the Republic of South Africa, providing annexes with information on used fuel and waste management facilities, inventories and ongoing decommissioning projects. Information is provided on the safety of used fuel and radioactive waste management, as well as on imports/exports (transboundary movements) and disused sealed sources, as required by the Joint Convention. The report confirms that the Republic of South Africa is in compliance with the Articles of the Joint Convention.

*In the South African context, nuclear fuel that has been iradiated in the nuclear reactor is called "used fuel" instead of "spent fuel ".

Section A

INTRODUCTION

SECTION A: INTRODUCTION

A.1. BACKGROUND

Recognising the importance of the safe management of spent nuclear fuel and radioactive waste, the international community agreed upon the necessity of adopting a convention, with the objective of achieving and maintaining a high level of safety, worldwide, in spent fuel and radioactive waste management. This was the origin of the Joint Convention on the Safety of Spent Fuel Management and on the Safety of Radioactive Waste Management (the "Joint Convention").

The Joint Convention was adopted on 5 September 1997, at a Diplomatic Conference, convened by the International Atomic Energy Agency (IAEA), at its headquarters from 1 to 5 September 1997. It was opened for signature at the IAEA General Conference on 29 September 1997. Pursuant to Article 40, the Joint Convention entered into force on 18 June 2001, which was 90 days after the date of deposit with the IAEA of the 25th instrument of ratification, acceptance or approval, including the instruments of fifteen States each having an operational nuclear power plant.

Since the entry into force of the Joint Convention, there have been six Review Meetings of the Contracting Parties, held at the IAEA Headquarters in Vienna. These are detailed in Table 1.

Table 1: Dates of Joint Convention Review Meetings

Review Meeting	Dates
First Review Meeting	3-14 November 2003
Second Review Meeting	15-24 May 2006
Third Review Meeting	11-20 May 2009
Fourth Review Meeting	14-23 May 2012
Fifth Review Meeting	11-22 May 2015
Sixth Review Meeting	21 May - 1 June 2018

South Africa is a Contracting Party to the Joint Convention having acceded to the Joint Convention on 15 November 2006 and our obligations under the convention entered into force on 13 February 2007. South Africa has participated in all Review Meetings since the Third Review Meeting of the Joint Convention in 2009.

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Provisions of the Joint Convention

The Joint Convention is the first international instrument that deals with the safety of management and storage of spent fuel and radioactive waste in Contracting Parties with and without nuclear programmes. It also elaborates on, and expands the existing IAEA nuclear safety regime, while promoting international standards in this area. The Joint Convention is aimed at achieving and maintaining a high level of safety in spent fuel and radioactive waste management, ensuring that there are effective defences against potential hazards during all stages of the management of such materials, as well as preventing accidents with radiological consequences.

The Joint Convention covers the safety of spent fuel and radioactive waste management from civilian applications. The Joint Convention also applies to the management of military or defence-originated spent fuel and radioactive waste, if and when such materials are transferred permanently to, and managed within exclusively civilian programmes.

The Joint Convention calls on the Contracting Parties to review safety requirements and conduct environmental assessments, both at existing and proposed spent fuel and radioactive waste management facilities. It provides for the establishment and maintenance of a legislative and regulatory framework to govern the safety of spent fuel and radioactive waste management.

The Joint Convention establishes rules and conditions for the transboundary movement of spent fuel and radioactive waste that, inter alia, requires the State of destination to have adequate administrative and technical capacity and a regulatory infrastructure to manage spent fuel or radioactive waste in a manner consistent with the Joint Convention. It obligates a State of origin to take appropriate steps to permit re-entry into its territory of such material if a transboundary movement cannot be completed in conformity with the Joint Convention.

A-2. PURPOSE

This report summarises South Africa's approach to the safety of used fuel* management and the safety of radioactive waste management and demonstrates how South Africa fulfils its obligations under the Joint Convention. This is South Africa's fifth report on compliance with obligations under the Joint Convention. The previous reports were produced in October 2008, September 2011, September 2014 and October 2017.

A-3. STRUCTURE OF THE REPORT

In developing this report, South Africa has drawn from the experience acquired from the previous Review Meetings of the Contracting Parties of the Joint Convention and the National Reports under the Convention on Nuclear Safety. The report constitutes a self-supporting report, based on existing documentation, and reflects the viewpoints of government, the regulatory authorities and industry.

This report is structured in accordance with the "Guidelines Regarding the Form and Structure of National Reports" for the Joint Convention (INFCIRC/604/Rev. 3)– i.e., an "article-by-article" format, with each one being addressed in a dedicated chapter, carrying the corresponding text of the relevant article of the Joint Convention on a shaded background at the top of the chapter. After the Introduction (Section A), the various sections deal successively with the following topics in the specific order prescribed by the guidelines:

- Section B: Policy and practices under the Joint Convention (Article 32-1);
- Section C: Scope (Article 3);
- Section D: Spent-fuel and radioactive-waste inventories (Article 32-2);
- Section E: Legislative and regulatory system in force (Articles 18 to 20);
- Section F: Other general safety provisions (Articles 21 to 26);
- Section G: The safety of spent-fuel management (Articles 4 to 10);
- Section H: The safety of radioactive-waste management (Articles 11 to 17);
- Section I: Transboundary movements (Article 27);
- Section J: Disused sealed sources (Article 28);
- Section K: Planned safety-improvement actions;
- Section L: Annexes in support of Section D.

A-4. SUMMARY RESULTS FROM THE PREVIOUS REVIEW MEETING

The Guidelines Regarding the Form and Structure of National Reports requires National Reports to contain conclusions from the discussion of the Contracting Party's National Report at the previous Review Meeting. This report reflects the discussions and conclusions from the Joint Convention Sixth Review Meeting as well as the questions and comments from the other Contracting Parties.

*In the South African context, nuclear fuel that has been iradiated in the nuclear reactor is called "used fuel" instead of "spent fuel ".

SECTION A: INTRODUCTION

Ahead of the Joint Convention Sixth Review Meeting South Africa received forty one (41) questions from thirteen (13) Joint Convention Contracting Parties as per the Table 2 below:

Table 2: Summary of comments/questions (C/Qs) at Sixth Review Meeting

Contracting Party	Country Group	Number of questions/comments posed to South Africa
Armenia	6	1
Belgium	4	3
Spain	5	3
Norway	6	4
France	2	6
USA	1	6
Euratom	6	2
Germany	7	1
Sweden	6	8
Poland	1	1
Romania	7	1
FYR of Macedonia	6	1
China	6	4
Total		**41**

The distribution of the questions posed to South Africa ahead of the 6th Review Meeting per the Article of the Joint Convention is depicted in Figure 1 below.

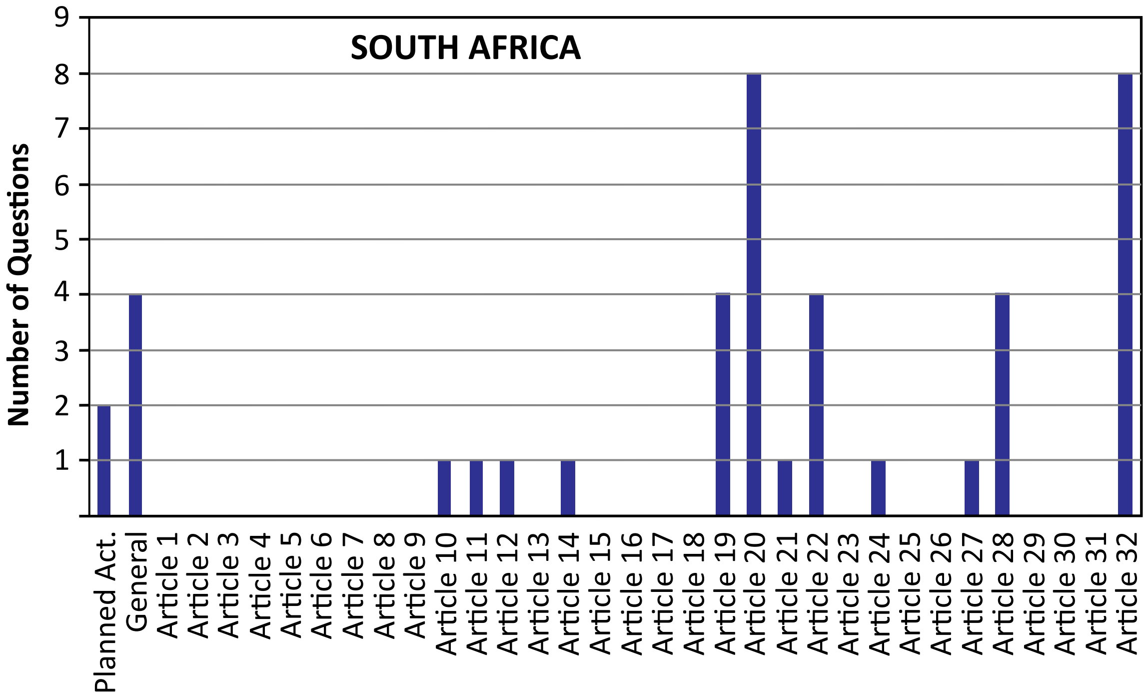

Figure 1: Distribution of questions posed to South Africa ahead of the 6th Review Meeting per the Article of the Joint Convention

The Country Group discussions on South Africa's National Report at the Sixth Review Meeting focussed on:

- Used fuel management
- Planned increase in dry storage capacity for used fuel at Koeberg Nuclear Power Station (Koeberg);
- Human resource challenges
- Role of the regulator in public communication and public engagement in the regulatory process
- Establishment of the independent regulatory verification laboratory for environmental monitoring
- Assistance provided to other countries for management of orphan and disused spent radioactive sources
- Mine tailings management
- Legislation on establishment of National Radioactive Waste Management Fund;
- Establishment of the National Radioactive Waste Disposal Institute (NRWDI);

The Contracting Parties recognised the following actions related to planned measures to improve safety and the addressing of Challenges from the Fifth Review Meeting:

- Progress on legislative framework for the National Radioactive Waste Management Fund.
- Progress on operational arrangements for NRWDI.
- Planned increase in used fuel dry storage capacity at Koeberg NPP.
- Declared timeframes for establishment of the National Geological Disposal Facility
- Hosting of 2016 Integrated Regulatory Review Service Mission to South Africa as planned.
- Progress achieved to integrate the regulatory responsibilities of NNR and RADCON.
- Addressing of human resource challenges.

The Contracting Parties noted the following challenges for South Africa:

- Completion of the process to integrate the regulatory responsibilities of NNR and RADCON (SAHPRA)
- Development of roadmap and milestones for implementation of the Deep Geological Disposal Facility
- Enhancing of human resources at NRWDI
- Establishing legislation related to Radioactive Waste Management Fund within the short term;

The Contracting parties recognised the following Areas of Good Performance for South Africa:

- Comprehensive efforts being made in South Africa to accomplish capability building needs by developing essential skills demanded by the national programme.
- Establishment of customised competence management evaluation system and integrated talent management model for the regulatory body.
- Continued assistance provided South Africa to recover and manage sources in other countries.
- Cooperative governance of the various regulatory functions in an integrative manner by formal co-operative governance agreements and operative coordination committees.

The Contracting Parties at the Sixth Review meeting recognised the following planed measures to improve safety ahead of the Seventh Review Meeting:

- Complete the process for implementing the recommendations resulting from the self-assessment and the IRRS mission in 2016, in particular, those related to the enhancement of the independence of the regulatory body.
- Complete implementation of the action plan developed as outcome of the IAEA Emergency Preparedness Review (EPREV) mission hosted in 2014.
- Phased implementation of increasing dry storage capacity to meet the needs arising from the life time extension of the two units at Koeberg NPP to possible 60 years.

A-5. OVERVIEW MATRIX FOR USED FUEL AND RADIOACTIVE WASTE MANAGEMENT

The Guidelines Regarding the Form and Structure of National Reports require National Reports to contain an overview matrix detailing the management of used fuel and radioactive waste management. Table 3 below represents the overview matrix for South Africa.

Table 3: Overview matrix for management of used fuel and radioactive waste

	Long-term management policy	Funding of liabilities	Current practices/ facilities	Planned facilities
Used fuel	Long-term storage with possible reprocessing or transmutation prior to disposal. Disposal in geological repository.	Long Term: Owners/ generators to contribute to National Radioactive Waste Management Fund to be established Currently based on polluter pays principle owners/ generators of used fuel are required to make financial provisioning for management of used fuel	Combination of wet and dry storage on site	Short Term: Additional dry storage facilities to be developed as needed. Long term: Geological repository to be developed by National Radioactive Waste Disposal Institute (NRWDI)
Nuclear fuel cycle waste	Near surface disposal of Low and intermediate level radioactive waste (short lived) LILW-SL	Currently owners/ generators - based on polluter pays principle Long Term: Owners/ generators to contribute to National Radioactive Waste Management Fund to be established	Vaalputs National Radioactive Waste Disposal Facility (near surface disposal) for LILW- SL Long term storage for other wastes	Possible medium depth disposal facility for Low and intermediate level radioactive waste (long lived) LILW- LL or geological disposal based on investigations to be undertaken by NRWDI
Application waste	Near surface disposal of LILW-SL	Currently owners/ generators - based on polluter pays principle Long Term: Owners/ generators to contribute to National Radioactive Waste Management Fund to be established	Vaalputs (near surface disposal) Long term storage for other wastes	Possible medium depth disposal facility for LILW-LL or geological disposal based on investigations to be undertaken by NRWDI

	Long-term management policy	Funding of liabilities	Current practices/ facilities	Planned facilities
Decommissioning liabilities	Phased decommissioning with release or clearance from regulatory control. Immediate dismantling is the preferred option. Disposal of LILW-SL in near surface repository. Disposal routes for other wastes to be established by NRWDI.	Owners/ generators - based on polluter pays principle	Recycling and clearance of material meeting clearance requirements. Disposal of LILW-SL at Vaalputs Storage for other wastes	Disposal routes for other wastes to be established by NRWDI
Disused sealed sources	Return to manufacturer. Recycling and reuse where possible. Disposal routes to be investigated by NRWDI.	Contractual agreements between owner and supplier. Where no agreement exists owners/ generators - based on polluter pays principle	Storage in dedicated facilities at Necsa Pelindaba site	Disposal routes to be established by NRWDI
Mining & milling waste	Stabilise in place	Mine operator	Stabilise in place	

Section B

POLICIES AND PRACTICES

SECTION B: POLICIES AND PRACTICES

Article 32: Reporting

1. In accordance with the provisions of Article 30, each Contracting Party shall submit a national report to each review meeting of Contracting Parties. This report shall address the measures taken to implement each of the obligations of the Convention. For each Contracting Party, the report shall also address:
   i. spent fuel management policy;
   ii. spent fuel management practices;
   iii. radioactive waste management policy;
   iv. radioactive waste management practice;
   v. criteria used to define and categorize radioactive waste.

B-1. RADIOACTIVE WASTE MANAGEMENT POLICY FRAMEWORK FOR SOUTH AFRICA

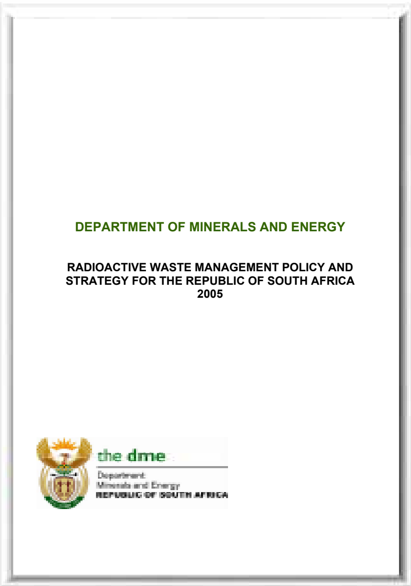

Figure 2: Radioactive Waste Management Policy and Strategy of South Africa - 2005

The effective implementation of the Radioactive Waste Management Policy and Strategy for the Republic of South Africa (hereinafter referenced to as “Policy and Strategy”) (see Figure 2), is critical towards addressing the radioactive waste management issues in South Africa.

The Policy and Strategy serves as a national commitment to ensure the establishment of a comprehensive radioactive waste governance framework. The strategic intent of this Policy and Strategy is to establish a framework that addresses radioactive waste management issues, in a coordinated and cooperative manner.

The national Policy and Strategy was published in 2005, by the then Department of Minerals and Energy, now the Department of Mineral Resources & Energy (DMRE). The Policy and Strategy outlines the policy principles that the Republic of South Africa will endeavour to implement through its institutions, in order to achieve the overall safety of the public and the environment. The scope of this policy relates to all radioactive wastes, except operational radioactive liquid and gaseous effluent (waste discharges), which is permitted to be released to the environment routinely under the authority of the relevant regulators (i.e. NNR and SAHPRA).

The Policy and Strategy defines the respective roles of government, regulators, waste generators and operators. The Policy and Strategy reaffirms that the nuclear facilities are strategic assets of the country that benefits both the present and future generations. Therefore, these assets should be developed, and the resulting radioactive waste should be managed to ensure the safety of the public and the environment.

The Policy and Strategy lays down options to be considered for managing used fuel and high-level waste, with an option that would be best for safe management of radioactive waste.It furthermore provides for the development of institutional and financial arrangements to implement long-term waste management solutions in a safe, environmentally sound, comprehensive, cost-effective and integrated manner.

The Policy and Strategy calls of the establishment of two management structures for radioactive waste management, in the form of the National Committee on Radioactive Waste Management (NCRWM), and the NRWDI. The NCRWM has been established to advise the Minister and oversee the effective implementation of

Policy and Strategy. NRWDI was established in terms of the NRWDI Act, and became operational 2014. NRWDI is mandated to manage radioactive waster disposal on a national basis and is the implementing body with the direct responsibility for the siting, construction and operation of radioactive waste disposal and related facilities.

The Policy and Strategy also calls for the National Radioactive Waste Management Fund to be established via the statutes. The purpose of the Fund is to ensure that there are sufficient provisions for the safe management of all radioactive waste in the country in the long term.

B-2. NUCLEAR ENERGY POLICY


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DEPARTMENT OF MINERALS AND ENERGY

NUCLEAR ENERGY POLICY FOR THE REPUBLIC OF SOUTH AFRICA

JUNE 2008

Figure 3: Nuclear Energy Policy for the Republic of South Africa - 2008

The Nuclear Energy Policy for the Republic of South Africa (see Figure 3), published in June 2008, presents a policy framework, which governs all energy related applications of nuclear technology in South Africa. The policy covers the prospecting and mining of uranium ore and any other ores containing nuclear materials; the entire nuclear fuel cycle, and focuses on all applications of nuclear technology for energy generation.

The long-term vision of the policy is for South Africa to become globally competitive in the use of innovative technology for the design, manufacture and deployment of state- of-the-art nuclear energy systems and power reactors, as well as nuclear fuel cycle systems.

The objectives of the policy are the following:

- The promotion of nuclear energy as an important electricity supply option via the establishment of a national industrial capability for the design, manufacture and construction of nuclear energy systems;
- The establishment of the necessary governance structures for an extended nuclear energy programme;
- The creation of a framework for safe and secure utilisation of nuclear energy with minimal environmental impact;
- A contribution to the country's National Programme of Social and Economic Transformation, Growth and Development;
- Guiding actions to develop, promote, support, enhance, sustain and monitor the nuclear energy sector in South Africa;

- A long-term attainment of global leadership and self-sufficiency in the nuclear energy sector;
- Exercising control over unprocessed uranium ore for export purposes for the benefit of the South African economy;
- Establishing mechanisms to ensure the availability of land (nuclear sites) for future nuclear power generation;
- Allowing for the participation of public entities in the uranium value chain;
- Promoting energy security in South Africa;
- Improvement of the quality of human life and supporting the advancement of science and technology;
- A reduction in greenhouse gas emissions;
- Skills development related to nuclear energy.

The following institutional arrangements are considered necessary for the implementation of this policy:

- A National Nuclear Energy Executive Coordination Committee: This Cabinet-level committee was established in November 2011.
- An organisation for National Nuclear Research, Development and Innovation: Necsa fulfils this role;
- An organisation for electricity generation from nuclear power: Eskom shall be the main owner and operator of nuclear power stations in South Africa;
- A national nuclear safety regulator: The NNR fulfils this role;
- A national nuclear architectural engineering, component manufacturing and construction capability. This institution needs to be established as part of the phased decision -making approach;
- A national radioactive waste management agency: currently the NRWDI is responsible for the disposal of radioactive waste on a national basis and the generators of radioactive waste have responsibility for the predisposal management of their waste.

B-3. RADIOACTIVE WASTE MANAGEMENT PRACTICES

Within the South African legislative framework, radioactive waste, for regulatory purposes, is defined as material that contains or is contaminated with radionuclides at concentrations or activities greater than clearance levels as established by the regulatory body, and for which no further use is foreseen.

It should be recognised that this definition is purely for regulatory purposes, and that material with activity concentrations equal to or less than clearance levels is radioactive from a physical viewpoint, although the associated radiological hazards are considered negligible.

In accordance with the Policy and Strategy, the ultimate goal in the radioactive waste management process is safe disposal, 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 practice, the following hierarchy of waste management options shall be followed where practicable:

- Waste avoidance and minimisation;
- Reuse, reprocessing and recycling;

- Storage;
- Conditioning and final disposal.

Radioactive material for which no further use is foreseen and could satisfy requirements for clearance, reuse, reprocessing or recycling, is considered as potential radioactive waste– for example contaminated metal and used nuclear fuel. The disposal and waste management options for the various classes of radioactive waste are detailed in Table 4.

As part of the South African strategy for long-term radioactive waste management, it is envisaged that a single national site shall be developed for the disposal of each of the waste classes indicated in Table 4, with the exception of NORM waste, which is disposed of in bulk, on the waste generator's site. This is to maximise benefits from economies of scale, pertaining to all activities associated with disposal and waste management.

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 Vaalputs in the Northern Cape Province.

B-4. NATIONAL RADIOACTIVE WASTE DISPOSAL INSTITUTE (NRWDI)

The National Radioactive Waste Disposal Institute (NRWDI) is an independent juristic person established by statute under Section 3 of the National Radioactive Waste Disposal Institute Act (No. 53 of 2008) (NRWDIA) to discharge the institutional obligation of the Minister of Mineral Resources and Energy to safely manage radioactive waste disposal and related waste management activities on a national basis. In this regard NRWDI operates within a well-defined legislative and governance framework (see Figure 4) and international conventions pertaining to the management and disposal of radioactive waste. Its mandate and powers are deliberated through Sections 5 and 6 of the NRWDIA.

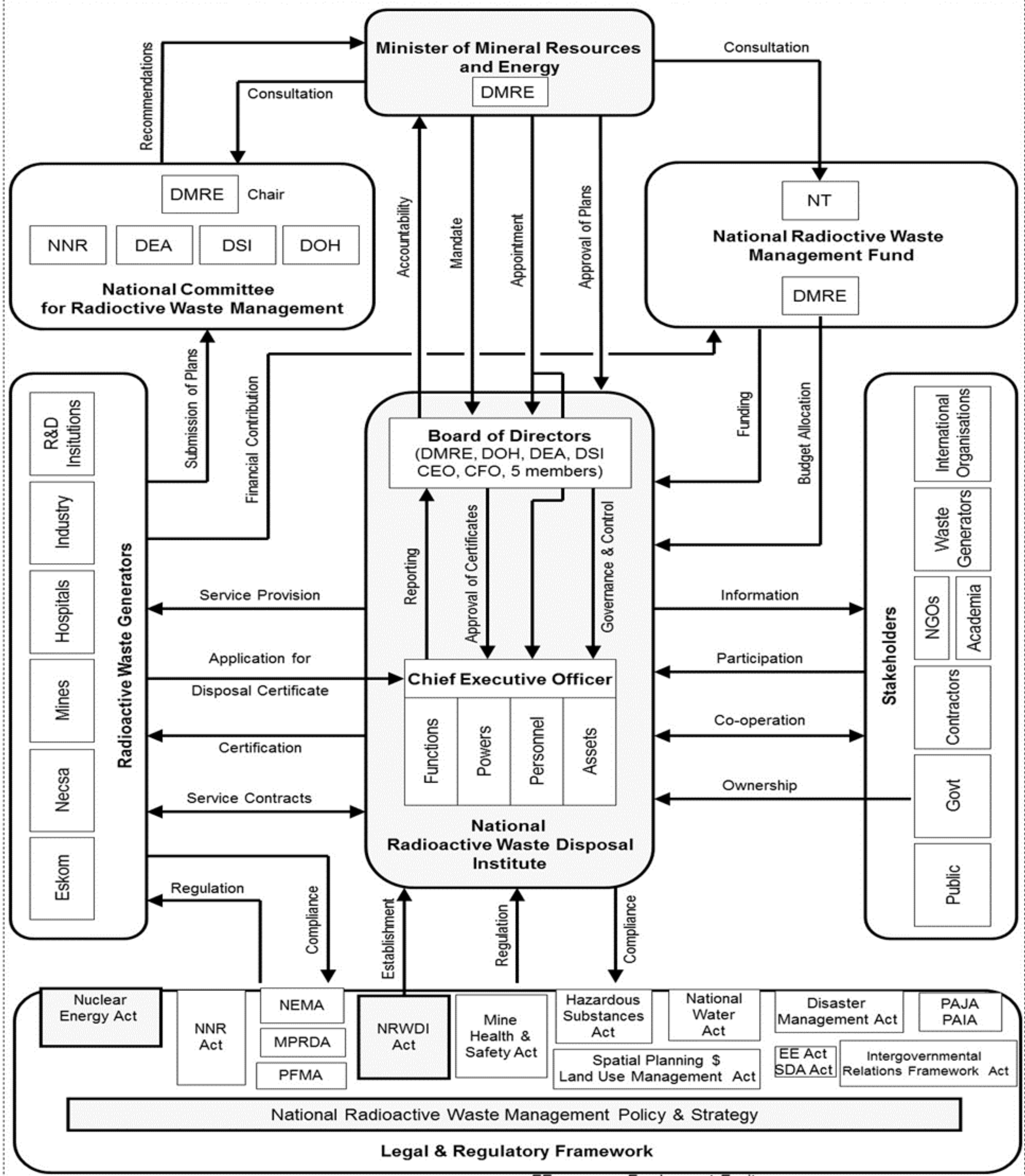
As a State-owned Entity (SOE), NRWDI is also governed by the Public Finance Management Act, Act 1 of 1999 (as amended by Act 29 of 1999) and is listed as Schedule 3A public entity. The governance of NRWDI is entrusted to a Board of Directors appointed in accordance with Section 7 of the NRWDIA, with the Minister of Mineral Resources and Energy being the Executive Authority responsible for NRWDI.

The Chief Executive Officer is appointed by the Minister of Mineral Resources and Energy in terms of Section 15 of the NRWDIA and is the Accounting Officer for the NRWDI. The CEO is responsible for ensuring that functions of NRWDI are performed in accordance with the NRWDIA and the Public Finance Management Act. The CEO holds office for a period not exceeding three years and may be reappointed upon expiry of that term of office.

The functional mandate of NRWDI in accordance with the NRWDIA is as follows:

- Perform any function that may be assigned to NRWDI by the Minister in terms of section 55(2) of the Nuclear Energy Act in relation to radioactive waste disposal;
- Design and implement disposal solutions for all classes of radioactive waste;
- Develop radioactive waste acceptance and disposal criteria in compliance with applicable regulatory, health, safety, and environmental requirements and any other technical and operational requirements;
- Assess and inspect the acceptability of radioactive waste for disposal and issue radioactive waste disposal certificates;

- Manage, operate and monitor operational radioactive waste disposal facilities, including related storage and predisposal management of radioactive waste at disposal sites;
- Manage and monitor closed radioactive waste disposal facilities;
- Investigate the need for any new radioactive waste disposal facilities and site, design and construct such new facilities as may be required;
- Conduct research and develop plans for the long-term management of radioactive waste storage and disposal;
- Maintain a national radioactive waste database and publish a report on the inventory and location of all radioactive waste in the Republic at a frequency determined by the Board of Directors;
- Manage the disposal of any ownerless radioactive waste on behalf of the State, including the development of radioactive waste management plans for such waste;
- Assist generators of small quantities of radioactive waste in all technical aspects related to the disposal of such waste;
- Implement any assignments or directives from the Minister regarding radioactive waste disposal;
- Provide information on all aspects of radioactive waste disposal to the public in general, living in the vicinity of radioactive waste disposal facilities;
- Co-operate with any person or institution on matters relating to the performance of any duty contemplated in this section falling within these functions; and
- Any other function necessary to achieve the objectives of NRWDIA.



Abbreviations / Acronyms

CEO	Chief Executive Officer
CFO	Chief Financial Officer
DEA	Department of Environmental Affairs
NT	National Treasury
DOH	Department of Health
DMRE	Department of Mineral Resources and Energy
DSI	Department of Science and Innovation
EE	Employment Equity
MPRDA	Minerals and Petroleum Resources Development Act
NEMA	National Environmental Management Act
NNR	National Nuclear Regulator
NRWDI	National Radioactive Waste Disposal Institute
PFMA	Public Finance Management Act
PAJA	Promotion of Administrative Justice Act
PAIA	Promotion of Access to Information Act
SDA	Skills Development Amendment

Figure 4: Legislative and regulatory environment within which NRWDI operates.

Figure 5 details the approved NRWDI organisational structure. While the NRWDI organisation is maturing and in the process of filling vacancies, NRWDI will make use of external technical support consultants in some technical areas, both locally and internationally, where in-house expertise is not readily available.

In line with the provisions of Section 30 (8) of the NRWDIA, Necsa continues to manage and operate the Vaalputs National Radioactive waste Disposal Facility until such time that the nuclear installation license had been issued to NRWDI.

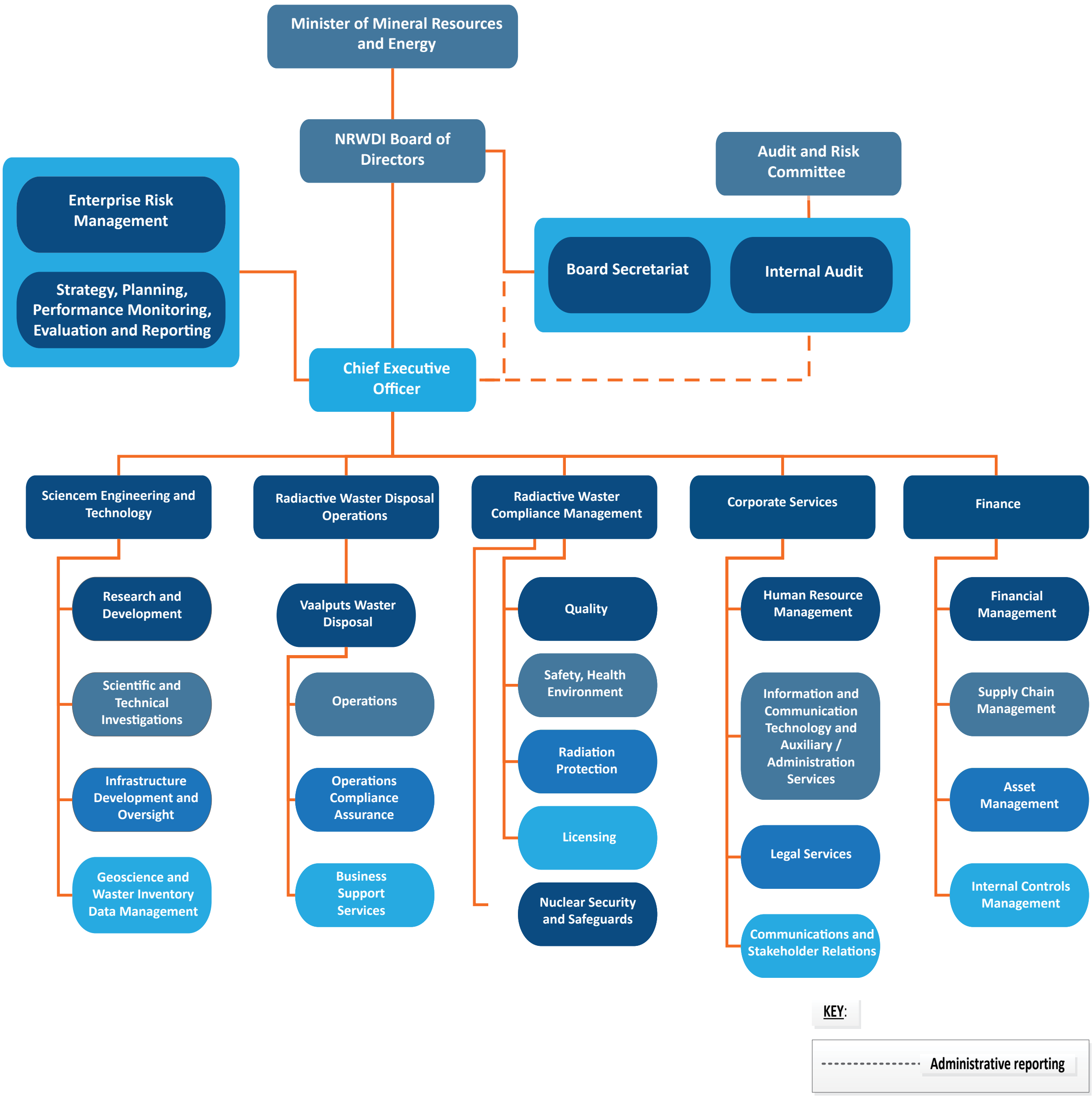


Figure 5: NRWDI Organisational Structure

B-5. SPENT FUEL MANAGEMENT POLICY

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 as a strategic asset.

The Policy and Strategy for the Republic of South Africa prescribes the framework within which used fuel shall be managed in South Africa. Used nuclear fuel is currently stored in licensed facilities on the waste generator's site. The two radioactive waste storage mechanisms, currently being used in South Africa, are dry and wet storage.

The Policy and Strategy gives focus on the need to investigate various options for the safe management of used fuel and high-level waste, such as:

- Long-term above-ground storage in an off-site facility licenced for this purpose;
- Reprocessing, conditioning and recycling;
- Deep geological disposal;
- Transmutation.

South Africa is not actively pursuing investigations into transmutation but is observing international developments in this regard. It is required that the choice of the most suitable option must take due cognisance of policy principles and objectives. Policy and Strategy indicates that the preferred waste management option shall be based on the best available technology not entailing excessive cost. All conclusions on investigations shall be subject to public consultation.

The South African policy indicates that disposal is the ultimate endpoint for radioactive waste and that is consistent with the current international recommendation for long term radioactive waste management. In line with several studies conducted and international consensus and as indicated in the Policy and Strategy, disposal of used fuel in deep geological repository is the preferred option.

B-6. SPENT FUEL MANAGEMENT PRACTICES

In South Africa, two mechanisms (dry and wet storage) are currently in use for the management of used fuel.

Used fuel from the Koeberg is currently stored in authorised used fuel pools on site (see Figure 6), as well as in casks designed and constructed for the storage of used fuel. The current capacity for wet storage on site is 1 350 storage spaces for used fuel assemblies per used fuel pool and the current capacity for dry storage on site is 112 used fuel assemblies.

The facilities for wet storage and dry storage at Koeberg are described in Appendices A1-1.1 and A1-1.2 respectively.

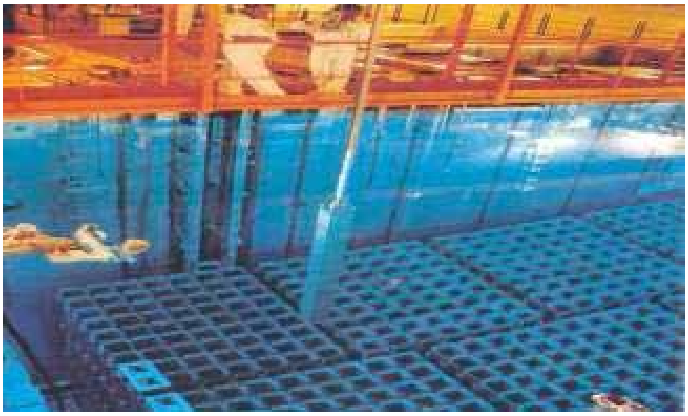


Figure 6: Used fuel pool at Koeberg

Additional used fuel storage capacity will be required due to a need to increase the energy output at Koeberg and to extend the operating lifetime of the two units at Koeberg from the current 40 years to a possible 60 years. To this end, the power utility Eskom is seeking to expand the current dry storage capacity at Koeberg in the short term. The planned increase in used fuel dry storage capacity on-site is discussed in Section G-2.3. An off-site centralised interim storage facility (CISF), for used fuel, is also being contemplated.

The used fuel from the SAFARI-1 Research Reactor is initially stored in the reactor pool for at least two years to facilitate cooling of the used fuel prior to it being cropped before shipment to the Thabana Pipe Store, an authorised dry storage facility on the Pelindaba site. The used fuel is transported to the Thabana Pipe Store in a transport cask specifically designed for this purpose. The Thabana Pipe Store is described in Annex A1-2.2.

The storage capacity of the Thabana Pipe Store was increased in 2007. Currently the facility has 60 storage pipes, rendering a total storage capacity of 1 200 fuel elements. The South African Nuclear Energy Corporation (Necsa), operator of the SAFARI-1 Research Reactor and the Thabana Pipe Store, have applied to the Regulator (NNR) for a proposed further expansion of the Thabana Pipe Store. The application is currently being reviewed by the NNR.

B-7. CRITERIA USED TO DEFINE AND CATEGORISE RADIOACTIVE WASTE

The National Radioactive Waste Classification Scheme (Table 4) establishes the criteria used to define and classify radioactive waste, as well as the generic waste treatment/conditioning requirements and possible disposal/management options.

Necsa uses a radioactive waste categorization process to segregate waste in terms of origin or specific source material, a combination of radiological, chemical, mechanical, thermal and biological properties and waste class. These characteristics are used to categorise the wastes in order to determine the applicable processing technology that will be used to render the final waste matrix acceptable for packaging, storage and final disposal. The aim of this categorization scheme is to:

- Allow for sorting of waste in terms of origin and similar properties or characteristics that dictate the waste management process;
- Ensure that wastes with similar properties and characteristics follow similar waste management processing steps and are subjected to similar waste endpoints;
- Ensure standardization of the waste management and waste handling processes;
- Allow for optimization of the waste management process where there are different waste producers;
- Support nuclear liability assessment of wastes.

At Koeberg, a waste management procedure is in place for the categorization and segregation of waste. Waste is categorised according to the physical, chemical and radiological properties of the waste to establish the need for further adjustment, treatment, conditioning, or its suitability for further handling, processing, storage or disposal. The method employed at Koeberg to group various types of radioactive waste according to their characteristics is aligned with the national classification systems. LILW-SL includes, spent resins, evaporator concentrates, filters, metallic objects, sludge and miscellaneous waste which are categorized according to the activity and dose rate in order to be placed in the appropriate containers.

NORM authorisation holders are required to establish radioactive waste management programmes for the management of waste emanating from their operations. The programme must include categorization of waste. Categorization of NORM waste is based on both activity concentrations for homogenous waste and on surface contamination for non-homogenous waste.

Table 4: National radioactive waste classification scheme

Waste Class	Waste Description	Waste Type/Origin	Waste Criteria	Generic Waste Treatment/Conditioning Requirements˜	Disposal/Management Options
(1) HLW	Heat-generating radioactive waste with high, long and short-lived radionuclide concentrations	(1) Used fuel declared as waste or used-fuel recycling products (2) Sealed sources	(1) Thermal power > 2 kW/m³ OR (2) Long-lived alpha, beta and gamma-emitting radionuclides at activity concentration levels > levels specified for LILW-LL OR (3) Long-lived alpha, beta and gamma emitting radionuclides at activity concentration levels that could result in an inherent intrusion⁺ dose (the intrusion dose assuming the radioactive waste is spread on the surface) above 100 mSv per annum	Waste package suitable for handling, transport and storage (storage period in order of 100 years). The waste form shall be solid with additional characteristics as prescribed for a specific repository	(1) Regulated Deep Disposal (100s of meters) (2) Reprocessing, conditioning and Recycling (3) Long-term above-ground storage
(2) LILW-LL	Radioactive waste with low or intermediate short-lived radionuclide and intermediate long-lived radionuclide concentrations	(1) Irradiated uranium (isotope production) (2) (3) Un-irradiated uranium (nuclear fuel production). (4) (5) Fission and activation products (nuclear power generation and isotope production) (6) Sealed sources	(1) Thermal power (mainly due to short-lived radio nuclides (T ½ < 31 y) <2 kW/m3) AND (2) Long-lived alpha radio nuclides (T ½ > 31 y) concentrations o Alpha: < 4000 Bq/g o Beta and gamma: <40000 Bq/g (Maximum per waste package up to 10 x the concentration levels specified above) **OR** (3) Long-lived alpha, beta and gamma emitting radionuclides at activity concentration levels that could result in an inherent intrusion dose (the intrusion dose assuming the radioactive waste is spread on the surface) between 10 and 100 mSv per annum	Waste package suitable for handling, transport and storage (storage period in order of 50 years). The waste form shall be solid with additional characteristics as prescribed for a specific repository	(1) Regulated medium depth disposal (10s of meters) (2) Managed as NORM-E-Waste (unirradiated uranium)

˜Treatment and conditioning requirements are mainly dependent on specific waste type in a waste class.

⁺Intrusion refers to human actions that affect the integrity of a disposal facility and which could potentially give rise to radiological consequences. Only those human actions that result in direct disturbance of th disposal facility (i.e. the waste itself, the engineered barrier materials and repository host environment) are considered.

Waste Class	Waste Description	Waste Type/Origin	Waste Criteria	Generic Waste Treatment/Conditioning Requirements˜	Disposal/Management Options
(3) LILW-SL	Radioactive waste with low or intermediate short-lived radionuclide and/or low long-lived radionuclide concentrations.	(1) Un-irradiated uranium (nuclear fuel production). (2) (3) Fission and activation products (nuclear power generation and isotope production) (4) Sealed sources	(1) Thermal power (mainly due to short-lived radio nuclides (T½ < 31 y) <2 kW/m3) AND (2) Long-lived alpha radionuclides (T ½ > 31 y) concentrations o Alpha: < 400 Bq/g o Beta and gamma: <4000 Bq/g (Maximum per waste package up to 10 x the concentration levels specified above) OR (3) Long-lived alpha, beta and gamma emitting radionuclides at activity concentration levels that could result in an inherent intrusion dose (the intrusion dose assuming the radioactive waste is spread on the surface) below 10 mSv per annum	Waste package suitable for handling, transport and storage (storage period in order of 10 years). The waste form will be solid with additional characteristics as prescribed for a specific repository	(1) Regulated near surface disposal (2) Managed as NORM-E-Waste (unirradiated uranium)
(4) VLLW	Radioactive waste containing a very low concentration of radioactivity	(1) Contaminated or slightly radioactive material originating from operational and decommissioning activities	(1) Concentration or authorised discharge or reuse criteria and levels approved by the relevant regulator	Waste stream-specific requirements and conditions	(1) Clearance (2) Authorized disposal discharge or reuse

Waste Class	Waste Description	Waste Type/Origin	Waste Criteria	Generic Waste Treatment/Conditioning Requirements˜	Disposal/Management Options
(5) NORM-L (Low activity)	Potential radioactive waste containing low concentrations of NORM	(1) Mining and minerals processing. (2) Fossil fuel electricity generation. (3) Bulk waste – unirradiated uranium (nuclear fuel production)	(1) Long-lived radionuclide concentration: <100 Bq/g.	Unpackaged waste in a miscible form	(1) Reuse as underground backfill material in an underground area (2) Extraction of any economically recoverable minerals, followed by disposal in any mine tailings dam or other sufficiently confined surface impoundment (3) Authorised disposal (4) Clearance
(6) 6 NORM-E (enhanced activity)	Radioactive waste containing enhanced concentrations of NORM	(1) Scales (2) Soils contaminated with scales	(1) Long-lived radio nuclide concentration > 100 Bq/g.	Packaged or unpackaged waste in a miscible or solid form with additional characteristics for a specific repository	(1) Reuse as underground backfill material in an identified underground area (2) Extraction of any economically recoverable minerals, followed by disposal in any mine tailings dam or other sufficiently confined surface impoundment (3) Regulated deep or medium-depth disposal

Section C

SCOPE OF APPLICATION

SECTION C: SCOPE OF APPLICATION

Article 3. Scope of Application

1. This Convention shall apply to the safety of spent fuel management when the spent fuel results from the operation of civilian nuclear reactors. Spent fuel held at reprocessing facilities as part of a reprocessing activity is not
covered in the scope of this Convention unless the Contracting Party declares reprocessing to be part of spent fuel management.
2. This Convention shall also apply to the safety of radioactive waste management when the radioactive waste results from civilian applications. However, this Convention shall not apply to waste that contains only naturally occurring radioactive materials and that does not originate from the nuclear fuel cycle, unless it constitutes a disused sealed source or it is declared as radioactive waste for the purposes of this Convention by the Contracting Party.
3. This Convention shall not apply to the safety of management of spent fuel or radioactive waste within military or defence programmes, unless declared as spent fuel or radioactive waste for the purposes of this Convention by the Contracting Party. However, this Convention shall apply to the safety of management of spent fuel and radioactive waste from military or defence programmes, if and when such materials are transferred permanently to, and managed within exclusively civilian programmes.
4. This Convention shall also apply to discharges as provided for in Articles 4, 7, 11, 14, 24 and 26.

C-1. USED FUEL AND REPROCESSING

The options currently being investigated as part of the South African long-term waste management strategy for used fuel includes reprocessing, conditioning and recycling. The National Backend Strategy will provide the strategic intent of the government of South Africa in the management of HLW and used fuel.

Necsa is undertaking preliminary investigations into recovery of uranium from aluminide target plate residues. Currently there are no formal reprocessing, conditioning or recycling of used fuel being undertaken at present.

While South Africa continues to monitor international developments with regard to the possible transmutation of used fuel, there is no current investigation or research into this option taking place in South Africa. This option and the reprocessing are not considered to be financially viable at this stage.

The used fuel, arising from both Koeberg and the SAFARI-1 Research Reactor, falls under the scope of application of this National Report.

C-2. THE SAFETY OF RADIOACTIVE WASTE MANAGEMENT

The scope of the Policy and Strategy 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 (NNR or SAHPRA).

The safety of radioactive waste management is applied to all phases of regulated nuclear practices in South Africa. These include the following:

- The operation of nuclear reactors and other facilities within the nuclear fuel cycle;
- The production and use of radioactive materials in the fields of research, medicine, industry, agriculture, commerce and education;
- The extraction, processing and combustion of raw materials containing naturally occurring radioactive materials (NORM);
- Decommissioning and environmental restoration programmes associated with any of the above.

As such, South Africa's reporting under the Joint Convention relates to all types of radioactive waste within the scope of the Policy and Strategy, including radioactive waste that contains only Natural Occurring Radioactive Material (NORM), irrespective of whether such waste arises from within the fuel cycle or not.

C-3. SAFETY OF SPENT FUEL AND RADIOACTIVE WASTE FROM MILITARY OR DEFENCE PROGRAMMES

The Republic of South Africa no longer has active military or defence nuclear programmes. South Africa voluntarily discarded its former nuclear weapons programme and acceded to the Treaty on the Non-Proliferation of Nuclear Weapons on 10 July 1991. The objective of the treaty is to prevent the spread of nuclear weapons; facilitate peaceful nuclear cooperation between treaty members; and provide a foundation for nuclear disarmament.

Furthermore, the Pelindaba Treaty (also referred to as the African Nuclear Weapons Free Zone Treaty) prohibits the production of nuclear weapons in the African region. The Pelindaba Treaty was opened for signature on 11 April 1996 and all 53 African Union members (including the Republic of South Africa) signed the treaty.

C-4. DISCHARGES

Radioactive liquid and gaseous effluent discharges, which are permitted to be routinely released into the environment under the authority of the relevant regulators (NNR or SAHPRA), are reported on under the Joint Convention.

The regulatory annual effective dose limit prescribed by the NNR for members of the public from authorised actions is 1 mSv per annum. No action may be authorised which would give rise to any member of public receiving a radiation dose from all authorised actions exceeding 1 mSv per annum.

In accordance with the Regulations on Safety Standards and Regulatory Practices (SSRP), published as Regulation No. R388 dated 28 April 2006, the public doses resulting from effluent discharges (both liquid and gaseous) must comply with the dose constraint of 0.25 mSv/a and the system of Annual Authorised Discharge Quantities (AADQs) applicable to the site.

Section D

INVENTORIES AND LISTS OF USED FUEL AND DIOACTIVE WASTE MANAGEMENT FACILITIES

SECTION D: INVENTORIES AND LISTS OF USED FUEL AND RADIOACTIVE WASTE MANAGEMENT FACILITIES

Article 32. Reporting, paragraph 2

1. This report shall also include:

   i. a list of the spent fuel management facilities subject to this Convention, their location, main purpose and essential features;

   ii. an inventory of spent fuel that is subject to this Convention and that is being held in storage and of that which has been disposed of. This inventory shall contain a description of the material and, if available, give information on its mass and its total activity;

   iii. a list of the radioactive waste management facilities subject to this Convention, their location, main purpose and essential features;

   iv. an inventory of radioactive waste that is subject to this Convention that:

      a. is being held in storage at radioactive waste management and nuclear fuel cycle facilities;

      b. has been disposed of; or

      c. has resulted from past practices.

This inventory shall contain a description of the material and other appropriate information available, such as volume or mass, activity and specific radionuclides;

   v. a list of nuclear facilities in the process of being decommissioned and the status of decommissioning activities at those facilities.

D-1. LIST OF SPENT FUEL MANAGEMENT FACILITIES

A list of used fuel management facilities, their location, main purpose and essential features are presented in Section L: Annex 1.

D-2. USED FUEL INVENTORIES

The inventories of used fuel from Koeberg and the SAFARI-1 Research Reactor are currently stored at the Koeberg and Pelindaba sites respectively and are detailed in Section L: Annex 2.

D-3. LIST OF RADIOACTIVE WASTE MANAGEMENT FACILITIES

The list of radioactive waste management facilities (storage and disposal), including their location, main purpose and essential features, are detailed in Section L: Annex 3.

D-4. INVENTORY OF RADIOACTIVE WASTE

The inventories of radioactive waste in storage facilities at Koeberg, are presented in Section L: Annex 4.

The inventories of radioactive waste at Necsa operated storage facilities are presented in Section L: Annex 5.

The inventories of radioactive waste disposed at Vaalputs National Radioactive Waste Disposal Facility are presented in Section L: Annex 6

A description of the radioactive waste generated by NORM facilities and inventories of radioactive waste associated with such facilities are presented in Section L: Annex 7.

A description of the radioactive waste generated at iThemba Labs and inventories thereof are presented in Section L: Annex 8.

D-5. LIST OF NUCLEAR FACILITIES IN THE PROCESS OF BEING DECOMMISSIONED

A list of Necsa nuclear facilities in the process of being decommissioned, as well as the status of decommissioning activities, is detailed in Section L: Annex 9.

Section E

LEGISLATIVE AND REGULATORY SYSTEMS

SECTION E: LEGISLATIVE AND REGULATORY SYSTEMS

E-1. IMPLEMENTING MEASURES

Article 18: Implementing Measures
Each Contracting Party shall take, within the framework of its national law, the legislative, regulatory and administrative measures and other steps necessary for implementing its obligations under this Convention.

E-2. LEGISLATIVE AND REGULATORY FRAMEWORK

Article 19: Legislative and Regulatory Framework

1. Each Contracting Party shall establish and maintain a legislative and regulatory framework to govern the safety of spent fuel and radioactive waste management.
2. This legislative and regulatory framework shall provide for:
   (i) the establishment of applicable national safety requirements and regulations for radiation safety;
   (ii) a system of licensing of spent fuel and radioactive waste management activities;
   (iii) system of prohibition of the operation of a spent fuel or radioactive waste management facility without a licence;
   (iv) a system of appropriate institutional control, regulatory inspection and documentation and reporting;
   (v) the enforcement of applicable regulations and of the terms of the licences;
   (vi) a clear allocation of responsibilities of the bodies involved in the different steps of spent fuel and of radioactive waste management.
3. When considering whether to regulate radioactive materials as radioactive waste, Contracting Parties shall take due account of the objectives of this Convention.

E-2.1. LEGISLATIVE AND REGULATORY FRAMEWORK TO GOVERN THE SAFETY OF SPENT FUEL AND RADIOACTIVE WASTE MANAGEMENT

The South African legislative framework on nuclear energy dates back to 1948, when the predecessor of the present Necsa, namely the AEB, 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.

The Uranium Enrichment Corporation (UCOR) was established in 1970, in terms of the provisions of the Uranium Enrichment Act, (Act No. 33 of 1970). This allowed the enrichment of uranium by a state corporation separate from the AEB but subject to licensing by the latter.

The 1976 amendment of the Hazardous Substances Act, (Act No 15 of 1973) (HSA) mandated the National Department of Health with regulatory responsibility for Group III Hazard Substances (involving exposure to ionising radiation emitted from equipment).

Milestones in the South African Radioactive Waste Management Legislative Framework

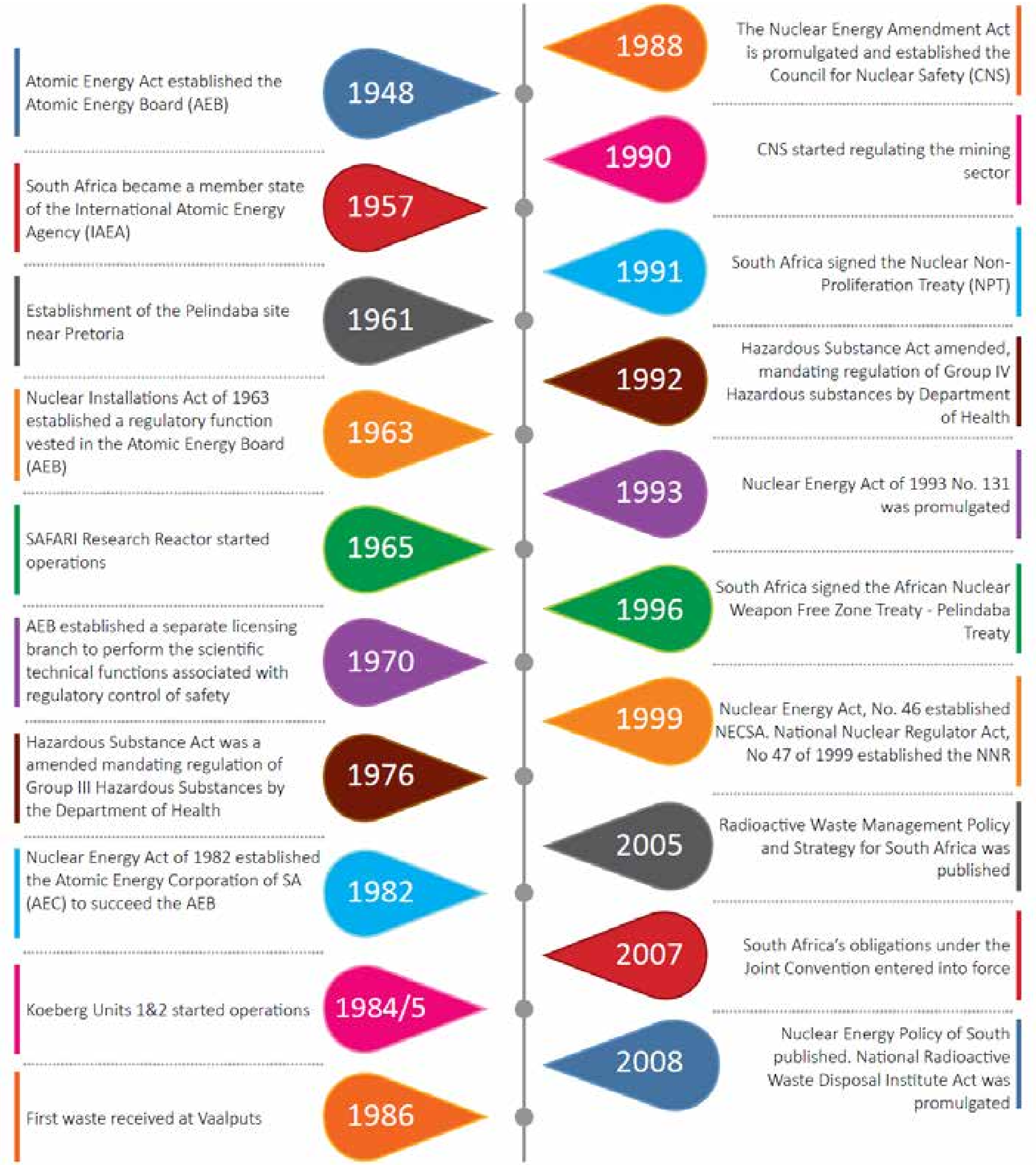


Figure 7: Milestones in South African radioactive waste management legislative framework

A major change took place in 1982, when the AEC was established and made responsible for all nuclear matters, including uranium enrichment. This change was mandated by the provisions of the Nuclear Energy Act, 1982 (Act No. 92 of 1982). In 1988, a major amendment to the Nuclear Energy Act (Nuclear Energy Amendment Act, 1988 (Act No. 56 of 1988)), mandated the establishment of the autonomous CNS, responsible for nuclear licensing and separate from the AEC.

The HSA was amended in 1992 to provide that the NDoH would undertake regulatory responsibility for Group IV Hazardous Substances. Group IV Hazardous substances include radioactive material that is not at nuclear installations or not part of the nuclear fuel cycle, for example fabricated radioactive sources and medical isotopes.

The old Nuclear Energy Act was replaced by a new Act in 1993 (Nuclear Energy Act, 1993 (Act No. 131 of 1993)). This maintained the autonomous character of the CNS, but made provision for the implementation of the Safeguards Agreement with the IAEA, pursuant to the requirements of the Nuclear Non-Proliferation Treaty to which South Africa acceded in June 1991.

At present, the nuclear sector in South Africa is governed by the Nuclear Energy Act, 1999 (Act No. 46 of 1999) (NEA) and the National Nuclear Regulator Act, 1999 (Act No. 47 of 1999) (NNRA), which superseded the previous Nuclear Energy Act 1993 (Act No. 131 of 1993). The Department of Mineral Resources and Energy (DMRE) administers these Acts.

The NDoH administers HSA and Medicines and Related Substances Act, 1965 (Act No. 101 of 1965 as amended by Act 72 of 2008 and Act 14 of 2015) (MRSA), related to Group III and Group IV hazardous substances.

In terms of section 46 of the Nuclear Energy Act, 1999 (Act No. 46 of 1999), the discarding of radioactive waste and storage of irradiated nuclear fuel require the written permission of the Minister of Energy and are subject to any conditions that the Minister of Energy, in concurrence with the Minister of Environmental Affairs and the Minister of Water Affairs, may impose. The conditions so imposed will be additional to any conditions contained in a nuclear authorisation, as defined in the National Nuclear Regulator Act, 1999 (Act No. 47 of 1999).

The governance and regulation of radioactive waste management is also subject to the provisions of the following other acts:

- National Radioactive Waste Disposal Institute Act, 2008 (Act No. 53 of 2008) (NRWDIA);
- Minerals and Petroleum Resources Development Act, 2002 (Act No. 28 of 2002) (MPRDA);
- Mine Health and Safety Act, 1996 (Act No. 29 of 1996) (MHSA);
- National Water Act, 1998 (Act No. 36 of 1998) (NWA);
- Water Services Act, 1997 (Act No. 108 of 1997) (WSA);
- The Dumping and Sea Control Act, 1980 (Act No.73 of 1980).
- Environment Conservation Act, 1998 (Act No. 73 of 1989) (ECA);
- Environment Conservation Amendment Act, 2003 (Act No. 50 of 2003) (ECAA);
- National Environmental Management Act, 1998 (Act No. 107 of 1998) (NEMA); and
- National Environmental Management: Integrated Coastal Management Act 2008 (Act No. 24 of 2008) (NEM: ICMA);

E-2.2. LEGISLATIVE AND REGULATORY FRAMEWORK

E-2.2.1. NATIONAL SAFETY REQUIREMENTS AND REGULATIONS FOR RADIATION SAFETY

The NNRA provides the NNR with a mandate t° establish and enforce national standards in the areas of radiological health, safety and environmental protection.

In terms of the NNRA, the NNR formulated national safety standards and regulatory practices, which were recommended by the NNR Board to the Minister of Energy. The Safety Standards and Regulatory Practices (SSRP), Regulation R 388 of 2006, was published on 28 April 2006 and these regulations are being enforced on all nuclear authorisation holders in the country. These regulations are based on international safety standards and regulatory practices, and provide for criteria and requirements related to exclusion, exemption and regulation of facilities and activities involving radioactive material.

Other regulations published by the Minister of Energy, in terms of the NNRA, include the following:

- The regulations on the keeping of a record of all persons in a nuclear accident defined area – Regulation R 778 of 2006;
- The regulations on the content of the Annual Report on the Health and Safety related to Workers, the Public and the Environment – Regulation R 716 of 2006;
- The regulations on the Establishment of Public Safety Information Forums – Regulation 968 of 2008;
- The regulations on Cooperative Governance in respect of the monitoring and control of radioactive material or exposure to ionising radiation – Regulation 709 of 2002;
- The regulations on the Prescribed Format for the Application for a Nuclear Installation Licence or a Certificate of Registration or a Certificate of Exemption – Regulation 1219 of 2007;
- The regulations on the Licensing of Sites for New Nuclear Installations – Regulation 927 of 2011.

The Hazardous Substances Act, 1973 (Act No. 15 of 1973), as amended, makes provision for the Minister of Health to establish the following regulations:

- Authorising, regulating, controlling, restricting or prohibiting the manufacture, modification, importation, storage, transportation or dumping and disposal of any grouped hazardous substance or class of grouped hazardous substance;
- Providing for the appointment of such committees as may be considered necessary for the purpose of advising the Director-General on any matter concerning any Group III or Group IV hazardous substances;
- Regarding safety standards in connection with the importation into and exportation from the Republic; the

manufacture, packing, disposal, dumping, sale, serving, applying, administering or the use of grouped hazardous substances; and the manner in which such standards shall be brought to the notice of persons concerned in any of the said activities in respect thereof, and in general with regard to any matter which the Minister considers necessary or expedient to prescribe or regulate in order to attain or further the objects of the Act.

In terms of the above provisions, the Minister of Health published regulations relating to Group IV Hazardous Substances – Regulation GN.R.247 – dated 26 February 1993.

E-2.2.2. LICENSING OF SPENT FUEL AND RADIOACTIVE WASTE MANAGEMENT ACTIVITIES

The authorisation processes are defined in South African legislation (NNRA, NEA, HSA, MRSA). Prior to the granting of an authorisation, the applicant is required to apply to the relevant regulator (Minister of Mineral Resources and Energy, NNR or SAHPRA), in the prescribed format, detailing the intended activities and providing a demonstration of the safety and compliance with the requirements and regulations. The documentation submitted must address safety in the design of any facilities concerned and safety in the way the facility will be constructed, commissioned, operated, maintained and decommissioned or closed.

In accordance with the provisions of section 21 of the NNRA:

"Any person wishing to site, construct, operate, decontaminate or decommission a nuclear installation may apply in the prescribed format to the chief executive officer for a nuclear installation licence and must furnish such information as the board requires."

The above therefore represents the logical licensing stages that are applicable to any nuclear installation. The applicant may, however, choose to combine individual stages. Such a combination of stages may be approved by the NNR, subject to the applicant ensuring that all the necessary safety documentation, relevant to the combined stages, has been submitted.

The combination of licensing stages needs to be established with a view to streamlining and scheduling the licensing process. Allowance must be made for assessments that may prove to be time-consuming. The applicant must produce a safety case for each licensing stage or combination of licensing stages. Based on the applicant's proposal for the combination of licensing stages, the NNR may impose hold and/or witness points. The applicant must not proceed beyond an imposed hold or witness point without prior NNR approval.

A safety case is a collection of safety arguments and evidence in support of the safety of a facility or action. The safety case provided must identify and characterise all sources of radiation associated with the facility and all possible exposure pathways that may arise from such sources under both normal operating conditions and accident situations.

The NNR undertakes an evaluation of the submitted documentation to ensure that the action or facility will meet the standards and requirements. From the evaluation, conditions are identified for inclusion in the nuclear authorisation.

The authorisation conditions represent a framework within which the applicant or holder of the nuclear authorisation is obliged to adhere to particular requirements in respect of siting, design, construction, operation, maintenance and decommissioning or closure. The conditions of authorisation also oblige the holder of the authorisation to provide a demonstration of compliance by the submission of routine and non-routine reports.

Typical conditions included in a nuclear authorisation address:

- The description and configuration of the authorised facility or action;
- Restrictions on siting and activities that can be undertaken prior to issue of a construction license;
- Restrictions related to construction, installation functional testing of SSC's and commissioning of plant;
- Requirements in respect of modification to facilities;
- Operational requirements in the form of operating technical specifications, procedures or programmes as deemed appropriate;
- Maintenance testing and inspection requirements;

- Operational radiation protection programmes;
- Radioactive waste management programmes;
- Emergency planning and preparedness requirements as deemed appropriate;
- Physical security;
- The transport of radioactive material;
- Quality assurance;
- Reporting.

In accordance with the requirements of the National Environmental Management Act, 1998 Act No. 107 of 1998) (NEMA), an environmental assessment has to be conducted prior to the construction of a used fuel management or radioactive waste management facility. Furthermore, the Environment Conservation Amendment Act, 2003 (Act No. 50 of 2003) (ECAA) prescribes that no person may establish, provide or operate a disposal site without a permit issued by the Minister of Environmental Affairs.

E-2.2.3. PROHIBITION OF THE OPERATION OF A SPENT FUEL OR RADIOACTIVE WASTE MANAGEMENT FACILITY WITHOUT A LICENCE

The legislative system prohibits the operation of a used fuel or radioactive waste management facility without appropriate authorisation.

The NNRA prohibits the following:

- The siting, construction, operation, decontamination or decommission of a nuclear installation, except under the authority of a Nuclear Installation Licence.
- The undertaking of any action not requiring a Nuclear Installation Licence or a Nuclear Vessel Licence, except under the authority of a Certificate of Registration or a Certificate of Exemption.

The HSA provides that no person shall produce, otherwise acquire or dispose of or import into the Republic or export from there, or be in possession of, or use or convey or cause to be conveyed, any Group IV Hazardous Substance, except in terms of a written authority issued by the Director-General of the NDoH.

In accordance with the provisions of the Nuclear Energy Act, 1999 (Act No. 46 of 1999, the discarding of radioactive waste and storage of irradiated nuclear fuel require the written permission of the Minister of Energy and are subject to such conditions that the Minister, in concurrence with the Minister of Environmental Affairs and the Minister of Water Affairs, deems fit to impose. The conditions so imposed will be additional to any conditions contained in a nuclear authorisation as defined in the NNRA.

Furthermore, NEMA requires that:

- all facilities, activities or processes involving radioactive material or nuclear fuel;
- the establishment of new or the expansion of existing facilities concerned with the production, enrichment, reprocessing, storage or disposal of nuclear fuels and wastes; must be subjected to an Environmental Impact Assessment (EIA) and may not be constructed or operated without a permit issued by the Minister of Environmental Affairs.

E-2.2.4. INSTITUTIONAL CONTROL, REGULATORY INSPECTIONS AND DOCUMENTATION AND REPORTING

The nuclear authorisation requires the holder to develop and maintain a documented safety case, which demonstrates compliance with the requirements of the applicable act and regulations, and which includes as a minimum the following:

- A detailed description of the plant and site;
- The scope of activities to be undertaken;
- Specifications of systems, structures and components that are important to safety;
- Onsite and off- site environmental factors or components that are relevant to nuclear and radiation safety;
- A plant operational safety assessment, including associated nuclear and radiation safety rules, criteria, standards and requirements relevant to the safety assessment;
- Operational safety related programmes and limiting conditions of operations, including:
  - o a programme for compliance with dose and risk limits as deemed appropriate;
  - o a programme to ensure that nuclear installations are built and operated in accordance with good engineering practice and international norms and standards;
  - o a programme for incident and accident management. including emergency planning, preparedness and response measures;
  - o a quality management programme; o a system of records and reporting; o a radiation protection programme;
  - o a radioactive waste management programme;
  - o a programme for the transport of radioactive material;
  - o an environmental monitoring and surveillance programme; and
  - o a programme for decommissioning.

The holder of a nuclear authorisation is responsible for ensuring that all operational safety-related programmes are formally documented and implemented accordingly. Furthermore, in terms of the provisions of the NNRA, the holder of a nuclear authorisation is required to implement an inspection programme to ensure compliance with the requirements of the nuclear authorisation, as well as to provide any information or report as required by the NNR, which includes:

- reports on problem, incident and accident notification, investigation and closeout;
- quality assurance and audit reports, including closeout reports;
- environmental monitoring reports; and
- reports on liquid and gaseous effluent discharges.

The NNR conducts independent compliance assurance activities to determine the extent to which holders of nuclear authorisations comply with the conditions of authorisation. The nature of the NNR's compliance assurance activities is commensurate with the nature of authorisation issued and the risk posed by the facility or action. The compliance assurance activities involve a combination of audits, routine inspections, non-routine inspections, a review of routine reports and a review of occurrence reports.

The NNR compiles an annual Compliance Assurance Plan (CAP), which specifies the facilities and aspects to be inspected. The CAP also specifies the frequency and the number of inspections to be conducted at each facility. These inspections provide assurance of compliance with the regulatory provisions related to radioactive waste management and the safety of used fuel management at authorised facilities.

Similarly, with regard to facilities and activities regulated by SAHPRA, SAHPRA conducts independent compliance assurance activities to verify compliance to the conditions in the issued permits. SAHPRA uses a graded approach in its compliance assurance activities. Higher risk facilities are inspected more frequently than those that pose a lower risk.

Facilities and activities regulated by SAHPRA are also required to submit prescribed reports to the regulator.

E-2.2.5. ENFORCEMENT OF APPLICABLE REGULATIONS AND OF THE TERMS OF THE LICENCES;

Offences, and the appropriate sanctions for the commission of such offences, are contained in the NNRA. The NNR may, in terms of the NNRA, revoke an authorisation at any time. It is furthermore empowered to impose such conditions, as it deems necessary for preventing nuclear damage, upon the holder of the relevant authorisation during his period of responsibility as defined.

E-2.2.6. A CLEAR ALLOCATION OF RESPONSIBILITIES OF THE BODIES INVOLVED IN THE DIFFERENT STEPS OF SPENT FUEL AND OF RADIOACTIVE WASTE MANAGEMENT

The Policy and Strategy clearly defines the responsibilities of government, regulatory bodies, as well as those of generators of radioactive waste and operators of radioactive waste disposal facilities. Furthermore, the Policy and Strategy makes provision for the establishment of a NCRWM to oversee the implementation of the national Policy and Strategy on radioactive waste management, as well as the establishment of NRWDI.

To give effect to cooperative governance, as per the Constitution of the Republic, the NNR and the following government departments are represented on the NCRWM:

- DMRE;
- The Department of Environment, Forestry and Fisheries (DEFF);
- The Department Health;
- The Department of Water and Sanitation;

In accordance with the provisions of section 6 of the NNRA, the NNR is required to enter into cooperative governance agreements with other organs of state that have overlapping regulatory functions or responsibilities. The purpose of these agreements is to:

- ensure the effective monitoring and control of the nuclear or radiation hazard;
- co-ordinate the exercise of such functions;
- minimise the duplication of such functions and procedures regarding the exercise of such functions; and
- promote consistency in the exercise of such functions.

E-3. THE ESTABLISHMENT OF A REGULATORY BODY

Article 20: Regulatory Body

1. Each Contracting Party shall establish or designate a regulatory body entrusted with the implementation of the legislative and regulatory framework referred to in Article 19, and provided with adequate authority, competence and financial and human resources to fulfil its assigned responsibilities.
2. Each Contracting Party, in accordance with its legislative and regulatory framework, shall take the appropriate steps to ensure the effective independence of the regulatory functions from other functions where organizations are involved in both spent fuel or radioactive waste management and in their regulation.

E-3.1. NATIONAL NUCLEAR REGULATOR (NNR)

The NNR is the national authority 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 ionising radiation.

The NNR, established as an independent juristic person in terms of the provisions of the NNRA, comprises of a Board of Directors, a Chief Executive Officer and staff members. The NNR's mandate and authority are conferred through sections 5 and 7 of the NNRA, which detail the objects and functions of the NNR.

The powers of the NNR, in terms of the NNRA, embrace all actions aimed at providing confidence and assurance that the risks arising from the undertaking of actions involving radioactive material to which the NNRA applies, remain within acceptable safety limits. In practice, this resulted in the NNR establishing safety standards and regulatory practices, including probabilistic risk limits and derived operational standards; conducting proactive safety assessments; determining conditions of authorisation; and obtaining assurance of compliance therewith.

The competence of the NNR is ensured by both its autonomous establishment and its funding provisions, which consist of monies appropriated from Parliament; fees paid to the NNR in respect of nuclear authorisations; and donations or contributions received by the NNR with the approval of the Minister.

E-3.1.1. ORGANISATION OF THE NNR

The structure of the NNR is depicted in Figure 8 below.

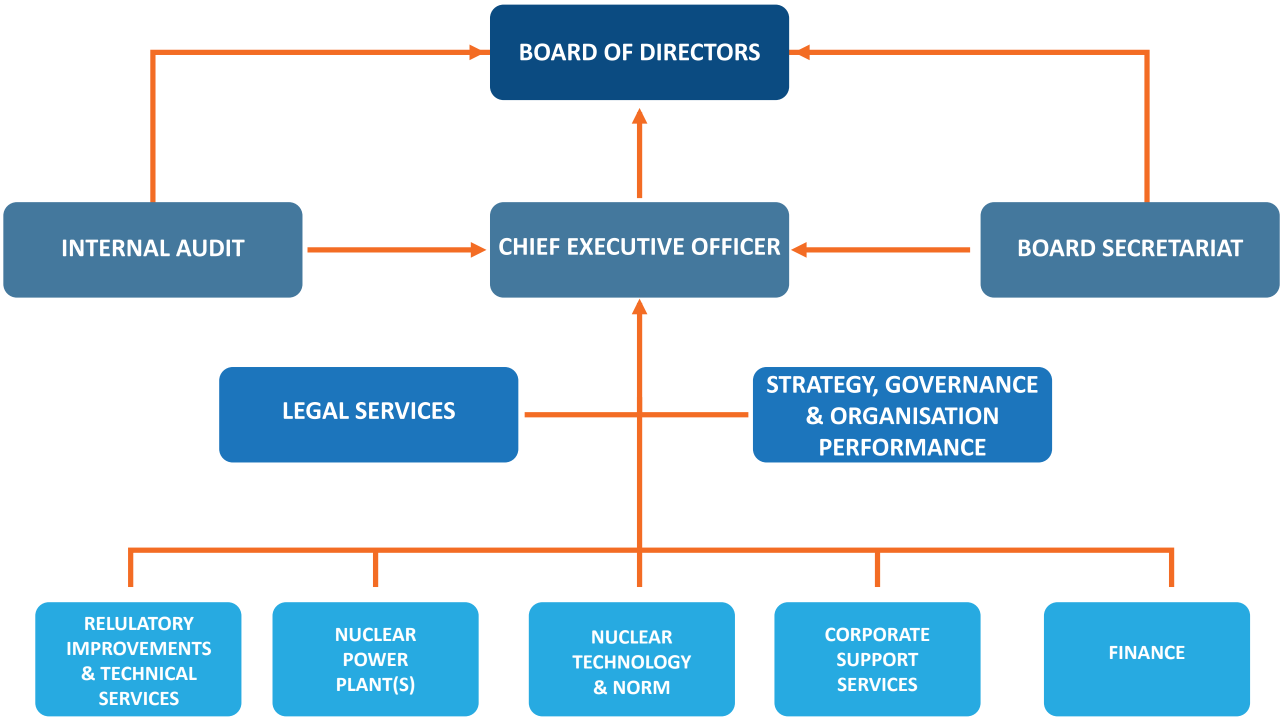


Figure 8: NNR organisational structure

THE BOARD OF DIRECTORS:

The Executive of the regulatory body reports to a Board of Directors, which is appointed by the Minister of Energy. The Board consists of twelve (12) directors, including an official from the DMRE, an official from the Department of Environmental Affairs, a representative of organised labour, a representative of organised business, a representative of communities who may be affected by nuclear activities, and up to seven (7) other directors who hold office for a period not exceeding three (3) years. The directors are eligible for re-appointment at the end of their term of office. The Chief Executive Officer of the NNR is a member of the Board of Directors.

A person is disqualified from being appointed to or remaining a director of the Board if such person, inter alia:

- is a holder of a nuclear authorisation or an employee of such holder;
- becomes a Member of Parliament, a provincial legislature, a Municipal Council, the Cabinet or the Executive Council of a province.

THE CHIEF EXECUTIVE OFFICER:

The Chief Executive Officer is appointed by the Minister of Energy and is also a member of the Board. The Chief Executive Officer has the responsibility to ensure that the functions of the Regulator are performed in accordance with the NNRA and the Public Finance Management Act, 1999 (Act No. 29 of 1999) (PFMA) The Chief Executive Officer holds office for a period not exceeding three years, as specified in the letter of appointment and may be reappointed upon expiry of that term of office.

NNR FUNCTIONAL STRUCTURE:

The functional structures of the NNR were developed with the objective of:

- Promoting efficiency;
- Promoting effectiveness; and
- Enhancing the organisation's ability to integrate/collaborate.

The NNR is organised in such a way as to ensure that it is capable of discharging its responsibilities and fulfilling its functions effectively and efficiently. The following sections provide an overview of the NNR's functional structure

Nuclear Power Plant (NPP) Division:

The Nuclear Power Plant division's mandate is to provide assurance of compliance with conditions of authorisation through a system of compliance inspections, audits and investigations as part of the provision of efficient and effective nuclear regulatory services. This is in accordance with the NNR Act, which requires that a compliance assurance programme be implemented. This division undertakes and implements assurance activities at authorised facilities and enforces compliance. Reviews and assessments are also carried out within the division. The division effects its mandate by means of a structure that covers projects, inspections and assessments. Major projects that involve plant modifications are licensed through the NPP Projects department. Compliance assurance activities for all conditions of each licence inform the CAP that is followed by the nuclear power plant. Outages, incidents and applications during the course of the year will trigger inspections, and reviews and assessments by the NPP division. These actions can also result from an observation during a plant walkdown. On occasion, non-compliances require more than just a corrective action, but a thorough investigation.

Nuclear Technology and NORM (NTN) Division:

The NTN division consists of the Naturally Occurring Radioactive Material (NORM) and Nuclear Technology and Waste Projects (NTWP) business units.

The mandate of the NORM business unit is to contribute to compliance assurance and to develop and implement standards with regard to regulatory processes, e.g. inspections, authorisations and enforcement. This includes processing new applications, issuing licences, collecting environmental samples, reviewing safety case documentation, and conducting investigations, inspections, reviews and assessments.

The mandate of the NTWP business unit is to conduct inspections, investigations, and reviews and assessments within the context of the NNR's compliance regime. NTWP is tasked with implementing compliance assurance and enforcement activities for a specific category of facilities in an effort to ensure the protection of people, property and the environment against nuclear damage. The main facilities that fall under this category are the Pelindaba site and the Vaalputs National Radioactive Waste Repository. Any other matter that deals with nuclear technology, and which is not associated with NPPs and NORM, primarily falls within the NTWP division.

Regulatory Improvement and Technical Services (RITS) Division:

The RITS division consists of six (6) business units being:

- Emergency Planning and Response (EPR);
- Environment and Radiation Protection (ERP);
- Engineering Services (ES);
- Regulations, Standards and Projects (RSP);
- the Centre for Nuclear Safety and Security (CNSS); and
- the laboratory.

The RITS division provides strategic leadership and management in delivering regulatory improvement services to all the technical programmes of the NNR through its cross-cutting and in-depth review and assessment capabilities. The division offers technical expertise in emergency preparedness and response, laboratory services, nuclear safety and security culture, development of regulatory standards and nuclear projects, and the co-ordination of nuclear security activities.

The division conducts in-depth reviews and assessments in the areas of waste management, environment and radiation protection, transporting radioactive materials and issuing nuclear vessel licences, engineering services, and independent verification by computer codes.

The laboratory unit within RITS provides radio analytical services for various radionuclides (NORM and artificial radionuclides) from environmental samples such as water, sediments, soil and biological samples for independent verification purposes. This also requires the maintenance and calibration of portable instruments and the co-ordination of personal and environmental thermoluminescence dosimeters (TLD) to ensure that the laboratory discharges its analytical services and functions effectively.

The environmental surveillance programme includes the independent verification and radiological environmental analysis of samples collected around NNR regulated facilities such as Koeberg Nuclear Power Station, Necsa and the mining and minerals processing facilities.

A key component of this division is the regulatory research and development that is conducted on emerging issues regarding nuclear and radiation safety housed under the CNSS. The CNSS was established to develop capabilities in order to improve regulatory practices related to nuclear safety and security. By developing necessary skills and capacity, the CNSS will attempt to address the anticipated nuclear safety and security needs of the regulatory body as well as those of the nuclear industry at large.

The CNSS collaborates with academic, research and other relevant institutions in order to execute any activities that fall within the mandate of the NNR and to maximise the use of available resources.

Its ultimate objective is to enable the NNR to be self-sufficient in fulfilling its own mandate and to develop human capital and build necessary skills and capacity in nuclear safety and security, thereby contributing to the implementation of national strategies and policies, as well as ensuring that the NNR maintains its efficiency and effectiveness.

The CNSS executes its mandate through the following four main programmes:

- Education and Training: Formulates and implements effective education and training programmes with the aim of creating a pipeline of skills, thereby increasing the number of nuclear science and engineering professionals with adequate competencies in radiation protection, nuclear safety and security.
- Regulatory Research and Development: Facilitates the development and execution of regulatory research and development activities.
- Technical and Scientific Support: Provides technical and scientific support and/or expert advice or any other service in the fields of nuclear safety and security.
- Strategic Partnerships: Forms partnerships and collaborations with various local and international partners based on the hub-and-spoke model.

Corporate Support Services (CSS):

This CSS Division provides strategic leadership and direction in the areas of Human Resources, Physical Security, Information and Communications Technology (ICT), Knowledge and Quality Management, Integrated Management Systems, Change Management, Communication and Stakeholder Relations as well as Facilities and Occupational Health and Safety. The primary focus of this Division is to ensure efficient processes and resources in support of the organisation's strategic objectives.

Financial Management:

This Financial Management Division provides strategic leadership to manage and direct the finances of the NNR. The management function includes financial planning, financial reporting, effective supply chain processes, efficient usage of public funds, safeguarding of assets and enforcing adherence to applicable legislation. The division also provides oversight over the implementation of financial systems that support robust systems of internal control.

Internal Audit:

Internal Audit provides assurance to stakeholders that the NNR operates in a responsible manner by:

- Evaluating the organisation's governance process;
- Performing an objective assessment of the effectiveness of risk management and the internal control framework; and
- Systematically analysing and evaluating business processes and associated controls.

Legal, Compliance and Risk:

This function provides the NNR with comprehensive legal advice and support on legal matters, ensures compliance with applicable prescripts and legislation, and assists with the development of legislative provisions and regulations. This division is also responsible for risk management, which is a systematic and formalised process instituted by the NNR in order to identify, assess, manage and monitor risks.

Strategy, Governance and Organisational Performance:

The purpose of this function is twofold:

- it ensures the effective and efficient functioning of the board, its committees and all other internal governance principles and practices.
- it ensures the formulation, development and planning of the organisation's strategy by the board and the executive in order to enable the execution of its mandate in line with the Act.

The function also monitors and evaluates the organisation's performance at both strategic and operational levels, providing performance-enhancing solutions that address performance gaps to aid in the attainment of performance targets and intended outcomes. These solutions include the implementation of appropriate quality management systems and operational excellence tools.

This function also provides the NNR with consistent standard project management methodology. The project management office strives to introduce best practice principles and standardise project management tools and techniques to assist the NNR in achieving its strategic objectives through delivery of projects.

E-3.1.2. HUMAN RESOURCES

The NNR plays a pivotal role in overseeing the effective regulation of the nuclear industry and maintaining high safety standards.

Through its Human Resources Policy and Processes, the NNR seeks to:

- Provide a basis for efficient and effective human resource management;
- Balance the interests of employees with that of the organisation;
- Ensure fair, equitable and legally compliant human resource practices and
- Provide tools and standards for organisational excellence.

In order to ensure that regulatory staff possess the necessary qualifications, skills, knowledge, attributes and competence to carry out its regulatory mandate the NNR approaches the management of talent in an integrated manner. At the core of this approach lies the identified key competences for all regulatory staff. Key competencies have been identified using an adapted form of SARCoN (IAEA-TECDOC-1757) Methodology for the Systematic Assessment of the Regulatory Competence Needs (SARCoN) for Regulatory Bodies of Nuclear Installations.

Figure 9 below illustrates how competence management is integrated into all human resource related processes. The identified competencies for each role in the organisation will thus inform recruitment decisions, job evaluation, training and development gaps and priorities etc. In addition, the NNR is currently running projects to determine the optimal functional structure and staffing needs of the organisation taking into account national and international benchmarks.

Figure 9: NNR Competence Management Model

To ensure the continued attraction and retention of high performing staff, the NNR developed its own job evaluation system, which provides a relative ranking for all roles in the organisation taking into account the scaled and weighted factors detailed in Table 5.

Table 5: Scaled and weighted factors for job evaluation

Factor
Span of Control
Span of Accountability
Span of Influence
Span of Change
Strategic Input
Problem Solving and Impact of Decisions
Time Horizon
Communication
Organisational Dependence
Dealing with Complexity
Mindfulness
Depth of Knowledge
Breadth of Knowledge

Salaries are benchmarked every three years to ensure competitiveness of the NNR remuneration compared to the market. As part of its capacity building initiatives the NNR also seeks to develop its own future talent pool through the internship and bursary programmes. Training and development of its staff is a key priority for the NNR to ensure that staff are exposed to the latest information, technology and trends.

The structural depth of the NNR (see Figure 10) follows the shape of a diamond:

- Layer 1 is made up of the CEO and Executives;
- Layer 2 is made up of line management;
- Layer 3 is made up of professionals and technical employees; and
- Layer 4 is made up of technical staff in training and administrative employees.

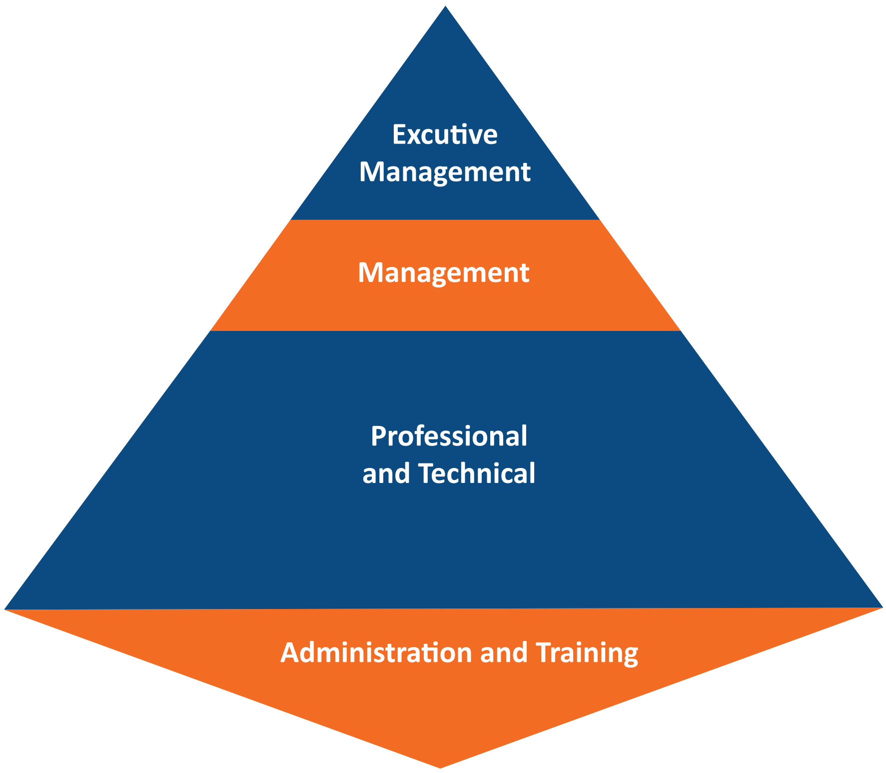


Figure 10: NNR Structural Depth Shape

The NNR has increased its staff by approximately 40% over the last 3 years. The overall, the staff complement of the NNR comprises:

- Management (32);
- Technical/Professional staff (104); included technical admins, researchers, and interns; and
- Support staff (41).

E-3.1.3. FINANCIAL RESOURCES

The provisions in section 17 of the NNR Act requires that the funds of the Regulator consist of:

- Money appropriated by Parliament;
- Fees paid to the Regulator in terms of section 28; and
- Donations or contributions received by the Regulator, with the approval of the Minister, from any source.

The funds of the NNR and the determination of authorisation fees are governed by the NNR funding model which is underpinned by the following principles:

- The authorisation fee must incorporate the full costs associated with the planned regulatory activities, as well as the costs associated with direct and indirect support to regulatory activities.
- The fee must be aligned to the regulatory actions as determined by the level of hazards or risk (graded approach) presented by the action being carried out by the authorisation holders.
- The fee must be in accordance with the appropriate legislation, including National Treasury regulations.
- The fee must be levied annually and billed quarterly, monthly or on whatever basis that may be agreed upon between the nuclear authorisation holders and the NNR.
- The fee must provide for sustainable cost recovery systems and financial provisions.

Regulatory activities covered by the funding model

The funding model provides for the following:

- Planned direct regulatory activities;
- Authorisation activities;
- Reviews and assessments;
- Compliance assurance inspections and audits; and
- Development of regulatory standards and guides.

Costs associated with direct and indirect support to regulatory activities include the following:

- Investigations and enforcements;
- Management, human resources, and finance;
- ICT services and the preparation of documents, including policies, standards, guides, procedures and notices;
- Training services (internal and external);
- Infrastructure management and maintenance;
- Travelling and related costs; and
- Personnel costs.

Proactive regulatory activities and special projects (e.g. commissioning nuclear expansion projects) include the following:

- Processing new applications; and
- Training and development related to new technologies.

E-3.2. SAHPRA

The Division Medical Devices and Radiation Control, within SAHPRA, administers the Hazardous Substances Act, 1973 (Act No. 15 of 1973), related to Group III hazardous substances (involving electronic generators of ionizing radiation) and Group IV hazardous substances (radioactive sources and radioactive material used outside nuclear installations or not part of the nuclear fuel cycle, for example as applied in medicine, industry and research and education).

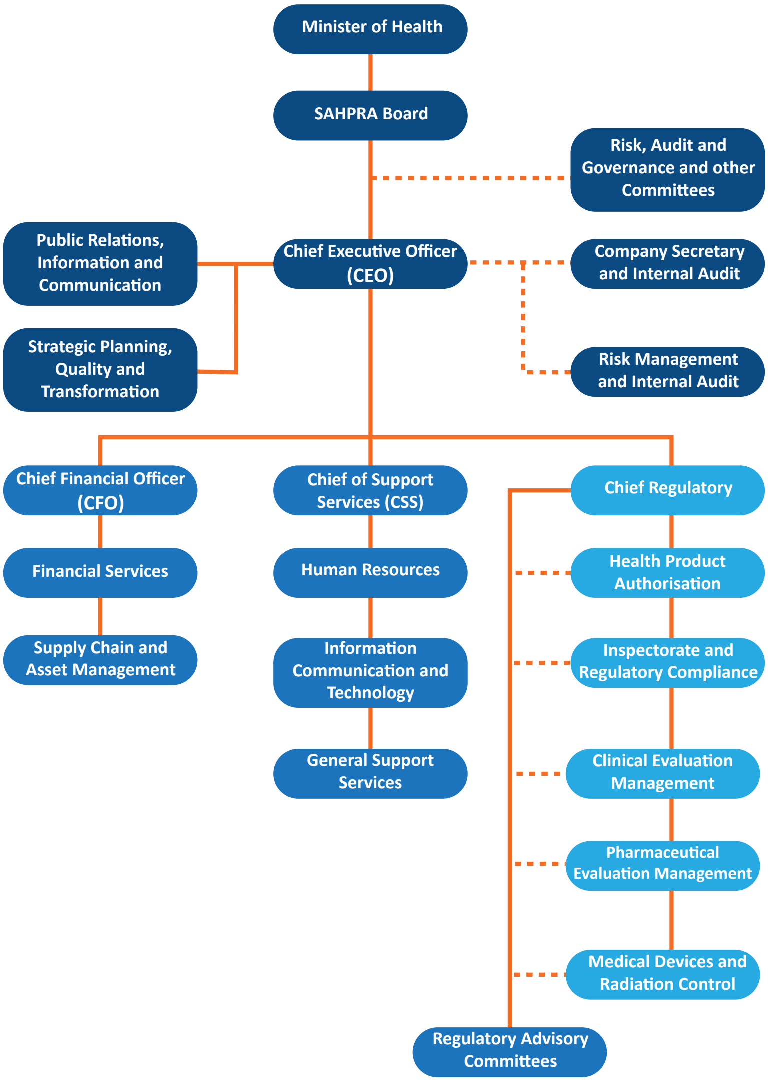


Figure 11: Organisational structure and reporting lines for SAHPRA

SAHPRA applies regulatory requirements, for the control of radioactive sources, through a system of regulations, conditions to licenses, codes of practices and regulatory guides. The Radiation Control processes applications and issues licenses to sell, install, possess and use Group III products as well as authorizations to acquire, produce, possess, import, export, use, transport, sale and disposal of Group IV hazardous substances (sealed and unsealed radioactive sources) in terms of the Hazardous Substance Act.

E-3.2.1. HUMAN RESOURCES

The SAHPRA programme division Medical Devices and Radiation Control has a staff compliment of 42 comprising:

- Management (5);
- Technical/Professional staff (11); and
- Support staff (13).

E-3.2.2. FINANCIAL RESOURCES

Financial resources for SAHPRA are comprised of monies appropriated from Government, revenues generated from fees levied and interest earned.

E-3.3. INDEPENDENCE OF THE REGULATORY FUNCTION

NNR

The independent authority of the NNR is de jure entrenched in the NNRA, subject to the extent that powers are conferred on the Minister of Energy to appoint the governing, non-executive Board of Directors and the Chief Executive Officer.

The NNR operates independently from government in terms of carrying out its mandate, which ensures that public health is assured for all South Africans who are exposed to the dangers of nuclear and radiation hazards. The purpose of this independence is to ensure that regulatory decisions can be made free of other interests that may conflict with safety. The NNRA makes provision for a comprehensive appeals process. Further, the NNRA specifically forbids any representative of an authorisation holder or political structure from being appointed as a Director of the Board or as Chief Executive Officer.

With regard to the de facto independence of the NNR, the NNRA provides that, if the Minister rejects a recommendation of the Board on the contents of Regulations to be published, the Minister and Board must endeavour to resolve their disagreement. Although, in the absence of a resolution to such disagreement the Minster has the power to make the final decision. No failure to resolve the disagreement has thus far emerged, regarding the relevant recommendations by the Board.

The NNR is directly accountable to Parliament, through the Minister of Energy, on nuclear and radiation safety issues and operates independently from government, to the extent that it is able to carry out its mandate without undue influence being brought upon it. South Africa is satisfied that the regulatory body is effectively independent, consistent with the recommendations of the IAEA as published in GSR Part 1. The recent regulatory self-assessment and IAEA integrated Regulatory Review Services (IRRS) mission however, recommended aspects that could strengthen this regulatory independence.

These include the following:

- Allocation of adequate financial resources on the part of Government;
- Strengthening the existing provision that the publication of regulations, related to safety standards and regulatory practices, must be on the recommendation of the NNR Board.

The process of revising the NNRA to give effect to these recommendations has been initiated.

SAHPRA

Similar to the NNR:

- SAHPRA is established as an independent regulatory body in terms of the Medicines and Related Substances Act, 1965 (Act No. 101 of 1965), as amended.
- The SAHPRA reports to the SAHPRA Board, which comprises of not more than ten (10) persons appointed by the Minister of Health.

SAHPRA is responsible for the regulation of health products intended for human and animal use; the licensing of manufacturers, wholesalers and distributors of medicines, medical devices, radiation emitting devices and radioactive nuclides; and the conduct of clinical trials. SAHPRA's mandate was expanded to include the regulation and control of radiation emitting devices and radioactive nuclides under the Medicines Act and the Hazardous Substances Act, 1973 (Act No. 15 of 1973). Further as per Section 2(3) of the MRSAA, SAHPRA is required to perform its functions without fear, favour or prejudice.

In executing its functions, the SAHPRA may:

- Liaise with any other regulatory authority or institution and may, without limiting the generality of this power, require the necessary information from, exchange information with and receive information from any such authority or institution in respect of –
    - o matters of common interest; or
    - o a specific investigation; and
- Enter into agreements to co-operate with any regulatory authority in order to achieve the objects of the Medicines Act.

Section F

GENERAL SAFETY PROVISIONS

SECTION F: GENERAL SAFETY PROVISIONS

F-1. RESPONSIBILITY OF THE LICENCE HOLDER

Article 21: Responsibility of the Licence Holder

1. Each Contracting Party shall ensure that prime responsibility for the safety of spent fuel or radioactive waste management rests with the holder of the relevant licence and shall take the appropriate steps to ensure that each such licence holder meets its responsibility.
2. If there is no such licence holder or other responsible party, the responsibility rests with the Contracting Party, which has jurisdiction over the spent fuel or over the radioactive waste.

F-1.1. RESPONSIBILITY FOR SAFETY

The South African Regulatory Framework requires that the primary responsibility for ensuring protection of the health and safety of the workers and members of the public, as well as protection of the environment, rests with the holder of, or applicant for a nuclear authorisation. The responsibility for nuclear and radiation safety extends in an unbroken chain through the line management to the workers in the facility.

As an external "action-forcing" agency, the NNR influences the actions of the holder/applicant only to the extent necessary to ensure adequate protection of the public and worker health and safety. While the NNR may identify current and potential safety problems and offer alternative strategies for addressing each issue, resolving these safety problems remains the sole responsibility of the holder/applicant. It is recognised that regulation can bolster but never replace the commitment of line management and the workers to integrating proper health and safety practices into work planning and performance.

The NNR ensures that the nuclear authorisation holder meets its primary responsibility with regard to safety, essentially by the establishment of safety standards; the issuance of a nuclear authorisations and regulatory letters; and by a compliance assurance programme. The latter comprises inspections, surveillance and audits, as well as various forums for interaction with the authorisation holders.

These requirements include requirements for the authorisation holder to maintain effective safety-related processes, independent of production. Safe practices are achieved by ensuring that the authorisation holder complies with the conditions of the nuclear authorisation.

Holders of, and applicants for, nuclear authorisations demonstrate their compliance with regulatory requirements; health, safety and environmental legislation; permits; conditions of authorisation; national and international norms and standards; as well as via holder and applicant-specific policy and standards documents. The following aspects are generally covered in holder or applicant-specific documents:

- Safety policy and philosophy;
- Authorisation strategies;
- Integrated safety assessments;
- Identification of radioactive waste categories;
- Determination of radioactive content;
- Classification of radioactive waste;
- Processing and conditioning of radioactive waste;
- Storage and material accounting;

- Identification of waste management end points;
- Receipt, disposal and transport guidelines;
- Administrative guidelines;
- Exclusions;
- Authorisation holder inspections programmes;
- Non-compliance identification and reporting;
- Radiation protection programme and radiation dose limitation;
- Nuclear security arrangements;
- Emergency preparedness and response arrangements;
- Management of radioactive effluents, including control of radioactive discharges to the environment.

F-1.2. RESPONSIBILITY FOR USED FUEL OR RADIOACTIVE WASTE

In accordance with the legislative requirements, the holder of a nuclear authorisation, whose operations generate or have generated used fuel or radioactive waste, is responsible for all radioactive waste management measures and the associated costs, in accordance with the "polluter pays" principle.

It is a pre-condition to the granting of a nuclear authorisation that the applicant demonstrates the ability to safely manage all radioactive waste that may result from the proposed operations. Furthermore, regulatory oversight of authorised nuclear facilities and actions is accomplished in cooperation with other national agencies and regulators, in compliance with the NNRA and other applicable laws. The NNR requires a smooth transition as nuclear facilities and actions pass from one life cycle stage to the next (siting, construction, commissioning, operations, end of life, decontamination and decommissioning, including clean up, demolition and environmental restoration activities).

In terms of the Policy and Strategy, 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. At present, Necsa fulfils government's obligations in this regard, until the NRWDI has been capacitated and authorised to take over and execute this function.

F-2. HUMAN AND FINANCIAL RESOURCES

Article 22: Human and Financial Resources

Each Contracting Party shall take the appropriate steps to ensure that:

1. qualified staff are available as needed for safety-related activities during the operating lifetime of a spent fuel and a radioactive waste management facility;
2. adequate financial resources are available to support the safety of facilities for spent fuel and radioactive waste management during their operating lifetime and for decommissioning;
3. financial provision is made which will enable the appropriate institutional controls and monitoring arrangements to be continued for the period deemed necessary, following the closure of a disposal facility.

F-2.1. QUALIFIED STAFF

In accordance with the provisions of the SSRP, Regulation R 388:

"An adequate number of competent, qualified and trained staff must be responsible for carrying out the functions associated with radiation protection and nuclear safety and for maintaining an appropriate safety culture."

Therefore, the holder of a nuclear authorisation has the primary responsibility for ensuring that the employees are qualified and authorised to do their jobs. Nuclear authorisation holders are required to report to the NNR on its staffing and competency levels. Holder employee training programmes include initial, complementary and refresher training programmes.

Management at Eskom is responsible for human resources planning to fulfil corporate responsibilities in accordance with Eskom's requirements regarding resource management. The selection of operating and support staff for Koeberg and their training to provide sound judgement is essential to the safe and successful operation of the plant.

Training courses, programmes and schedules are established for Koeberg to maintain a fully qualified organisation to be responsible for operation, maintenance, technical aspects and response to emergencies in accordance with its licence, technical specifications and appropriate government regulations. All training is reviewed by management and kept up to date to reflect changes to the power station equipment and facilities, procedures, government regulations and quality assurance requirements. Nuclear industry operating experience and occurrence reports are also taken into account.

Management at Necsa is responsible for human resources planning to fulfil corporate responsibilities in accordance with Necsa's requirements for resource management. This includes the identification and provision of staff training and orientation requirements, as prescribed by their management system. Necsa implemented a knowledge management programme in order to aid the qualification and experience of the workforce.

The organisational structure for the National Radioactive Waste Disposal Institute (NRWDI) was reviewed and approved by the Board. NRWDI currently has 32 positions filled at Head Office and 19 positions filled at Vaalputs. The approved organisational structure provides for new positions that were created to ensure that NRWDI has the required and appropriate set of skills and staff compliment to discharge its functional mandate and obligations as required for the holder of a nuclear authorisation. Organisational changes that may impact on safety are submitted to the Regulator for acceptance prior to implementation.

While the NRWDI organisation is maturing and in the process of filling vacancies, NRWDI will make use of external technical support consultants in some technical areas, both locally and internationally, where in-house expertise is not readily available. Such outsourced services are systematic and controllable by NRWDI through supply chain management and technical as well as management oversight processes.

The iThemba LABS management is responsible for Human Capital planning to ensure corporate responsibilities line with the National Research Foundation (NRF) rules and guidelines are fulfilled. The NRF provides for the training and development of staff, in-house training is provided as an additional orientation mechanism to ensure regulatory and operational objectives are met.

F-2.2. FINANCIAL RESOURCES

In general, the financing of decommissioning and waste management follows the the “polluter pays” principle. In accordance with this principle, all holders of nuclear authorisations are responsible for ensuring that sufficient resources are in place to meet their responsibilities with regard to decommissioning and radioactive waste management. It is furthermore a requirement of the SSRP, Regulation R.388, that it must be demonstrated to the regulator that sufficient resources will be available from the time of cessation of the operation to the termination of the period of responsibility (release from regulatory control).

Vaalputs is currently the sole disposal facility in the country and receives low and intermediate level waste from Koeberg and Necsa. The disposal concept, involves near surface disposal in engineered trenches. Although the state financed the initial development and establishment costs of the site, Eskom and Necsa pay fees, based on the amount of radioactive material sent to Vaalputs.

The State stands as guarantor for the management of nuclear liabilities arising from the former strategic nuclear facilities on the Pelindaba site. On an annual basis Necsa receives special budgetary allocation through the Ministry of DMRE. The discharge of these nuclear liabilities involves the decommissioning and decontamination of past strategic disused nuclear facilities, the management of all historical nuclear waste as well as waste generated during the decommissioning of these facilities.

Decommissioning is currently taking place at the following facilities:

- 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) is currently being undertaken. The mining companies finance the decommissioning costs themselves

  and subcontract the operations out to specialised agencies.

Based on a 40-year operation, the decommissioning of Koeberg is currently scheduled for after 2025. 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 Koeberg, Necsa and Mines are 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 radioactive waste.

The responsibility for disposal costs associated with radioactive sources resides with the owners of the source. Authorised holders of sealed sources make financial provision for disposal of such sources through their facility decommissioning plans.

The Policy and Strategy calls for the establishment of a National Radioactive Waste Management Fund. 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;
- Funding for other activities related to radioactive waste management.

In keeping with the polluter pays principle, the contributions to the fund will come from the generators of radioactive waste. The contributions shall be managed in an equitable manner, without cross-subsidisation; and will inter alia, be based on classification of the waste and the volumes.

F-2.3. FINANCIAL PROVISION FOR POST-CLOSURE MANAGEMENT OF FACILITIES

The Policy and Strategy mandates that Government is responsible for control over and funding of closed radioactive waste disposal facilities.

A Long-Term Provision Fund for Vaalputs was established to finance the activities in the post closure institutional control period (currently anticipated to be 300 years). Regular contributions to the fund are made from the Vaalputs annual budget. The envisaged Radioactive Waste Management Fund will collection and management of funds to be used during post closure institutional control period.

Financial provision for the closure and post-closure of mining and mineral processing operations is regulated by the Directorate Mineral Resources, in terms of the Minerals and Petroleum Resources Development Act, 2002 (Act No. 28 of 2002) (MPRDA), and is funded by the mines.

F-3. QUALITY ASSURANCE

Article 23: Quality Assurance

Each Contracting Party shall take the necessary steps to ensure that appropriate quality assurance programmes, concerning the safety of spent fuel and radioactive waste management, are established and implemented.

Holders of a nuclear authorisation are required in terms of section 26 (2) of the NNRA, No 47 of 1999 to establish, implement and maintain an inspection programme. Further, one of the SSRP's principle nuclear safety requirements, is that a quality management programme must be established, implemented and maintained in order to ensure compliance with the conditions of the nuclear authorisation. The implementation of a quality management programme is required to provide adequate confidence in the validity of the operational safety assessment and safety management processes.

All holders of nuclear authorisations have a Quality Assurance Programme in place and the achievement and maintenance of quality are verified by audits, surveillance, self- assessment and peer reviews. Staff members undertaking monitoring activities are independent of direct responsibility for the activity being monitored. The detection, correction of and the taking of future preventative actions, related to non-conformances, deficiencies and deviations from quality requirements, are specified in various authorised procedures.

Management reviews are conducted on an annual basis. The inputs for management reviews are obtained from monitoring activity reports, corrective action reports, quality non-conformance reports and other reporting mechanisms. During these reviews, an assessment of the current Quality Assurance Programme is performed and the programme is amended as required. NNR audits the implementation thereof as part of the CAP.

F-3.1. QUALITY ASSURANCE AT KOEBERG

Eskom Quality Assurance (QA) Programme, including the Quality Policy Directive, is specified in the Safety and Quality Management Manual of its Nuclear Division. The QA Programme is based on the IAEA Safety Code 50-C/SG-Q, the NNR Licence Document LD-1023 and the Eskom Nuclear Division Safety and Quality Management Manual.

The licence holder, in conformance with NNR's licensing requirements, implements a comprehensive audit programme of planned, periodic monitoring of the nuclear installation. This programme is informed by indicators, which include audit findings, inspection of non-compliance, operating experience and problem reports. The audit programme is discussed with the NNR and takes into account the NNR's planned audit and inspection programme.

Achievement and maintenance of quality is verified by audits, surveillances, self- assessments and peer reviews. These are conducted in accordance with authorised procedures and are performed by certificated auditors, using approved checklists. Staff members performing monitoring activities are independent of direct responsibility for the activity being monitored.

Monitoring reports are issued and reviewed for comment by the monitored organisation. Follow-up action is taken to verify that deficiencies or discrepancies have been corrected. The results of monitoring activities and management reviews are maintained as quality assurance records. The detection, reporting, disposition and correction of non- conformance, deficiencies and deviations from quality requirements are specified in various authorised procedures. Non-conforming items are marked conspicuously and, where possible, separated from other items.

Management reviews are conducted on an annual basis. The base material for management reviews is obtained from monitoring activity reports, corrective action reports, quality non-conformance reports and other reporting mechanisms. During these reviews, an assessment of the adequacy of the current QA programme is performed and changes are made if deemed necessary.

Non-conformance of components is dispositioned as follows: Use-as-is, repair, rework or unfit-for-purpose- based on reviews and evaluations by responsible, competent engineers. Non-conformance dispositions are reviewed and accepted by the responsible management.

Conditions adverse to quality, include failures, malfunctions, deficiencies, deviations, defective material or equipment and incorrect material or equipment. Significant conditions adverse to quality involve programmatic problems, as opposed to individual failures.

Significant conditions adverse to quality are identified, the root cause of the condition is determined and corrective action is taken to prevent a repetition. The appropriate management is informed.

Permanent QA records are retained for the life of the item to which they refer. Record storage facilities were constructed to prevent damage or deterioration of records due to fire, flooding, insects, rodents and adverse environmental conditions.

F-3.2. QUALITY ASSURANCE AT Necsa

The quality activities and behavioural performance are managed by means of a process based Integrated Management System (IMS). The quality department is responsible to ensure the integrated management system is established, implemented and maintained according to ISO 9001, ISO 14001, ISO 18001 standards, and NNR Requirements Document RD 0034.

Roles and responsibilities with regards to implementation and management of the IMS processes are defined in the quality management systems manual in conformance to the dictates of the Necsa Quality policy.

The system aims to provide management with comprehensive feedback on the overall performance of the plant. Regular scheduled audits, gap analysis and inspections are conducted to determine the extent of compliance.

Annually auditors assess compliance via internal audits. Audit reports are compiled and submitted to management and assistance is provided to rectify non- conformances/deficiencies.

Activities affecting quality performance are performed in accordance to documented instructions, procedures, drawings, specifications or appropriate qualitative acceptance criteria to ensure that satisfactory results are attained. Each process is described to a level of detail commensurate with its complexity and the need to ensure consistent and acceptable results.

Quality awareness training is conducted on a continuous basis to ensure sustainable operations and to foster a culture of continual improvement.

Annual management reviews are conducted to ensure continuing suitability, adequacy and effectiveness of the system. Measurable quality objectives are established at all levels within the organisation. Skills are identified via a job matrix and the individual development programme is implemented to ensure the training needs are met. Personnel performance is measured via a balanced score card system.

F-3.3. QUALITY ASSURANCE AT VAALPUTS

Vaalputs implements an integrated management system (IMS) as required by the NNR Requirements Document RD 0034. The Vaalputs quality management system is certified ISO 9001:2015 compliant and the Vaalputs environmental management system is ISO 14001 compliant. The safety management system complies with the ISO 45001 standard.

F-3.4. QUALITY ASSURANCE AT NRWDI

The NRWDI head office has established ISO 9001:2015 quality management system (QMS) which is currently in the process of being externally certified. The QMS aims to integrate the safety, health and environmental management systems. Once completed, the Integrated Management System (IMS) will be aligned with the Vaalputs IMS. The set of QMS processes established at NRWDI include Quality policy; Control of documented information; Control of retained (inactive) documented information; Management responsibility; Management review; Work environment (health and safety of employees); Internal audit; Procedure for competence, awareness and training; Control of non-conformances, corrective and preventive action etc

The NRWDI management system is reviewed at planned intervals to ensure its continued suitability, adequacy and effectiveness and to identify opportunities for improvement. Scheduled and unscheduled internal audits are preformed to quantify compliance and to provide information on whether the management system is effectively implemented and maintained. Non-conformances are analysed to identify trends and possible recurring events. Quality training and awareness sessions are conducted on a routine basis to ensure that all staff members apply the principles of quality management and continually improve their processes.

F-3.5. QUALITY ASSURANCE AT iThemba LABS

The NRF iThemba LABS RSHEQ division is responsible for the development and maintenance of the business unit quality management system. The QMS is maintained in support of the parent organization policy commitment, to a clean, safe, and healthy environment for the benefit of the employees, contractors, service providers, and other stakeholders. The NRF commits to meeting workplace safety, health, and environmental regulated issues.

This commitment is met through a set of procedures that covers:

- Implement quality policy or set a sub-policy addressing specific operational requirements including specialist risks;
- Develop, and maintain procedures that address operational risks;
- Maintain records of safety, health, and environmental in line with the statutory record-keeping
- Managements responsibility to mitigate safety risk, including implementing corrective action plans that mitigate any identified risks not addressed in the business units' procedures;
- Manage safety, health and environmental risks in a manner that minimizes these risks and meets all the legal requirements;
- Maintain, and regularly test, emergency action plans and safety protocols;
- Train, certify and register employees and contractors up to a necessary level with respect to safety, health and the environment;
- Audit performance against procedures and report the outcomes to the Safety Health, Environment, and Risk (SHER) Manager as required.

F-3.6. QUALITY ASSURANCE AT NORM FACILITIES

Holders of NORM authorisation are required to establish, implement and maintain a quality management programme. The quality management programme calls for an organisational structure, the identification of roles and responsibilities, levels of authority, as well as communication protocols of staff members to be clearly documented.

The quality management programme entails a quality policy and objectives to be met during all phases of the operation of the facility, including decommissioning. The programme is reviewed at defined intervals by the facility's Executive Management to assess the status and adequacy of the programme. During such a review, audit and surveillance findings, system deficiencies, document discrepancies, non-conformance reports, corrective action requests and any other performance-related reporting mechanisms are evaluated to determine the extent and consequences of the deviations and their effect on the programme.

The programme calls for the establishment, implementation and authorisation of the following mandatory procedures:

- Document control procedure;
- Records control procedure;
- Non-conformance control procedure;
- Internal audit procedure;

- Corrective action procedure; and
- Preventive action procedure.

The NORM facilities ensure effective implementation of the programme by conducting internal audits and self-inspections on various conditions of the nuclear authorisation, including radioactive waste management. Furthermore, in accordance with the approved waste management programmes the NNR conducts its compliance assurance quality audits at these facilities to ensure effective implementation of the established quality management programmes.

F-4. OPERATIONAL RADIATION PROTECTION

Article 24: Operational Radiation Protection

1. Each Contracting Party shall take the appropriate steps to ensure that during the operating lifetime of a spent fuel or radioactive waste management facility:
   i. the radiation exposure of the workers and the public caused by the facility shall be kept as low as reasonably achievable, economic and social factors being taken into account;
   ii. no individual shall be exposed, in normal situations, to radiation doses which exceed national prescriptions for dose limitation which have due regard to internationally endorsed standards on radiation protection; and
   iii. measures are taken to prevent unplanned and uncontrolled releases of radioactive materials into the environment.
2. Each Contracting Party shall take appropriate steps to ensure that discharges shall be limited:
   i. to keep exposure to radiation as low as reasonably achievable, economic and social factors being taken into account; and
   ii. so that no individual shall be exposed, in normal situations, to radiation doses which exceed national prescriptions for dose limitation which have due regard to internationally endorsed standards on radiation protection.
3. Each Contracting Party shall take appropriate steps to ensure that during the operating lifetime of a regulated nuclear facility, in the event that an unplanned or uncontrolled release of radioactive materials into the environment occurs, appropriate corrective measures are implemented to control the release and mitigate its effects.

F-4.1. OPERATIONAL RADIATION PROTECTION: LEGAL FRAMEWORK

The NNRA makes provision for the NNR to impose any condition in a nuclear authorisation that is deemed necessary to ensure the protection of persons, property and the environment against the risk of nuclear damage. The fundamental radiation protection criteria are detailed in the SSRP. These include the prescribing of dose limits for workers and members of the public, as well as the setting of dose constraints for public exposure.

F-4.1.1. DOSE LIMITS

In achieving the objectives for the control of occupational exposure, the NNR requires that no individual shall receive an annual dose in excess of the prescribed dose limits and that all exposures are as low as is reasonably achievable.

The NNR has prescribed dose limits for both members of the public and the occupationally exposed workforce. These limits are detailed below:

Occupational Exposure

The occupational exposure of any worker shall be so controlled that the following limits are not exceeded:

- an (average) effective dose of 20 mSv per year averaged over five consecutive years;
- a (maximum) effective dose of 50 mSv in any single year;
- an equivalent dose to the lens of the eye of 150 mSv in a year;
- an equivalent dose to the extremities (hands and feet) or the skin of 500 mSv in a year;
- in special circumstances, provided that radiation protection in the action has been optimised, but occupational exposures still remain above the dose limit, the NNR may approve a temporary change in the dose limit, subject to the agreement of the affected employees, through their representatives where appropriate, and provided that all reasonable efforts are being made to improve the working conditions to the point where compliance with the dose limits can be achieved. This temporary change shall not exceed 5 years and shall not be renewed.

Apprentices and Students

For apprentices aged 16 to 18 years, who are training for employment, involving exposure to radiation; and for students aged 16 to 18 who are required to use sources in the course of their studies, the occupational exposure shall be so controlled that the following limits are not exceeded:

- an effective dose of 6 mSv in a year;
- an equivalent dose to the lens of the eye of 50 mSv in a year;
- an equivalent dose to the extremities or the skin of 150 mSv in a year.

Women

The annual effective dose limit for women of reproductive capacity is the same as that which is generally specified for occupational exposure. Following declaration of pregnancy, a limit on the equivalent dose to the abdomen of 2 mSv applies for the remainder of the pregnancy.

Emergencies

In the event of an emergency or when responding to an accident, a worker who undertakes emergency measures may be exposed to a dose in excess of the annual dose limit for occupationally exposed persons:

- for the purpose of saving a life or preventing serious injury;
- if undertaking actions intended to avert a large collective dose; or
- if undertaking actions to prevent the development of catastrophic conditions.

Under any of the above circumstances, all reasonable efforts must be made to keep doses to the worker below twice the maximum annual dose limit. In respect of life-saving interventions, every effort shall be made to keep doses below ten times the maximum annual dose limit. In addition, workers undertaking interventions that may result in their doses approaching or exceeding ten times the annual dose limit, may only do so when the benefits to others clearly outweigh their own risk.

Exposure of Visitors and Non-occupationally Exposed Workers at Sites

The annual effective dose limit for visitors to sites and those not deemed to be occupationally exposed, is 1 mSv. The annual dose equivalent limit for individual organs and tissues of such persons is 10 mSv.

Public Exposure

The annual effective dose limit from all authorised actions for members of the public, is 1 mSv. No action may be authorised that would give rise to any member of the public receiving a radiation dose, from all authorised actions, exceeding 1 mSv in a year. To ensure compliance with this limit, a public dose constraint of 0.25 mSv per annum is applied at authorised sites.

Holders of nuclear authorisations are required to establish complementary operational programmes, which are sufficiently comprehensive to ensure compliance with those limits. These are augmented by operational verification programmes on aspects relating to radiation protection in design, in order to ensure that the parameters of the safety assessment remain current, as well as to assist in ensuring that the operational programmes are not compromised. The necessary principles are embodied in the nuclear authorisation and radiological protection programmes of the authorisation holders.

F-4.1.2. ALARA FOR WORKERS AND THE PUBLIC

The ALARA Programmes at Eskom and Necsa are aimed at minimising radiation doses. A hazard-graded approach is used to determine safety requirements for radiation risks associated with facilities during normal operations, as well as during abnormal or accident conditions. Interdependencies between related actions and their associated risks are taken into account. During the design of a new facility or the modification of existing facilities, design objectives are set to optimise exposure protection of both workers and the public Dose optimisation is used to limit doses associated with various activities and dose constraints are set to ensure that desired levels of safety are achieved.

Doses to the public are kept ALARA, with the application of optimisation for discharges to the environment and through implementation of a system of Annual Authorised Discharge Quantities (AADQ).

NORM facilities are required to conduct Occupational and Public Radiological Safety Assessments at defined intervals to assess that doses are kept in accordance with the requirements of the ALARA principles. Radiation monitoring is conducted for both workers and the environment at NORM facilities at defined intervals.

F-4.1.3. OCCUPATIONAL DOSE CONTROLS

All holders of nuclear authorisations undertake various radiation protection actions to limit the exposure of workers and ensure compliance with the dose limits. These include: establishing a radiation protection programme; optimised design of facilities; establishing radiation and contamination control zones; a work permit system for non-standard tasks; registration of radiation workers – i.e. workers whose radiation risk profile indicates that, based on normal operations, they may receive an effective dose of 1 mSv/a or more are classified as radiation workers and will undergo the necessary dose monitoring, health evaluations and training.

The holders of nuclear authorisations maintain dose records for workers and projections of public doses, based on the quantities of effluent released. Doses that are above the reference levels for individual workers are investigated and, at higher values, interventions are implemented to limit further exposure.

In the mining industry a limited number of shafts have potential to give radiation dose exposures above the annual effective dose limit of 50 mSv/a, largely due to radon at underground operations, those mines are classified as Special Case Mines (SCMs). These authorization holders are required to put in place administrative and engineering controls to manage and reduce the levels of exposures. Administrative controls include removing of workers from underground to surface operations, or relocation of workers from high to low risk radon areas within a shaft or to another shaft. Engineering controls include ventilation systems in these shafts which are continuously being monitored and improved to reduce the dose exposure to below 50 mSv/a and as low as can reasonably be achieved.

F-4.1.4. MEASURES TO PREVENT UNPLANNED/UNCONTROLLED RELEASES

The SSRP and conditions of authorisation stipulate that the principle of defence-in-depth must be applied in the design and operation of a nuclear installation, in accordance with good engineering and international norms and practice. This includes prevention and mitigation of accidents and redundant measures to reduce the probability of discharges into the environment. The degree to which defence-in-depth is applied must take the magnitude of the hazard into account.

F-4.2. DISCHARGE CONTROL

In the SSRP, provision is made for the control of discharges to the environment:

"The NNR may, for the purposes of controlling radioactive discharges from a single authorised action, determine a source- specific Annual Authorised Discharge Quantities (AADQ) in the nuclear authorisation, which must take into account the dose constraint and links to optimisation."

The term, "discharge", is used to refer to the ongoing or anticipated releases of radionuclides arising from the normal operations of an authorised action/facility or a source within an authorised action/facility. It is a requirement that both discharges into the atmosphere and discharges into water bodies need to be addressed.

Any person applying for an authorisation for the discharge of radioactive effluents must submit the relevant information necessary to support the application, to the NNR. The application must contain an assessment of the nature, magnitude and likelihood of the exposures attributed to the discharges and an appropriate safety assessment, including an explanation of how radiological protection has been optimised and the assessed dose/risk to members of the public from the discharge of radioactive effluents as a result of normal operations.

The effectiveness of radiation protection measures for each authorised discharge, together with the potential impact of this discharge on humans and the environment, must also be assessed.

The submission must also address the issues of waste generation and management inter-dependencies. In this regard, the submission must demonstrate that the generation of radioactive wastes, in terms of activity and volume, is kept to the minimum practicable and that available options for waste disposal are taken into account, so as to ensure that a discharge into the environment is an acceptable option.

Authorised discharge limits will be issued in the form of a "discharge authorisation". A revised application for a discharge authorisation must be applied for in event of the following:

- whenever an increase in discharges or the discharge of new radionuclides is being considered; or
- whenever it is identified that a model assumption has been invalidated.

Authorisation holders are responsible for setting up and implementing the technical and organisational measures that are necessary for ensuring the protection of the public in relation to the radioactive discharges for which they are authorised.

F-4.2.1. DISCHARGE LIMITS AND REGULATORY REPORTING

Discharge authorisations are normally set in terms of annual limits. While these are the primary limits, shorter-term levels must be set in order to trigger investigations; and ensure that the procedure used and the associated conditions and assumptions used to estimate doses, remain valid – e.g. to prevent significantly higher doses being received, due to higher than normal discharges in conditions of poor dispersion in the environment.

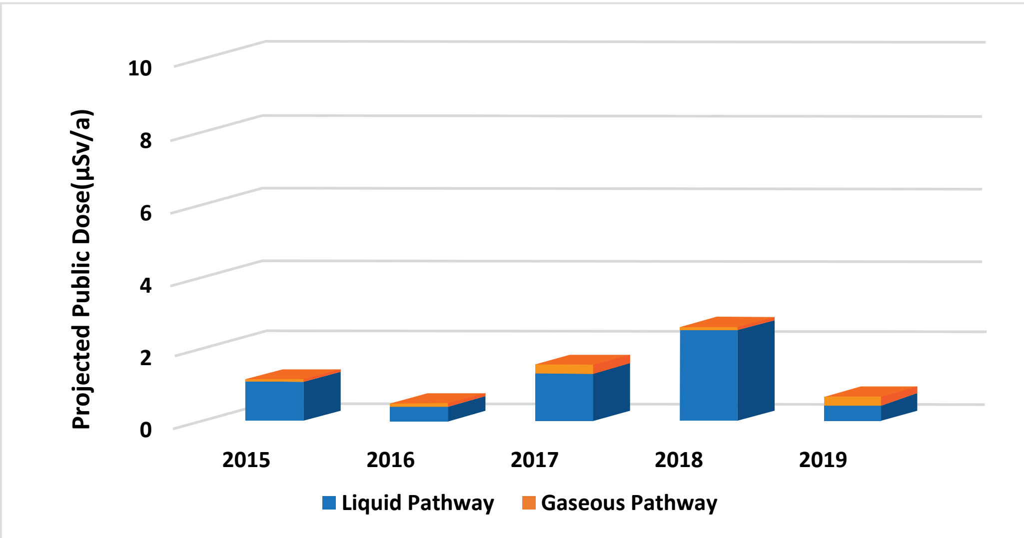
As an illustration, these levels could be set at 40% of the annual limit for a calendar quarter; 15% of the annual limit for a calendar month; or 5% of the annual limit for a week, with due cognisance taken of the nature and operation of the source. Although this is not be seen as a breach of the statutory discharge authorisation, the operator is required to:

- notify the regulatory body if the shorter-term levels are exceeded;
- state the reasons for their being exceeded; and
- propose mitigation measures.

In addition to the above and based on the model results, an appropriate set of environmental investigation/ reporting levels must be developed. The site environmental monitoring programme must take due cognisance of the predicted discharge impact and this must serve as a means of verifying model predictions. All licensees have NNR- approved programmes implemented. Adherence to the requirements is verified by the NNR through the compliance assurance programme.

Koeberg

The projected public doses, resulting from Koeberg, for the five years between 2015 and 2019, is depicted in Figure 12 below:

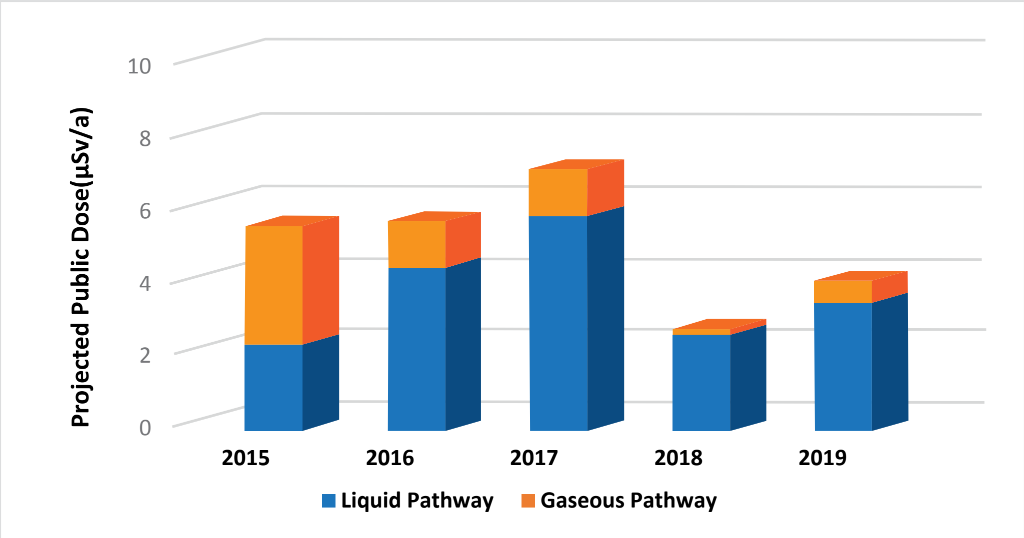


	2015	2016	2017	2018	2019
Total Projected Public Dose (µSv/a)	1.15	0.48	1.59	2.61	0.67
Gaseous Pathway (µSv/a)	0.06	0.08	0.25	0.10	0.18
Liquid Pathway (µSv/a)	1.09	0.40	1.34	2.51	0.49

Figure 12: Koeberg projected public doses for the period 2015 to 2019

Necsa

The projected public doses, resulting from the nuclear facilities on the Necsa Pelindaba site for the period 2015-2019 is depicted in Figure 13 below:



	2015	2016	2017	2018	2019
Total Projected Public Dose (µSv/a)	5.45	5.57	6.96	2.61	3.99
Gaseous Pathway (µSv/a)	3.15	1.23	1.25	0.17	0.58
Liquid Pathway (µSv/a)	2.3	4.35	5.71	2.72	3.41

Figure 13: Projected public doses from the Necsa Pelindaba site for 2015 to 2019

Mines

Some mining companies are discharging water pumped from underground operations into the streams and dams either directly as fissure water or after treatment if it is process water. The mines are required to conduct Radiological Public Safety Assessment to assess the radiological impact of water in the environment. The NNR conducts its own verification programme by collecting samples (sediment and water) at identified points around authorised sites and thereafter analysis and interpretation and compliance to the annual dose limits is verified.

At present source-specific AADQ's are not applied at mining and mineral processing facilities. The NNR is currently undertaking investigations in this regard and plans to introduce source specific AADQ's for mining and mineral processing facilities in the future.

F-4.3. UNPLANNED RELEASE OF RADIOACTIVE MATERIALS INTO THE ENVIRONMENT

The unplanned release of radioactive materials into the environment is a reportable event in terms of the conditions of authorisation. In reporting the event, the holder of a nuclear authorisation is responsible for investigating the cause of the event and determining appropriate corrective and preventative actions to be undertaken. The NNRA further gives NNR the authority to impose any condition necessary for the rehabilitation of the site or to ensure protection of persons, property and the environment from nuclear damage.

F-5. EMERGENCY PREPAREDNESS

Article 25: Emergency Preparedness

1. Each Contracting Party shall ensure that before and during operation of a spent fuel or radioactive waste management facility there are appropriate on- site and, if necessary, off-site emergency plans. Such emergency plans should be tested at an appropriate frequency.
2. Each Contracting Party shall take the appropriate steps for the preparation and testing of emergency plans for its territory insofar as it is likely to be affected in the event of a radiological emergency at a spent fuel or radioactive waste facility in the vicinity of its territory.

F-5.1. EMERGENCY PLANS

The NNRA requires the establishment of an emergency plan, where the possibility of a nuclear accident affecting the public may take place. The NNR must ensure that such emergency plans are effective for the protection of persons, should a nuclear accident take place. The emergency plan includes a description of facilities, training and exercising arrangements, liaison with off-site authorities as well as relevant international organisations, and emergency preparedness provisions.

All facilities have emergency plans, describing the emergency organisation, emergency scenarios (including the initiating event, source term and consequences), as well as actions to control an emergency (including data to be reported, mitigation measures to be implemented and personnel monitoring requirements).

Furthermore, the Minister may, on recommendation of the Board of Directors and in consultation with the relevant municipalities, make regulations pertaining to the development surrounding any nuclear installation, to ensure the effective implementation of any applicable emergency plan.

In addition, the conditions of licence require the following:

(a) The licensee must ensure that emergency planning and preparedness processes include procedures to ensure that all persons, in the employ of the licensee, who have duties in connection with such processes, are properly trained and instructed in the:

- (i) performance of the processes;
- (ii) use of any equipment that may be required; and
- (iii) precautions to be observed.

(b) Where emergency planning and preparedness processes require the assistance or cooperation of, or it is expedient to make use of the services of any person, local authority or any other body; the licensee must ensure that such persons, local authority or other bodies are consulted in the periodic review and update of such processes.

(c) The licensee must ensure that all emergency planning and preparedness processes are exercised and tested at such intervals and at such times and to such extent as the NNR may specify or, where the NNR has not so specified, as the licensee considers necessary to ensure their continued viability.

In order to assess the effectiveness of the emergency preparedness and response arrangements, the NNR normally performs audits and arranges an emergency exercise during which the response to a given scenario is tested. This testing of the licensee's emergency preparedness and response is additional to the self-testing required of licensees.

In terms of other relevant legislation applicable to emergency planning, the Disaster Management Act, 2002 (Act No. 57 of 2002) was promulgated on 15 January 2003. This Act provides for:

- an integrated and coordinated disaster management policy that focuses on preventing or reducing the risk of disasters, mitigating the severity of disasters, emergency preparedness, rapid and effective response to disasters, and post- disaster recovery;
- the establishment of national, provincial and municipal disaster management centres;
- disaster management volunteers; and
- matters relating to these issues.

The National Disaster Management Framework comprises six key performance areas (KPAs). Each KPA is informed by specified objectives and, as required by the Act, key performance indicators (KPIs) to guide and monitor its implementation. These KPAs are:

KPA 1 focuses on establishing the necessary institutional arrangements for implementing disaster management within the national, provincial and municipal spheres of government and describes some of the mechanisms for funding disaster management.

KPA 2 addresses the need for disaster risk assessment and monitoring to set priorities, guide risk reduction actions and monitor the effectiveness of efforts in this regard.

KPA 3 introduces disaster management planning and implementation to inform developmentally oriented approaches, plans, programmes and projects that reduce disaster risks.

KPA 4 presents implementing priorities concerned with disaster response, recovery and rehabilitation.

KPA 5 describes mechanisms for the development of both non- accredited and accredited education and training for disaster management and associated professions and the incorporation of relevant aspects of disaster management in primary and secondary school curricula. It also addresses priorities and mechanisms for supporting and developing a coherent and collaborative disaster risk research agenda.

KPA 6 presents processes for evaluation, monitoring and improvement of disaster management, as envisaged in the implementation of the Act. It introduces a range of mechanisms for measuring and evaluating compliance with both the National Disaster Management Framework and the Act. These include performance audits; self-assessments; peer reviews; reviews of significant events and disasters; as well as rehearsals, simulations, exercises and drills.

F-5.1.1. IMPLEMENTATION OF EMERGENCY PLANS

Parties involved with emergency preparedness and response include the licensees, local authorities in the region, provincial authorities, national government and the NNR. According to section 38(1) of the NNRA, the licensee must enter into an agreement with the relevant municipalities and provincial authorities to establish an emergency plan.

When a nuclear accident occurs, the holder of the nuclear authorisation in question must implement the emergency plan as approved by the NNR. In terms of the decision- making arrangements regarding a nuclear accident, the authority to implement on-site protective actions rests with the nuclear installation emergency controller. In terms of the Disaster Management Act, 2002 (Act No. 57 of 2002), read with the Disaster Management Amendment Act, 2015 (Act No. 16 of 2015), the off-site authorities are required to verify and implement off-site protective actions, as recommended by the authorisation holder in the event of a nuclear accident, in accordance with the procedures stipulated in the emergency plan.

In support of the emergency plan, an environmental monitoring plan has been implemented for the past few decades, which provides a baseline for background radiation and radiological concentrations in various environmental media in the surrounds of the Pelindaba, Vaalputs and Koeberg sites. These include air, water (river, dam and borehole), sediment, soil, vegetation, fish, produce and milk as applicable to the sites. Quarterly and annual reports of the findings are presented to the NNR.

In view of their low potential for off-site consequences, NORM facilities are generally not required to establish formal off site emergency plans. The exception being the transport actions of Nufcor, (authorised under COR-16 for the processing of natural uranium and the associated transport actions). Additionally emergency preparedness and response plans are in place for all mine residue facilities.

F-5.2. INTERNATIONAL ARRANGEMENTS

South Africa has signed and ratified the following International Conventions and codes of conduct that are pertinent to emergency preparedness:

- The Convention on Early Notification of a Nuclear Accident;
- The Convention on Assistance in the Case of a Nuclear Accident or Radiological Emergency;
- Code of Conduct for the Safety and Security of Radioactive Sources.

Necsa is the National Competent Authority responsible for communication with the IAEA in case of a nuclear emergency. In case of a nuclear accident the DMRE, as part of the joint-decision making team, will communicate with the neighbouring countries through the diplomatic channels.

South Africa successfully hosted an IAEA Emergency Preparedness Review (EPREV) mission in 2014. Based on the recommendations and suggestions from the mission report, an action plan has been developed and is currently being implemented.

F-5.3. PREPARATION AND TESTING OF EMERGENCY PLANS

Preparedness is achieved by training a specific group of professionals, with a view to enhancing efficiency in responding to an emergency situation. Those who develop and provide specialist support services in respect of the licence holder's emergency preparedness and response arrangements, are nuclear professionals and specially trained personnel. These include government representatives and technical advisors from the regulatory body.

For other staff members, training courses are developed at a level appropriate to the function required of the individual. The NNR tests the efficiency of these plans at Koeberg and Necsa every 18 to 24 months.

F-6. DECOMMISSIONING

Article 26: Decommissioning

Each Contracting Party shall take the appropriate steps to ensure the safety of decommissioning of a nuclear facility. Such steps shall ensure that:

i. qualified staff and adequate financial resources are available;

ii. the provisions of Article 24 with respect to operational radiation protection, discharges and unplanned and uncontrolled releases are applied;

iii. the provisions of Article 25 with respect to emergency preparedness are applied; and

iv. records of information important to decommissioning are kept.

F-6.1. QUALIFIED STAFF AND ADEQUATE FINANCIAL RESOURCES

Decommissioning is regarded as a phase in the life cycle of authorised facilities. Specific requirements, applicable to decommissioning (early decommissioning planning, arrangements to ensure appropriate information management, staffing and financial resources) are covered in regulations and in the regulatory framework.

Staffing requirements are based on the complexity and the extent of the decommissioning activities to be performed. Qualification of staff is achieved through a formalised process according to functions to be performed. Further maintenance of the knowledge and skills of staff is achieved through participation in international training workshops, seminars, and work assignments in other organisations nationally and internationally.

Decommissioning cost estimates are required to be performed periodically during the operational lifetime of authorised facilities, in order to provide up to date cost estimates, identify critical factors impacting on these estimates, and assess the basis for financing decommissioning.

F-6.2. OPERATIONAL RADIATION PROTECTION, DISCHARGES AND UNPLANNED AND UNCONTROLLED RELEASES ARE APPLIED

The SSRP prescribes the requirements for decommissioning of facilities, plants or equipment that have an impact on radiation protection and nuclear safety. An applicant for, or a holder of, a nuclear authorisation, is required to establish a decommissioning strategy for the facility concerned. The decommissioning strategy shall include a description of the options, overall timescales for the decommissioning of the facility and the end-state after completion of all decommissioning activities and shall explain the reasons for the preferred option.

Furthermore, a holder of a nuclear authorisation is required to submit to the NNR an initial decommissioning plan for the facility, based on the established decommissioning strategy commensurate with the type and status of the facility. The initial decommissioning plan must be submitted to the regulator at its various stages of development.

The initial decommissioning plan must:

- take into account major safety issues;
- support the fact that decommissioning can be safely conducted, using proven techniques or techniques being developed;
- include a generic study, indicating the feasibility of decommissioning;
- take cognisance of environmental aspects of decommissioning, such as the management of waste and radioactive effluents; and
- provide a basis to assess the costs of the decommissioning activities and the means of financing it.

Prior to the start of decommissioning, an authorisation holder must submit to the NNR a final decommissioning plan, which must be supported by an appropriate assessment of the safety of the proposed decommissioning activities and must specify all institutional controls necessary after termination of the period of responsibility of the holder.

It must be demonstrated to the NNR that sufficient financial resources will be available from the time of cessation of the operation to the termination of the period of responsibility.

F-6.3. DECOMMISSIONING AT KOEBERG

Based on a 40-year operational life, the decommissioning of Koeberg is currently scheduled for after 2025. It is anticipated that the operational life of Koeberg will be extended to 60 years and decommissioning activities will commence after 2045. Financial provision for the decommissioning (and used fuel management) has continued to be accumulated on a monthly basis since commercial operations of the installation began in 1984. The financial provision is reflected in the annual financial statements of the licence holder.

The financial provision amount for decommissioning and used fuel management made each month is determined by present value calculations of the associated financial plans. These financial plans are reviewed regularly and annually adjusted with the South African inflation rate.

Financial and human resources for the management of low and intermediate level radioactive waste are part of the normal operations of the nuclear installation and hence included in the business and financial plans.

F-6.4. DECOMMISSIONING AT Necsa

A decommissioning strategy and plan is required for all operational and new facilities. It is required that the decommissioning be considered in the design phase of the new facilities and new processes. The ability to decommission a facility is a design consideration. Prior to termination of operations, a final decommissioning strategy is selected and motivated and a decommissioning plan is submitted to the NNR for approval. The decommissioning plan shall, as a minimum requirement, cover Phase 1 decommissioning activities. Continued decommissioning (Phase 2 and 3) shall be determined, depending on the circumstances of each case. In between phases, the facility shall be placed under Care and Maintenance to ensure the facility is in a safe state and well secured. NNR approves and authorises the facility to be in a Care and Maintenance state. An explanation of the decommissioning phases is provided in Section L Annex 8. Any deviations from the approved decommissioning plan, including the use of new technologies and dismantling techniques, must first be approved by the regulator before implementation.

For each decommissioning phase or a combination of phases, an authorisation from the Regulator is required. It is required that safety of the workers and the public is demonstrated under normal operating conditions, as well as during emergencies. The conditions of approval also include, inter alia, radiation safety/management programmes, waste safety programmes, nuclear security, access egress control, fire safety, quality control, emergency plans, etc. to be in place before authorisation to decommission is granted.

The Regulation (R388 of 2006), published in terms of the NNRA, requires that a site, used in the conducting of an authorised action, may be released for unrestricted use, provided that:

- it is demonstrated that radioactive contamination and radioactive materials, which can reasonably be attributed to the authorised action, have been removed from the site; or in the case of naturally occurring radioactive nuclides, have activity concentrations below the levels for exclusion; or
- where the provision above cannot reasonably be achieved, remedial measures have been implemented to achieve optimisation of protection, constrained in accordance with the annual effective dose received by the average member of the critical group for all feasible future situations arising from the residual radioactive contamination and radioactive materials, which can reasonably be attributed to the regulated action, does not exceed the dose constraint that was applicable during operations.

In the event that the release of a site in accordance with the conditions above can only be reasonably achieved by imposing restrictions on the use of the site, the Regulator may approve the release of that site for restricted use.

F-6.5. PROVISIONS WITH REGARD TO EMERGENCY PREPAREDNESS

Decommissioning is regarded as a phase of authorisation and all the main requirements applicable to the operational phase are applicable to decommissioning.

F-6.6. RECORDS OF INFORMATION IMPORTANT TO DECOMMISSIONING

The nuclear authorisation holder is required to maintain a record of the facility history. The final facility history shall include:

- updated facility description;
- reference to past safety health and environmental assessments;
- normal operational discharge quantities
- type waste generated during operation and waste anticipated during decommissioning;
- of radiological surveillance results and characterisation reports;
- events registered and dose exposure records; as well as
- the prescribed decommissioning reports.

All records generated during decommissioning are maintained in hard copy and electronically in a PDF format, and both formats are retrievable via the document management system. The holder of the nuclear authorisation is required to maintain the records for a period of 50 years.

Section G

SAFETY OF SPENT FUEL MANAGEMENT

SECTION G: SAFETY OF SPENT FUEL MANAGEMENT

G-1. GENERAL SAFETY REQUIREMENTS

Article 4: General Safety Requirements

Each Contracting Party shall take the appropriate steps to ensure that all stages of spent fuel management; individuals, society and the environment are adequately protected against radiological hazards. In so doing, each Contracting Party shall take the appropriate steps to:

i. ensure that criticality and removal of residual heat generated during spent fuel management are adequately addressed;

ii. ensure that the generation of radioactive waste associated with spent fuel management is kept to the minimum practicable, consistent with the type of fuel cycle policy adopted;

iii. take into account interdependencies among the different steps in spent fuel management;

iv. provide for effective protection of individuals, society and the environment, by applying at the national level suitable protective methods as approved by the regulatory body, in the framework of its national legislation which has due regard to internationally endorsed criteria and standards;

v. take into account the biological, chemical and other hazards that may be associated with spent fuel management;

vi. strive to avoid actions that impose reasonably predictable impacts on future generations greater than those permitted for the current generation;

vii. aim to avoid imposing undue burdens on future generations.

G-1.1. CRITICALITY AND REMOVAL OF RESIDUAL HEAT GENERATED DURING SPENT FUEL MANAGEMENT

G-1.1.1. KOEBERG

Koeberg only handles and stores used fuel generated from the two Koeberg reactor units. Used fuel assemblies (UFAs) are stored only in designated high-density storage racks in the storage pools. These racks contain borated steel plates and the coolant is mixed with boric acid to ensure sub-criticality of the used fuel during storage. The boron concentration in the used fuel pools is maintained between 2 440 and 2 700 mg B/kg.

Spent core components like thimble plugs, burnable poison rods and control rods are stored as inserts inside the used fuel. Sub-criticality and residual heat removal in the Koeberg used fuel pools are managed via Operating Technical Specifications (OTS), sections 1.0 and 2.0, for all plant states.

The used fuel pool cooling system (PTR) performs the following functions with regard to the used fuel:

- Maintaining the irradiated fuel in subcritical conditions.
- Biological protection of staff by:
  - maintaining sufficient depth of water in the used fuel pool; and
  - removing corrosion products, fission products and suspended particles present in the used fuel pool water by filtration, demineralisation and surface skimming.

- Cooling by:
  - o removing residual heat released by irradiated fuel assemblies stored in the used fuel pool (temperature in the used fuel pool is maintained between 10 and 50°C); and
  - o backing up the residual heat removal system (RRA), in case the RRA becomes unavailable after opening the reactor coolant circuit.

UFAs are stored and handled under water in compliance with biological protection criteria. Criticality control during for the movement of fuel assemblies in the used fuel pools is achieved via an administrative procedure, KAF-023.

Four CASTOR X/28 F used fuel dry storage casks are currently located in the Cask Storage Building (CSB) on site. These casks, containing 112 UFAs in total, were analysed to accommodate used fuel with enrichments up to 3.5 wt%. The casks do not require any active safety systems with regard to criticality and residual heat removal. However, the ambient air temperature is monitored by the ventilation system in the CSB. The ventilators open automatically upon the loss of electrical supplies or when the air temperature reaches 38°C; and they can also be opened manually.

Fuel handling at Koeberg is performed by qualified fuel handlers under the supervision of an authorised fuel handling supervisor. The licensed senior shift supervisor in the relevant control room tracks all fuel movements and is ultimately accountable for fuel handling and nuclear safety. A licensed operator will also monitor the count rate while fuel movements are taking place inside the reactor during core loading and unloading. Approved procedures are used for all fuel handling activities. All fuel movements are automatically tracked by the fuel handling crane software as well as through a manual (paper) system.

G-1.1.2. Necsa

Irradiated uranium target plates, fuel assemblies and control rods from the SAFARI-1 research reactor are stored only in designated racks in the storage pool. These are:

- Storage racks for standard and cropped fuel assemblies;
- The control rod rack in the storage pool for intact control rods;
- The cool-off rack in the reactor pool for Molybdenum target plates.

Special arrangements are made for irradiated fuel that is located in other areas during transfer or for inspection, testing and cropping. All fuel transfers are carried out in accordance with the designated fuel transfer permit procedures and forms.

Safety precautions for handling fuel assemblies: Fuel is handled only under the supervision of a licenced shift supervisor, assisted by at least two reactor operators; one of which is a licenced reactor operator. A licenced reactor operator must be in the control room to record every fuel movement in the control room log-book and when fuel is being loaded into or unloaded from the reactor core. He/she must also monitor the status of the core nuclear instrumentation during these activities.

Requirements for the shipment of fuel: Special arrangements for the shipment of fuel out of the reactor building (e.g. the shipment of fresh fuel back to the manufacturer for some reason, or the shipment of used fuel for long-term storage) shall be made only in accordance with the designated fuel transfer permit procedures and forms. Used fuel is shipped only in a properly designed and licenced used fuel cask.

Criticality of fuel in transit: In order to prevent accidental criticality while handling fuel, no more than six fuel units, i.e. fuel elements and/or control rods, may be present in any location not included in the description of designated storage locations.

The Thabana Pipe Store is a dry storage facility for used fuel from the SAFARI-1 research reactor. 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.

During the design of the Thabana Pipe Store, used fuel storage facility criticality was taken into consideration. The operating technical specification limits the acceptance of used fuel to the Thabana Pipe Store to fuel that has undergone a cooling period of at least two years. A subsurface borehole design was selected for the dual purpose of shielding and heat transfer.

G-1.2. THE GENERATION OF RADIOACTIVE WASTE ASSOCIATED WITH SPENT FUEL MANAGEMENT

No waste that is associated with used fuel management is generated at Koeberg. At SAFARI-1 on the Necsa Pelindaba site, LILW comprising components such as end adaptors, cadmium section, lower member end adaptors are generated during the cropping of the used fuel elements.

G-1.3. INTERDEPENDENCIES AMONG THE DIFFERENT STEPS IN SPENT FUEL MANAGEMENT

Used fuel is currently kept in interim storage at the generator’s facilities. The facilities have been designed so as to retrieve elements at a later stage. No decisions have been made with regard to processing or disposal. The Policy and Strategy outlines a framework within which these decisions will be made. As far as reasonably practicable, the effects of future radioactive waste management activities, disposal in particular, will be taken into account when any radioactive waste management activity is being considered.

G-1.4. EFFECTIVE PROTECTION OF INDIVIDUALS, SOCIETY AND THE ENVIRONMENT BY APPLICATION OF PROTECTIVE METHODS AS APPROVED BY THE REGULATORY BODY

The SSRP issued in terms of the NNRA, prescribed dose and risk criteria applicable to members of the public and the workforce, as well as general safety principles, such as defence-in-depth, ALARA and conformance to good engineering practice. The dose criteria, discussed in Section F-4, are applied in accordance with international practice (e.g. ICRP, IAEA). The risk criteria, established by the Regulator in the late 1960s, are based on analyses of risk to society, imposed by industry and various natural disasters.

These standards refer directly to the primary concerns of nuclear safety, namely radiological risk to the public and plant personnel, and are intended to ensure protection of the environment against radiological hazards.

The applicant is required to submit a safety case, which must include documentation relevant to the demonstration of compliance with the SSRP. The safety case typically includes the following:

- A Safety Analysis Report (SAR);
- Risk and dose assessment;
- General Operating Rules (GOR);
- SAR/GOR supporting documentation;

- Other licence binding documents;
- Changes to the SAR/GOR and supporting documentation relevant to the particular application;
- Project management documentation;
- Safety-related programmes applicable during a given licensing stage.

In terms of the NNRA, the NNR issues a nuclear installation licence, which holds the licensee responsible to the above standards, as well as to the safety case which, for nuclear installations, includes the plant-specific Safety Analysis Report.

Used fuel management is managed as part of the operational processes of Koeberg and SAFARI-1. This implies that the protection of individuals, society and the environment is assessed in terms of the same criteria applicable to operating conditions.

G-1.5. BIOLOGICAL, CHEMICAL AND OTHER HAZARDS ASSOCIATED WITH SPENT FUEL MANAGEMENT

It is required that waste characterisation be conducted throughout the pre-disposal management steps. Waste category specific characterisation requirements shall be specified and shall cover the establishment of physical, chemical, biological and radiological properties to determine waste processing needs and the ultimate suitability of the waste package for storage and disposal. Waste characterisation data and records are used for verification and quality assurance purposes. Biological, chemical and other hazards associated with used fuel, are considered in relation to radiological hazards. The storage pipes of the Thabana Pipe Store are sealed (kept under pressure of an inert gas to avoid degradation while also monitoring for leaks). A risk assessment of the facility was conducted.

G-1.6. AVOIDANCE OF ACTIONS THAT IMPOSE REASONABLY PREDICTABLE IMPACTS ON FUTURE GENERATIONS GREATER THAN THOSE PERMITTED FOR THE CURRENT GENERATION

South Africa manages radioactive waste in a manner that protects human health and the environment, now and in the future in accordance with the following principles:

- Secure an acceptable level of protection for human health;
- Provide an acceptable level of protection of the environment;
- Assure those possible effects on human health and the environment beyond national borders will be taken into account;
- Predicted impacts on the health of future generations will not be greater than relevant levels of impact that are acceptable today;
- That current radioactive waste management processes will not impose undue burdens on future generations;
- Radioactive waste will be managed within an appropriate national legal framework, including clear allocation of responsibilities and provision for independent regulatory functions;
- Generation of radioactive waste shall be kept to the minimum practicable;
- Interdependencies among all steps in radioactive waste generation and management shall be appropriately taken into account;
- The safety of facilities for radioactive waste management shall be appropriately assured during their lifetime.

In accordance with the provisions of the Policy and Strategy, the government will initiate investigations into the best long- term solutions for the management of used fuel. The process of selecting a site for long-term High Level Waste (HLW) management shall involve a public participation process.

G-1.7. AIM TO AVOID IMPOSING UNDUE BURDENS ON FUTURE GENERATIONS

The Policy and Strategy embodies the principle of no undue burden on future generations. In line with this principle, final disposal is regarded as the ultimate step in radioactive waste management, although a stepwise waste management process is acceptable. Long- term storage of certain types of waste, such as used fuel, may be regarded as one of the steps in the management process.

Investigations shall be conducted, by the National Radioactive Waste Disposal Institute (NRWDI), to consider the various options for the safe management of used fuel, and the following options will be investigated:

- Long-term above ground storage in an off-site facility licenced for this purpose;
- Deep geological disposal;

Eskom is currently authorised by the NNR for on-site storage of their used nuclear fuel in the used fuel pools at Koeberg. A few spent fuel assemblies that have sufficiently cooled down have also been moved to on-site dry storage casks. In addition, Eskom is planning to construct an on-site Transient Interim Storage Facility (TISF) for their used fuel to mitigate the risk of running out of storage capacity in the used fuel pools.

According to the Policy and Strategy, the on-site storage of used fuel is finite and therefore not sustainable indefinitely. The Policy and Strategy therefore makes provision for a national off-site above-ground storage facility for used fuel. The strength of this option is that if more appropriate technologies are developed in future, then the waste can be managed using those technologies. In this regard, NRWDI is in the process of establishing a project to construct and operationalise a CISF away from the reactor sites to accept and store the national inventory of used fuel. This arrangement would continue to provide an interim solution for the South African used fuel management programme until a deep geological repository is established and implemented.

In accordance with the Policy and Strategy, the current preferred strategy for used fuel management in South Africa is to dispose of used fuel in a deep geological repository after an interim storage period. Depending on the operational life of Koeberg and South Africa's future nuclear programme, a deep geological repository for South Africa is planned to be operational by 2065. This solution will be implemented in a phased manner that includes site selection, site characterisation and construction. These activities will be the responsibility of NRWDI.

G-2. EXISTING FACILITIES

Article 5: Existing Facilities
Each Contracting Party shall take the appropriate steps to review the safety of any spent fuel management facility existing at the time the Convention enters into force for that Contracting Party and, to ensure that if necessary, all reasonably practicable improvements are made to upgrade the safety of such a facility.

G-2.1. LEGISLATIVE FRAMEWORK

The conditions of authorisation require the holder of a nuclear installation licence to provide a safety assessment, including a risk assessment, and to keep the assessment up to date. The assessment must take into account experience feedback (local and international) in terms of incidents or emergent safety issues.

G-2.2. KOEBERG: OVERVIEW AND MAIN RESULTS OF SAFETY ASSESSMENTS PERFORMED

The holder is required by conditions of licence to maintain an up to date plant specific safety assessment. Koeberg completed periodic safety re-assessments in 1998 and 2010. A subsequent review commenced in July 2019, is currently in an advanced stage of progress with a planned completion date of December 2021.

Teams from the World Association of Nuclear Operators (WANO) comprising experienced nuclear professionals from various WANO regions, conducted peer reviews at the Koeberg Nuclear Power Station in 2014, 2017 and again in March 2019. The purpose of these WANO Peer Reviews is to determine strengths and areas for improvement (AFIs) in the operations, maintenance, and support of the nuclear units at the Koeberg Nuclear Power Station.

As a basis for the review, the teams used the Performance Objectives and Criteria for WANO Peer Reviews: WANO PO&C 2013-1 dated March 2013. These were applied and evaluated in light of the experience of team members and best practices within the nuclear industry.

For a peer review, the team spends two weeks in the field observing selected evolutions, including surveillance testing and normal plant activities. In the March 2019 peer review, WANO identified gaps in performance in several areas and due to the declining performance trajectory in a number of areas, downgraded Koeberg's performance status to a "station of special focus".

The Koeberg Management has focussed all efforts on a recovery plan to ensure resolution of key issues to bring the station back in line with industry best practise. The implementation of recovery plan actions have progressed well and the success of these efforts were evident when the WANO Interim Performance Summary Report (IPSR), issued in April 2020, indicated a stabilised positive trajectory for the Station.

Modifications Implemented at Koeberg

Some of the modifications relevant to this Convention, which resulted in safety improvements, include the following:

- Re-racking of the used fuel pools with high-density fuel storage racks;
- Castor X/28 F dry storage casks for interim used fuel storage;
- Re-racking of the used fuel pools with super-high density fuel storage racks to accommodate the full design life of the plant;
- Increased used fuel pool cooling;
- Upgrading of the used fuel pool crane;
- Upgrading of control room alarms;
- Code repair of stress corrosion cracking on the refuelling water storage tank and pipe-work of the used fuel pool, containment spray and low head safety injection systems.

Generally, modifications were initiated as a result of various factors, such as:

- a need for additional used fuel storage capacity;
- international operating experience feedback;
- other international sources to improve nuclear safety or the installation's cost- effectiveness; and
- potential weaknesses in the design, identified during the safety re- assessment of the nuclear installation, or resulting from the activities reported under Section H.

G-2.3. PLANNED INCREASE IN USED FUEL DRY STORAGE CAPACITY

It is recognised that the current used fuel storage capacity at Koeberg is finite and limited. Due to a need to increase the energy output at Koeberg, Eskom, implemented a revised fuel management strategy. This has required more fuel assemblies than those in previous reloads, with a commensurate release of more (partially and completely irradiated) used fuel assemblies into the used fuel pools (SFPs). Consequently, the SFPs are filling up more rapidly than originally anticipated.

Furthermore, Eskom is considering extending the operating lifetime of the two units at Koeberg, beyond 40 years. This proposed plant life extension will also require additional used fuel storage capacity. To this end, the power utility Eskom is planning to expand the current dry storage capacity at Koeberg.

As part of the Koeberg used fuel storage management strategy, Koeberg established the Koeberg used fuel storage project to cater for the station's used fuel storage needs in three phases as described below:

- Phase 1:
    - Phase 1A: Procurement of seven metal dry storage casks to ensure continued operation beyond 2018, without exceeding the used fuel pool storage capacity. A number of UFAs will be transferred from the used fuel pools into the new dry storage casks. These casks will be stored with the four existing metal dry storage casks in the CSB on site.
    - Phase 1B: Procurement and placement of used fuel inserts to gain back the currently unoccupied storage cells in the used fuel pools due to a checker- boarding arrangement. This will open up previously unusable storage cells in the used fuel pools, allowing for an increase in the total number of UFAs that can be stored in the used fuel pools.
    - Phase 1C: Procurement of a further seven metal casks. These casks will be of the same design as the Phase 1A casks.

Fourteen HI-STAR 100 metal casks have been delivered to the Koeberg site fr Phase 1A and Phase 1C of the project. Eskom has been granted permission by the NNR to load two (2) of the HI-STAR 100 casks with spent fuel from the Unit 2 SFP while the CSB has been licensed to store up to four (4) of these new casks. Two HI-STAR 100 casks were successfully loaded and stored in the CSB by July 2020.

- Phase 2: Procurement of approximately 30 - 40 additional dry storage casks to allow ongoing operation of Koeberg until 2025.
- Phase 3: Establishment of the Transient Interim Storage Facility (TISF) for the storage of the casks procured in Phase 2.

The TISF will comprise concrete pad(s) within a site footprint of approximately 12 800 m² and will be designed to accommodate storage of not more than 160 casks, for used nuclear fuel generated at Koeberg up to the end of operational life of plant. The design of the concrete pad(s) of the TISF will accommodate various types of dry storage systems. The dry storage casks will be placed on the pad(s) in a modular manner over time. Spent fuel assemblies generated beyond 2025 will also be stored in casks at the TISF should the CISF not be available. The proposed TISF will be constructed on vacant land in the security- protected area on Koeberg site. An auxiliary building will also be included to house ancillary equipment. The TISF will be built and managed in accordance with NNR approved safety standards. The TISF licensing strategy has been submitted to the NNR for approval.

As part of the project, an Environmental Impact Assessment for the TISF was conducted. On 17 May 2017, the DEA granted Environmental Authorisation (EA) for the proposed Transient Interim Storage Facility (TISF) at Koeberg Nuclear Power Station in terms of the National Environmental Management Act 107 of 1998, and the Environmental Impact Assessment Regulations, 2014.

The next step requires a technical specification for the detailed design and infrastructure of the TISF. The commercial process for the establishment of the facilty will then follow. Construction of the TISF will commence once NNR approval of the detailed design has been granted and will take approximately 12 months to complete.

G-3. SITING OF PROPOSED FACILITIES

Article 6: Siting of Proposed Facilities

1. Each Contracting Party shall take the appropriate steps to ensure that procedures are established and implemented for a proposed spent fuel management facility:
   i. to evaluate all relevant site-related factors likely to affect the safety of such a facility during its operating lifetime;
   ii. to evaluate the likely safety impact of such a facility on individuals, society and the environment;
   iii. to make information on the safety of such a facility available to members of the public;
   iv. to consult Contracting Parties in the vicinity of such a facility, insofar as they are likely to be affected by that facility, and provide them, upon their request, with general data relating to the facility to enable them to evaluate the likely safety impact of the facility upon their territory.
2. In so doing, each Contracting Party shall take the appropriate steps to ensure that such facilities shall not have unacceptable effects on other Contracting Parties by being sited in accordance with the general safety requirements of Article 4.

G-3.1. RELEVANT SITE-RELATED FACTORS LIKELY TO AFFECT THE SAFETY OF SUCH A FACILITY DURING ITS OPERATING LIFETIME

In terms of the NNRA, nuclear authorisations are required for the siting of nuclear installations. The regulation on the siting of new nuclear installations requires the applicant for a nuclear site licence for the siting of a nuclear facility to submit, in support of the application, a Site Safety Report (SSR) to the NNR comprising the following:

- Motivation for the choice of the site;
- Statement as to the proposed use of the site (maximum thermal power, general design characteristics, etc.);
- Source term analysis;
- Characteristics of the site, in terms of external events;
- Probabilistic Risk Assessment (including cumulative impact of nuclear installations);
- Analysis of the impact on the public, due to normal operations;
- Analysis to demonstrate the viability of an emergency plan; and
- Identification and determination of the emergency planning zones.

The SSR is required to address the following topics: description of site and environs, population growth and distribution, land use, adjacent sea usage (if applicable), nearby transportation, civil and industrial facilities, meteorology, oceanography and cooling water supply, impact of natural hazards, impact of external man-made hazards, hydrology, geology and seismology, fresh water supply, site control, emergency services, radioactive effluents, and ecology.

The following regulatory documents directly relevant to the siting of new nuclear installations have been issued by the NNR:

- RD-0024: Requirements on Risk Assessment and Compliance with Principal Safety Criteria for Nuclear Installations;
- RG-0011: Interim Guidance for the Siting of Nuclear Facilities;
- PP-0014: Consideration of External Events for Nuclear Installations; and
- PP-0015: Emergency Plan Technical Basis for New Nuclear Installations.

G-3.2. EVALUATION OF THE SAFETY IMPACT OF THE FACILITY ON INDIVIDUALS, SOCIETY AND THE ENVIRONMENT

Holders of nuclear authorisations must comply with the requirements of the SSRP. The NNR requires the holder of an authorisation to provide adequate source term data to demonstrate that the projected dose to the critical group, due to normal operations and accident conditions of moderate frequency ($1–10^{-2}$ per annum), complies with an average dose limit of 0.25 mSv per annum to the critical group.

With regard to accidents of a frequency lower than 10^{-2} per annum, the licence holder is required to calculate the projected accident source terms in order to demonstrate compliance with the risk criteria laid down by the regulatory body in terms of maximum individual risk, average population risk and societal risk. The licensee performs the dose and risk calculations.

The NNR furthermore stipulated limits on urban developments in the vicinity of the installation and holds regular meetings with the licence holder and local authorities in this regard. The licence holder is required to maintain an effective emergency plan. The emergency plan is regularly tested by the licence holder and independently by the Regulator – every 18-24 months (as reported under Section F-5).

G-3.3. AVAILABILITY OF INFORMATION ON THE SAFETY OF THE FACILITY TO MEMBERS OF THE PUBLIC

All used fuel management facilities are considered nuclear installations and, in terms of the NNRA, the holders of nuclear installation licences must establish a Public Safety Information Forum (PSIF) in order to inform the persons living in the municipal area on nuclear safety and radiation safety matters.

PSIFs were established for both Koeberg and the nuclear facilities at the Necsa Pelindaba site and quarterly meetings are held with the public living in the area of the nuclear installation, in order to inform them on current safety issues. The public and other interested parties are invited to NNR emergency exercises as observers, during which time opportunities are offered to evaluate the state of emergency preparedness.

In terms of the NNRA, the applicant for a new nuclear installation licence must:

- serve a copy of the application upon every municipality affected by the application and such other body or person as the Chief Executive Officer determines; and
- publish a copy of the application in the Government Gazette, as well as in two newspapers circulating in the area of every such municipality

Any person who may be directly affected by the granting of a nuclear installation or vessel licence pursuant to an application, may make representations to the Board, relating to health, safety and environmental issues connected with the application, within 30 days of the date of publication. Should the NNR Board be of the view that further public hearings are required, the Board will arrange for such hearings. Furthermore, in terms of South African environmental legislation, an environmental impact assessment (EIA), which is subject to public participation, must also be performed for all radioactive waste management facilities.

G-3.4. CONSULTATION WITH CONTRACTING PARTIES

At present, South Africa does not undertake any specific consultation with other Contracting Parties regarding new facilities. However, any Contracting Party that may be affected will be included in the consultations detailed under G-3.3.

Necsa is the national competent authority responsible for communication with the IAEA in case of a nuclear emergency. In case of a nuclear accident the DMRE as part of the joint decision making team will communicate with the neighbouring countries through the diplomatic channels.

South Africa hosted an IAEA EPREV Mission in 2013. Various strengths, weaknesses and areas for improvement in the current response arrangements have been identified. Following the EPREV mission South Africa developed an action plan to address the findings. The action plan includes actions related to the development of a protocol for communication with neighbouring states in the event of a nuclear or radiological emergency. Engagements have been initiated between relevant stakeholders on the trans-boundary nuclear emergencies and the National Nuclear Disaster Management Plan is being amended to include such arrangements.

G-3.5. STEPS TO ENSURE THAT FACILITIES SHALL NOT HAVE UNACCEPTABLE EFFECTS ON OTHER CONTRACTING PARTIES BY BEING SITED IN ACCORDANCE WITH THE GENERAL SAFETY REQUIREMENTS

When any new facility is being sited or when significant modifications to an existing licence are made, which could have an effect on public safety, the public is consulted on the new or revised application for a licence. The potential effect from the project on the public is assessed in terms of the basic safety requirements specified in the SSRP. After authorisation, the NNR implements a compliance assurance programme. Feedback is given to the public and other affected parties, at the PSIFs.

G-4. DESIGN AND CONSTRUCTION OF FACILITIES

Article 7: Design and Construction of Facilities

Each Contracting Party shall take the appropriate steps to ensure that:

i. the design and construction of a spent fuel management facility provide for suitable measures to limit possible radiological impacts on individuals, society and the environment, including those from discharges or uncontrolled releases;

ii. at the design stage, conceptual plans and, as necessary, technical provisions for the decommissioning of a spent fuel management facility are taken into account;

iii. the technologies incorporated in the design and construction of a spent fuel management facility is supported by experience, testing or analysis.

G-4.1. LEGISLATION AND LICENSING PROCESS ON DESIGN AND CONSTRUCTION

The requirements of the NNRA and the principal safety requirements formulated in the SSRP, form the basis for the stipulation of the regulatory requirements for design and construction of nuclear installations. These requirements are applicable to all existing and new facilities. Authorisation to operate a facility is only given after it has been verified by the NNR that the construction was in accordance with the design.

With regard to Koeberg, where appropriate, the requirements of the vendor country are taken into consideration and safety and engineering standards, including those relating to design, manufacturing and construction, are required to be those of countries with acceptable records of safety.

At Necsa, management processes are in place to ensure that all projects, which include the modification and the establishment of new facilities, are assessed to determine the Safety, Health, Environmental and Quality (SHEQ) requirements for both the internal and external approval of the project. The requirements include the interpretation of the regulatory framework as applicable to all the project phases (design to decommissioning), which is then communicated to, and agreed with the NNR. For large projects phased approval is implemented with interim hold points.

G-4.2. CONCEPTUAL PLANS AND TECHNICAL PROVISIONS FOR THE DECOMMISSIONING OF A SPENT FUEL MANAGEMENT FACILITY AT THE DESIGN STAGE

In accordance with the provisions of the SSRP, a decommissioning strategy must be submitted as part of the prior safety assessment for any new facility. NNR requirement document RD-0026 furthermore requires that a decommissioning strategy, consistent with the SSRP and Policy and Strategy must be submitted as part of the conceptual decommissioning plan during the design phase. The decommissioning strategy is required to be updated throughout the operation of the authorised action as a basis for a detailed decommissioning plan.

G-4.3. TECHNOLOGIES INCORPORATED IN THE DESIGN AND CONSTRUCTION OF A SPENT FUEL MANAGEMENT FACILITY ARE SUPPORTED BY EXPERIENCE, TESTING OR ANALYSIS

The SSRP requires that:

“Installations, equipment or plants requiring a nuclear installation licence, nuclear vessel licence or a certificate of registration and having an impact on radiation or nuclear safety must be designed, built and operated in accordance with good engineering practice.”

Furthermore in accordance with the provisions of NNR Requirements document RD-0034, being Quality and Safety Management Requirements for Nuclear Installations, the following requirements must be complied with:

(1) The application of the selected codes and standards, as prescribed by the authority that released the code/standard must be fulfilled by the organisations involved in the process. Any deviations must be justified and presented to the NNR for acceptance.

(2) QA measures must be defined and must be compatible with the technical requirements of the selected codes and standards. The involvement of the licensee in the QA measures must be commensurate with the safety and quality classification of the SSC.

(3) All SSC important to nuclear safety must be designed according to the latest or applicable approved standards as at the time of licensing of the nuclear installation and must be accepted by the relevant South African authorities.

(4) If no approved standards are available for a specific application, internationally recognised codes or standards must be proposed for acceptance. The licensee may also request NNR acceptance of a specific edition of a code or standard. If possible, the SSC should be of a design proven in previous equivalent applications and it must be consistent with the reliability goals determined for the respective SSC.

(5) Where new or innovative designs or features are used, the licensee must provide the results of the investigation into the applicability of the codes and standards to the NNR. It must be demonstrated that the selected codes and standards are fully applicable to the SSC. In any other case a revised code, standard or specification must be developed and approved.

(6) Design and development outputs must contain the information necessary for verification and validation of pre- determined requirements and/or design criteria. The licensee must ensure that the outputs are reviewed against inputs as part of a design review process, in order to provide objective evidence that the requirements/or design criteria have been met.

(7) Validation of the output of the design and development processes must be performed in a controlled manner to ensure that the resulting product is capable of meeting the requirements for the specified use.

(8) Design control procedures must be established for verifying or checking the adequacy of the design and as a basis for the performance of design reviews.

(9) The verification or checking process must be performed by individuals, departments or organisational units other than those who have developed the original design.

(10) The licensee must establish a process for the selection and acceptance of the codes and standards which must be based on the classification of the SSC and graded quality assurance measures. The selected codes and standards have to be determined and justified by the licensee. The justification of a code or standard for an intended application must be acceptable to the NNR.

(11) The licensee must demonstrate to the NNR how the deviations will be incorporated and covered during the design and licensing process in case of deviations from an existing code or standard with the potential to result in verification, validation and approval processes. The requirements resulting from such deviations must be implemented in the selection and implementation process of the codes and standards and the qualifications of the suppliers and the SSC.

(12) Procedures must be established for suppliers for selecting and reviewing the suitability of materials, parts, equipment and processes that are essential to the safety functions of SSC.

(13) Provisions must be implemented to ensure that quality assurance measures are included in the design specifications and that responsibilities are determined to ensure that compliance with these measures is controlled and achieved. The requirements that are essential to quality and procedural processes must be specified prior to commencing with the activity to which they relate.

(14) The licensee must ensure that design verification procedures are implemented and measures performed within their own organisations and Level 1 suppliers (suppliers assigned responsibility for products of high importance to nuclear safety or having direct influence on the safety performance of the nuclear installation) if:

(i) new safety features for nuclear installations are considered that differ significantly from proven technology or that use simplified, inherent, passive or other innovative means to accomplish their safety functions.

(ii) Design changes occur for components of existing nuclear installations.

(15) In case of design changes, the design verification measures must be commensurate with those applied to the original design and must be performed, based on processes agreed with the NNR.

(16) Design changes must be controlled as part of a configuration management system. Design changes affecting the safety functions and occurring after the submission of a safety case must be submitted to, and accepted by the NNR in accordance with agreed processes.

(17) A test programme must be implemented by the licensee or its suppliers to demonstrate the safe performance of new safety features. It must be ensured that the safety features will perform as predicted, in order to provide sufficient data to validate analytical codes; and that the effects of systems interactions are acceptable. The test programme must include suitable qualification testing of a prototype, simulating the most adverse design conditions. The test

programme must be defined in writing and make provision for sign-offs as the test programme conditions are met.

Additional guidance in this regard is included in NNR Position Paper PP-008, namely Design Authorisation Framework.

G-5. ASSESSMENT OF SAFETY OF FACILITIES

Article 8: Assessment of Safety of Facilities

Each Contracting Party shall take the appropriate steps to ensure that:

i. before construction of a spent fuel management facility, a systematic safety assessment and an environmental assessment appropriate to the hazard presented by the facility and covering its operating lifetime shall be carried out;

ii. before the operation of a spent fuel management facility, updated and detailed versions of the safety assessment and of the environmental assessment shall be prepared when deemed necessary to complement the assessments referred to in paragraph (i).

G-5.1. PRIOR SAFETY ASSESSMENT AND ENVIRONMENTAL ASSESSMENT

The SSRP requires that:

“Measures to control the risk of nuclear damage to individuals must be determined on the basis of a prior safety assessment which is suitable and sufficient to identify all significant radiation hazards and to evaluate the nature and magnitude of the associated risks, with due regard to the dose and risk limits.”

In accordance with the regulations published, an environmental impact assessment is required for all proposed used fuel management facilities.

G-5.2. OPERATION SAFETY ASSESSMENTS AND ENVIRONMENTAL ASSESSMENTS

The requirements for life cycle safety assessments and safety cases are detailed in Section E-2.2.2 of this report.

G-6. OPERATION OF FACILITIES

Article 9: Operation of Facilities

Each Contracting Party shall take the appropriate steps to ensure that:

i. the licence to operate a spent fuel management facility is based upon appropriate assessments as specified in Article 8 and is conditional on the completion of a commissioning programme demonstrating that the facility, as constructed, is consistent with design and safety requirements;

ii. operational limits and conditions derived from tests, operational experience and the assessments, as specified in Article 8, are defined and revised as necessary;

iii. operation, maintenance, monitoring, inspection and testing of a spent fuel management facility are conducted in accordance with established procedures;

iv. engineering and technical support in all safety-related fields are available throughout the operating lifetime of a spent fuel management facility;

v. incidents significant to safety are reported in a timely manner by the holder of the licence to the regulatory body;

vi. programmes to collect and analyse relevant operating experience are established and that the results are acted upon, where appropriate;

vii. decommissioning plans for a spent fuel management facility are prepared and updated, as necessary, using information obtained during the operating lifetime of that facility, and are reviewed by the regulatory body.

G-6.1. SAFETY ASSESSMENTS AND SAFETY CASES

The requirements for life cycle safety assessments and safety cases are detailed in section E-2.2.2: A system of licensing of spent fuel and radioactive waste management activities, of this report.

The NNR is charged, by virtue of the provisions of the NNR, to consider all relevant aspects of an application for a nuclear licence, which it may receive. In considering an application, the NNR may direct the applicant to furnish such information as may be required to reach a decision on the granting or refusal of a nuclear licence, as well as the conditions under which such a licence ought to be granted.

The licensing process covers several stages, including siting, early site works, construction, commissioning and operation.

The holder is required to submit the relevant supporting safety documentation for each phase, which would cover the following:

(i) Credentials as an applicant (e.g. legal, financial and organisational aspects);
(ii) Licensing and construction schedules;
(iii) A Site Safety Report;
(iv) A Safety Analysis Report (including plant design);
(v) General Operating Rules covering all operational safety-related programmes, covering commissioning, plant operations, quality assurance, safety management, radiation protection, waste management, maintenance, inspection and testing, emergency planning and physical security.

A site licence, followed by a construction licence, may be issued or, optionally, a combined construction licence, covering siting may be issued. The construction licence would not be issued until the first four items listed above have been submitted and reviewed by the Regulator and relevant inspections conducted. Provisional submissions of general operating rules will generally be required at this stage as well.

The operating licence will generally constitute a phased process, involving several licences, issued in stages. Again these would only be issued once the Regulator is satisfied with the submissions covering the relevant aspects of the general operating rules and additional aspects of the safety analysis report (SAR) as necessary, and the relevant inspections and tests have been conducted, confirming compliance with the approved design.

G-6.2. OPERATIONAL LIMITS AND CONDITIONS

The conditions of authorisation stipulate that the plant must be operated in accordance with limits and conditions consistent with the overall safety case, which includes the outcome of the testing and commissioning programmes.

Further to this, the operating licence holds the applicant to the safety case and relevant operating rules, which include the processes for maintaining the safety case valid and current, incorporating experience feedback, as well as modifications to the plant and safety-related procedures.

G-6.3. PROCEDURES FOR OPERATIONS, MAINTENANCE, MONITORING, INSPECTION AND TESTING

The conditions of authorisation stipulate that all activities relating to nuclear safety shall be conducted in accordance with procedures and in accordance with a quality management system accepted by the Regulator. As referred to in section G-6.1, these include operations, maintenance, monitoring, inspection and testing.

G-6.4. ENGINEERING AND TECHNICAL SUPPORT

To comply with the conditions of the nuclear authorisation, the licence holder must have sufficient resources in order to address the full scope of requirements imposed by the regulatory body. These are covered by the quality assurance and safety management requirements referred to in section G-6.1. The NNR monitors and reports on the organisational aspects, including competence and staffing levels of the holders on an annual basis. Deficiency in engineering or technical support is directed to the licence holder for rectification.

With regard to Koeberg for example, the licence holder entered into technical cooperation agreements with Electricité de France to provide additional technical support as necessary.

G-6.5. INCIDENT REPORTING

Requirements on incident reporting and corrective actions are specified in the conditions of licence. The licence holder is also required to maintain a problem management and reporting system to the satisfaction of the regulatory body.

Koeberg reports nuclear safety significant events to the regulatory body, WANO and INPO, and the regulator body reports events to the IAEA-IRS (Incident Reporting System) and INES (International Nuclear Event Scale) reporting systems.

G-6.6. OPERATING EXPERIENCE FEEDBACK SYSTEM

The holder is required by a condition of licence to implement an operating experience feedback system. The licence requires implementation of the relevant processes for analysis of experience feedback from the plant and relevant international experience feedback, as well as corrective action.

With regard to Koeberg, the process includes operating experience feedback from Electricité de France, WANO, INPO and manufacturers.

G-6.7. DECOMMISSIONING PLANS

In accordance with the Regulations on Safety Standards and Regulatory Practices (SSRP), decommissioning plans are required for all facilities from the design stage through to decommissioning. The plans must be updated periodically and submitted to the Regulator for approval before actual decommissioning commences.

G-7. DISPOSAL OF SPENT FUEL

Article 10: Disposal of Spent Fuel

If, pursuant to its own legislative and regulatory framework, a Contracting Party has designated spent fuel for disposal, the disposal of such spent fuel shall be in accordance with the obligations of Chapter 3 relating to the disposal of radioactive waste.

In the South African context, the term, "used fuel", is used instead of "spent fuel". Pending the outcome of current investigations into possible reprocessing of used fuel to extract radioactive isotopes for further use, used fuel is not classified as radioactive waste. In view of the above, there are currently no immediate plans for the disposal of used fuel.

According to the Policy and Strategy, various options must be considered for long-term safe management of used fuel. These options include the following:

- Long-term above ground storage on an off-site facility licenced for this purpose;
- Reprocessing, conditioning and recycling;
- Deep geological disposal;
- Transmutation.

In 2013, South Africa conducted an INIR Mission, in which it was recommended for it to develop an integrated national nuclear fuel cycle strategy, including used fuel/high level waste disposal. In line with the findings of the INIR Mission, and as a result of the integration of all aspects of the fuel cycle, and policy considerations, the Government is in the process of making recommendations based on benchmark studies and best practices around the world.

There are currently no plans for South Africa to reprocess spent fuel for either recycling or transmutation. This is largely due to the unfavourable economics of reprocessing for the limited volumes of spent fuel linked to the limited size and nature of the current nuclear power programme in South Africa compared to countries engaged in spent fuel reprocessing, which possess economies of scale. Direct disposal of spent fuel in a deep geological repository is the preferred option, pursued by the South African power utility, Eskom, in its reference technical plan for the management of spent fuel generated by its Koeberg nuclear power station, the only nuclear power plant in South Africa. The Eskom plan indicates that spent fuel will be removed from Koeberg, transferred to a centralised interim storage facility (CISF) for at least another 50 years of storage and finally disposed of in a deep geological repository to be established as from around 2065.

Section H

SAFETY OF RADIOACTIVE WASTE MANAGEMENT

SECTION H: SAFETY OF RADIOACTIVE WASTE MANAGEMENT

H-1. GENERAL SAFETY REQUIREMENTS

Article 11: General Safety Requirements

Each Contracting Party shall take the appropriate steps to ensure that at all stages of radioactive waste management individuals, society and the environment are adequately protected against radiological and other hazards. In so doing, each Contracting Party shall take the appropriate steps to:

i. ensure that criticality and removal of residual heat generated during radioactive waste management are adequately addressed;

ii. ensure that the generation of radioactive waste is kept to the minimum practicable;

iii. take into account interdependencies among the different steps in radioactive waste management;

iv. provide for effective protection of individuals, society and the environment, by applying at the national level suitable protective methods as approved by the regulatory body, in the framework of its national legislation which has due regard to internationally endorsed criteria and standards;

v. take into account the biological, chemical and other hazards that may be associated with radioactive waste management;

vi. strive to avoid actions that impose reasonably predictable impacts on future generations greater than those permitted for the current generation;

vii. aim to avoid imposing undue burdens on future generations.

H-1.1. CRITICALITY AND RESIDUAL HEAT REMOVAL DURING RADIOACTIVE WASTE MANAGEMENT

In accordance with the legislation and conditions of authorisation, a safety case must be submitted by an applicant to the NNR to obtain a nuclear authorisation. The authorisation is granted when the NNR has satisfied itself that the applicant has addressed all aspects of safety satisfactorily and that appropriate control programmes are implemented to deal with issues of concern. The applicant is required to have a criticality safety program in place for all operations involving uranium and plutonium (except in instances where the isotopic mass fraction is less than that of natural uranium), including the analysis, verification and implementation thereof. Effective implementation of this programme is verified by the NNR.

NNR guidance related to criticality safety requires that the applicant for a nuclear authorisation, should demonstrate that:

(1) (an adequate organisation with responsibility to implement the criticality safety program is being established;

(2) an adequate criticality safety programme, to ensure safe operation of the facility, is being established, including an adequate criticality accident alarm system (CAAS);

(3) adequate controls and limits on parameters relied on to prevent nuclear criticality are implemented; and

(4) accident sequences, identified in the Criticality Safety Evaluations (CSEs) and documented in the safety analysis, leading to nuclear criticality have been assessed.

The applicant's implementation of criticality safety technical practices to ensure the safe operation of the facility, are required to be described as part of the submitted safety case. The submitted safety case should include:

(1) The commitment to implement criticality safety controls and limits in accordance with processes, as described in the application, by incorporating them into the applicant's criticality safety programme;

(2) Processes, including a description of the management measures that ensure operability of the CAAS and emergency response procedures;

(3) The processes to ensure that limits on controlled parameters have an adequate safety margin. These processes should include those to ensure that the methods used to develop criticality safety limits are properly validated;

(4) The processes to ensure that sufficient criticality safety controls, developed in the CSEs and taken up in the safety analysis, are identified for each process;

(5) The areas of review as they relate to criticality safety, with specific reference to:

(i) potential accident sequences that could result in nuclear criticality;

(ii) specific controls relied on to provide reasonable assurance that an inadvertent criticality will not occur; and

(iii) a demonstration that the likelihood of failure is sufficiently low, so as to demonstrate compliance with the double contingency principle;

(6) A commitment to prepare and maintain applicable safety basis documentation, which will be in sufficient detail so that criticality controls and contingency analyses can be reviewed and inspected by the NNR and the applicant.

H-1.2. MINIMISATION OF RADIOACTIVE WASTE

The Policy and Strategy embodies waste minimisation as a principle and requires that the generation of radioactive waste shall be kept to the minimum practicable in terms of activity and volume by application of design, operating and decommissioning measures. Waste is segregated by physical, chemical, radiological and biological characteristics, in order to reduce volumes and facilitate good practice in radioactive waste management.

The waste management process is regarded as an integrated process that includes waste generation, predisposal waste processing (pre-treatment, treatment and conditioning), waste storage, waste transport and waste disposal. Effective implementation is verified by the NNR.

H-1.3. INTERDEPENDENCIES IN RADIOACTIVE WASTE MANAGEMENT

The Policy and Strategy embodies the principle that interdependencies among all steps in radioactive waste generation and management shall be appropriately taken into account.

Interdependencies in the generation and management steps are managed by the preparation of a facility radioactive and hazardous waste management programme and waste management plans. Requirements are identified during the facility hazard assessment and included in the integrated safety assessment of the facility. The facility waste management programme identifies waste streams and end points and ensures that waste management and transport steps meet the requirements of the NNR.

Non-conformities in earlier processes (e.g. the predisposal processes) may impact on later processes (e.g. final disposal). It may not always be possible or effective to rectify such non-conformities in a retrospective manner. In such a case, an integrated waste management approach is endorsed by integrated safety, health, environment and quality management practices, which aim to prevent harmful effects on current and future generations for the total life cycle of radioactive waste management.

H-1.4. EFFECTIVE PROTECTION OF INDIVIDUALS, SOCIETY AND THE ENVIRONMENT WITH DUE REGARD FOR INTERNATIONALLY ENDORSED STANDARDS AND CRITERIA

The NNRA mandates that the NNR should provide for the protection of persons, property and the environment against nuclear damage through the establishment of safety standards and regulatory practices. The NNR published said regulations, in the form of SSRP on 26 April 2006.

In developing its regulations standards and guidance, the NNR takes due account of international standards and criteria, in particular the safety standards of the IAEA, recommendations from the ICRP and reports from UNSCEAR.

The NNR also tracks regulatory practices at other regulators and has signed bilateral agreements for the sharing of information, standards and regulatory practices with a number of international nuclear regulators, including nuclear regulatory bodies in Argentina, Canada, Finland, France, South Korea, Russia, the United Kingdom and the United States of America.

South Africa is also a member of the Network of Regulators of Countries with a Small Nuclear Programme (NERS), the Forum of Nuclear Regulatory Bodies in Africa (FNRBA) and the Southern African Development Community (SADC) Nuclear Regulatory Network (NRN) and, as such, shares experiences, safety standards, etc. with regulators of countries who are members of these networks.

H-1.5. BIOLOGICAL, CHEMICAL AND OTHER HAZARDS

The NNR has no specific requirements regarding biological, chemical and other hazards. However, these are considered in as far they have a connection with radiological hazards. In addition, all facilities regulated by the NNR and the SAHPRA have to comply with all other national legislation with regard to other types of hazards.

Necsa employs a radioactive waste characterisation process for the characterising of radiological, chemical, mechanical, thermal and biological properties of radioactive wastes. These characteristics are used to categorise the waste in order to determine the applicable processing technology that will be used to render the final waste matrix acceptable for packaging, storage and final disposal.

The waste acceptance criteria of Vaalputs furthermore imposes requirements on predisposal operators to record and report all radioactive, as well as hazardous chemical and biological waste constituents. It further prescribes a list of prohibited waste (e.g., pyrophoric material, hazardous chemicals, gas generating constituents, etc.) that will not be accepted for final disposal.

H-1.6. PROTECTION OF FUTURE GENERATIONS

The protection of future generations is a principle embodied in the Policy and Strategy. In accordance with the Policy and Strategy principle, radioactive waste shall be managed in such a way that the predicted impact on future generations will not be greater than the relevant levels of impact that are acceptable today.

The SSRP prescribes the NNR dose and risk criteria and applicants for, and holders of nuclear authorisations are required, by means of their submitted safety case documentation, to demonstrate compliance with the prescribed dose and risk criteria.

In the case of waste disposal, permanent containment and isolation in a repository cannot always be guaranteed over long periods of time. It could be possible for some fraction of the waste inventory to migrate to the biosphere, potentially giving rise to exposures in future years. Doses to individuals and populations over long time-scales can only be estimated and the reliability of these estimates decrease as the time period increases in future. The Post-Closure Radiological Safety Assessment for Vaalputs considered various long and short-term intrusion and exposure scenarios and concluded that the dose to the most exposed individual (inadvertent intrusion) would still be within prescribed limits.

H-1.7. UNDUE BURDEN ON FUTURE GENERATIONS

In accordance with the Policy and Strategy, radioactive waste shall be managed in such a way that it will not impose an undue burden on future generations. South Africa also adopted the "Polluter Pays Principle", in that the financial burden for the management of radioactive waste shall be borne by the generator of the waste.

In the Republic of South Africa, 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 certain types of waste, such as high-level waste, long-lived waste and spent sources may be regarded as one of the steps in the management process.

In practice, the following hierarchy of waste management options will be followed were practicable:
- Waste avoidance and minimisation;
- Reuse, reprocessing and recycling;
- Storage;
- Conditioning and final disposal.

To provide future generations with freedom of choice and to build confidence, all radioactive waste disposal options shall provide for a defined period during which the retrieval of the waste will be possible. Furthermore, to minimise the burden on future generations, decommissioning and closure of facilities should be implemented as soon as practicable.

H-2. EXISTING FACILITIES AND PAST PRACTICES

Article 12: Existing Facilities and Past Practices

Each Contracting Party shall in due course take the appropriate steps to review:

i. The safety of any radioactive waste management facility existing at the time the Convention enters into force for that Contracting Party and to ensure that, if necessary, all reasonably practicable improvements are made to upgrade the safety of such a facility;

ii. The results of past practices in order to determine whether any intervention is needed for reasons of radiation protection bearing in mind that the reduction in detriment resulting from the reduction in dose should be sufficient to justify the harm and the costs, including the social costs, of the intervention.

H-2.1. SAFETY OF EXISTING RADIOACTIVE WASTE MANAGEMENT FACILITIES

In terms of the NNRA, the applicant is required to submit a safety case, which must include documentation relevant to the demonstration of compliance with the SSRP. Approved, existing safety cases reflect the current situation of the waste management facility.

In accordance with the SSRP, an operational safety assessment must be performed and submitted to the Regulator at intervals specified in the nuclear authorisation and which must be commensurate with the nature of operation and the radiation risk involved. The compliance assurance programmes of the NNR are established to monitor compliance with the conditions of authorisation.

As an integral part of the operational safety assessment, in addition to the ongoing assessment, which focuses on immediate aspects of installation and procedural modification, a requirement to undertake a periodic safety re-assessment is also in place. The conditions of authorisation for nuclear installations require that the licensee establish and implement processes for the periodic and systematic review and reassessment of safety cases submitted to the Regulator.

H-2.1. REVIEWING THE RESULTS OF PAST PRACTICES IN ORDER TO DETERMINE WHETHER ANY INTERVENTION IS NEEDED.

The waste management facilities at Koeberg, Necsa and Vaalputs comply with safety requirements laid down by the NNR. The requirements prescribe the following:

- Compliance with a system of justification of facilities/actions;
- Compliance with dose and risk limits;
- Compliance with dose constraints and annual allowable discharge quantities;
- Use of the ALARA principle;
- Application of the “defence-in-depth” principle and good engineering practice.

When the Vaalputs facility was developed more than three decades ago, the emphasis was on the performance of natural barriers (e.g. low permeability geo-sphere) rather than engineered barriers. The initial safety report, the probabilistic safety assessment and the post-closure safety assessment for Vaalputs have not shown that any optimisation/improvement of the disposal concept are required in order to enhance the long-term safety performance of the site.

The post-closure safety reassessment, however, highlighted that the safety of the disposal operations can be improved by, for example, backfilling and covering disposal trenches more promptly and thereby limiting exposure of waste packages to environmental agents. The assessment was prompted by a nuclear occurrence that was raised as a result of some waste packages showing deterioration in a trench that was left uncovered for an extended period. The proposed corrective measures were incorporated into operational procedures and into the waste acceptance criteria.

H-3. SITING OF PROPOSED FACILITIES

Article 13: Siting of Proposed Facilities

1. Each Contracting Party shall take the appropriate steps to ensure that procedures are established and implemented for a proposed radioactive waste management facility:

i. to evaluate the safety of all relevant site-related factors likely to affect the safety of such a facility during its operating lifetime as well as that of a disposal facility after closure;

ii. to evaluate the likely safety impact of such a facility on individuals, society and the environment, taking into account possible evolution of the site conditions of disposal facilities after closure;

iii. to make information on the safety of such a facility available to members of the public;

iv. to consult Contracting Parties in the vicinity of such a facility, insofar as they are likely to be affected by that facility, and provide them, upon their request, with general data relating to the facility to enable them to evaluate the likely safety impact of the facility upon their territory.

2. In so doing, each Contracting Party shall take the appropriate steps to ensure that such facilities shall not have unacceptable effects on other Contracting Parties by being sited in accordance with the general safety requirements of Article 11.

H-3.1. SITE-RELATED FACTORS LIKELY TO AFFECT THE SAFETY OF A FACILITY DURING ITS OPERATING LIFETIME, AS WELL AS THAT OF A DISPOSAL FACILITY AFTER CLOSURE

The DEA and the NNR require holders of nuclear authorisations to evaluate all relevant site-related factors likely to affect the safety of such a facility during its operating lifetime, as well as that of a disposal facility after its closure. Where a major hazard installation is located on-site outside of a nuclear installation, a risk assessment has to be conducted every five years and submitted to the Department of Labour (DoL) in terms of the major hazard installation regulations of the Occupational Health and Safety Act, 1993 (Act No. 85 of 1993).

In terms of the NNRA, nuclear authorisations are required for the siting of nuclear installations. In anticipation of applications for new nuclear sites, Regulation 927 of 2011 on siting of new nuclear installations was published in November 2011.

Regulation 927 of 2011 establishes regulatory requirements pertaining to sites for new nuclear installations. In developing these regulations, the NNR took cognisance of international standards and practices from sources such as the IAEA and also from relevant nuclear safety authorities of other countries.

Regulation 927 of 2011 requires that the applicant wishing to site a nuclear installation must submit a site safety report to the NNR, which will sufficiently characterise the site and demonstrate that the safety standards of the NNR could be met in respect of the plant design. Typically, the site safety report would address the following topics: Description of site and environs; population growth and distribution; land-use; adjacent sea-usage (if applicable); nearby transportation; civil and industrial facilities; meteorology; oceanography and cooling water supply; the impact of natural hazards; the impact of external man-made hazards; hydrology, geology and seismology; fresh water supply; site control; emergency services; radioactive effluents; and ecology.

Although all these topics need to be supported by up-to-date validated data, one important factor in determining the suitability of the site is that the projected population growth and distribution around the site have to be such as to provide the assurance that emergency planning and preparedness arrangements for the site could be kept viable throughout the lifetime of the nuclear installation. Should the NNR conclude that the proposed site is not viable and suitable for licensing, the applicant will need to consider other alternative sites.

H-3.2. EVALUATION OF THE SAFETY IMPACT OF A FACILITY ON INDIVIDUALS, SOCIETY AND THE ENVIRONMENT, AFTER CLOSURE

The Vaalputs facility is the sole disposal facility in the country. A post-closure safety assessment of the disposal facility was undertaken. This assessment was based on the IAEA ISAM methodology and demonstrated that the post-closure impact would be acceptable in terms of the current dose limits.

The post-closure safety assessment identified that the operational safety of the disposal site can be improved by, for example, backfilling and covering disposal trenches more promptly and thereby limiting exposure of waste packages to environmental agents. The water content in waste disposed of at Vaalputs must be limited. These suggestions were incorporated into operational procedures and into the waste acceptance criteria to improve the safety of the facility.

A conceptual plan is also in place for the care and maintenance of the Vaalputs site up to 300 years post-closure. Also see sections H-5.2 and H-6.9.

H-3.3. AVAILABILITY OF INFORMATION ON SAFETY TO MEMBERS OF THE PUBLIC

Current regulations require that an EIA and a nuclear licence for nuclear-related projects be subjected to public participation in the decision-making phases, prior to the establishment and operation of the nuclear facility. Detail on this process is provided in Section G-3.3.

Nuclear installation licences are made available to the public or anybody visiting a nuclear facility by displaying the licences in three languages within accessible areas of facility building.

Information regarding the safe operation of nuclear facilities is communicated to interested and affected parties via PSIF. Also see Section G-3.3.

H-3.4. CONSULTATION WITH CONTRACTING PARTIES IN THE VICINITY OF A FACILITY AND PROVISION OF GENERAL DATA RELATING TO THE FACILITY TO ENABLE THEM TO EVALUATE THE LIKELY SAFETY IMPACT OF THE FACILITY UPON THEIR TERRITORY.

The current radioactive waste management facilities pose no impact beyond the borders of the Republic and, as such, neighbouring Contracting Parties have not been engaged on the likely impact of the radioactive waste facility. Any Contracting Party who may be affected by the granting of a new nuclear authorisation for a radioactive waste management facility will be included in the consultation process, detailed in Section G-3.3.

H-3.5. STEPS TAKEN TO ENSURE THAT FACILITIES DO NOT HAVE UNACCEPTABLE EFFECTS ON OTHER CONTRACTING PARTIES, BY BEING SITED IN ACCORDANCE WITH THE GENERAL SAFETY REQUIREMENTS

When any new project is initiated or when modifications to an existing licence are made, which could have an effect on public safety, the public is invited to participate in the new or revised application for a licence. The potential effect from the project on the public is assessed in terms of the safety requirements specified in the SSRP. After authorisation, the NNR implements a compliance assurance programme. Feedback is given to the public and other affected parties at PSIF.

The general requirements related to siting of new nuclear facilities is described in Section G-3: SITING OF PROPOSED FACILITIES. Furthermore, the safety case for a new nuclear facility must include the following:

- Assessment of the suitability of the site considering, amongst others, external events and civil engineering issues;
- Assurance of safety including concept designs and engineered safety features that will ensure an acceptable low risk of public exposure, probabilistic safety assessment and source term analysis;
- Public and environmental impact analyses;
- Emergency planning including the identification of emergency planning zones, preliminary work on establishment of emergency plans and proposed arrangements for control of developments;
- Security measures;
- Organisation for site licensing including an overview of the management system, processes and associated procedures; and
- Site Safety Report.

Strict application of the regulatory framework including submission of appropriate safety case demonstrating compliance to the prescribed risk and dose criteria, aligned with international good practice, ensures that other Contracting Parties will not be subjected to unacceptable effects as a result of nuclear facilities in South Africa.

H-4. DESIGN AND CONSTRUCTION OF FACILITIES

Article 14: Design and Construction of Facilities

Each Contracting Party shall take the appropriate steps to ensure that:

i. the design and construction of a radioactive waste management facility provides for suitable measures to limit possible radiological impacts on individuals, society and the environment, including those from discharges or uncontrolled releases;

ii. at the design stage, conceptual plans and, as necessary, technical provisions for the decommissioning of a radioactive waste management facility other than a disposal facility are taken into account;

iii. at the design stage, technical provisions for the closure of a disposal facility are prepared;

iv. the technologies incorporated in the design and construction of a radioactive waste management facility is supported by experience, testing or analysis.

H-4.1. CONTROL MEASURES FOR DESIGN AND CONSTRUCTION

The requirements of the NNRA and the principal safety requirements formulated in the SSRP, form the basis for the stipulation of the regulatory requirements for the design and construction of nuclear installations.

All storage facilities at Koeberg were designed to limit the release of radon and dust into the atmosphere and also to limit the amount of seepage and run-off from the source into the environment.

All projects at the Necsa site follow the project approval process with specific requirements determined by the categorisation of the project in terms of risk level. Necsa's management system prescribes the requirements and aspects to be considered in the safety assessment of each nuclear facility at Necsa, including all waste management, storage and conditioning facilities

Before construction of a nuclear facility, a safety assessment report and an environmental assessment are required. In the event of construction, the contractor must:

- have a health and safety file that contains the information prescribed in the construction regulations in terms of the Occupational Health and Safety Act 1993 (Act No. 85 of 1993) which includes a Necsa approved Health and Safety plan that addresses hazards that may impact on individuals, society or the environment; and
- must be in good standing with the government compensation fund or a licenced insurer.

H-4.2. CONCEPTUAL PLANS FOR DECOMMISSIONING AT THE DESIGN STAGE

The SSRP requires a decommissioning strategy to be submitted as part of the prior safety assessment and it must be updated throughout the operation of the nuclear installation as a basis for detailed decommissioning planning.

For all new projects that are undertaken, it is required that conceptual plans for decommissioning are developed during the design stage.

H-4.3. TECHNICAL PROVISIONS FOR CLOSURE AT THE DESIGN STAGE

Continued monitoring and environmental surveillance of the Vaalputs site are ensured through the decommissioning and after-care strategy, which is a nuclear licence requirement and represents additional safety control measures that contribute to building confidence in the safe operation of the repository. A strategy is required for the decommissioning of all nuclear facilities.

H-4.4. TECHNOLOGIES THAT ARE INCORPORATED IN DESIGN AND CONSTRUCTION ARE SUPPORTED BY EXPERIENCE, ANALYSIS AND TESTING

The same set of requirements applicable to used fuel facilities applies to facilities discussed in this section. (See Sections G and E.)

At Koeberg, experienced staff members from various disciplines provide technical support for the application of new technologies with regard to design and construction.

With regard to the Vaalputs disposal site, technical and scientific data, obtained from monitoring and measurement results, are used to improve mathematical models for safety assessments and also for confirming the disposal system performance and the possible impact of the waste disposal operations on the environment.

H-5. ASSESSMENT OF SAFETY OF FACILITIES

Article 15: Assessment of Safety of Facilities

Each Contracting Party shall take the appropriate steps to ensure that:

i. before construction of a radioactive waste management facility, a systematic safety assessment and an environmental assessment appropriate to the hazard presented by the facility and covering its operating lifetime shall be carried out;

ii. in addition, before construction of a disposal facility, a systematic safety assessment and an environmental assessment for the period following closure shall be carried out and the results evaluated against the criteria established by the regulatory body;

iii. before the operation of a radioactive waste management facility, updated and detailed versions of the safety assessment and of the environmental assessment shall be prepared when deemed necessary to complement the assessments referred to in paragraph (i).

H-5.1. SAFETY ASSESSMENT AND AN ENVIRONMENTAL ASSESSMENT BEFORE CONSTRUCTION

In accordance with environmental legislation, any authorisation granted for a nuclear installation by the DEA would be conditional to the necessary nuclear authorisation from the NNR being in place. No authorisation (Record of Decision) is required for facilities commissioned before September 1997, unless the operational status of the facility changes.

The NNR requirements for safety assessment are stipulated in the SSRP. The same set of requirements applicable to used fuel facilities, applies to facilities discussed in this section. (See Section G, and Section E.)

At Koeberg, a safety assessment and an EIA were developed and submitted for approval by the respective regulators. These are reviewed and revised at defined intervals.

At Necsa, the safety assessment report, the facility operating instructions and the environmental impact assessment requirements of the facility, identified during the project review process, constitute key elements of the safety case of the waste management facility.

The Vaalputs facility was granted a nuclear licence to commence operations in 1986, based on the Vaalputs National Radioactive Waste Disposal Safety Report. A probabilistic safety assessment of the Vaalputs operations was conducted in 1996, to assess the probabilities of different event sequences and failure scenarios, and this assessment was incorporated into the nuclear licence. The post-closure radiological safety assessment was reviewed in 2007 and 2013 respectively. The operational safety assessment was updated in 2012.

H-5.2. POST-CLOSURE SAFETY ASSESSMENT OF A DISPOSAL FACILITY

In accordance with NNR requirements, the post-closure safety performance of the Vaalputs repository system has subsequently been assessed in 2000, 2007 and again in 2013, by means of the post-closure radiological safety assessments. These assessments indicated that the natural barrier component of the multi-barrier system provided sufficient isolation of the waste disposed of in the Vaalputs repository. The predicted radiation exposure of the public (critical group) is at levels considered to be acceptable, as required by the national regulatory authorities.

The 2013 post-closure radiological safety assessment of Vaalputs demonstrated that the repository isolation concept, comprising near-surface trenches located in the region above the groundwater table, provided effective isolation from the biosphere for the duration of the operational and institutional control period. The institutional control period commences after repository closure and is envisaged to be 300 years for the Vaalputs repository, given the current operational constraints and source term.

Safety assessments of Vaalputs demonstrate that the repository system has characteristics that:

- provide a high level of operational and long-term safety;
- demonstrate compliance with performance standards, thus enhancing public confidence in the disposal system;
- ensure safety without placing an excessive financial burden on the current and future generations;
- prevents or substantially delays movement of water or radionuclides towards the accessible environment; and
- provides for the safe closure of the facility once all operations have ceased, given that the necessary after-care measures are taken in the institutional control period.

H-6. OPERATION OF FACILITIES

Article 16: Operation of Facilities

Each Contracting Party shall take the appropriate steps to ensure that:

i. the licence to operate a radioactive waste management facility is based upon appropriate assessments as specified in Article 15 and is conditional on the completion of a commissioning programme demonstrating that the facility, as constructed, is consistent with design and safety requirements;

ii. operational limits and conditions, derived from tests, operational experience and the assessments as specified in Article 15 are defined and revised as necessary;

iii. operation, maintenance, monitoring, inspection and testing of a radioactive waste management facility are conducted in accordance with established procedures. For a disposal facility the results thus obtained shall be used to verify and to review the validity of assumptions made and to update the assessments as specified in Article 15 for the period after closure;

iv. engineering and technical support in all safety-related fields are available throughout the operating lifetime of a radioactive waste management facility;

v. procedures for characterization and segregation of radioactive waste are applied;

vi. incidents significant to safety are reported in a timely manner by the holder of the licence to the regulatory body;

vii. programmes to collect and analyse relevant operating experience are established and that the results are acted upon, where appropriate;

viii. decommissioning plans for a radioactive waste management facility other than a disposal facility are prepared and updated, as necessary, using information obtained during the operating lifetime of that facility, and are reviewed by the regulatory body;

ix. plans for the closure of a disposal facility are prepared and updated, as necessary, using information obtained during the operating lifetime of that facility and are reviewed by the regulatory body.

H-6.1. ASSESSMENTS AND COMMISSIONING PROGRAMME

The same set of requirements applicable to used fuel facilities applies to facilities discussed in this section. (See Section G, and Section E.)

At Koeberg, inspections are conducted by both the operator and the regulator during commissioning, in order to ensure that the facility is performing in accordance with design parameters and also that the safety requirements are being met.

With regard to facilities in operation at Necsa, facility-specific project commissioning requirements are documented in the pre-planning phase, in accordance with the requirements of the approved SHEQ system.

All nuclear facilities, including Vaalputs, operate in terms of a nuclear installation licence, issued by the NNR under the NNRA. The Vaalputs nuclear licence (NIL-28) includes requirements pertaining to the following:

- Risk assessment and compliance with safety criteria;
- Modifications and licence change requests;

- Reporting nuclear occurrences;
- Probabilistic safety assessment;
- Waste acceptance criteria;
- A quality and environmental management system;
- A radiological environmental surveillance programme;
- Radiological control programmes;
- Control over radioactive effluents;
- Technical design specifications;
- Emergency planning;
- A maintenance programme;
- Security requirements;
- A meteorological programme;
- An in-service inspection and testing programme;
- Operational procedures.

In terms of commissioning, at Koeberg inspections are done by both the operator and the regulator during commissioning, in order to ensure that the facility is performing in accordance with design parameters and also that the safety requirements are being met.

H-6.2. OPERATIONAL LIMITS AND CONDITIONS

Facility-specific operating technical specifications (OTS) ensure that safety-related systems, structures and components required for normal operations and emergencies are identified during risk assessments. The conditions for any abnormal operation allowed must be clearly understood.

The OTS includes safety limits, limiting safety settings, limiting conditions for operation, surveillance and maintenance requirements and the administrative controls involved in compliance with these requirements.

H-6.3. THE USE OF ESTABLISHED PROCEDURES

Facility-specific in-service inspection (ISI) and maintenance procedures are intended to ensure that specific safety related systems, structures and components required for normal operations or emergencies, function properly. The process is limited to the physical systems, structures and components identified in the risk assessment as items relied upon for safe operation.

Procedures for operation, maintenance, monitoring, inspection/auditing and testing have been established and are being implemented by the operator and results thereof are provided to the NNR during inspections and audits.

H-6.4. ENGINEERING AND TECHNICAL SUPPORT

The same set of requirements applicable to used fuel facilities applies to facilities discussed in this section. (See Section G, and Section E.)

At Koeberg, the General Manager: Engineering, is responsible for providing technical support for critical safety components of waste processing facilities on site.

Necsa is structured to ensure that the necessary technical and engineering support is available to facility managers.

H-6.5. PROCEDURES FOR CHARACTERISATION AND SEGREGATION OF RADIOACTIVE WASTE

Waste is characterised in accordance with the Policy and Strategy.

At Koeberg, a waste management procedure is in place for the characterisation and segregation of waste. Characterisation of waste at Koeberg includes the determination of the physical, chemical and radiological properties of the waste, so as to establish the need for further adjustment, treatment, conditioning or its suitability for further handling, processing, storage or disposal. The method employed at Koeberg to group various types of radioactive waste according to their physical characteristics is aligned with the national classification systems. Low and intermediate level short-lived waste (LILW-SL) includes active spent resin, spent resins from demineralisers, evaporator concentrates, miscellaneous waste, low-active water filters, high-active water filters, metallic objects, sludge, wood and miscellaneous waste, which are categorised according to the activity and dose rate in order to be placed in the appropriate containers.

Necsa management system documents provide guidance on the following topics:

- Removal of material from radiological areas (SHEQ-INS-8040);
- Clearance of materials from authorised facilities (SHEQ-INS-8110);
- Off-site transport of radioactive material or contaminated equipment (SHE-INS-8170);
- Quantities for the control of radioactive discharges into the environment from thePelindaba site (SHEQ-INS-8240);
- Management of radioactive emissions at the Pelindaba site (SHEQ-INS-8230);
- Radiological environmental surveillance requirements for the Pelindaba site and vicinity (SHEQ-INS-8340);
- Management of solid radioactive waste (SHEQ-INS-8360);
- Solid radioactive waste classification scheme (SHEQ-INS-8380);
- Radioactive waste characterisation (SHEQ-INS-8390);
- Radioactive waste categorisation (SHEQ-INS-8370).

The Segmented Drum Scanner facility (SDS), which is housed in a steel structure with natural ventilation, is an automated facility that is used for assaying drums of solid nuclear waste. The results of the assay are used to determine whether the drum contents meet the acceptance criteria for further processing, disposal or transfer to interim storage. The SDS measures gamma emission from the drum over a wide energy spectrum and then computes the drum inventory from the measurements and other inferred characteristics which are determined by prior characterisation of the waste stream.

Each waste drum that is presented for assay is identified by a unique number which is recorded in a database containing historical data related to the origin, geometry and contents of the drum. The result from the SDS is used to classify the contents in accordance with the waste classification scheme, and the results are recorded in a database which serves as the primary record of the drum inventory and history.

Waste acceptance requirements and criteria and discharge requirements are specified in facility-specific procedures. Facility managers are responsible for waste characterisation. The necessity for detailed radionuclide characterisation depends in part on the projected dose to the critical group.

NNR requirements document RD-004, namely Radioactive Waste Management: Mining and Minerals Processing, specifies requirements for facilities dealing with NORM materials.

H-6.6. REPORTING OF INCIDENTS

At Koeberg, an occurrence reporting procedure is in place, which provides for detection, classification and reporting of reportable incidents within prescribed time-frames. All incidents relating to radioactive waste management are reported, classified, investigated and recorded in accordance with the Koeberg Incident Reporting and Investigation Procedure. Incidents relating to radioactive waste management are assigned Problem Notification Numbers and the classification of the incident is performed in accordance with an Eskom incident classification system and the International Nuclear Event Scale as required. A Lead Investigator is assigned and the investigation is recorded and reported in a format that addresses the following aspects:

- The title or description of the incident;
- The plant state before the occurrence;
- A chronological sequence of events;
- The investigation and assessment;
- The technical causes, direct causes and root causes identified;
- Previous operating experience relating to the incident;
- Conclusion, recommendations and corrective actions;
- Reporting to key stakeholders.

Necsa's incident reporting is addressed through the following management system documents:

- Implementation of the Conventions on the early notifications and assistance in the case of nuclear accidents and radiological emergencies (SHEQ-INS-4143);
- Event-rating scale (SHEQ-INS-4145);
- Categorisation and notification of SHEQ-related events (SHEQ-INS-4140);
- The Necsa emergency plan (SHEQ-INS-3500);
- Notification and reporting to all relevant authorities (SHEQ-INS-4144);
- Emergency plan for Necsa, Madibeng and Tshwane to control the off-site impact of Necsa emergencies (SHEQ- PLN-3500);
- Requirements for SHEQ-related event investigation (SHEQ-INS-4150).

NORM facilities are required to establish and implement occurrence reporting mechanism for dealing with incidents. Facilities are required in terms of the NNR document RD-012: Notification Requirements for Occurrences: Mining and Mineral Processing, to report any incident involving radioactive material e.g. slime spillage.

The following process is followed when reporting incidents/occurrences:

- The NNR is notified immediately.
- Formal Notification report submitted and should detail the following:
  - Occurrence Number;
  - Date and time of the occurrence;
  - Initial classification;
  - Description of occurrence;
  - Description of immediate actions taken;
  - Description of planned actions;
  - Other organisations or individuals that have been informed.
- A formal close out report is then submitted within 30 days of the occurrence detailing the following:
  - The results of the investigation into the cause of occurrence,
  - The corrective actions taken to prevent recurrence.
- An interim report is submitted in case the 30 days for closing the occurrence is not sufficient.

H-6.7. ANALYSIS OF OPERATING EXPERIENCES

The detail reported under section G-6.6 is also of relevance here.

In addition, the licensee management systems provide for the following:

- ALARA reviews: Detail is provided in Section F-4.1.2 in response to Article 24.
- Safety Reviews: Safety reviews are conducted routinely at facilities with a frequency depending on the associated risk and when modifications are made. The purpose of facility safety reviews is to keep facility staff members alert to process hazards; a review of operating procedures; identification of equipment or process modifications that could have introduced new hazards; the application of new technology to existing hazards; a review the adequacy of inspections and safety instructions; and ensuring periodic reviews of the safety assessment.

H-6.8. DECOMMISSIONING PLANS

Requirements related to decommissioning are reported in Section F-6.

With regard to the radioactive waste management facilities, decommissioning strategies and initial decommissioning plans are prepared for each operation and they are reviewed and updated every two years, so as to take into account any changes and events that might have occurred.

The decommissioning strategies and initial decommissioning plans must identify:

- existing systems and equipment that will be used during decommissioning to ensure that they are available when needed;
- necessary changes or replacements of existing system; and
- need for new facilities to carry out decommissioning and waste management.

An authorisation holder shall immediately inform the Regulator of its decision to terminate the operation of a facility or undertaking of an authorised action and submit a final decommissioning plan. Typically, the final decommissioning plan should:

- be consistent with the decommissioning strategy proposed for the facility;
- be consistent with the safety case for decommissioning;
- describe the decommissioning activities, including the timeframe and the end- state of the decommissioning project, and the content of the individual phases, if a phased approach is proposed;
- describe the facilities, systems and equipment needed to perform the decommissioning project;
- describe the human resources required for safe decommissioning;
- describe the management of residual material and waste in accordance with the national radioactive waste management Policy and Strategy, and
- describe the programme of the final radiation survey of the end-state of decommissioning.

An authorisation holder shall not commence with decommissioning activities without prior approval from the NNR or SAHPRA.

H-6.9. CLOSURE PLANS

The Vaalputs post-closure engineering design incorporates information obtained during the operating lifetime of the facility. It forms part of the post-closure safety assessment of the repository and provides for the following:

- A detailed description of the Vaalputs repository as envisaged at the time of closure;
- A basis for the assessment of potential closure system performance;
- An indication that an integrated decommissioning and closure design has been developed;
- Evidence that good engineering principles and practises were followed in the operation and closure of the facility and that they are aimed at optimising the site and disposal operations with regard to the radiological impact arising from historical disposals.

It is envisaged that an assessment of the long-term safety of the Vaalputs site will be conducted at the end of the operational period to determine whether the remaining facilities and the environmental pathways should continue to be monitored after site closure, taking into account the total nuclide inventory as well as updated safety assumptions and conditions at the time. This safety assessment will form the basis according to which post-closure residual risks (engineering and environmental) will be managed in the institutional control period.

Other actions to be undertaken at site closure include:

- Final radiological survey of the site and buildings;
- Environmental monitoring and comparison of results with baseline measurements;
- Assembling and archiving records;
- Phases 1 and 2 decommissioning of buildings, processes and facilities;
- Erecting adequate security fencing and/or intrusion barriers around the site perimeter and around the disposal area;
- Placing durable markers and monuments at strategically chosen locations to demarcate the repository and to acquaint possible intruders with the former use of the site for radioactive waste disposal;

- If required, construct storm water ditches to prevent rainwater from seeping towards the disposal trenches and thereby causing possible ponding conditions during possible heavy rainstorms; and
- Constructing a final cap over the disposal trenches, if so indicated by the safety assessment.

The institutional control period will commence after repository closure and is assumed to be three hundred years for the Vaalputs near surface repository given the current operational constraints.

H-7. INSTITUTIONAL MEASURES AFTER CLOSURE

Article 17: Institutional Measures after Closure

Each Contracting Party shall take the appropriate steps to ensure that after closure of a disposal facility:

i. records of the location, design and inventory of that facility required by the regulatory body are preserved;

ii. active or passive institutional controls such as monitoring or access restrictions are carried out, if required; and

if, during any period of active institutional control, an unplanned release of radioactive materials into the environment is detected, intervention measures are implemented, if necessary.

H-7.1. PRESERVATION OF RECORDS

To date no radioactive waste disposal facilities have been closed in the Republic of South Africa.

The SSRP makes provision for a system of record-keeping to be implemented by holders of nuclear authorisations.

Furthermore, the conditions of authorisation require that licensees must implement and maintain a document management system, in order to ensure that every document required; every record made; every authority, consent or approval granted and every directive or certificate issued in pursuance of these conditions of licence is preserved for 30 years or such other period as the NNR may approve.

All records and documentation pertaining to radioactive waste management and test results; and checks and inspections carried out on waste for disposal at Vaalputs are kept as quality records at Koeberg and Necsa (Predisposal Operations Section of NLM) in accordance with the approved Records Management System.

The Radwaste Management Section at Koeberg keeps records of equipment, as well as shipping containers stored at the Low Level Waste Building. Koeberg employs a Radwaste Tracking Programme, which contains electronic data relating to the processing and management of LILW-SL radioactive waste.

In addition, the NNR maintains a document management system that is aligned with the requirements of the National Archives and Records Services.

H-7.2. INSTITUTIONAL CONTROLS

The institutional control period for the Vaalputs installation commences after repository closure and is assumed to be 300 years (100 years for active institutional control, followed by 200 years passive institutional control), given the current operational constraints.

The active institutional control measures after closure of the site includes the following:

- Measures to ensure that records of the location, design and inventory of the facility are preserved;
- Radiological monitoring of environmental performance;
- Patrolling and maintenance of the disposal site security fences
- Deterring animal, plant and human intrusion;
- Maintaining a cover over the waste;
- Monitoring of the performance of structures to confirm compliance with the design;
- Ensuring proper rehabilitation and plant growth of previously disturbed areas.

In the passive institutional control phase, it would clearly be preferable to put in place further regulatory measures to minimise the likelihood of intrusion into the site that was used for radioactive waste disposal. The following is regarded as means to achieve this:

- Site location on official maps;
- Land use restrictions/control;
- Use of records;
- Use of markers.

H-7.3. INTERVENTION MEASURES DURING INSTITUTIONAL CONTROL

Monitoring and measurement programs will be implemented in the institutional control period for Vaalputs with the aim to detect possible intrusion, non-performance of safety features or other adverse environmental impacts in order to timeously implement intervention measures.

The surveillance programs in the institutional control period may include the following:

- Monitoring and control of possible burrowing animal activity in the trench-cap area;
- Radiological monitoring of environmental performance (exposure pathways) for confirmatory purposes;
- Patrolling and maintenance of disposal site perimeter fences;
- Deterring animal, plant and human intrusion into the wastes;
- Monitoring of possible cap subsidence caused by void volumes associated with the degradation of waste;
- Maintaining cover over the waste;
- Ensuring proper rehabilitation and plant growth over previously disturbed areas;
- Monitoring possible gas released from waste in order to prevent pressure build- up that may adversely affect the integrity of the overlying caps;
- Monitoring of the performance of barriers to confirm compliance with the design.

Monitoring and measurement will be maintained until such time as the results confirm that the facilities have stabilised sufficiently to the extent that the residual risk, as evaluated by the final safety assessment, demonstrates that restrictions on use of the site are no longer required (i.e., the site is passively safe).

Where non-conformities with regard to safety performance of the disposal site are detected within the institutional control period, it is foreseen that these will be corrected on a case-by-case basis, in accordance with the best practise at the time. A ground stability unit is responsible for monitoring the geological stability of the site.

Section I

TRANSBOUNDARY MOVEMENT

SECTION I: TRANSBOUNDARY MOVEMENT

Article 27: Transboundary Movement

1. Each Contracting Party involved in transboundary movement shall take the appropriate steps to ensure that such movement is undertaken in a manner consistent with the provisions of this Convention and relevant binding international instruments. In so doing:

i. a Contracting Party which is a State of origin shall take the appropriate steps to ensure that transboundary movement is authorized and takes place only with the prior notification and consent of the State of destination;

ii. transboundary movement through States of transit shall be subject to those international obligations which are relevant to the particular modes of transport utilized;

iii. a Contracting Party which is a State of destination shall consent to a transboundary movement only if it has the administrative and technical capacity, as well as the regulatory structure, needed to manage the spent fuel or the radioactive waste in a manner consistent with this Convention;

iv. a Contracting Party which is a State of origin shall authorize a transboundary movement only if it can satisfy itself in accordance with the consent of the State of destination that the requirements of subparagraph (iii) are met prior to transboundary movement;

v. a Contracting Party which is a State of origin shall take the appropriate steps to permit re-entry into its territory, if a transboundary movement is not or cannot be completed in conformity with this Article, unless an alternative safe arrangement can be made.

2. A Contracting Party shall not licence the shipment of its spent fuel or radioactive waste to a destination south of latitude 60 degrees South for storage or disposal.

3. Nothing in this Convention prejudices or affects:

i. the exercise, by ships and aircraft of all States, of maritime, river and air navigation rights and freedoms, as provided for in international law;

ii. rights of a Contracting Party to which radioactive waste is exported for processing to return, or provide for the return of, the radioactive waste and other products after treatment to the State of origin;

iii. the right of a Contracting Party to export its spent fuel for reprocessing;

iv. rights of a Contracting Party to which spent fuel is exported for reprocessing to return, or provide for the return of, radioactive waste and other products resulting from reprocessing operations to the State of origin.

The Policy and Strategy prescribes that:

"No Import or Export of Radioactive Waste: In principle, South Africa will neither import nor export radioactive waste."

SAHPRA is mandated for the purposes of the Hazardous Substances Act, 1999 (Act No. 15 of 1973) (HSA) to act as the national competent authority in connection with the International Atomic Energy Agency's Regulations for the Safe Transport of Radioactive Material.

Transport of sealed sources, classified in terms of the HSA as Group IV hazardous substances, requires prior authorisation from the SAHPRA

The NNR is mandated for the purposes of the NNRA to act as the national competent authority in connection with the IAEA's Regulations for the Safe Transport of Radioactive Material

Transport of radioactive materials, including radioactive waste that has activity concentrations above the exclusion levels specified in the SSRP, requires prior authorisation from the NNR. In accordance with the provisions of section 20(2) of the NNRA:

"No vessel which is propelled by nuclear power or which has on board any radioactive material capable of causing nuclear damage may –

(a) Anchor or sojourn in the territorial waters of the Republic; or

(b) Enter any port of the Republic, except under the authority of a nuclear vessel licence".

The NNR adopted the IAEA Regulations for the Safe Transport of Radioactive Material (SSR-6) and this is referenced in the conditions of authorisation issued by the NNR. All transport of radioactive material must comply with the requirements of the IAEA Regulations.

I-1. REVIEW OF CONTROLS AT PORTS OF ENTRY

With effect from 21 July 2020, Border Management Authority Act, 2020 (Act 2 of 2020) (BMAA), came into force. The BMAA recognises the need for integrated and coordinated border management, in alignment with the South African Constitution, as well as international and domestic law. As such, the Act seeks to oversee the management of legitimate trade and secure cross-border travel, prevent illegal cross-border movement and the smuggling and trafficking of human beings, protect the country's environment and natural resources, and shield the country from harmful and infectious diseases, pests and substances.

In particular, the Act aims to ensure effective and efficient border law enforcement functions at ports of entries and along the country's borders. To achieve this, the Act provides for the establishment of the Border Management Authority, the appointment and employment of border officials, and the establishment of:

- Inter-Ministerial Consultative Committee,
- Border Technical Committee and
- Advisory committees.

The Border Management Authority will co-operate and co-ordinate its border law enforcement functions with other organs of state, border communities and/or any other persons.

Section J

DISUSED SEALED SOURCES

SECTION J: DISUSED SEALED SOURCES

Article 28: Disused Sealed Sources

1. Each Contracting Party shall, in the framework of its national law, take the appropriate steps to ensure that the possession, remanufacturing or disposal of disused sealed sources takes place in a safe manner.
2. A Contracting Party shall allow for reentry into its territory of disused sealed sources if, in the framework of its national law, it has accepted that they be returned to a manufacturer qualified to receive and possess the disused sealed sources.

J-1. FRAMEWORK OF THE NATIONAL LAW TO ENSURE THAT THE POSSESSION, REMANUFACTURING OR DISPOSAL OF DISUSED SEALED SOURCES TAKE PLACE IN A SAFE MANNER.

J-1.1. AUTHORISATION OF WORK WITH SEALED SOURCES

All sealed sources inside a nuclear installation fall under the regulatory control of the NNR and are authorised in terms of the conditions of the Nuclear Installation Licence.

Outside a nuclear installation, sources are controlled as Group IV Hazardous Substances, and regulated by SAHPRA

J-1.2. APPLICATION OF CONTROL

Control over the possession, remanufacturing and disposal of sealed sources is effected through a procedure that includes the following:

- Approval of activities by the Regulator;
- Responsibilities;
- Control over production;
- Source registers;
- Work procedures;
- Use of sources at other sites;
- Industrial radiography requirements;
- Storage conditions and control;
- Labelling of sources and source containers;
- Smoke detector control;
- Pre-disposal management;
- Leak test requirements;
- Transport and transfer requirements.

The relevant regulatory authority (NNR or Radiation Control) is required to be notified in advance of the production, subdivision, acquisition, import, export, transfer and pre-disposal management of sources.

J-2. MANAGEMENT OF DISUSED SEALED RADIOACTIVE SOURCES

The management procedure for sealed sources forms an inherent part of the regulatory procedures. Each time a sealed source is to be disposed of, a written permission must be obtained from the SAHPRA. Disused sealed radioactive sources (DSRS) are held at the Necsa Nuclear Liability Management (NLM), which is a temporary waste storage site at Pelindaba or, as is the case with some imported sources, are re-exported to their country of origin.

The procedure for the management of DSRS is as follows:

(1) Authorisation holders who wish to dispose of DSRS have to apply to SAHPRA on the prescribed application form, namely RN525.

(2) Upon receipt of the application, the applicant's existing authority to possess and use radioactive nuclides is checked to ensure that the source that is being applied for appears under the particular authority. If they are satisfied that everything is in order, a separate authority for disposal is issued. The holder is advised to contact Necsa with regard to transport and delivery arrangements. The Nuclear Liabilities Management (NLM) Division at Necsa is then contacted and provided with the full details of the specific application. After Necsa has taken possession of the source, SAHPRA is advised and the holder's authority is amended by the removal of the source from the old authority and a new one issued.

(3) Necsa charges a fee for this service. The tariffs are reviewed and updated annually and cover the full cost, including storage, possible conditioning and eventual disposal. Once the source is transferred to Necsa, the former owner is relieved of all further liability in respect of the source.

J-3. RE-ENTRY OF DISUSED SEALED RADIOACTIVE SOURCES

South Africa implements the Code of Conduct on the Safety and Security of Radioactive Sources. South Africa does accept the return to suppliers of sources that were manufactured in South Africa. Regulatory approval is required for all imports and exports of sources.

The SAHPRA requires that Form RN781 (Application for Authority to import, convey and cause to convey radioactive nuclides) be submitted for all imports of sources into South Africa Application for Authority to export, convey and cause to convey radioactive nuclides is required for export of all radioactive sources, including for repatriation the DSRS. (Form RN782 applies).

Such authority is issued, if the SAHPRA is satisfied that everything is in order and the applicant can then make the necessary arrangements for exports/imports. Upon confirmation of export, the particular source is removed from the old authority and a new one is issued.

In the case of Category 1 and Category 2 sources, a four-part agreement (seller, buyer, regulatory body in seller state and regulatory body in buyer state) is employed for all transboundary movements of sealed sources.

Table 6 below details the DSRS repatriated from Botswana and Namibia during 2019.

Table 6: Repatriated disused sealed radioactive sources (DSRS)

Date	Country	Port entry	No of DSRS repatriated	Type of source	Activity	Source category	Packaging
2019/04/29	Namibia	OR Tambo	1	Level Gauge	1145MBq	3	Type A
2019/06/28	Botswana	Martins Drift	19	Level Gauge	0.9-1.85 GBq	3	Type A
2019/07/01	Namibia	OR Tambo	4	Level Gauge	1.61-1.67 GBq	3	Type A

SECTION J: DISUSED SEALED SOURCES

Table 7 below details the number of DSRS that were characterised and conditioned by Necsa during 2019.

Table 7: DSRS Characterised and Conditioned during 2019

Country of Origin	No of sources	Nuclide	Descriptions	Conditioning Place
South Africa	15	Am-241	Transport containers, XRF Analyser, Moisture gauge, Thickness gauge, Reference source	Necsa South Africa
South Africa	6	Am-241/ Be-9	Troxler, Soil gauge, Moisture gauge	Necsa South Africa
South Africa	2	Ba-133	Density gauge	Necsa South Africa
South Africa	11	C-14	Reference source	Necsa South Africa
South Africa	1	Cd-109	XRF analyser	Necsa South Africa
South Africa	1	Cf-252	Reference source	Necsa South Africa
South Africa	2	Cm-224	XRF analyser	Necsa South Africa
South Africa	11	Co-57	Research	Necsa South Africa
South Africa	29	Co-60	Level gauge, Mass flow meter	Necsa South Africa
South Africa	740	Cs-137	Desity gauge, Reference source, Level gauge, Belt mass meter, Scintillation counter	Necsa South Africa
South Africa	1	Fe-55	XRF analyser	Necsa South Africa
South Africa	10	Ge-68	Reference source	Necsa South Africa
South Africa	1	Ir-192	Transport containes	Necsa South Africa
South Africa	4	Kr-85	Static Eliminator	Necsa South Africa
South Africa	7	Po-210	Reference source, Static eliminator	Necsa South Africa
South Africa	2	Pu-238	XRF analyser	Necsa South Africa
South Africa	356	Ra-226	Reference source, Transport container	Necsa South Africa
South Africa	3	Ra-226/ Be-9	Reference source	Necsa South Africa
South Africa	15	Sr-90	Thickness gauge	Necsa South Africa
South Africa	4	Th-228	Reference source	Necsa South Africa
	1221			

Section K

GENERAL EFFORTS TO IMPROVE SAFETY

SECTION K: GENERAL EFFORTS TO IMPROVE SAFETY

K-1. NATIONAL MEASURES

K-1.1. REVIEW OF POLICY WITH RESPECT TO USED FUEL

South Africa successfully conducted an International Atomic Energy Agency (IAEA) integrated Nuclear Infrastructure Review Mission (INIR) in 2013. The INIR Mission Report recommended that South Africa should establish an integrated national nuclear fuel cycle strategy, including used fuel and high-level waste management and disposal. Whilst recognising the existence of the Policy and Strategy, it is also important that clarity is provided on the intentions of government in addressing the challenges around the high-level waste and used fuel.

In addressing the IAEA recommendations South Africa is currently contemplating the feasibility of adopting a direct disposal option for management of used fuel, without any prior reprocessing. This option will include a period of interim storage at a centralised national storage facility. In this regard a draft policy addressing options for the management of the back-end of the nuclear fuel cycle has been developed and is being consulted on with national stakeholders.

K-1.2. PROMULGATION OF BORDER MANAGEMENT AUTHORITY ACT (BMAA)

The BMAA is described in Section I-1. The implementation of the Act is expected to result in more efficient border management, which will benefit commercial cross-border traders. However, one of the aims of the Border Management Authority Act will be to curb the occurrence of cross-border crime, with various obligations and duties imposed on border officials to accomplish this aim.

K-1.3. NATIONAL RADIOACTIVE WASTE MANAGEMENT FUND

The Policy and Strategy makes provision for a National Radioactive Waste Management Fund that will be managed by the South African Government. 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 for radioactive waste management;
- Funding for other activities related to radioactive waste management.

In keeping with the polluter pays principle, the contributions to the fund will be made by the generators of radioactive waste. The contributions shall be managed in an equitable manner, without cross-subsidisation and, inter alia, be based on the classification of the waste, as well as the volumes. Figure 14 presents the schematic framework for the operation of the National Radioactive Waste Management Fund.

Since the last Joint Convention review cycle, South Africa progressed the development of legislation for the establishment of a National Radioactive Waste Management Fund. A formal Bill titled the Radioactive Waste Management fund Bill was established and has been consulted upon with upon with nuclear organisations which include the radioactive waste generators, National Nuclear Regulator, National Radioactive Waste Disposal Institute (implementing agent) and the National Treasury. The Bill has also been subject of a Socio-economic Impact Assessment System (SEIAS) evaluation, as mandated by the National Department of Planning, Monitoring and Evaluation. The aim of the SEIAS evaluation is to minimise unintended consequences from policy initiatives and legislation, including unnecessary costs from implementation and compliance.

The Bill was further submitted to the office of the State Law Advisor for confirmation of compliance with the Constitution and current legislative drafting practice.

The Bill is currently serving on Government platforms such as Economic Sectors, Investment, Employment and Infrastructure Development Clusters enroute to Cabinet to seek approval for its public consultation. Following Cabinet approval, the Bill will be published in a Government Gazette for public comment.

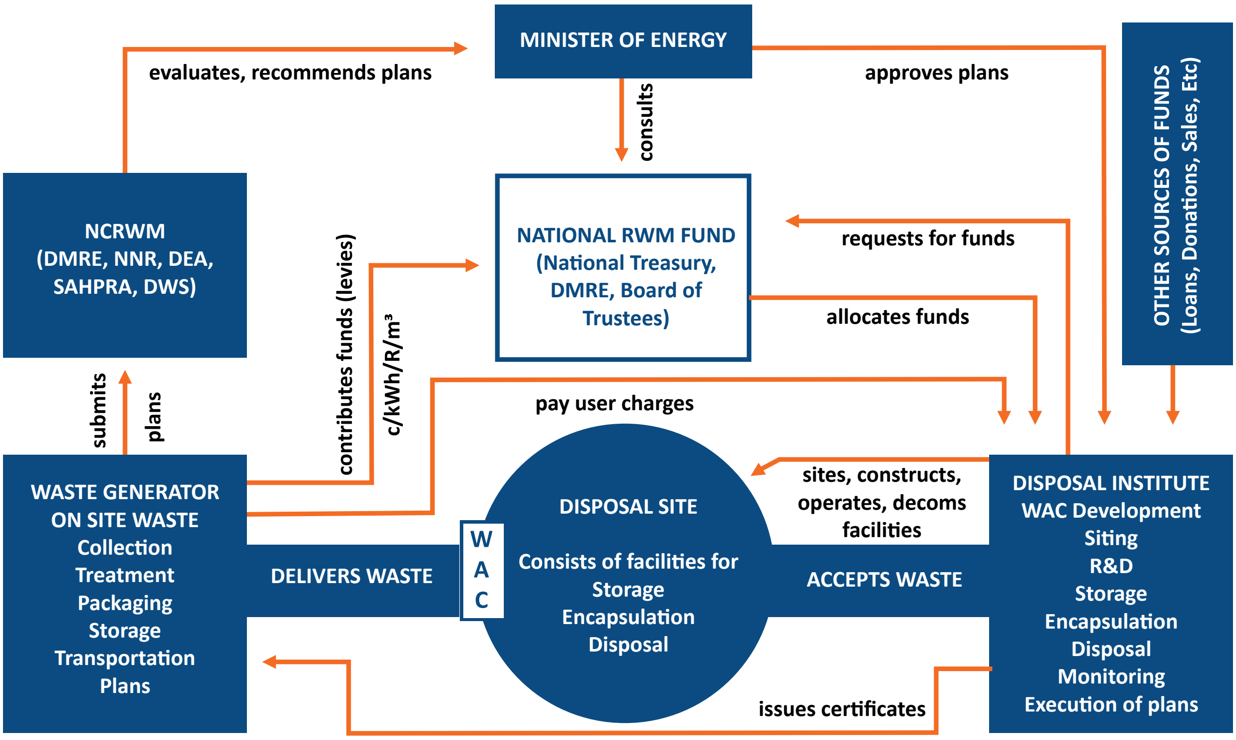


Figure 14: Schematic framework for the operation of the National Radioactive Waste Management Fund

K-1.4. AMENDMENTS TO NATIONAL NUCLEAR REGULATOR ACT

Noting that the primary legislation governing regulation of the nuclear sector was last updated in 1999, South Africa had previously embarked on a review and update of both the Nuclear Energy Act, 1999 (Act No. 46 of 1999) and the NNRA. Since the last Review Meeting, South Africa progressed the amendments to the NNRA. Some of the key amendments being introduced include:

(1) Provision for consolidation of the current SAHPRA (Radiation Control) regulatory mandate related to radioactive sources and non- ionising radiation under the mandate of the NNR.

(2) Ensure alignment with other national legislation;

(3) Provide clarity regarding transfer of nuclear authorisations;

(4) alignment of certain terminology and definitions with the practices adopted by the regulator and recommended by the IAEA

(5) strengthen the provisions regarding issuing of regulations on the recommendation of the NNR Board;

(6) introduce a system of administrative fines for non-compliances;

(7) better clarification of the objects and functions of the regulator;

(8) clarify restrictions on activities related pre-construction activities at proposed nuclear sites;

(9) strengthen provisions related to responsibilities of authorisation holders consistent with IAEA recommendations;

(10) Provisions for emergency planning strengthen consistent with IAEA recommendations;

(11) Strengthen and clarify powers of an inspector.

The amendments have been the subject of SEIAS evaluation and review by the State Law Advisor.

K-1.5. EMERGENCY PREPAREDNESS REVIEW SERVICES (EPREV) MISSION

The National Action plan to address the findings from the EPREV is being monitored on a quarterly basis by the team constituted by members from the respective EPREV participating organizations and is being coordinated by the Department of Mineral Resources and Energy.

In line with the commitments in the National EPREV Action Plan, the NNR developed and issued the Regulatory Guidance document, RG-0020- Interim Guidance on Emergency Preparedness and Response for Nuclear and Radiological Emergencies. The Guidance document specifies the NNR position pertaining to certain aspects as identified during the mission, relating to the latest IAEA requirements.

Further, the NNR has completed the project of upgrading its Regulatory Emergency Response Centre (RERC). The RERC serves as a centralized location for the NNR responders in case of nuclear or radiological emergencies, upon notification from the authorisation holders, the cooperative agreement partners or other stakeholders. Identified and trained NNR staff members will be able to monitor the evolution of the emergency conditions, perform independent verification analysis and provide independent advice to off-site response authorities regarding the protective actions recommended by the authorization holders.

The new RERC infrastructure and capabilities include redesigned rooms, audio and video communications equipment, an online radiological monitoring network, on-line plant and technical data from nuclear installations, plume modelling tools and radiological measurement instrumentation. A suite of emergency procedures for the RERC is in place and is periodically reviewed based on feedback from training, lessons learned and conduct of exercises. A resource plan has been developed for the activation of the RERC in case of a nuclear or radiological emergency. The first full-scope internal RERC emergency exercise was conducted in November 2019. RERC testing will be performed on a continuous basis in accordance with the approved exercise programme.

K-1.6. NATIONAL DOSE REGISTER

The NNR has coordinated a joint regulatory project to establish a National Dose Register (NDR) in collaboration with Directorate Radiation Control. Following a feasibility study, and proposal to IAEA to use Regulatory Authority Information System (RAIS) as the central database, the implementation of the project was supported by the IAEA through a number of Expert Missions. The design, development of templates, testing (pilots), roll out and effectiveness review of the system were performed with the assistance of IAEA experts.

Dosimetry service providers and nuclear authorisation holders utilize an excel template to upload occupational exposure records onto a web-based NDR Portal, from where the data is transferred to RAIS. The NDR implementation has been included in amendments to the legislation, NNR standards, and an internal procedure as part of the NNR integrated management system. A Steering Committee consisting of the Regulatory Bodies and some of the major Dosimetry Services and holders, was established to oversee and monitor the implementation of the NDR. Annual training is conducted for data providers, and includes regional training and awareness sessions where data providers and authorisation holders are encouraged to register and upload records on the NDR. The NNR has formed a NDR team that provides IT and admin support to data providers and addresses troubleshooting issues as well as queries received via the NDR-help email service. Skills transfer from IAEA experts to local staff have been being completed, with respect to trouble shooting and support for uploading of exposure records, and customisation capability in the short to medium term.

In order to improve the use of the NDR, data providers have been grouped with corresponding upload timelines in order to ensure all national records are uploaded. There has been a steady increase in the number of Data Providers from all groupings registering and utilizing the NDR, since the roll-out of the NDR project in 2016 up to June 2020. Currently there are about 70% of Data Providers registered on the NDR system. The issue of compliance to upload requirements have been included NDR training sessions and in regulatory inspections.

K-2. INTEGRATED REGULATORY REVIEW SERVICES (IRRS) MISSION

Following the conduct of the IRRS mission to South Africa (December 2016), the IRRS findings relevant to the NNR in the IAEA report have been incorporated into the NNR IRRS and Self-Assessment Action Plan. This action plan is implemented with annual targets and deliverables.

Apart from the National Nuclear Regulator (NNR), 3 other entities participated in the peer review namely the Department of Mineral Resource and Energy, Department of Health and Directorate Radiation Control within the Department of Health. With the Directorate Radiation Control being moved to the South African Health Products Regulatory Authority (SAHPRA), the NNR coordinates strategic level meetings twice a year with SAHPRA and the Department of Mineral Resource and Energy (previously Department of Energy) where the status of the IRRS actions are monitored and discussed. DMRE is making progressing in addressing the recommendations and suggestions contained in the IRRS Mission Report.

With respect to the NNR actions, regular internal workshops and meetings are scheduled to monitor the progress of implementing the Action Plan. The NNR has appointed about 27 teams to implement the actions over 4 years, and good progress has been made in addressing the recommendations and suggestions contained in the IAEA IRRS Mission Report. The NNR had implemented about 70% of actions, and there are 10 actions scheduled for 2020/21 financial year. Major milestones achieved so far include strengthening of the management system, update of relevant regulatory standards, reviewing of core process documents, initiating the implementation of a systematic approach for the acquisition of the operating and regulatory experience information, as well as decommissioning provisions.

K-3. ESTABLISHMENT OF AN INDEPENDENT REGULATORY VERIFICATION LABORATORY

The NNR's compliance assurance programme includes independent verification analyses of environmental samples collected around regulated facilities such as Koeberg Nuclear Power Station, Necsa facilities, mining and mineral processing facilities and radioactive waste storage and disposal sites. Since the establishment and operationalisation of the NNR environmental laboratory at the Agricultural Research Council (ARC) and the National Metrology Institute of South Africa (NMISA) premises, the NNR reliance on the services of the accredited external service provider, Necsa Radioanalysis Laboratory, have been reduced.

Sample analyses have been phased in systematically with the NNR currently performing about 85% of the samples required to be analysed in accordance with the Regulatory Verification Plan. The Laboratories located at ARC and NMISA premises currently have the capability and capacity to analyse samples for the following radionuclides and techniques in the table below:

Table 8: Radionuclides Analysis Capability at NNR Laboratories

Sample Matrix	Radionuclides	Nuclear Techniques	Laboratory
Water Soil/Sediments Biological samples (e.g. fish)	Gamma emitting radionuclides e.g. Cs-137, Co-60, Ra-226	Gamma Spectroscopy	NNR ARC and NMISA
	Alpha emitting radionuclides in water	Alpha Spectroscopy	NNR ARC
	Tritium	Liquid Scintillation Counting	NNR ARC and NMISA
	Gross Alphas/Betas	Gross Alpha/Beta Counter	NNR ARC

The established NNR verification facilities have also been taking part in the IAEA ALMERA proficiency testing exercises for the past four years as part of the Quality Assurance program. The method development for Strontium-90 analysis is currently underway.

The NNR has applied for accreditation of the laboratory to the South African National Accreditation System (SANAS) which is the independent body in South Africa recognised to accredit testing laboratories. The laboratory has developed a set of procedures that has been tested, verified and validated in preparation for accreditation. SANAS has conducted the document review of the laboratory Quality Management System and the laboratory is currently working on closing the gaps that were identified by SANAS during the document review process. Accreditation will be sought per method in a phased approach until all the radio-analytical methods are accredited.

K-4. UPDATE OF NNR LEGISLATIVE FRAMEWORK

The NNR initiated the Regulatory Framework project in December 2011 to address some of the findings that emanated from the Lifecycle 1 of the Self-Assessment project in 2010, in which the IAEA Self-Assessment Tool (SAT) was used. The NNR subsequently completed Lifecycle 2 of the Self-Assessment using the IAEA Regulatory Infrastructure for Safety (SARIS) tool. The NNR has also been subjected to the Integrated Regulatory Review Services (IRRS) mission on December 2016. The relevant findings of the IRRS Mission have been captured in the Regulatory Framework Plan.

The NNR is currently transitioning from a 3 tier to a 2 tier regulatory standards hierarchy in line with the Regulatory Philosophy which provides the overall basis of safety standards and regulatory practices of the NNR. Existing requirements documents and existing guidance documents have been revised and consolidated. The current hierarchy of regulatory standards include regulations, regulatory guidance documents, and position papers. The regulatory framework project includes the following:

(1) Review and update of the Regulatory Philosophy document;

(2) Review and update of regulations;

(3) Review and update of regulatory guidance documents;

(4) Development of Position Papers; and

(5) Development of internal Technical Assessment Guides.

K-4.2. SUITE OF REGULATIONS

A new suite of draft regulations were developed in accordance with the NNR regulatory philosophy and submitted to the Department of Mineral Resources and Energy (DMRE) for promulgation. The suite of revised regulations comprises the General Nuclear Safety Regulations integrating all thematic areas in a coherent and harmonised set of requirements that will be complemented by a series of facilities and/or action Specific Safety Regulations. The General Nuclear Safety Regulations (GNSR) address all radiation exposure situations (existing, planned and emergency), and apply to all actions, whereas the Specific Safety Regulations apply to specific facilities and/or actions. The regulations matrix is depicted in the figure 15 below.

The issuance of the suite of regulations is dependent on the proposed amendments to the NNR Act that are not yet promulgated. Whilst awaiting the issuance of the General Nuclear Safety Regulations, draft regulations on Long Term Operation (LTO) for nuclear installations based on the current regulatory framework were developed and submitted to the Department of Mineral Resources and Energy for publication.

Regulation Matrix	
General Nuclear Safety Regulations (Section 36 of NNRA)	**Specific Nuclear Safety Regulations (Section 36 of NNRA)**
(1) Scope of Regulatory Control	(1) Nuclear Facilities
(2) Nuclear Authorisations	(2) Waste Disposal Facilities
(3) Management of Safety	
(4) Safety Assessment	**Administrative Regulations**
(5) Radiation Protection and Waste Safety	(3) Financial liability
(6) Transport Safety	(4) Enforcement (System of fines still to be developed)
(7) Emergency Planning	(5) Public Safety Information Forum
General Nuclear Security Regulations (Section 36 of NNRA)	(6) Public Participation
(1) Nuclear security and PPS for NI's, etc.	

Figure 15: Suite of NNR regulations

K-4.3. REGULATORY GUIDES AND POSITION PAPERS

A regulatory framework analysis was performed to determine the status of existing regulatory guidance documents, to identify any specific gaps and to draft specific documents. The analysis recommended the need to develop and/or revise 43 regulatory guidance documents. The NNR implements an annual framework plan, using teams from different departments to draft and review the regulatory documents. Following internal and external stakeholder reviews, 9 regulatory guidance documents were issued in the past 4 years, including:

- RG-0019: Guidance on the Safety Assessment of Nuclear Facilities; 2018
- RG-0020: Emergency Preparedness and Response for Nuclear and Radiological Emergencies; 2018
- RG-0021: Guidance on the security during transport of nuclear or radioactive material; 2016
- RG-0022: Guidance on security incident reporting for nuclear facilities; 2016

- RG-0023: Conduct and Re-Registration of NPP Operators; 2017
- RG-0024: Interim guidance on safety assessment of occupational radiation hazards from NORM facilities and activities; 2018
- RG-0026: Site Decommissioning for planned exposures and remediation of existing exposures for release of land from Regulatory Control; 2018
- RG-0027: Ageing Management and Long Term Operation of Nuclear Power Plants; 2019
- RG-0028: Periodic Safety Review. 2019

K-4.4. NNR SOURCE REGISTER

The IAEA IRRS Mission recommended that the NNR should implement processes to ensure that the register of sealed sources is maintained and kept up to date. As such NNR developed a plan to address the IRRS recommendation, including hosting an IAEA Expert Mission in June 2019 to further develop the NNR source register which only contains radioactive sources from NNR regulated facilities.

Upon completion of the IAEA Expert Mission, the source register template was revised and submitted it to the NNR authorisation holders for review and acceptance. In addition to this the NDR Portal was modified to include the source register, which uses a similar mechanism to upload radioactive source data into RAIS. The on-going actions includes internal testing of the system which was performed uploading the NNR Laboratory sources information. This was done in preparation for the conduct of a Pilot testing and training of authorization holders which is scheduled for completion in 2020. The roll-out of the project is scheduled for 2021. The NNR Source register team is currently working on updating the Source Register procedures. Transfer skills of skills to NNR staff related to software customisation and enhancement was facilitated through the IAEA Expert Mission.

K-4.5. SAFETY AND SECURITY CULTURE

The NNR has developed and implemented an Integrated Management System (IMS) that is aligned with international requirements and best practices. The IMS is required to include provisions for promoting and supporting a strong safety and security culture. Consequently, this undertaking requires the establishment of safety and security culture-related policies, guidelines and tools, including provisions for the self-assessment and continual improvement of the NNR's safety and security culture, in accordance with international safety and security standards and best practices.

In this regard, the NNR has established a Safety and Security Culture Working Group (SSCWG), a cross-functional group responsible to develop tools to assess and improve safety and security culture within the organisation. As an indication that senior management is committed to build a strong safety and security Culture within the organisation, these are some of the activities that were conducted as part of the safety and security culture Improvements:

Revision of the NNR values and adoption of safety and security as one of the values. This was done to instill a culture of safety and security within the organisation, in dealing with authorisation holders and in NNR's interactions with other stakeholders;

- Safety and security culture is included as one of the strategic objectives in the organisational Annual Performance Plan and Risk Registers;
- Participation of NNR personnel in several IAEA Technical Meetings on safety culture since 2014;
- Conduct of Safety and Security Culture Survey for Necsa Management;

- Review of Eskom and Necsa Safety Culture Self-Assessment reports Bi-annual Awareness and training sessions for NNR personnel;
- Conduct of NNR Safety Culture Self-Assessment; and
- Conduct of an IAEA Expert Mission in November 2019 to review the NNR Safety Culture Self-Assessment report, upon request from NNR.

K-5. INTERNATIONAL COLLABORATION

South Africa views establishment and maintenance of international collaboration as a vital part of the national programme to enhance nuclear and radiation safety and security and radioactive waste management used fuel management in particular. Through international cooperation, countries can coordinate on the development of formal agreements with each other, enabling an exchange of detailed scientific and technical information, or joint sponsorship of activities in areas such long-term storage.

South Africa's international activities link to the world's evolving used fuel and high-level waste management practices, and provide a forum for exchanging strategies and technologies with other nations. Participation in such activities benefits South Africa through the acquisition and exchange of information, and peer review by experts of other participating nations. These international projects serve the national goals in advancing scientific understanding, enhancing environmental protection, and improving global safety and security. In fostering international cooperation on used fuel and radioactive waste management and disposal, the goal is to lead to an optimized national disposal system and promote the exchange of institutional and technical knowledge with the international community.

South Africa is a member of the NERS, the FNRBA and the NRN and, as such, shares experiences, safety standards, etc. with regulators of countries who are members of these networks.

The NNR has bilateral agreements with nuclear safety authorities internationally, including nuclear regulatory bodies in Argentina, Canada, Finland, France, South Korea, Russia, the United Kingdom and the United States of America the bilateral agreements serve as a legal mechanism for information sharing and technical cooperation among the parties concerned.

The NNR is represented in the IAEA Commission on Safety Standards (CSS) and the IAEA Safety Committees NUSSC, WASSC, TRANSSC and RASSC.

Section L

ANNEXES

SECTION L: ANNEXES

The following Annexes are included in the South African National Report:

ANNEX 1: USED FUEL MANAGEMENT FACILITIES

A1-1. LIST OF USED FUEL MANAGEMENT FACILITIES AT KOEBERG NUCLEAR POWER PLANT:

Used fuel at Koeberg is stored in two interim storage facilities, namely the interim wet storage facility and the interim dry storage facility. These are detailed below:

A1-1.1. INTERIM WET STORAGE FACILITY AT KOEBERG

Koeberg (see Figure 16), comprises two 900 MW reactors. Each of the Koeberg reactor units is served by a used fuel pool with a capacity of 1 507 UFA storage spaces. Some 157 of these spaces are reserved for emergency core unloads. That makes 1 350 spaces available for used fuel storage in each pool.

The interim wet storage facility at Koeberg comprises borated used fuel pools at both reactor units, which are designed for the temporary storage of fresh fuel, just delivered and for the cooling and storage of irradiated or used fuel discharged from the reactor core. Each pool consists of two regions. Region 1 is reserved for core unloading and fresh fuel to be loaded during a refuelling outage. Region 2 is reserved for the storage of used fuel only.

Figure 16*: Koeberg*

Figure 17: UFA casks in storage at Koeberg

Figure 18: A side view of the Castor X28 UFA casks at Koeberg

A1-1.2. INTERIM DRY FUEL STORAGE FACILITY AT KOEBERG

There are older UFAs with low enrichment (<3%) and low burn-up (<30GWd/t) that were removed from the pools and transferred to four dry-storage Castor X/28F casks with a capacity to store 28 UFAs each. These casks have been stored in the CSB on Koeberg site since 2000. Figure 17 and Figure 18 show pictures of the UFA casks in storage.

A1-2. USED FUEL MANAGEMENT FACILITIES AT Necsa

At Necsa, a combination of wet and dry storage is employed for the management of used fuel from SAFARI-1. The wet storage facility is located in the reactor pool and the dry storage facility, namely the Thabana Pipe Store, is located outside the reactor on the Necsa site. A description of the two storage facilities is provided below:

A1-2.1. THE REACTOR POOL

The wet storage facility consists of the following:

- Twelve high-density storage racks that can host 24 fuel elements per rack;
- Control racks that can host ten control rods;
- The low- density storage racks are currently not in use, but are kept as a backup in case of capacity problems in the pool.

These storage racks are described below:

High Density Storage Rack

The main storage facility for used and partially used fuel elements is the high density rack (HDR) unit, which consists of six modules each, with a capacity of 24 elements. The modules are locked onto a base-frame that stands on the storage pool floor. Sub- criticality is maintained by the presence of cadmium sheets between the rows of fuel elements. The high density storage modules are criticality safe, even when the racks are filled with fresh fuel elements. Each module is equipped with a hinged cover, which is secured in the closed position by means of a cam-lock. The function of the covers is to protect the fuel elements from falling objects and to maintain the subcritical geometry, should the rack (or individual modules) accidentally be tipped over.

Low Density Storage Racks

Used and partially used fuel elements can also be stored in so-called low density storage racks (to distinguish them from the high density storage racks). These form part of the original “standard” equipment of SAFARI-1 and each has a capacity of 16 elements in two parallel rows of 8 each. The rows are far enough apart to avoid criticality. Bars around the racks maintain this spacing between rows of elements in adjacent racks. Hinged covers are fitted to these racks to protect the elements from falling objects and to prevent them from falling out if the racks fall over.

Following the installation of the high density rack in early 1994, the low density racks have largely been out of service, although a number of low density racks are kept in the storage pool for the storage of cropped fuel elements and control rods. The rest of them have been maintained in a commissioned condition in storage outside the pools. Eleven low density racks are available, with a total capacity of 176 elements. At times, when the high density racks are full, one or more low density racks are reinstalled in the storage pool to store additional fuel elements.

Control Rod Storage Rack

Two control rod storage racks are attached to the rail on the eastern side of the storage pool. Each of these holds five (5) complete control rods, effectively making up ten (10) control rods in a single row at a pitch of 86 mm. The criticality analysis shows this arrangement to be criticality safe, even when loaded with fresh control rods.

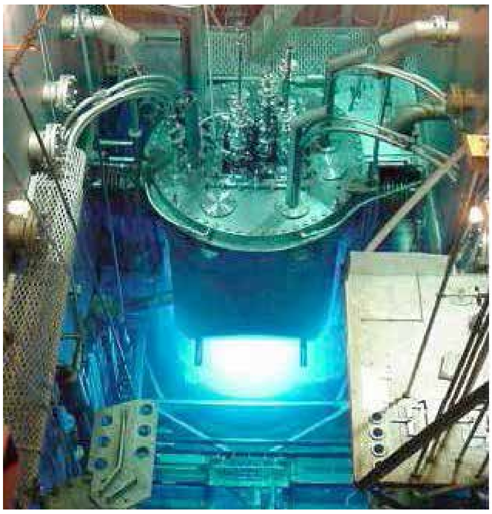


Figure 19: A top view of SAFARI-1 pool

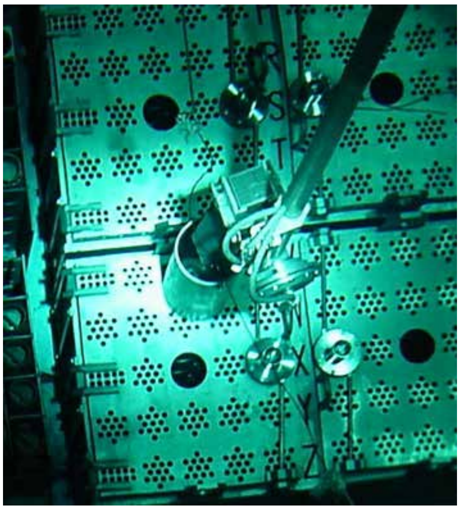


Figure 20: A top view of SAFARI-1 Fuel Racks

A1-2.2. THABANA PIPE STORE

The Thabana Pipe Store is part of the Thabana Complex, authorised under Nuclear Installation Licence NIL-04 (Variation 0) and is located on the Pelindaba-East side of the Necsa Pelindaba site. The Thabana Pipe Store was designed and built for the interim storage of used fuel from the SAFARI-1 research reactor. This is a dry storage facility in which the design allows for the placement and retrieval of the stored items and comprises of subsurface sealed stainless steel storage pipes.

These pipes are positioned in boreholes and the pipe openings are shielded with a lead plug and an airtight flange. The pipes are kept under a positive pressure with an inert gas. The operating technical specification limits the acceptance of used fuel to the Thabana Pipe Store to fuel that has undergone a cooling period of at least 2 years. This subsurface borehole design was selected for the dual purpose of shielding and heat transfer.

In 2007 the storage capacity of the facility was increased. The original design was used when expanding the facility. The facility currently has 60 storage pipes, giving a total storage capacity of 1 200 used fuel elements.

In March 2018, Necsa submitted an authorisation change request to inform the NNR of the proposed expansion of the Thabana Pipe Store and initiate the licensing process thereof. The proposed expansion aims to –

- Expand the current storage capacity for storage of cropped used fuel and control rods produced by SAFARI-1, taking account of the envisaged operation of SAFARI-1 until 2030.
- Cater for the storage of uranium residue from the Molybdenum production process at the NTP Radiochemicals Complex.

Figure 21: A frontal view of the Thabana Pipe Store

Figure 22: Thabana Pipe Store

ANNEX 2: INVENTORIES OF USED FUEL

A2-1. INVENTORY OF USED FUEL AT KOEBERG

Table 9: Inventory of used fuel in storage at Koeberg as at 31 December 2019

Storage	Location	Region	Number	tonHM
Wet Storage	Unit 1 Used Fuel Pool	Region 1	93	43
		Region 2	1140	524
		Sub-total	1 233	567
	Unit 2 Used Fuel Pool	Region 1	110	51
		Region 2	1 054	485
		Sub-total	1 164	535
Dry Storage	Castor X/28F Casks		112	52
Total			**2 509**	**1 154**

A2-2. INVENTORY OF USED FUEL AT Necsa, PELINDABA

Table 10: Inventory of used fuel at the Necsa Pelindaba site as at 31 December 2019

Storage Type	Location	Used fuel elements	Used control rods	Used control rods (tHM)
Wet Storage	Safari-1: High Density Rack Storage	212	29	0.02938
	Safari-1: Low Density Storage Rack	0	3	0.00311
	Safari-1 Below Hot-Cell	1	0	0.00
	Sub-total	213	32	0.03249
Dry Storage	Thabana Pipe Storage Facility	1062	154	0.05661
Total		**1275**	**189**	**0.089105**

ANNEX 3: RADIOACTIVE WASTE MANAGEMENT FACILITIES

A3-1. Necsa PELINDABA SITE

Necsa is a diverse nuclear installation (see Figure 23), with various research and commercial programmes, including a variety of radioactive waste storage facilities in operation. The radioactive waste generated needs to be isolated from the environment and therefore it is containerised, characterised, immobilised, treated, conditioned and stored before disposal can be considered. These waste management actions require the waste to be segregated and therefore the waste is handled in various locations and stores.

Figure 23: View of the Pelindaba site

The various waste management facilities, their purpose and locations on the Pelindaba site are detailed in Table 11.

Table 11: List of radioactive waste management facilities on the Pelindaba site as at 31 March 2020

PURPOSE	NAME	LOCATION
Decontamination of uranium contaminated metals	Decontamination services	V-A8
De-heeling of UF_6 containing cylinders	UF_6 cylinder De-heeling facility	Area 27
Liquid Effluent Treatment	LEMS	P-2400
	Uranium- bearing liquid effluent treatment facility	V-A8
Predisposal operations	Volume Reduction Facility	Area 14 Pelstore
Metal smelter & cutting room	Test Smelter and Production Smelter	Area 26
Historic liquid waste evaporation facilities. (Under evaluation for rehabilitation)	Pelindaba East Pans 1 to 6 and 9	Pelindaba East
	Pelindaba CaF_2 Pans 1 to 6	Thabana
	Beva Evaporation Ponds A, B, C & 1 to 14	Pelindaba West
Storage of lead test assembly (post reactor test; fuel pin) related waste and uranium residue	Cell 3: NTP Radiochemicals Complex	P1701
LILW and VLLW drummed and containerised solid waste storage facilities (conditioned and un-conditioned waste)	Pelstore	Area 14 Complex
	Thabana Stores 1-5	Thabana
	UF_6 Cylinders and drum store	Area 21
	UF_6 Cylinder store	Area 16
	Pelindaba East Bus Shed Waste Drum Store	Pelindaba East
	Building A-west drum store	A-West
	A-Building Drum Store	V-A8
Storage of non-clearable decontaminated metals	Quarantine Camp	Quarantine Camp
Historic disposal trenches. Evaluated for possible retrieval or approve as a disposal site	Thabana Radioactive Waste Storage Facility (Trenches)	Thabana Complex
Storage of spent sources and other historic waste	Stainless Steel Tubular Facilities	Pelindaba West
Radioactive material originating from the mines, Zircon sand, and redundant NORM contaminated equipment	Dorbyl Camp	Pelindaba East
Disused Sealed Radioactive Sources	Area 24 Disused Sealed Radioactive Source Storage Facility	Area 14 Complex

Below is a short description of some of the radioactive waste management facilities at the Necsa Pelindaba site.

A3-1.1. PELSTORE

Pelstore forms part of the Area 14 Waste Management Complex, which is located at Necsa's Pelindaba East site. The building previously housed the Z Plant Uranium Enrichment Facility. During the decommissioning of the enrichment facility, all equipment was removed and the building was cleaned to remove loose contamination. The facility has been used as a storage area since 2001.

The Pelstore consists of a concrete building and is utilised for the storage of containerised solid radioactive waste. The facility consists of a smooth concrete floor surface of about 15 600m². The purpose of the Pelstore facility is to store containers with solid waste, prior to, and after treatment and conditioning. The storage facility comprises:

- a drum repacking and inspection area;
- the elevated grid floor storage area;
- the main container storage area;
- various adjacent, separate, smaller and enclosed storage rooms.

Waste types of various origins are stored in the facility before being processed or disposed of. The majority of the waste originated from the previous Necsa nuclear fuel cycle programme. Waste originating from industry, the SAFARI-1 research reactor and the medical isotope programme, is also stored in the facility. The waste is stored in dedicated marked blocks, in such a way that easy access to the containers can be obtained with the applicable handling equipment and for the purpose of inspections and traceability. Information for each waste container in any of the storage facilities is kept on a central database, referred to as the Waste Tracking System. It includes content description, drum/waste container origin, characterisation results, external dose rate, movements and the current position of waste packages.

The Pelstore facility (see Figure 24) may store up to 104 000 waste containers. The current inventory is about 61 003 waste containers, as at December 2019.

Figure 24: Section of the Pelstore at the Pelindaba site

The Volume Reduction Facility (VRF) is located in Pelstore (See Figure 25). The facility consists of two sub-systems, which are the Drum Press and the Filter Press. The VRF is utilised for conditioning of waste for disposal, by compacting the waste into pucks and the packing of the pucks into 210ℓ drums.

Figure 25: Section of Volume Reduction Facility(VRF) in Pelstore at the Pelindaba site.

Figure 26: Radioactive waste shipment outside Pelstore on Pelindaba site

A3-1.2. THABANA STORES 1 – 5

This facility (see Figure 27 and Figure 28) consists of five (5) naturally ventilated, corrugated iron sheds (walls and roofs), each with a concrete floor. The Thabana stores were built in the late 1970s in support of the former Y and Z Enrichment Plants. Waste contained in plastic or metal drums is stored in this facility. These stores are controlled as radiological areas.

Figure 27: Side-view of Thabana Store 1

Details of these stores are as follows:

Store 1: The floor area is 300m^2; the height is 3.6m and has a storage capacity of about 2 000 drums.

Stores 2 and 3: Stores 2 and 3 are two adjacent stores with no separating wall in between. Store 2 has a total floor area of 400m^2, with a height of 3.6m and Store 3 has a floor area of 500m^2, with a height of 3.6m and both stores have a storage capacity of about 8 000 drums each.

Store 4: The total floor area is 975m^2 and the height is 3.6m and it has a storage capacity of about 4 500 drums.

Store 5: The total floor area is 110m^2 and the height is 3.6m and it has a storage capacity of about 400 drums.

Figure 28: Thabana Store 4

A3-1.3. STAINLESS STEEL TUBULAR STORAGE FACILITY

There are four stainless steel tubular storage facilities at Thabana. Only two of these facilities are in use and the other two were never used. Operations of the Tubular Storage Facility ceased in 1994.

The first Tubular Storage Facility consists of 7 tubes that were used for the storage of spent sources and other waste from SAFARI-1. The arrangement of the tubes is such that there are six in a circle and one in the middle, all embedded in concrete. The dimensions of this facility is 3.41 m deep and the concrete block in which the steel tubes are imbedded, is 1.83m x 1.83m. Tubes 2, 3 and 7 are filled with waste and sealed with high density concrete.

The second tubular facility consists of a pipe of approximately 1 m diameter and 9.4 m deep. Three stainless steel pipes are positioned inside this pipe and then the tube was filled with high density concrete. Each stainless-steel pipe has a lead plug at the top of the pipe and a concrete cover. This facility is being used for the management and storage of high radiation Co-60 sources.

A3-1.4. PELINDABA EAST BUS SHED

This storage facility is situated on the east side of the Pelindaba site next to the Necsa Emergency Control Centre. The facility was built in the 1980s for the parking of the busses used as staff transport. The bus shed became defunct in the early 1990s. The facility was then an open structure with no side walls and only the southern side had a brick wall. The facility was upgraded by closing all the sides with IBR sheeting. The floor of the facility consists partially of concrete and partially of tarmac. The roof of the facility comprises IBR sheeting.

The Bus Shed is used for the storage of medical waste from hospitals, compressed waste historically treated in the Volume Reduction Facility contained in the 200 ℓ metal drums and other untreated waste drums.

The facility is a naturally ventilated and has an enclosed structure with overall dimensions of 65m x 29m. The largest part of the facility is used as a storage area, but the south eastern corner houses the Segmented Drum Scanner (SDS). The SDS (see Figure 29) is used for assaying drums of solid nuclear waste. The results of the assay are used to determine whether the drum contents meet the acceptance criteria for further processing, disposal, or transfer to interim storage. It measures gamma emission from the drum over a wide energy spectrum and then computes the drum inventory from the measurements and other inferred characteristics which are determined by prior characterisation of the waste stream. Each waste drum that is presented for an assay is identified by a unique number which is recorded in a database containing historical data related to the origin, geometry and contents of the drum. The result from the SDS is used to classify the contents in accordance with the waste classification scheme, and records the results in a database, which serves as the primary record of the drum inventory and history.

Figure 29: Drum going through the Segmented Drum Scanner at Bus Shed

A3-1.5. BUILDING A-WEST DRUM STORE

The Building A-West Drum Storage Facility is situated in the south-western corner of the A Building complex of the Necsa site. The store has a concrete floor area of 2 120 m² and an IBR roof and is used for the storage of uranium contaminated waste, contained in drums. It has a storage capacity for about 10 000 drums.

During the operation of the Y Enrichment Plant, this facility served as a Y Plant compressor rebuilding, maintenance and testing facility that became defunct together with Y Plant in the early 1990s. Since about 1996, it has been used as a waste drum store for uranium contaminated alumina gel and other waste originating from the Y and the Z Enrichment Plants.

A3-1.6. DORBYL CAMP

The Dorbyl Camp store is situated at the eastern side of the Pelindaba site, adjacent to Area 18, which houses the defunct cooling towers of the decommissioned Z Enrichment Plant. The facility consists of one large corrugated iron store, approximately 1 120 m^2, and a smaller store of approximately 735 m2, divided into three smaller stores. The three smaller stores are next to each other under one roof. These stores are also constructed of corrugated iron sheets, except for the northern storage area, which is closed off on two sides with wire fencing. Also inside the Dorbyl camp are 6m shipping containers, used for the storage of radioactive material originating from NORM facilities e.g contaminated equipment, zircon sand and samples from various mines.

A3-1.7. LIQUID EFFLUENT MANAGEMENT SERVICES

The Liquid Effluent Treatment Facility Complex is situated on the Pelindaba East side at the Pelindaba site. This facility was constructed in 1963 for the handling of all liquid effluent generated on the Pelindaba site.

Liquid Effluent Treatment Facility Complex consists of the following facilities or sub- processes:

(1) Industrial Effluent Treatment Facility;

(2) Low Active Effluent Treatment Facility;

(3) Medium Active Effluent Treatment Facility;

(4) Solidification Facility;

(5) Laundry;

(6) Hot Yard;

(7) Decontamination Hall.

All the sub-facilities are enclosed within a security fence and covers an area of approximately 15 750m^2. The complex is a T-shaped building and consists of an office block, services wing running east-west and the plant wing running north-south.

A3-1.8. DISUSED SEALED RADIOACTIVE SOURCE STORAGE FACILITY (AREA 24)

The Area 24 Disused Sealed Radioactive Source Storage Facility is located at Necsa's Pelindaba East site. The building was previously used as a chemical facility, where non- radioactive chemicals were stored for the defunct plating plant. SAHPRA is the current regulator of the facility.

The facility has three storage rooms (Stores 1-3), a workshop, a lead shield cell (see Figure 30) and 21 bunkers. Store 2 has a large high-density bunker that is used for source containers with high external radiation levels.

Sources of various origins are stored in the facility (see Figure 31) before being processed or disposed of. The conditioning process is concerned with the receiving, temporary storage, characterisation, conditioning and long-term storage of the sources.

Furthermore, the facility is used to store the conditioned disused radioactive sources in the bunkers for a period of about 50 years. The current inventory of the disused sealed radioactive sources (DSRS) in the facility is 9 532.

Figure 30: Lead shielded cell for source conditioning

Figure 31: Disused sealed sources stored in Area 24

A3-1.9. AREA 21 STORAGE FACILITY

The Area 21 storage facility is a storage facility located at the Pelindaba East site of Necsa. The facility has a concrete floor, which is higher than the outside ground level. The storage facility is a barn-type construction, comprising three rows of concrete pillars, where each row supports a concrete beam. The purpose of the concrete beams is to support the long- travel of two 25 ton overhead cranes.

This facility is used for the storage of UF6 cylinders, containing UF_6 heels from the previous enrichment and conversion processes; ISO shipping containers filled with contaminated metal, destined for a smelter; and four-ton concrete drums containing solidified liquids from the isotope production facility.

A3-1.10. UF_6 CYLINDER DE-HEELING FACILITY

Area 27 De-heeling facility on Pelindab East. The facility comprises of a single floor building consisting of steel frame covered by galvanised iron sheets for walls. The building was previously utilised as a waste transfer facility for the former enrichment facility (Z-plant). The facility is now used for the consolidation of all the remaining UF_6 on the Necsa site into Type 48Y cylinders by de-heeling and decontaminating aging and redundant cylinders containing UF_6.

A3-1.11. DECONTAMINATION FACILITY

The A8 decontamination facility is part of A-Building, located on Pelindaba East side of the Necsa site. The facility is used for the decontamination of uranium contaminated components, evaporation of radiological contaminated liquid, the processing of solid waste and storage of radiological contaminated waste drums. The A-8 Decontamination facility consists of the Dry Decontamination Facility, Wet Decontamination Facility and the A-Building Drum Store. The Dry and Wet Decontamination Facilities are authorised to decontaminate components according to the level of contamination on the component. The drum store is authorised for the storage of waste drums originating from the Dry and Wet Decontamination facilities.

A3-1.12. BEVA EVAPORATION PONDS

The BEVA Evaporation Ponds are situated on the West of Pelindaba site. The ponds were built in the early 1980s to serve as an evaporation facility for effluent from the BEVA and Pelindaba West Facilities. During the operational phase of the ponds some were contaminated with radioactive material. The ponds were taken out of operation in the late 1990s and since then no water or effluent was accepted into the ponds.

The ponds are constructed of concrete with the following floor dimensions:

Ponds 1 to 8	1 406 m^2 each
Ponds A to C	1 608 m^2 each
Ponds 9 to 14	2 029 m^2 each

Ponds 1 to 11 and A to C are empty. Only ponds 12 and 14 contain sludge and pond 13 contains only water. The sludge in ponds 12 and 14 contain mainly Uranium contaminated sludge of approximately 1 716 m^3.

A3-1.13. PELINDABA EAST PANS 1 TO 6 AND 9

The Pelindaba East Pans are situated on the East side of the Pelindaba site. The pans 1 to 6 contains sludge that originates floor washings, equipment flush and effluent waters from the former conversion and enrichment plants. The waste categorisation of the sludge in Pans 1 to 5 is different from the sludge in Pan 6 due to the Uranium enrichment level content. Pan 9 contains only chemical effluent origination from chemical production facilities and is still in operation. The sludge in Pans 1 to 5 and Pan 6 is approximately 10 301 m^3 and 1 000 m^3, respectively.

A3-1.14. PELINDABA CaF_2 PANS 1 TO 6

The CaF_2 pans are located on the northern side of Thabana which is situated between the Pelindaba East and West sites. The CaF_2 pans contain CaF_2 contaminated with U-nat. There are a total of 6 pans of which 5 contain CaF_2. The pans were constructed for the spent scrubber liquor from the former conversion facility operations. The scrubber liquor was neutralised with the addition of lime which resulted in a calcium-uranium complex (natural uranium) in a fluoride matrix which was transferred to the evaporation pans. The size of each pan is approximately 39 m x 39 m x 3.5 m. CaF_2 Pans 1 to 5 contain approximately 9287 m^3 of contaminated CaF_2 sludge, and CaF_2 Pan 6 was never used to date hence it is empty.

A3-2. VAALPUTS NATIONAL RADIOACTIVE WASTE DISPOSAL FACILITY

The Vaalputs National Radioactive Waste Disposal Facility is located in the district of Kamiesberg in the Northern Cape Province. In 1977, the state mandated a specialist study group to look at waste management alternatives for the intended commercial nuclear programme. In 1978, the study group recommended that the state proceeded with a programme to locate a suitable site for the disposal of radioactive waste in South Africa. From 1979 to 1982, a comprehensive site selection programme was undertaken in accordance with criteria that were regarded as internationally acceptable. The Vaalputs site was selected as the preferred option from three candidate sites and was subsequently acquired in 1983.

Figure 32: Truck arriving at Vaalputs

Detailed site suitability studies commenced in 1983. A preliminary safety report was compiled and submitted to the regulatory authority in 1984. The report was approved for building operations to commence. An intermediate safety report was issued to the regulatory authority in October 1986, according to which Vaalputs was granted a nuclear authorisation to operate. The method of disposal of radioactive waste at Vaalputs was approved to be shallow land disposal in near surface trenches a few meters deep.

The Vaalputs buildings include the administrative, operational and maintenance areas. The administrative area consists of a reception/display area, offices, a canteen, a conference room, controlled and uncontrolled area change rooms, toilet facilities and a records room. The operational area consists of a laundry, a sample counting room, a waste reception area, a decontamination area, a shielded storage area and a liquid waste solidification area. The maintenance area consists of a mechanical workshop/vehicle service area; store facilities for components, spares, equipment and flammable liquids; a store facility for site maintenance equipment; and utility sections comprising a standby generator, a compressed air facility, a ventilation facility, fire extinguishing pumps, an electrical sub-station and a liquid effluent containment area.

The first revision of the Vaalputs waste acceptance criteria was issued early in 1986 and the first waste shipments from Koeberg were received in November of the same year. Vaalputs is currently authorised for the receipt and shallow land disposal of solid low level radioactive waste (LLW), originating from Koeberg and the Necsa.

The waste disposal site comprises the following:

- A securely fenced-in area of 900 m x 1 120 m;
- A 700 m x 500 m area for the disposal trenches;
- An exclusion area or buffer zone, between the trench area and the fence;
- A meteorological monitoring station;
- Covered carports and storage areas for waste-handling machinery and equipment.

Figure 33: Concrete waste packages being placed into a disposal trench at Vaalputs

The operational phase commenced in November 1986 and, under the current nuclear programme, is estimated to extend for 50 years up to 2036. The 50 years expected operational lifetime of the Vaalputs repository is based on current knowledge and information. Any expansion in the South African nuclear programme, resulting in more waste being sent to Vaalputs over longer time periods, would require for the operational lifetime and post-closure arrangements of Vaalputs to be reassessed and redefined accordingly.

The disposal concept for the LLW is shallow land disposal (see Figure 34) consisting of near surface trenches located in the region above the groundwater table. Trenches (see Figure 33, Figure 35 and Figure 36) are excavated in the surficial cover in the waste disposal area, which is up to 30 m thick in places and generally consists of an overlying layer of topsoil (sand), approximately 0,5 m thick, a layer of indigenous calcrete 1 to 2 m thick and 10 to 25 m thick clay material that extends down to the underlying granite formations. The sand, calcrete and clay material excavated from the trenches are kept separate in the stockpiling area and is later used to backfill and cap the trenches.

DISPOSAL CONCEPT

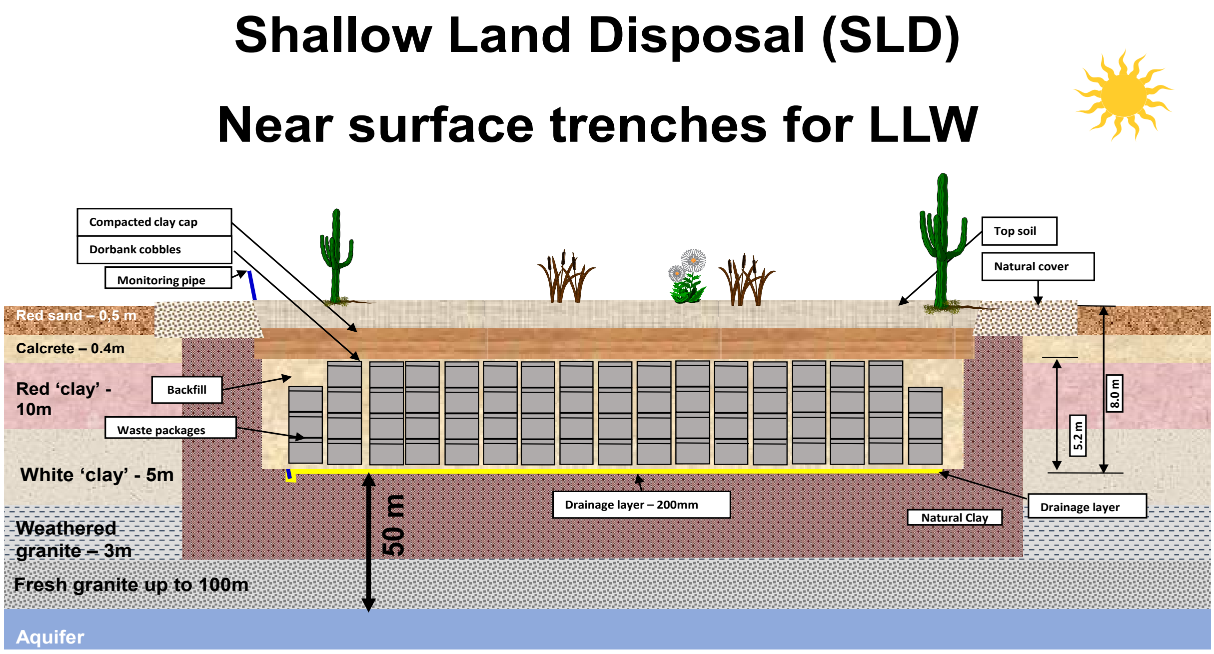


Figure 34: Graphical illustration of the Vaalputs near-surface disposal concept (not to scale)

Figure 35: LLW disposal trench at Vaalputs

As at the end of 2019, less than 10% of the total site capacity for LLW in metal containers and 12% of the total site capacity for concrete containers have been utilised.

The institutional control period commences after repository closure and is assumed to be three hundred (300) years for the Vaalputs near surface repository, given the current operational constraints. It is envisaged that this phase will be maintained until such time as the results of the final safety case confirm that the residual impact no longer requires further control of the site. During the institutional control period, it is possible that the Vaalputs site may continue to be subjected to regulations, including nuclear licensing.

Figure 36: LLW metal containers being emplaced in a disposal trench

At the end of the institutional control phase (300 years post-closure) it is envisaged that a final safety assessment would show that no further monitoring and measuring would be required; that no further corrective action would be necessary; and that the site could be declared safe to the extent that all controls applicable to a radioactive waste disposal site could be lifted.

Figure 37: An aerial view of the Vaalputs site

ANNEX 4: INVENTORIES OF RADIOACTIVE WASTE AT KOEBERG

Table 12: Inventory of processed LILW-SL at the Koeberg Necsa low-level Storage Building as at 31 December 2019

Drum Type	Active Volume (m^3)	Capacity (m^3)	WANO Volume (m^3)
Concrete Drums	301	735	2 534
Metal Drums	642	702	753
Total	943	**1 437**	**3 287**

Active Volume: This is the actual volume of the waste collected.

Capacity: This is the volume that these waste products occupy in the drum – i.e. resin and cement combined.

WANO volume: This is the total volume occupied by the drum – i.e. based on the outside dimensions of the drum.

Table 13: Inventory of solid radioactive waste at the Koeberg Necsa Low-level Waste Storage Building as at 31 December 2019

Drum Type	Concentrates (C)	Resins (R)	Filters (F)	NCW	Trash	Sludge
C1	282	276	-	106		7
C2	-	384	-	1		-
C2F	-	-	164	-		-
C4	-	-	78	-		-
210ℓ metal drums	-	1467	-	1020	858	-
Total	**282**	**2127**	**242**	**1127**	**858**	**7**

Table 14: Drumming guidelines at Koeberg

	Contact Dose Rate	Radionuclide	Drum Type
Filter	< 2 mSv/h	Various	210ℓ metal drum
	2 - < 15 mSv/h		C1
	15 - < 500 mSv/h		C4
	> 500 mSv/h		C2F
Resins	< 2 mSv/h	Various	210ℓ metal drum
	2 - < 200 mSv/h		C1
	200 - < 3500 mSv/h		C2
	> 3500 mSv/h		C3
	Activity (MBq/litre)	**Radionuclide**	**Drum Type**
Concentrates	< 92.5	Various	C1
	> 92.5 MBq/litre		C2

ANNEX 5: INVENTORIES OF RADIOACTIVE WASTE AT Necsa FACILITIES

Table 15: Inventory of radioactive waste in storage facilities at the Pelindaba site

Storage Facility	HLW (m^3)	LLIW-LL (m^3)	LILW-SL (m^3)	VLLW (m^3)	NORM-L (m^3)	NORM-E (m^3)
Pelstore		~973	~9719	~1066		
Thabana Stores 1-5		~32	~368			
Stainless Steel Tubular Facilities		~0.36				
Building A-West Drum Store		~34	~396			
A-Building Drum Store			~107			
Dorbyl Camp					~3	
Area 21 Storage Facility			~2024	~516		
Cell 3 - NTP Radiochemicals Complex	~0.25				~1716	
BEVA Evaporation Ponds (13 and 14)					~10 301	
Pelindaba East Pans 1 to 5						
Pelindaba East Pan 6			~1000			
Pelindaba CaF2 Ponds 1 to 5			9 287			

* Volumes are based on waste currently registered at predisposal operations (Necsa central waste storage facilities), and exclude waste accumulated at waste generator facilities.

Table 16: Inventory of disused sealed sources at the Pelindaba site

SOURCE CATEGORY	LOCATION	RADIONUCLIDE	QUANTITY
1-2	SAFARI-1 pool	Co-60	79
	Area-24 source store	Co-60	19
		Cs-137	2
		Cs-137	745
	Stainless Steel Tubular Storage Facility	Co-60	3 Capsule
3 – 5	Area-24 source store	Various	10 784

ANNEX 6: VAALPUTS INVENTORY

Table 17: Inventory of radioactive waste disposed at Vaalputs as at 31 December 2019

Waste class	Waste generator	Waste package type	Number of waste packages
Low Level Waste	Necsa	100ℓ metal drums	6 154
Low Level Waste	Necsa	Concrete drums	420
Low Level Waste	Koeberg	210ℓ metal drums	20 012
Low Level Waste	Koeberg	Concrete drums	3 991
Low Level Waste	Koeberg	Used Fuel Racks	43
Low Level Waste	CSIR	Wooden boxes, carpets	28

ANNEX 7: RADIOACTIVE WASTE FROM NORM FACILITIES

A7-1. OVERVIEW OF NORM WASTES

Tailings (see Figure 38 and Figure 39) account for most of the residues from the mining industry. Most of the mine tailings containing elevated concentrations of natural radionuclides originate from the gold mining industry. The elevated radioactivity concentrations arise from elements in the uranium decay chain and vary over the same range as those in the ore body. Where uranium was extracted as a by-product of the gold recovery process, the uranium content has become depleted in relation to the other decay chain elements, resulting in a moderate reduction in total activity. The activity concentrations of mine tailings typically range from <0.1Bq/g to a maximum of around 100 Bq/g with a mean activity concentration of around 6 Bq/g. The mean activity concentrations for uranium-238 and radium-226 are 1.06 Bq/g and 1.40 Bq/g respectively. The lower mean value for uranium-238 is the result of uranium extraction.

Figure 38: Aerial view of tailings storage facility

Figure 39: Lateral view of tailings storage facility

Mineral sands operations also produce large quantities of tailings, which may vary in activity concentration from background levels up to two orders of magnitude higher. Thorium is the main contributor to the elevated activity concentration. Activity concentration of mineral sands on the East Coast of the country typically range from 0.1Bq/g to 50Bq/g, while mineral sands on the West coast have higher activity concentrations from 0.1 to 200Bq/g. Residues from the phosphate industry have an average alpha activity concentration of 10 Bq/g.

Figure 40: Waste rock dump

Waste rock (see Figure 40) accounts for the next largest category of mining residues, and again originates mostly from the gold mining industry. It contains the full uranium decay chain, but at lower activity concentrations than in tailings.

Mines and minerals processing facilities generate large quantities of steel scrap (see Figure 41), both during operations and during decommissioning. Some of this is radioactively contaminated. Usually, the radioactivity arises mostly from uranium, but in certain components, particularly those from acid plants, it arises predominantly from radium in the form of radium sulphate scale. Almost all the steel is normal mild steel on which the contamination resides only as a surface layer, which can often be fully or partially removed by high-pressure washing. A few components from certain mineral processing operations are made of stainless steel, into which the contamination tends to penetrate and is therefore hard to remove.

Figure 41: Scrap steel from mining operations

Contaminated timber scrap originates from the salvaging of damaged underground support timber and underground railway sleepers. The contamination on support timber is essentially ore dust and occurs over short periods and penetrates the timber only moderately. The contamination on sleepers takes place under wet conditions, in which uranium can become concentrated above the levels in the ore body. It occurs over long periods and penetrates more deeply into the timber.

A7-2. MANAGEMENT OPTIONS FOR NORM WASTES

Mine Residue: The majority of mine tailings, waste rock and phosphate residues are stored in above- ground impoundments or dumps referred to as Tailings Storage Facilities (TSF). Many of these are, or will be, stabilised in situ and will ultimately become final disposal sites.

Residues from uranium and acid plant maintenance and decommissioning that cannot, at present, be reprocessed or dispersed directly into tailings, are stored in controlled storage buildings at mines.

Contaminated Scrap: A few scrap-handling facilities possess nuclear authorisations, allowing them to handle contaminated steel scrap from mines. One such facility possesses a nuclear authorisation, allowing it to melt contaminated scrap steel originating from mines. The highly contaminated radioactive waste arising from mining operations which cannot be melted or disposed of is currently stored temporarily at authorized sites awaiting the final disposal option.

A7-3. INVENTORIES OF SELECTED NORM WASTES

Table 18: Inventory of radioactive waste at mining and mineral processing facilities (scrap processors and scrap smelters, laboratories and small users)

Type of waste	Quantities (Tons)
Restricted Scrap	5.45E+05
Semi-solids (tailings)	1.96E+07
Solids (waste rock)	2.23E+08

Table 19: Inventory of radioactive waste above 1000 Bq/g at mines sites

Holder	Type of waste	Estimated Tonnage
Vaal River	Steel	500
	Saddles	100
	Plastics	40
	Rubber and reinforced plastics	40
	Bricks	150
	Sand blast grit (black)	5
	Sand (white)	100
	Asbestos	10
	Scaled Rubber	25
	Bricks	500
	Concrete and other structural material	500
	Rubber Lining	100
Ergo Mines	PVC Plastics	2.5
	Saddles waste from old Acid Plant	0.1
	Bricks	14
Buffelsfontein Gold Mines Limited	Saddles	1.2
Nufcor	Paper, rubber, wood and steel	0.25
Harmony Gold Mining Company	Scales	800
	Saddles	3800
	Clay/calcine spiral	3000
	Sediment	600
	Rubber impeller	4
	PVC pipes	50000
	Rubber	50000
Palabora Mining Company	Scale from SX tank	1600
	Contaminated soil	1200
	ADU contaminated with soil	1200
	Scale from TX tank	3600
	Scale in pipes from old HM plant	600
Sibanye Gold Beatrix operations	Asbestos cooling tower plates	700
	Rubber Lining and Rubber lined pumps	1
Sibanye Gold Driefontein operations	PVC Cooling towers filters	20.7

ANNEX 8: INVENTORIES OF RADIOACTIVE WASTE AT iThemba LABS

A8-1. OVERVIEW OF WASTE AT iThemba LABS

iThemba LABS provides accelerator and ancillary facilities that are used for research and training in nuclear and accelerator physics, radiation biophysics, radiochemical and material sciences, radio nuclide production and radiotherapy. Proton beams are accelerated to energy of 66 MeV in the separated sector cyclotron (SSC) with a solid- pole injector cyclotron for use in the production of radioisotopes and neutron therapy. Radioisotopes produced at iThemba LABS are used in research and industry, various radio pharmaceuticals are prepared for diagnostic imaging at nuclear medicine centres. Further to this a 200 MeV beam is used for proton therapy and various research beams of light and heavy ions as well as polarized protons, pre-accelerated in a second solid-pole injector cyclotron, are used for nuclear physics experiments.

Radioactive waste is generated during the production of radioisotopes and the operation of the cyclotron for research activities. Packageable waste is segregated at source in terms of half-life of the radionuclide and packaged accordingly. The longest lived commercially produced radioisotope is Na-22 with a half-life of just over two and a half (2.6) years. Various short-lived nuclides are produced with half-lives ranging from minutes to several days (Table 20).

Packageable radioactive waste mainly consists of low - medium level radioactively contaminated solid waste (metal, paper, plastic, glass and rubber) with relatively short half-lives. Dry solid radioactive waste is packaged in plastic lined 210ℓ steel drums with a pneumatic compactor (see Figure 42) as per the waste management guidelines. Drums are sealed with steel lids which are held in place by a bolt on steel ring. The following information is recorded on each drum:

- Mass;
- Surface contact dose rate;
- Date of processing.

Figure 42: Compacting of solid radioactive waste at iThemba Labs

Activation of beam line components from the cyclotron and other beam diagnostic equipment used in the production of radioisotopes and research activities form part of the metal radioactive waste stream. These non-compactable metal components are stored in concrete drums and reusable components in vaults designated for this purpose.

Due to the short half-life of most radio isotopes produced at iThemba LABS, a portion of the historic radioactive waste has decayed sufficiently to be disposed of as non- active waste. Radioactive waste containing longer half-life isotopes as well as more recently produced waste which has been segregated, processed and packaged are stored on-site in 22-ton transport containers (see Figure 43) to be disposed of as required. The inventory of radioactive waste stored at iThemba labs is detailed in Table 21.

Figure 43: Storage of low level conditioned waste.

Table 20: Radioisotopes produced at iThemba LABS

Radioisotope	Half-life
Ga-67	3.26 d
Co-57	271.9 d
Sn-113	115.09 d
Tl-202	12.23 d
Be-7	53.29 d
Rb-83	86.2 d
Rb-82	6.47 h
Co-58	70.86 d
Mn-54	312.3 d
Y-88	106.65 d
Co-56	77.27 d
Rb-84	32.77 d
Ga-68	67.629 min
Ge-69	39.05 h
Zn-65	244.26 d
Na-22	2.6 y

Table 21: Inventory of radioactive waste at iThemba LABS

Waste Category	Sub Category	Units	Type
Packageable radioactive waste	Waste packages	359	210ℓ steel drum
	Radionuclide Production Processing	12	210ℓ steel drum
Bulk items (non-compactable)	Radionuclide Production Processing	1	Concrete Radwaste container
	Radionuclide Production Targetry	2	

ANNEX 9: LIST OF NUCLEAR FACILITIES AT Necsa IN THE PROCESS OF BEING DECOMMISSIONED

Table 22: Necsa facilities being decommissioned

FACILITY	DESCRIPTION	STATUS
Facilities having undergone Phase III decommissioning but are not yet released from regulatory control		
Area 20	Redundant Hydrogen recovery facility: The hydrogen recovery facility was decommissioned by removing all the contaminated process lines inside Area 20 and the feed lines from Area 16.	Phase 3
Area 28	Redundant development / testing facility: This compressor testing facility was used to develop and test compressors for use in the enrichment process in Area 14. Structures and equipment was removed and the walls and floors were decontaminated.	Phase 3
K3 Stores	Redundant SEA storage facility: This storage facility was cleared of its inventory of SEA's which was moved to the Pelstore at Area 14 in 2007. K3 Stores were cleaned.	Phase 3
X4 & X5 Labs	Redundant R & D laboratories: Decommissioning at X4 and X5 laboratories started in 1999 and was completed in 2005. The laboratories were cleaned	Phase 3
Building BEVA C3/C5	Redundant pressurised water reactor fuel assembly facility: C3/C5-building was decommissioned during 2006 / 2007 to the point where the building was ready for civil alterations required for the PBMR Pilot Fuel Plant. Both these projects were aimed at a complete (phase 2 & 3) discharge of the historical liability associated with the respective facilities.	Phase 3
Building P1700 Contaminated labs	Redundant development laboratories: The objective of phase 2 & 3 decommissioning of Lab G60 in Building P 1700 was decontamination of this laboratory and its structure to clearance levels hence reducing the nuclear liability to Necsa. Decommissioning started in August 2005 and was completed in November 2005. P1700 contaminated laboratory was cleaned.	Phase 3
Building P1900 East	Process development facility: The objective of the decommissioning project was to clear the Fan Room of building P1900-East from all radioactive contamination in order to release it from regulatory control. The objective was partly achieved by the removal and decontamination of radiologically contaminated equipment and material, and the removal and/or cleaning of fixed contamination from the building structure. This decommissioning was done during June and July 2005.	Phase 3
YG-Foundry	Redundant alloy development facility: The objective of the decommissioning project was to clear the southern section of the YG-Foundry building from all radioactive contamination in order to release it from regulatory control. The objective was achieved by the removal and decontamination of radiologically contaminated equipment and material, and the removal and/or cleaning of fixed contamination from the building structure. Decommissioning of the YG-Foundry took place between February 2003 and January 2004.	Phase 3

FACILITY	DESCRIPTION	STATUS
Facilities having undergone Phase III decommissioning but are not yet released from regulatory control		
Oil Purification Plant	Redundant lubrication oil purification facility: The objective of the decommissioning project was to clear the facility from all radioactive contamination in order to release it from regulatory control. The objective was achieved by the removal and decontamination of radiologically contaminated equipment and material. The facility is under care and maintenance	Phase 3
V-XB Facility	Redundant testing facility: The objective of the decommissioning project was to clear the facility from all radioactive contamination in order to release it from regulatory control. The Phase 2 decommissioning was completed in 2001 and the facility is currently under care and maintenance.	Phase 3
K3 Stores	Redundant SEA storage facility: This storage facility was cleared of its inventory of SEA's which was moved to the Pelstore at Area 14 in 2007. K3 Stores were cleaned.	Phase 3
P2800	Redundant Ammonium Diuranate Conversion facility: The facility was shutdown in 1985. The Phase 2 decommissioning was completed in 1998. All equipment was removed from the facility in 2004 and the facility is currently under care and maintenance.	Phase 3
J-Building	Redundant Development / testing facility: The objective of the phase 2 decommissioning project was to reduce the nuclear liability associated with J-Building. The objective was achieved by the removal and decontamination of radiological contaminated equipment from the building and thereby reducing the Care and Maintenance requirements for the building. Phase 2 decommissioning started in August 2000 and was completed in September 2001. J-Building is under Care and Maintenance awaiting phase 3	Phase 3
B1-Building Basement	Non-radiological chemical cleaning and de-greasing facility: The facility was shutdown in the 1990s. The radiologically controlled area which is under care and maintenance is the basement only. This area was radiologically contaminated due to a spill that took place in 1997 when Uranium contaminated water from another facility spilled into the basement of B1-Building due to a cross connection of Low Active effluent lines between the two facilities.	Phase 3
Facilities being decommissioned		
Area 14	Scrubber Area	Phase 3
Filter room	Redundant filter-room containing filtering processing equipment	Phase 3
Oil Basement	Redundant Enrichment plant service facility: The initial phase 2 was done in 1987 and all the oil pipes that could not be cleaned remained in the basement. Cutting these pipes into smaller sizes that can be accommodated in the smelter is an ongoing process.	Phase 2

SECTION L: ANNEX 9: LIST OF NUCLEAR FACILITIES AT NESCA IN THE PROCESS OF BEING DECOMMISSIONED

FACILITY	DESCRIPTION	STATUS
Area 16	Redundant Enrichment plant service facility: The objective of the phase 2 decommissioning project was to reduce the nuclear liability associated with Area 16. The objective was achieved by the removal and decontamination of radiological contaminated equipment from the building and thereby reducing liabilities. Phase 2 decommissioning started mid-2002 and was completed 2 years later in mid-2004. Area 16 is under Care and Maintenance awaiting phase 3 decommissioning.	Phase 2
C-building	Redundant Enrichment plant: Phase II decommissioning started approximately in June 1995 and was completed towards the end of September 2003. The building is consequently stripped of all process equipment and the levels of radiation and contamination are within white area limits. C-Building is under Care and Maintenance awaiting phase 3 decommissioning.	Phase 2
D-building	Redundant Enrichment plant: The plant was shut down in February 1990 and phase I decommissioning was completed shortly after the closure. Phase 2 decommissioning began mid-2000 and was completed late 2004. The building is consequently stripped of all process equipment and the levels of radiation and contamination are within blue area limits. D-Building is under Care and Maintenance awaiting phase 3 decommissioning.	Phase 2
J-building	Redundant Development / testing facility: The objective of the phase 2 decommissioning project was to reduce the nuclear liability associated with J-Building. The objective was achieved by the removal and decontamination of radiological contaminated equipment from the building and thereby reducing the Care and Maintenance requirements for the building. Phase 2 decommissioning started in August 2000 and was completed in September 2001. J-Building is under Care and Maintenance awaiting phase 3 decommissioning.	Phase 2
P2900	Redundant Conversion development facility: Operations at P2900, which was the pilot UF6 plant, were halted in 1985. Phase 2 decommissioning started a few years later and was completed by 1988.	Phase 2
E-building	Redundant Enrichment plant: E-Building was shut down and Phase 2 decommissioning was completed by 1991. The MLIS project then commenced but was halted. Phase 2 decommissioning of the MLIS project was completed in September 2000. E-Building is under Care and Maintenance awaiting phase 3 decommissioning.	Phase 2
Uranium Conversion Plant and Area 74 Laboratories	Uranium Conversion The Uranium Conversion Plant was used to convert uranium into either ammonium diuranate or uranium tri-oxide form, into pure UF6, which was supplied to enrichment facilities as feed material for the enrichment process. The facility is currently undergoing phase 2 decommissioning. The Area 74 laboratories performed various analyses for the conversion facility. The laboratories are currently under care and maintenance, waiting for a phase 3 decommissioning.	Phase 2

FACILITY	DESCRIPTION	STATUS
Area 40 Complex	Chemical Cleaning and Decontamination Facility: Area 40 was previously used as a chemical cleaning and decontamination facility for the old uranium enrichment plant. The facility is currently undergoing phase 2 decommissioning.	Phase 2
YM Vaccum Workshop	Servicing and Repairing of Vacuum Pumps Workshop: The facility was used to service uranium- contaminated vacuum pumps from al uranium processing facilities and non-contaminated vacuum pumps. The facility is under care and maintenance, waiting for a Phase 2 decommissioning.	Phase 2

Definitions:

Phase 1 decommissioning: covers the Termination of Operation, and the minimum decommissioning activities, such as the removal from inventory to obtain a state of passive safety. This phase is associated with a facility-specific care and maintenance programme, which is developed to be commensurate with acceptable risk.

Phase 2 decommissioning: covers continued decommissioning activities for the partial or complete removal and decontamination of process systems, with the aim of restricted re-utilisation of facilities or reducing care and maintenance requirements. Care and maintenance programmes, which are commensurate with the remaining risk, are maintained.

Phase 3 decommissioning: covers the activities required for clearance facilities. Activities may range from the final decontamination of facilities to clearance levels or from the complete demolition of buildings and removal of all contaminated materials. Phase 3 is the ultimate end point of decommissioning, after which a facility is released or removed from further regulatory control.

ANNEX 10: REFERENCE TO NATIONAL LAWS, REGULATIONS, REQUIREMENTS AND GUIDES

Table 23: National laws, regulations requirements and guides

Act Number	Department	Act
130/1993	DoL	Compensation for Occupational Injuries and Diseases Act
29/1996	DMRE	Mine Health and Safety Act
28/2002	DMRE	Mineral and Petroleum Resources Development Act
103/1977	Local Council: Hartbeespoort	National Building Regulations and Building Standards Act
40/2004	DMRE	National Energy Regulator Act
39/2004	DEA	National Environmental Management: Air Quality Act
59/2008	DEA	National Environmental Management: Waste Act • B33/2/121/9/P151: Class H:h disposal site (CaF_2 pans) • Records of Decision • 12/9/11/L438/7 – Necsa H:H (sewage industrial and chemical effluent treatment facilities)
102/1980	SAPS	National Key Points Act
93/1996	DoT	National Road Traffic Act
36/1998	DWA	National Water Act
39/1994	SSA	National Strategic Intelligence Act
87/1993 85/1993	South African Council for the Non-proliferation of Weapons of Mass Destruction DoL	Non-proliferation of Weapons of Mass Destruction Act Occupational Health and Safety Act • Major hazard installation Regulations. Government Gazette (GG) 22580 Notice Number (NN) 767 of 24 August 2001. • Construction Regulations. GG 25207 NN 1010 of 18 July 2003.
33/2004	SAPS	Protection of Constitutional Democracy Against Terrorist and Related Activities Act
57/2002	DCG&TA	Disaster Management Act • Manual: joint management of incidents involving chemical or biological agents or radioactive chemicals GG 28437 NN 143 February 2006

Act Number	Department	Act
107/1998	DEA	National Environmental Management Act • Environmental Impact Assessment Regulations GG 33306 NN543 18 June 2010 as amended. • Listing notice 1: List of activities and competent authorities identified in terms of section 24(2) and 24D GG 33308 NN 544 as amended • Listing notice 2: List of activities and competent authorities identified in terms of section 24(2) and 24D GG 33308 NN 545 as amended • Listing notice 3: List of activities and competent authorities identified in terms of section 24(2) and 24D GG 33308 NN 663 as amended • IEM Companion to the NEMA Environmental Assessment Regulations (Series 5); Public participation in the EIA process (Series 7); Environmental Management Framework (EMF) Regulations for 2010 in terms of. NEMA (Series 6). GG 33308 NN 603. • Records of Decision • A24/12/20/1294 Necsa – upgrade of the water and effluent collection and treatment infrastructure (2009) • 12/12/20/505 Necsa – extension of the Thabana Pipe Store facility
15/1973	NDoH: Radiation Control	Hazardous Substances Act
47/1999	DMRE	National Nuclear Regulator Act • Cooperative agreements concluded i.t.o s6 (2) and published i.t.o s6(4) of the Act on cooperative governance in respect of the monitoring and control of radioactive material or exposure to ionising radiation. GG 31232 NN 759 18 July 2008. • Regulations in terms of section 7(1)(j) of the Act on the contents of the Annual Public Report on the Health and Safety related to workers, the public and the environment related to all sites on which a nuclear installation is situated or on which any action which is capable of causing nuclear damage is carried out. GG 29050 NN 716 of 28 July 2006.

SECTION L: ANNEX 10: REFERENCE TO NATIONAL LAWS, REGULATIONS, REQUIREMENTS AND GUIDES

Act Number	Department	Act
47/1999	DMRE	• Regulations in terms of s 29 (1;2), read in conjunction with s47 of the Act on the categorisation of the various nuclear installations in the Republic, the level of financial security to be provided by holders of nuclear installation licences in respect of each of those categories, and the manner in which that financial security is to be provided. GG 26327 NN 581 of 7 May 2004. • Invitation for the public to comment on proposed draft regulations on the siting of new nuclear installations in terms of s 36. GG 32349 NN 914 3 July 2009. • Regulations in terms of s36, read with section 47 of the Act on Safety Standards and Regulatory Practices. GG 28755 NN 388 of 28 April 2006. • Regulations in terms of s37 (3) (a) of the Act on the Keeping of a Record of All Persons in a Nuclear Accident Defined Area. GG 29078 NN 778 of 4 August 2006. • Regulations in terms of s38(4). read with s47, of the Act on the Development Surrounding any Nuclear Installation to Ensure the Effective Implementation of any Nuclear Emergency Plan. GG 26121 NN 287 5 March 2004. • Regulations in terms of s47, read in conjunction with section 26 (4) of the Act on the Establishment of a Public Safety Information Forum by the Holder of a Nuclear Installation Licence to Inform the Persons Living in the Municipal Area in Respect of which an Emergency Plan has been Established GG 31403 NN 968 12 September 2008. • Regulations in terms of s47, read with s21 and 22 of the Act on the Format for the Application for a Nuclear Installation Licence or a Certificate of Registration or a Certificate of Exemption. GG 30585 NN 1219 of 21 December 2007
53/2008	DMRE	National Radioactive Waste Disposal Institute Act
46/1999	DMRE	Nuclear Energy Act • Declaration [in terms of section 2] of certain substances, materials and equipment as restricted material, source material, special nuclear material and nuclear-related equipment and material as indicated in Government Notice No. 740, Schedules 1,2,3,4 respectively GG 31954 NN 207 27 February 2009.
101/1965	NDoH	Medicines and Related substances act.
2/2020	DHA	Border Management Authority Act

ANNEX 11: LISTS OF NUCLEAR AUTHORISATIONS GRANTED BY NNR

Table 24: List of Nuclear Installation Licenses granted by NNR

Authorisation	Nuclear Installations
NIL 01	Koeberg Nuclear Power Station
NIL 02	SAFARI 1 Research Reactor
NIL 03	P2700 Complex
NIL 04	Thabana Complex comprising the following facilities: Thabana Pipe Store; Thabana Radioactive; Waste Storage facility; Thabana Containerised Radioactive Waste Storage facility;
NIL 05	HEU Vault - K0090
NIL 06	A 8 Decontamination Facility
NIL 07	Building A West Drum Store
NIL 08	ELPROD in Building P 2500
NIL 09	UMET in Building P 2600
NIL 10	Conversion Plant Complex
NIL 11	Area 14 waste management Complex
NIL 12	Quarantine Storage Facility
NIL 13	V YB Pelindaba East Bus Shed Complex
NIL 14	Pelindaba East Evaporation Ponds Complex
NIL 15	Oil Purification Facility
NIL 16	Area 21 Storage Facility
NIL 17	BEVA K3 Storage Complex
NIL 18	Area 16 Complex
NIL 19	Area 40 Complex
NIL 20	Area 27 De Heeling Facility
NIL 21	J Building
NIL 22	D Building
NIL 23	C Building
NIL 24	Building P 2900
NIL 25	Building XB
NIL 26	BEVA Evaporation Ponds
NIL 27	Building P 2800
NIL 28	Vaalputs National Radioactive Waste Disposal Facility
NIL 29	Area 26
NIL 30	E Building
NIL 31	Dorbyl Camp
NIL 32	X Building
NIL 33	Building P 1500
NIL 34	YM Vacuum Workshop

SECTION L: ANNEX 11: LIST OF NUCLEAR AUTHORISATIONS GRANTED BY NNR

Authorisation	Nuclear Installations
NIL 35	V H Building Laboratories
NIL 36	P 1900 Laboratories
NIL 37	P 1600 Laboratories
NIL 38	Fuel Development Laboratories Complex
NIL 39	NTP Radiochemicals Complex
NIL 40	Pelindaba Analytical Laboratories (PAL) in
NIL 41	Liquid Effluent Treatment Facility Complex
NIL 42	B1- Building Basement

Table 25: List of Certificates of Exemption granted by NNR

COE Number	Name of COE Holder	Type of COE issued
COE 02	Oranje Mynbou En Vervoer Maatskappy	Condition for reclaimation of gypsum
COE 03	Nitrogen Products (Pty) Limited	Condition for reclaimation of gypsum
COE 04	Oranje Mynbou En Vervoer Maatskappy	Conditions for reclaimation and release of waste
COE 10	Dino Properties (Pty)Ltd	Conditions for clean up of land
COE 12	The Maretsel Property Trust Developers	Conditions for removal of Tailing footprint

Table 26: List of Certificates of Registration granted by NNR

	COR Number	Name of COR Holder	Type of COR issued
1	COR-2	Anglogold Ashanti Limited: Vaal River Operations	Mining and Mineral Processing
2	COR-3	Anglogold Ashanti Limited - West Wits Operations	Mining and Mineral Processing
3	COR-4	Anglogold Ashanti Limited - Ergo Operations	Mining and Mineral Processing
4	COR-5	ARMgold/Harmony Freegold Joint Venture Company (Pty) Ltd (Tshepong, Matjhabeng & Bambani Operations)	Mining and Mineral Processing
5	COR-6	ARMgold/Harmony Freegold Joint Venture Company (Pty) Ltd (Joel operation)	Mining and Mineral Processing
6	COR-7	African Rainbow Minerals Gold Limited (Welkom Operations)	Mining and Mineral Processing
7	COR-10	Avgold Limited - Target Division	Mining and Mineral Processing
8	COR-11	Gravelotte Mines Limited	Mining and Mineral Processing
9	COR-13	MTC Demolition	Scrap Processor
10	COR-16	Nuclear Fuels Corporation of SA (Pty) Limited	Mining and Mineral Processing
11	COR-18	South Deep Join Venture	Mining and Mineral Processing
13	COR-20	Foskor Limited (Phalaborwa)	Mining and Mineral Processing
14	COR-22	Fer-Min-Ore (Pty) Limited (Zirtile Milling)	Mining and Mineral Processing
15	COR-23	Steenkampskraal Monazite Mine (Pty) Limited	Mining and Mineral Processing
16	COR-25	Eggerding SA (Pty) Limited	Mining and Mineral Processing
17	COR-26	Richards Bay Iron and Titanium (Pty) Limited	Mining and Mineral Processing
18	COR-27	Foskor Limited (Richards Bay)	Fertiler manufacturer

	COR Number	Name of COR Holder	Type of COR issued
19	COR-28	Randfontein Estates Limited-(Kusasaletheu)	Mining and Mineral Processing
20	COR-30	Mine Waste Solutions (Pty) Limited	Mining and Mineral Processing
21	COR-31	Ya-Rona Scrap Metals	Scrap Processor
22	COR-32	CJN Scrap	Scrap Processor
23	COR-33	Rampete Metal Processors (Pty) Ltd	Scrap Processor
24	COR-34	DMC Energy (Pty) Limited	Mining and Mineral Processing
25	COR-37	Harmony Gold Mining Company Limited (Free State Operations)	Mining and Mineral Processing
26	COR-38	Omnia Phosphates (Pty) Ltd	Fertiler manufacturer
27	COR-40	ARMgold/Harmony Freegold Joint Venture Company (Pty) Ltd (St Helena Operations)	Mining and Mineral Processing
28	COR-41	Blyvooruitzicht Gold Mining Company Limited	Mining and Mineral Processing
29	COR-43	Tronox KZN Sands	Mining and Mineral Processing
30	COR-46	Evander Gold Mines Limited	Mining and Mineral Processing - Surrendered
31	COR-47	Grootvlei Properties Mines Ltd	Mining and Mineral Processing
32	COR-48	DRDGOLD Limited	Mining and Mineral Processing
33	COR-50	Rappa Resources (Pty) Limited	Mining and Mineral Processing
34	COR-51	Consolidated Modderfontein (Pty) Limited	Mining and Mineral Processing
35	COR-52	Nigel Gold Mining Company Limited	Mining and Mineral Processing
36	COR-53	East Rand Proprietary Mines Limited	Mining and Mineral Processing
37	COR-57	Crown Gold Recoveries Pty) Limited	Mining and Mineral Processing
38	COR-58	Harmony Gold Mining Company Limited - Randfontein Operations	Mining and Mineral Processing
39	COR-59	Industrial Zone Limited	Mining and Mineral Processing
40	COR-61	Sedex Minerals	Mining and Mineral Processing
41	COR-64	Potchefstroom Plastiek Herwinning BK	Scrap Processor
42	COR-66	Mintek	small user
43	COR-69	Sibanye Gold Limited (Driefontein Operations)	Mining and Mineral Processing
44	COR-70	Sibanye Gold Limited (Kloof Operation)	Mining and Mineral Processing
45	COR-71	Sibanye Gold Limited (Beatrix Operation)	Mining and Mineral Processing
46	COR-76	Blastrite (Pty) Limited	Mining and Mineral Processing - Surrendered
47	COR-77	Anglo American Research Laboratories (Pty) Limited	small user
48	COR-74	Durban Roodepoort Deep Mine	Mining and Mineral Processing
49	COR-79	Durban Roodepoort Deep Limited	Mining and Mineral Processing
50	COR-80	Mogale Gold (Pty) Ltd	Mining and Mineral Processing
51	COR-81	Metrec	Mining and Mineral Processing
52	COR-84	The Big Bin CC	Scrap Processor

SECTION L: ANNEX 11: LIST OF NUCLEAR AUTHORISATIONS GRANTED BY NNR

	COR Number	Name of COR Holder	Type of COR issued
53	COR-86	Glenover Phosphate Limited (Mining Site) Operation)	Mining and Mineral Processing
54	COR-87	Rand Refinery Limited	Mining and Mineral Processing
55	COR-92	The Forensic Science Laboratory, SA Police	Small user
56	COR-95	Microzone Trading 69 cc	Scrap Processor
57	COR-97	Geratech Zirconium Beneficiation (Ltd)	Mining and Mineral Processing
58	COR-98	B G Scrap Metals (Pty) Ltd	Scrap Processor
59	COR-99	Roode Heuwel Sand Limited	
60	COR-100	South African Airforce (SAAF),Department of Defence (DoD),RSA	Mining and Mineral Processing
61	COR-101	The Reclamation Group (Pty) Ltd (Richards Bay)	Scrap Processor
62	COR-103	Linbeck Metal Trading (Pty) Ltd	Scrap Processor
63	COR-104	South African Port Operations (Dry Bulk Terminal - Richards Bay a Division of Transnet Limited)	Mining and Mineral Processing
64	COR-105	Tantilite Resources	Mining and Mineral Processing
65	COR-106	Mineral Sands Resources Pty Ltd	Mining and Mineral Processing
66	COR-107	Vesuvius South Africa (Pty) Ltd	Mining and Mineral Processing
67	COR-109	SM Mining Construction Pty Ltd	
68	COR-110	Geotron Systems (Pty) Limited	Small user
69	COR-111	Bosveld Phosphate	Fertilizer manufacturer
70	COR-112	Scaw Metals Group	Scrap Processor
71	COR-114	Interwaste Pty Ltd	Scrap Processor
72	COR-115	Witswatersrand Consolidated Gold Resources Limited	Mining and Mineral Processing
73	COR-116	Business Venture Investment 1692 Proprietary Limited	Mining and Mineral Processing
74	COR-117	Vic Ramos CC	Scrap Processor
75	COR-118	GoldPlats Recovery Ltd	Mining and Mineral Processing - Surrendered
76	COR-119	Huntrex 196 Pty Ltd (trading as Ceracast)	Mining and Mineral Processing
77	COR-131	East Rand Beneficiation (Pty) Ltd	Mining and Mineral Processing
78	COR-132	Grifo Engineering (Pty) Ltd	Service provider
79	COR-135	Tioxide SA (Pty) Ltd	Mining and Mineral Processing
80	COR-136	Thukela Refractories Isethebe	Mining and Mineral Processing
81	COR-137	Manos Engineering (Pty) Ltd	Scrap Processor
82	COR-138	Bright Refining (Pty) Ltd	Mining and Mineral Processing
83	COR-139	The New Reclamation Group (Westonaria Operations)	Scrap Processor
84	COR-140	China African Precious Metals	Mining and Mineral Processing
85	COR-141	Palabora Copper (Pty) Ltd	Mining and Mineral Processing
86	COR-142	Pan African Resources - Evander Gold Mining	Mining and Mineral Processing
87	COR-143	Zirco Roode Heuwel	Mining and Mineral Processing

	COR Number	Name of COR Holder	Type of COR issued
88	COR-144	Scamont Engineering (Pty) Ltd	Scrap Processor
89	COR-145	Re-Process Technology CC	Mining and Mineral Processing
90	COR-148	Saldanha Dry Bulk Terminal Cc	Service provider
91	COR-149	Cronimet RSA (Pty) Ltd	Scrap Processor
92	COR-150	Minrite (Pty) Ltd	Mining and Mineral Processing
93	COR-151	Covalent Water Company (Pty) Ltd	Mining and Mineral Processing
94	COR-152	SGS South Africa (Pty) Ltd (Cooke operations)	Small user
95	COR-153	Resource Reference Materials (Pty) Ltd	Small user
96	COR156	Necsa Calibration Pads	Small user
97	COR-159	North West Reclaiming	Scrap Processor
98	COR-160	Shiva Uranium One	Mining and Mineral Processing
99	COR-164	Sulzer Pumps (SA) Limited	Service provider
100	COR-165	Uramin Mago Lukisa	Mining and Mineral Processing
101	COR-166	Weston Scrap Metal	Scrap Processor - Surrendred
102	COR-167	Western Uranium (Pty) Ltd	Mining and Mineral Processing
103	COR-178	Durban Container Terminal - Business Unit of SA Port Operations	Mining and Mineral Processing
104	COR-180	SA Port Operations - Container Terminal Cape Town	Mining and Mineral Processing
105	COR-181	Transnet Limited (SA Port Operations -Multipurpose Terminal,Saldanha bay)	Mining and Mineral Processing
106	COR-182	Buffelsfontein Gold Mine Limited	Mining and Mineral Processing
107	COR-183	Tasman Pacific Minerals (Pty) Limited	Mining and Mineral Processing
108	COR-184	HVH Gold (Pty) Limited	Mining and Mineral Processing
109	COR-186	AfriSam (Pty) Limited	Mining and Mineral Processing
110	COR-190	Ezulwini Mining Company Ltd	Mining and Mineral Processing
111	COR-194	Exxaro Resources	Mining and Mineral Processing
112	COR-195	Houlgon Uranium & Power (Pty) Ltd	Mining and Mineral Processing
113	COR-197	Gold Reef City Theme Park	Mining and Mineral Processing
114	COR-198	Set Point Industrial Technologies (Pty) Ltd (Isando)	Small user
115	COR-199	Uramin Mago Lukisa	Mining and Mineral Processing
116	COR-200	Uramin Mago Lukisa	Mining and Mineral Processing
117	COR-201	A&S Mining Supplies	Service provider
118	COR-203	Cemo Pumps (Pty) Ltd	Service provider
119	COR-204	Holgoun Energy (Pty) Ltd	Mining and Mineral Processing
120	COR-206	Uranium One and Micawber 397 (Proprietary) Limited	Mining and Mineral Processing
121	COR-207	Set Point Industrial Technologies (Pty) Ltd (Mokopane)	Small user
122	COR-210	Tasman Pacific Minerals (Pty) Limited	Mining and Mineral Processing
123	COR-211	Tasman Pacific Minerals (Pty) Limited	Mining and Mineral Processing

SECTION L: ANNEX 11: LIST OF NUCLEAR AUTHORISATIONS GRANTED BY NNR

	COR Number	Name of COR Holder	Type of COR issued
124	COR-215	Margaret Water Company	Mining and Mineral Processing
125	COR-216	Paddy's Pad 1183 (Pty) Ltd	Mining and Mineral Processing
126	COR-217	Cango Caves Oudtshoorn Municipality	Mining and Mineral Processing
127	COR-218	Grindrod Terminals (Pty) Limited	Mining and Mineral Processing
128	COR-219	Southgold Exploration (Pty) Limited	Mining and Mineral Processing
129	COR-220	African Empowered Aggregates CC	Mining and Mineral Processing
130	COR-221	Tasman Pacific Minerals (Pty) Limited	Mining and Mineral Processing
131	COR-222	Tasman Pacific Minerals (Pty) Limited	Mining and Mineral Processing
132	COR-223	Tasman Pacific Minerals (Pty) Limited	Mining and Mineral Processing
133	COR-225	New Kleinfontein Goldmine (Pty) Limited	Mining and Mineral Processing
134	COR-226	Rand Uranium (Pty) Limited	Mining and Mineral Processing
135	COR-227	WG Wearne Limited	Mining and Mineral Processing
136	COR-228	Ergo Mining (Pty) Limited	Mining and Mineral Processing
137	COR-229	The New Reclamation Group (Pty) Limited	Scrap Processor
138	COR-230	ALS Chemex South Africa (Pty) Limited	Small user
139	COR-232	Central Rand Gold South Africa (Pty) Limited (West)	Mining and Mineral Processing
140	COR-233	Central Rand Gold South Africa (Pty) Limited (East)	Mining and Mineral Processing
141	COR-234	Pamodzi Gold Orkney (Pty) Limited	Mining and Mineral Processing
142	COR-235	IM Motlhabane Farming CC (T/A Motlhabane Recycle Scrap)	Scrap Processor
143	COR-236	Reclaim Invest 101 (Pty) Limited	Scrap Processor
144	COR-238	Tronox (Namakwa Sands Operations)	Mining and Mineral Processing
145	COR-239	Aflease Gold Limited	Mining and Mineral Processing
146	COR-240	Tantus Trading 180 (Pty) Ltd	Mining and Mineral Processing
147	COR-242	Enviro Mzingazi Gypsum (Pty) Limited	Mining and Mineral Processing
147	COR_245	Namakwa Uranium (Pty) Limited	Mining and Mineral Processing
148	COR_246	NTP Logistics (Pty) Limited	Mining and Mineral Processing
149	COR-247	SGS South Africa (Pty) Ltd	Small user
150	COR-248	Foskor Zirconia (Pty) Limited	Mining and Mineral Processing
151	COR-249	Pro Mass Transport (Pty) Ltd	Mining and Mineral Processing
152	COR-250	JCI Gold Limited	Mining and Mineral Processing
153	COR-252	Harmony Gold Mining Company Limited (South Operations)	Mining and Mineral Processing
154	COR-253	Avgold Limited (North Operations)	Mining and Mineral Processing
155	COR-254	WS Renovations Contractors	Service provider
156	COR-255	Genalysis Laboratory Services (SA) (Pty) Limited	Small user
157	COR-256	Chifley Trading CC	Service provider
158	COR-257	Samco Investments (Pty) Limited	Scrap Processor

	COR Number	Name of COR Holder	Type of COR issued
159	COR-258	SA Metal and Machinery Co (Pty) Limited	Scrap Processor
160	COR-259	University of Pretoria	Mining and Mineral Processing
161	COR-260	African Mineral Standards (a division of Set Point Industrial Technology (Pty) Ltd)	Small user
162	COR-261	North West University	Mining and Mineral Processing
164	COR-263	Aklin Carbide (Pty) Ltd	Service provider
165	COR-264	Umhlathuze Imports & Exports	Service provider
166	COR-265	Tau Lekoa Gold Mine (Pty) Ltd	Mining and Mineral Processing
167	COR-266	Nicolor (Pty) Ltd	Mining and Mineral Processing
168	COR-267	SGS South Africa (Pty) Ltd -(Randburg Operations)	Small user
169	COR-268	Far East Gold Special Purposes Vehicle (Pty) Ltd	Mining and Mineral Processing

DEFINITIONS & ACRONYMS / ABBREVIATIONS

DEFINITIONS

Authorised discharge	Planned and controlled release of radioactive material into the environment in accordance with an authorisation from the Regulator.
Authorised recycling	Release of waste from nuclear regulatory control in terms of compliance with conditional clearance levels and specific recycling conditions.
Care and maintenance	Actions, such as surveillance, inspection, testing and maintenance to ensure that facilities are maintained in a safe state between decommissioning phases.
Decommissioning	Actions taken at the end of the useful life of a facility, other than a repository or disposal facility, in retiring it from service with adequate regard for the health and safety of workers and members of the public and protection of the environment. Actions include shutdown, dismantling and decontamination, care and maintenance.
Discharge	A planned and controlled release of radionuclides into the environment. Such releases should meet all restrictions imposed by the regulatory body.
Disposal	The emplacement of waste in an approved specified facility (for example near surface or geological repository).
Geological disposal	Isolation of radioactive waste, using a system of engineered and natural barriers at a depth up to several hundred meters in a geologically stable formation.
High-level waste (HLW)	(a) The radioactive liquid containing most of the fission products and actinides originally present in used fuel – which forms the residue from the first solvent extraction cycle in reprocessing - and some of the associated waste streams. (b) Solidified HLW from (a) above and used fuel (if it is declared a waste). (c) Any other waste with an activity level comparable to (a) or (b). High-level waste in practice is considered long lived. One of the characteristics, which distinguish HLW from less active waste, is its level of thermal power (>2 kW/m^3).
In-service inspection	A system of planned, usually periodic observations and/or tests performed on all items relied on for safety (IROFS) in order to detect, characterise and monitor (as appropriate) any defects and anomalies that could threaten plant safety. ISI is part of the maintenance process and may be performed at any time that is considered appropriate, including after failure of IROFS.
Long-lived waste	Radioactive waste containing long-lived radionuclides having sufficient radiotoxicity in quantities and/or concentrations requiring long-term isolation from the biosphere. The term "long-lived radionuclide'' refers to half-lives usually greater than 31 years.
Low and intermediate level waste (LILW)	Radioactive waste in which the concentration of or quantity of radionuclides above clearance level, established by the regulatory body, but with a radionuclide content and thermal power below those of HLW. Low and intermediate level wastes are often separated into short-lived and long-lived wastes. Short-lived wastes may be disposed of in near surface disposal facilities.

Natural occurring radioactive material (NORM)	Material containing no significant amounts of radionuclides other than naturally occurring radionuclides.
Near surface disposal	Disposal of waste, with or without engineered barriers, on or below the ground surface where the final protective covering is of the order of a few meters thick, or in caverns a few tens of meters below the earth's surface.
Nuclear fuel cycle	All operations associated with the production of nuclear energy, including mining, milling, processing and the enrichment of uranium or thorium; manufacture of nuclear fuel; operation of nuclear reactor; reprocessing of nuclear fuel; decommissioning; and any action for radioactive waste management and any research or development action related to any of the foregoing.
Phase 1 Decommissioning	Covers the termination of operation and the immediate decommissioning activities, such as the removal of radioactive inventory to attain a state of passive safety. Care and maintenance programmes, which are commensurate with the remaining risk, are maintained.
Phase 2 Decommissioning	Covers continued decommissioning for the partial or complete removal and decontamination of process systems with the aim of restricted re-utilisation of facilities or reducing care and maintenance requirements. Care and maintenance programmes, which are commensurate with the remaining risk, are maintained.
Phase 3 Decommissioning	Phase 3 decommissioning covers the activities that are necessary for the clearance of facilities. Activities may range from final decontamination of facilities to clearance levels, or complete demolition of buildings and removal of contaminated material. Phase 3 is the ultimate end point of decommissioning, after which a facility is released or removed from further regulatory control.
Pre-treatment	Any or the entire operation prior to waste treatment, such as collection, segregation, chemical adjustment and decontamination.
Regulated disposal	Disposal of radioactive waste in a facility licenced by the Regulator for disposal of a specific waste class.
Processed waste	Waste that undergoes any operation that changes the characteristics of the waste, including waste pre-treatment, treatment and conditioning.
Repository	A nuclear facility (for example geological repository), where waste is emplaced for disposal. Future retrieval of the waste from the repository is not intended.
Reprocessing	A process or operation, the purpose of which is to extract radioactive isotopes from used fuel for further use.
Used fuel	Nuclear fuel removed from a reactor, following irradiation, which is no longer usable in its present form due to depletion of fissile material, poison build-up or radiation damage.
Spent source	A source that is no longer suitable for its intended purpose as a result of radioactive decay.
Storage	The placement of radioactive waste in a nuclear facility where isolation, environmental protection and human control (for example monitoring) are provided with the intent that the waste will be retrieved.

DEFINITIONS (Continued)

Transportation	Operations and conditions associated with and involved in the movement of radioactive material by any mode on land, water or air. The terms, ''transport'' and "shipping", are also used.
Treatment	Operations intended to benefit safety and/or economy by changing the characteristics of the waste. Three basic treatment objectives are volume reduction, removal of radionuclides from the waste and change of composition. After treatment, waste may or may not be immobilised to achieve an appropriate waste form.
Unprocessed waste	As generated raw material requiring further characterisation and processing before being regarded as a waste stream.

ACRONYMS/ABBREVIATIONS

AADQ	Annual Authorised Discharge Quantities
AEB	Atomic Energy Board
AEC	Atomic Energy Corporation
AFI	Area For Improvement
AFRA	African Regional Cooperative Agreement for Research, Development & Training related to Nuclear Science & Technology
ALARA	As Low as Reasonably Achievable, economic and social factors being taken into account
CAAS	Criticality Accident Alarm System
CAE	Compliance Assurance and Enforcement
CAP	Compliance Assurance Plan
CEO	Chief Executive Officer
CISF	Centralised Interim Storage Facility
CNS	Council for Nuclear Safety
COE	Certificate of Exemption
COR	Certificate of Registration
CSE	Criticality Safety Evaluation
CSS	Commission on Safety Standards
DSCA	Dumping at Sea Control Act, Act No. 73 of 1980
DEA	Department of Environmental Affairs
DHA	Department of Home Affairs
DMRE	Department of Mineral Resources and Energy
DoL	Department of Labour
DoT	Department of Transport
DPE	Department of Public Enterprises
DPW	Department of Public Works
DSRS	Disused Sealed Radioactive Source
ECAA	Environment Conservation Amendment Act, Act No. 50 of 2003
ECA	Environment Conservation Act, Act No. 73 of 1989
EIA	Environmental Impact Assessment
EMF	Environmental Management Framework
EPREV	Emergency Preparedness Review Service of the IAEA
FLO	Front-Line Official
GOR	General Operating Rules
HDR	High Density Rack
HLW	High-Level Waste
HSA	Hazardous Substances Act, Act No. 15 of 1973
HSE	Health Safety and Environment
IAEA	International Atomic Energy Agency
ICRP	International Commission on Radiological Protection

ACRONYMS/ABBREVIATIONS (Continued)

ICT	Information and Communications Technology
INES	International Nuclear Event Scale
INIR	Integrated Nuclear Infrastructure Review
INPO	Institute of Nuclear Power Operators
IRRS	IAEA Integrated Regulatory Review Service
ISO	International Organization for Standardization
IROFS	Items Relied on For Safety
IRPA	International Radiation Protection Association
IRS	Incident Reporting System
ISAM	IAEA Coordinated Research Program "Improvement of Safety Assessment Methodologies for Near Surface Disposal"
ISIP	In-Service Inspection and Maintenance Process
Joint Convention	Joint Convention on the Safety of Spent Fuel Management and on the Safety of Radioactive Waste Management
Koeberg	Koeberg Nuclear Power Station
KPA	Key Performance Area
KPI	Key Performance Indicator
LILW	Low and Intermediate Level Radioactive Waste
LILW (SL)	Low and Intermediate Level Radioactive Waste (Short lived)
LLW	Low-Level Waste
MHSA	Mine Health and Safety Act, Act No. 29 of 1996
MPRDA	Minerals and Petroleum Resources Development Act, Act No. 28 of 2002
MS	Management System
NCRWM	National Committee on Radioactive Waste Management
NDoH	National Department of Health
NEA	Nuclear Energy Act, Act No. 46 of 1999
Necsa	South African Nuclear Energy Corporation
NEMA	National Environmental Management Act, Act No. 107 of 1998
NERS	Network of Regulators of Countries with a Small Nuclear Programme
NIL	Nuclear Installation Licence
NPP	Nuclear Power Plant
NLM	Nuclear Liabilities Management, a division of Necsa
NNR	National Nuclear Regulator
NNRA	National Nuclear Regulator Act, Act No 47 of 1999
NTWP	Nuclear Technology and Waste Projects

NORM	Natural Occurring Radioactive Material
NRF	National Research Foundation
NRWDI	National Radioactive Waste Disposal Institute
NUSSC	IAEA Nuclear Safety Standards Committee
NWA	National Water Act, Act No. 36 of 1998
OHS	Occupational Health and Safety
OTS	Operating Technical Specification
PFMA	Public Finance Management Act, Act No. 29 of 1999
Policy and Strategy	Radioactive Waste Management Policy and Strategy for the Republic of South Africa,
PSIF	Public Safety Information Forum
PTR	Koeberg used fuel pool cooling system
PWR	Pressurised Water Reactor
QA	Quality Assurance
RASSC	Radiation Safety Standards Committee
RRA	Residual Heat Removal System
RWMF	Radioactive Waste Management Fund
SAPS	South African Police Service
SAR	Safety Analysis Report
SARS	South African Revenue Service
SARA	Standards, Authorisation, Review and Assessment
SDS	Segmented Drum Scanner
SHEQ	Safety, Health, Environmental and Quality
SSA	State Security Agency
SSC	Structures Systems and Components
SSR	Site Safety Report
TISF	Transient Interim Storage Facility
TRANSSC	IAEA Transport Safety Standards Committee
TSO	Technical Support Organisation
UCOR	Uranium Enrichment Corporation
UFA	Used Fuel Assembly
UFP	Used Fuel Pool
UNSCEAR	United Nations Scientific Committee on the Effects of Atomic Radiation
VRF	Volume Reduction Facility
Vaalputs	Vaalputs National Radioactive Waste Disposal Facility

WASSC	IAEA Waste Safety Standards Committee
WANO	World Association of Nuclear Operators
WSA	Water Services Act, Act No. 108 of 1997

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prepared by the

NATIONAL NUCLEAR REGULATOR

For the protection of persons, property and the environment against nuclear damage.

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