Eskom Holdings Limited

Draft Environmental Management Plan

Environmental Management Plan for a 400 MW(t) Pebble Bed Modular Reactor Demonstration Power Plant

DEAT Reference No: 12/12/20/745
Project Number: J27196
Date: September 2008
# PEBBLE-BED MODULAR REACTOR DEMONSTRATION POWER PLANT ENVIRONMENTAL IMPACT ASSESSMENT

## ENVIRONMENTAL MANAGEMENT PLAN

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# GLOSSARY OF ABBREVIATIONS

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<tr>
<td>ARCUS GIBB</td>
<td>ARCUS GIBB (Pty) Ltd</td>
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<td>CM</td>
<td>Construction Manager</td>
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<tr>
<td>DEAT</td>
<td>Department of Environmental Affairs and Tourism</td>
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<td>DME</td>
<td>Department of Minerals and Energy</td>
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<td>DPP</td>
<td>Demonstration Power Plant</td>
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<td>ECO</td>
<td>Environmental Control Officer</td>
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<td>EIA</td>
<td>Environmental Impact Assessment</td>
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<td>EIR</td>
<td>Environmental Impact Report</td>
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<td>EMP</td>
<td>Environmental Management Plan</td>
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<td>EMS</td>
<td>Environmental Management System</td>
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<tr>
<td>EPCM</td>
<td>Engineering, Procurement, Construction Management</td>
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<td>Eskom</td>
<td>Eskom Holdings Limited</td>
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<tr>
<td>I&amp;APs</td>
<td>Interested and Affected Parties</td>
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<tr>
<td>km</td>
<td>kilometre</td>
</tr>
<tr>
<td>KNPS</td>
<td>Koeberg Nuclear Power Station</td>
</tr>
<tr>
<td>kV</td>
<td>kiloVolt</td>
</tr>
<tr>
<td>NNR</td>
<td>National Nuclear Regulator</td>
</tr>
<tr>
<td>PBMR</td>
<td>Pebble Bed Modular Reactor</td>
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<tr>
<td>PM</td>
<td>Project Manager</td>
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<tr>
<td>RFESR</td>
<td>Revised Final Environmental Scoping Report</td>
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<td>RoD</td>
<td>Record of Decision (Environmental Authorisation)</td>
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<td>RE</td>
<td>Resident Engineer</td>
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<td>RWMP</td>
<td>Radioactive Waste Management Programme</td>
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<tr>
<td>SSC</td>
<td>Structures, Systems and Components</td>
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1 INTRODUCTION

1.1 Project background

The Eskom Conversion Act, 2001 (Act No. 13 of 2001) established Eskom Holdings Limited (Eskom) as a State Owned Enterprise, with the Government of South Africa as the only shareholder, represented by the Minister of Public Enterprises. According to the Memorandum of Association required by the Eskom Conversion Act and the Companies Act, 1973 (Act No. 61 of 1973), Eskom’s main objective is to “provide energy and related services including the generation, transmission, distribution and supply of electricity, and to hold interests in other entities.”

In accordance with this mandate, Eskom proposes to construct, commission, operate and decommission a 400 MW(t) Pebble Bed Modular Reactor Demonstration Power Plant (PBMR DPP) at the Koeberg Nuclear Power Station (KNPS) site in the Western Cape Province of South Africa.

As part of its main object, Eskom considers electricity generation technologies that are commercially proven for inclusion in its generation mix, and will consider technologies that have not been commercially proven for its generation mix only after they have been acceptably demonstrated. Consistent with the description of Research, Development and Demonstration projects in the White Paper on Energy Policy (1998), the primary intention of the PBMR DPP is to allow for the performance testing of the technology in a controlled environment. If the technology proves to be commercially viable, it may be used for power generation or co-generation i.e. creation of process heat which could be used for activities such as desalination and hydrogen production.

The EIA for the proposed 400 MW(t) PBMR DPP commenced in August 2005 with the submission of an application for authorisation of the proposed development to the Department of Environmental Affairs and Tourism (DEAT). The Scoping Phase has been concluded with the receipt of a decision in terms of section 6(3b) received in March 2008. This Environmental Management Plan forms part of the Impact Assessment Phase which is currently underway.

This EMP is designed to prevent and/or mitigate the potential environmental impacts, which the proposed PBMR could incur during the construction and operational phases. The European Environment Agency (2006) defines an EMP as follows:

An action plan or system which addresses the how, when, who, where and what of integrating environmental mitigation and monitoring measures throughout an existing or proposed operation or activity.

A separate management plan will consider the potential impacts of the decommissioning of the PBMR and the management and mitigation of those impacts. This will ensure the plan takes into account all environmental aspects experienced during the operation of the DPP.

1.1.1 Location and short description of the PBMR DPP

The Koeberg Nuclear Power Station (KNPS) site is located within the Eskom Controlled Area on the farm Duynefontein (farm number 34), within the Koeberg Private Nature Reserve, the latter being approximately 3000 ha in extent. The KNPS site is approximately two (2) km from the Duynefontein residential area, 30 km north of Cape Town and 10 km south of Atlantis, within the City of Cape Town Metropolitan Municipality jurisdiction.

1 http://glossary.eea.eu.int/EEAGlossary/E/environmental_management_plan
The existing Access Control Point (ACP) 1 security fence of the KNPS site will need to be moved to accommodate the PBMR DPP so that the plant will be within the boundaries of this security fence (Figure 1). The PBMR DPP would require approximately nine ha of the KNPS site, which is approximately 125 ha in extent. The site and surrounding nature reserve are managed according to a formal integrated environmental management system.

Figure 1: Proposed location of the PBMR DPP on the KNPS site

As Figure 2 highlights, the overall study area for the PBMR DPP is larger than just the development site for the plant, as there are a number of other areas influenced by the project which require management. The overall area thus consists of the following:
1. Site for the proposed PBMR DPP;
2. Areas identified as possible alternatives for the laydown of materials;
3. Area impacted upon by the proposed 132 kV power line; and
4. Areas impacted upon by the transportation of heavy equipment and machinery from Saldanha Bay. The transportation of heavy machinery and equipment may require changes to roads, intersections and the Modder River Bridge.

1.2 Purpose of the PBMR EMP

The EMP aims to:

1. Outline functions and responsibilities of accountable persons;
2. State key standards and guidelines, which are required to be achieved in terms of environmental legislation;
3. Outline mitigation measures and environmental specifications which are required to be implemented for construction and operation phases of the project, in order to minimise the extent of environmental impacts and to manage environmental impacts associated with the project through effective control; and
4. Prevent long-term or permanent environmental degradation.

The purpose of the PBMR EMP is to provide mitigation and management measures focussed on the following phases:

- **Construction Phase**
  This section of the EMP provides management principles for the construction phase of the project. Environmental actions, procedures and responsibilities as required within the construction phase are specified. These specifications will form part of the contract documentation and, therefore, the Contractor will be required to comply with the specifications to the satisfaction of the Project Manager and Environmental Control Officer, in terms of the construction contract.

- **Operation and Maintenance Phase**
  This section of the EMP provides management principles for the operation and maintenance phase of the project. Environmental actions, procedures and responsibilities as required from Eskom within the operation and maintenance phase are specified.

The purpose of this document is to ensure that the final EIA findings and recommendations are included into all contracts and site specifications for the construction activities and operational/maintenance practices to take place at the PBMR DPP site.

It should be noted that since this EMP represents an extension of the EIA process undertaken for the PBMR DPP, it is important that this guideline document and associated annexures be read in conjunction with the Final Scoping Report, the Final EIR, the RoD, and any other applicable Eskom policy and documentation. This contextualises the EMP and enables a more thorough understanding of its role and purpose in the integrated environmental management process for the PBMR DPP.
1.3 Structure of this document

This EMP has been divided into five chapters, each addressing a different aspect of the PMBR DPP:

**Chapter 1** provides a brief introduction and overview of the project and EMP background.

**Chapter 2** sets the context for the EMP by providing an overview of the project, summarising the objectives of the EMP, highlighting the scope of the EMP and briefly emphasising Eskom’s environmental commitments.

**Chapter 3** records the environmental specifications, guidelines and standards for the PMBR DPP. It outlines the approach to mitigation and monitoring of activities and environmental issues during the construction and operation phases of the project.

**Chapter 4** provides guidance for the implementation and management of the EMP, by highlighting the organisation structure and various roles and responsibilities, emphasising the importance of awareness training, and summarising the recommended approach to monitoring, compliance and corrective action.

**Chapter 5** presents a brief process-related conclusion to the EMP, and provides details for further contact.
2 CONTEXT FOR THE PBMR EMP

2.1 Overview of the proposed project

2.1.1 Background

As introduced above, the project comprises the construction, commissioning and operation of a Pebble Bed Modular Reactor Demonstration Power Plant (PBMR DPP). The PBMR DPP is based on the designs developed as a result of an extensive gas cooled High Temperature Reactor (HTR) development programme in Germany. Extensive research and development has been done on the 15 MW(e) [40 MW(t)] Arbeitsgemeinschaft Versuchs Reaktor (AVR) research reactor at the nuclear research centre in Jülich. The reactor operated from 1966 to 1988, when it was decommissioned due to political considerations, and because it had fulfilled all planned research tests and experiments. Although it was a prototype in test mode, it produced power for 70% of its life.

Experience gained from the AVR was used extensively in the design changes made to the AVR resulting in the design of the 300 MW(e) [750 MW(t)] Thorium High Temperature Reactor (THTR), which operated between 1985 and 1988. The THTR was a First-of-its-Kind production plant intended to demonstrate the viability of the different subsystem hardware designs, with specific emphasis on plant availability and maintainability. To this end, the design concentrated on building a plant with a lifetime of 40 years and an availability of 80% to 90%.

Based on the experience gained from the AVR and the THTR, two German-based groups further developed pebble bed reactor designs ranging from high power reactors mainly developed by ABB (previously Brown Boveri), to the modular inherently safe design of Siemens Interatom, the HTR-Modul. These two groups later combined to form Hochtemperatur Reaktorbau GmBh.

In 1999, Eskom obtained the right to access the HTR engineering database that included details of the Siemens/Interatom HTR-Modul design. This design can be regarded as the forerunner of the PBMR DPP. The PBMR DPP core design was made using the same design philosophy as was used in the design of the HTR-Modul. A concept licence was issued for this reactor, and the safety arguments used in the HTR-Modul safety application are relevant for the PBMR DPP safety case.

It must therefore be realised that the term First – Of – A – Kind (FOAK) used for PBMR DPP is in reality a FOAK configuration of developed technologies, namely the reactor unit and the helium turbine. Although as described above the key components of the PBMR technology have been tested and proven, the integrated PBMR DPP is a “FOAK engineering” project. In this regard, Eskom wishes to demonstrate the techno-economic feasibility of the integrated system.

2.1.2 Functioning of the PBMR technology

The PBMR DPP is a high-temperature, gas cooled reactor technology. It consists of a steel reactor pressure vessel, which contains and supports a metallic core barrel, which contains pebble fuel spheres. The reactor pressure vessel has a 6.2 m inner diameter of approximately 6 m, and is approximately 29 m high. The annular fuel core is located in the space between central and outer graphite reflectors.

Reactivity control elements can move into and out of the reactor. Two diverse reactivity control systems are provided for shutting the reactor down; one being reactivity control rods, and the other being small absorber spheres.

\[2\] This term refers to the combined technical feasibility and economic feasibility of the proposed configuration of the plant.
The PBMR fuel consists of particles (TRISO coated particles) of enriched uranium dioxide (fuel kernel) coated with silicon carbide and carbon (necessary to contain the potentially harmful by-products of the fission reaction). The particles are encased in graphite to form a fuel sphere or pebble about the size of a billiard ball. When fully loaded, the reactor would contain approximately 490 000 fuel spheres.

The nuclear fission reaction within the particles encased in the fuel spheres generates heat, which is emitted into the space between the fuel pebbles in the reactor core. This heat is removed from the reactor vessel through the introduction of helium coolant that flows down between the hot fuel spheres, exiting the reactor vessel at a temperature of approximately 900 °C. The hot helium is used to drive a closed cycle gas turbine-compressor and generator system in a similar fashion as steam would drive the turbine in a coal fired power station.

A schematic diagram and the physical layout of the main power system are shown in Figure 2 and Figure 3 respectively.

Figure 2: Schematic Diagram of the PBMR Main Power System
After passing through the turbine, the hot helium passes through the recuperator transferring part of the remaining heat to the gas going back to the core. A pre-cooler before the low pressure compressor and an intercooler before the high pressure compressor remove waste heat to a water based cooling system. The water in the closed circuit is cooled by chlorinated seawater through a secondary heat exchanger. At full operation, Koeberg Nuclear Power Station (KNPS) extracts 80 cubic meters ($m^3$) of water per second from the ocean. The proposed PBMR DPP would require an additional 2.5 $m^3$ of water per second to be extracted from the ocean. This water is chlorinated to 1 part per million (ppm) before reaching the KPNS condensers, where the water temperature increases to an average of about 10°C above ambient temperature. The seawater is proposed to be obtained from the existing Koeberg intake basin. It is proposed that the warmed and chlorinated seawater will then be returned to the sea via the existing Koeberg outfall structure. The water is to be jetted in a south-westerly direction at a speed of between 2 and 3 m/s at the outlet of the outfall structure. As the warm water is more buoyant, a warm water plume is formed. In the Koeberg, the surf-zone temperature standard deviation is in the order of 0.46°C. Additional water from the PBMR DPP is approximately 3% of the current outflow.

The target markets for the PBMR technology include electric power generation and process heat applications. The 400 MW(t) module is well suited to both of the markets. For electric power generation the use of multiple units suits markets where large increments of power are not possible and allows for a staged introduction of nuclear power generating capacity.

### 2.1.3 Environmental concerns in the project design

Environmental concerns were considered and addressed in each stage and activity of this project. This section provides a description of how important environmental issues were approached in the site alternatives considered, as well as in infrastructure and technical design.

Technology and location alternatives were considered and assessed during the Scoping Phase of this EIA, and are discussed briefly below.
(a) Site

The Scoping phase of this project provided information on four alternative sites for the PBMR DPP namely Thyspunt, Bantamsklip, Koeberg and Pelindaba. The information included a description of each site and a comparative evaluation of the four sites with respect to supporting infrastructure required and environmental and social aspects. The finding of this assessment was that all sites other than the Koeberg site should be eliminated from further consideration due to the absence of suitable infrastructure at these sites and the significant additional cost which would be involved to develop the required infrastructure at these sites. The cost of developing the new infrastructure and the environmental impacts associated therewith, aspects which are not applicable to Koeberg at a comparable scale, were the primary reasons for eliminating all other sites from further consideration in the EIA.

In addition, the no-go or “do nothing” alternative was also considered in the impact assessment phase of the EIA. In the context of this project, the no-go alternative implies that the PBMR DPP will not be developed.

(b) Construction phase infrastructure

The construction phase involves a variety of activities, each with potential impact on the environment. Construction phase infrastructure assessed included:

- General Infrastructure, including repair shops, warehouses and parking areas for construction vehicles and machinery.
- Proposed Main Construction Services, including, Potable water supply, Power supply and data cables
- Contractor Yard (Laydown Areas)
- Temporary Bypass around the Modder River Bridge
- Widening of Intersections
- Avoidance of Telkom Lines and Power Lines
- Propping of Culverts
- Improvement of the Picnic Areas along the routes as Laybye Areas

(c) Operational phase infrastructure

The operational phase infrastructure assessed included the following:

- Module building;
- Generator and Main electrical power system;
- Radioactive waste handling Building;
- Standby Diesel Generator Building;
- Cooling Water Plant Building;
- Administration Office Building;
- 132 kV Transmission Power Line and Extension of the Duine Substation;
- Internal and External Roads;
- Existing Infrastructure on the KNPS Site;
  - Cooling water from the sea using the existing intake basin and outflow structures;
  - Low and intermediate level radioactive waste management and storage structures and systems for the processing of such waste prior to disposal to Vaalputs Waste Disposal Site in the Northern Cape;
  - Existing transmission power line network including substations;
  - Sewage treatment facilities;
  - Certain internal roads; and
  - Existing security measures.
(d) Nuclear fuel cycle

Internationally, a nuclear fuel cycle is recognised (as illustrated in Figure 4). It starts with mining and moves through the extraction of the uranium, and the conversion of the uranium into a feed material for uranium enrichment. After uranium enrichment, nuclear fuel is fabricated, which means that the uranium is built into a structural assembly that is suitable for insertion into the particular type of nuclear reactor under consideration.

When the fuel is ‘spent’, which means that all or much of the uranium has been used up, the fuel elements are removed and then sent to depleted fuel storage. At this point there are time options, if the fuel is highly depleted it will be sent to a waste repository. If, on the other hand there is still a significant amount of usable uranium in the depleted fuel it could be sent for reprocessing to extract the uranium. The rest of the fuel element would then be sent to a waste repository.

Figure 4: Simplistic diagram of a generic nuclear fuel cycle (www_nrc_gov-images-materials-fuel-cycle-fac-nuclear-fuel-cycle_gif.htm)

The Scoping phase of this project concluded that although there are other technologies available that can generate electricity, these technologies are not comparable with the PBMR DPP with respect to the following:

- The purpose and need for the PBMR DPP, which is to construct and operate a demonstration plant for performance testing purposes;
• The technology must be in a phase of development which would allow it to be demonstrated. Comparing the PBMR DPP with a technology that has been operating commercially for many years will not provide an adequate basis of comparison as the information needed to allow this comparison is not available for the PBMR DPP. Similarly, comparing the PBMR DPP with a concept design of a future technology would also not provide any meaningful basis for comparing the two technologies as the concept technology would not have sufficient data upon which a reasonable comparison can be based; and
• The ability to generate both base and peak load on demand by the same technology.

For the reasons above, it was concluded that no other technology was a feasible alternative to the PBMR DPP and thus that no other technology alternatives was considered in the EIA Phase.

2.2 Objectives of the PBMR EMP

Environmental management does not end with obtaining the requisite environmental authorisations, and EMPs have a key role to play in full life-cycle environmental management. Figure 5 contextualises EMPs within the broader environmental assessment and management processes. There is a need to ensure that the remedial and mitigation requirements identified during the environmental impact assessment process are effectively realised during project implementation. This document is therefore applicable to all construction and operational/maintenance activities associated with the PBMR DPP project.

The implementation, review and updating of this EMP remains the accountability of Eskom. Responsibility for the various parts of the EMP specifications must be clearly stated in all contracts, work orders and job descriptions.

Figure 5: Commonly used tools in the IEM toolbox, at each stage in a typical activity life cycle (adapted from DEAT, 2004).
Specifically, the objectives of this EMP are:

- To give effect to the construction and operational requirements that will be articulated in the environmental authorization (if positive) and associated reporting;
- To give effect to the environmental commitments expressed in Eskom’s policies and commitments;
- To ensure that these requirements are expressed in an accessible manner and are binding upon those involved with project implementation;
- To allow for sufficient resources to be allocated to the project budget to give effect to the environmental requirements, and to ensure that the scale of intervention is consistent with the significance of identified impacts;
- To provide a coherent and pragmatic framework for the implementation of the requirements, ranging from the roles and responsibilities of the key project participants through to the auditing and reporting of compliance.

2.3 Scope of the PBMR EMP

The scope of the EMP must ensure that the objectives outlined in Section 2.2 will be addressed, and is primarily determined by the key documentation related to the EIA process, namely the Revised Final Environmental Scoping Report (RFESR), Final Environmental Impact Report (EIR) and the Environmental Authorisation.

In addition, a nuclear licence must be obtained from the National Nuclear Regulator (NNR), in accordance with the National Nuclear Regulator Act 1999, (Act 47 of 1999, “the NNRA”). This licence has requirements, and the EMP must also assist in ensuring that these conditions are met.

This section provides a brief overview of the key issues raised in relation to the EIA process, Environmental Authorisation and NNR licensing.

2.3.1 Environmental Impact Assessment

The following environmental impacts of the PBMR DPP were identified as issues for consideration in the Impact Assessment Phase of the EIA. The issues were identified through the public participation processes for both the 302 MW (t) PBMR DPP and the 400 MW (t) PBMR DPP. A description of the key impacts identified during the EIA process is provided below:

(a) Social Impacts

- Impacts related to crime, environmental awareness, health, benefits to communities, transport, quality of life, employment opportunities, perception on risk, communication, job creation and local/regional benefits during construction and operation;
- Expansion of the Koeberg nuclear legacy, land use rights, zoning, spatial planning, emergency zone implications on planning and services, roads and related aspects;
- The visual impact on the surrounding land;
- Noise impacts;
- Security issues, both radiological and non-radiological; and
- Illumination during construction and operation.

(b) Economic Impacts

- Tourism impacts;
- Future economic pathways of the PBMR DPP with respect to potential costs and benefits to the country; and
- Impacts related to decommissioning of the PBMR DPP.
(c) Financial Impacts
- Understanding of the relationship between the various institutions and shareholders that have a stake in the PBMR Company.

(d) Biophysical Impacts
- Potential impacts on the ecology within the marine and terrestrial environment including fauna, flora, surface and ground water and wetlands; and
- Impacts on cultural and historical resources.

(e) Technical Impacts
- Potential risk associated impacts on the PBMR DPP due to a natural marine disaster such as a tsunami and/or seiche; and
- Impact of possible changes in sea level;
- Impact of a change the seismo-tectonic conditions;
- Traffic impacts during construction; and
- Groundwater characteristics and impacts on the sub-region.

(f) Radiological Impacts
- Impacts of radiation emissions from the PBMR DPP on the plant itself and on its surrounding environment;
- Impact of climatic conditions (ambient temperature, rainfall and wind) on the performance of the technology;
- The impact of emergency response requirements on surrounding communities; and
- The impact of various incident scenarios with specific reference to excessive heating of the fuel, carbon fires, aircraft collisions, loss of coolant.

(g) Conventional Waste Impacts
- Impacts from construction and operational waste generated as a result of the PBMR DPP.

A number of other issues were also identified as requiring further investigation, although they are not necessarily possible impacts. These are:

(a) Financial aspects
- Financial investment sources for the proposed PBMR DPP; and
- Financial sources and funding instruments used for the development and future operation of the PBMR DPP.

(b) Radiological Waste Management
- On-site storage of radioactive waste and the national strategy for long term storage thereof;
- Final deposition and management of high level radioactive waste;
- Reprocessing of radioactive waste and the possible unauthorised use of radioactive waste by terrorists;
- Treatment of effluent; and
- Transport to and disposal of nuclear waste at Vaalputs.

(c) Emergency Response
- Adequacy of infrastructure to support (a) the evacuation of the projected 16 km population, (b) communication (c) other requirements of emergency preparedness.

(d) Epidemiology and Site Safety
- Epidemiological studies, creditable failure scenarios, occupational health and safety.

(e) Nuclear energy
- Impact on Eskom’s generation mix, both current and future;

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3 A stationary wave usually caused by strong winds and/or changes in barometric pressure.
• Commercialization and potential import / export impact of the proposed PBMR; and
• International trends and policies related to nuclear.

(f) Legal review
• The legal and other implications of changing from a demonstration plant to a commercial power generation plant;
• Conformance of the PBMR DPP to the NEMA principles;
• International acceptability of the NNR assessment process;
• The mechanisms and structure of the NNR process;
• Legal mandates of authorities involved; and
• Non-proliferation of Nuclear Weapons.

(g) Transportation of fuel supply
• Supply of fuel and transport of nuclear materials

2.3.2 Environmental Authorisation

The culmination of the Environmental Impact Assessment process will be the issuing of an Environmental Authorisation from the National Department of Environmental Affairs and Tourism. In the event that the Authorisation provides the proponent with a positive decision, the EMP will be required to be updated in order to include all of the conditions that the authorisation may require.

2.3.3 Nuclear licensing requirements

Eskom is seeking authorisation for the construction, commissioning, operation and decommissioning of a 400 MW(t) PBMR DPP. It is estimated that for the first seven years after construction of the PBMR DPP, operation of the facility will be primarily based on demonstrating key technical and commercial performance parameters such as construction costs, plant availability and efficiency, operational and maintenance costs and mid-life upgrade requirements. It is envisaged that after seven years of successful demonstration, the PBMR DPP will then be able to operate commercially for the remainder of its 40-year lifespan.

The two main components of the PBMR DPP requiring demonstration are as follows:
• Functional integrity; and
• Commercial performance.

With respect to the commercial performance of the PBMR DPP, the following aspects require demonstration:
• Direct cycle power conversion unit efficiency;
• Helium leakage verification;
• Operational modes and states;
• Reactor unit
• Main power system
• Generator
• Maintenance procedures;
• Plant availability;
• Reliability;
• Plant efficiency and sustainability;
• Operational and maintenance cost; and
• First outage.

PBMR follows an integrated Qualification Programme consisting of testing and evaluation that ensures compliance with functional performance, availability and safety requirements of the DPP. Qualification is performed for the plant functions of Structures, Systems and Components (SSC) with the following classifications:

• Safety Class Class High (SC-H);
• First-of-a-Kind (FOAK) and Equipment with Modified Application (EMA) SSC with Safety Class Medium (SC-M);
• SC-M SSC that will directly influence an SC-H SSC in the event of the SC-M SSC failure.

Qualification is the generation and maintenance of evidence to ensure that a safety classified system and its equipment will operate within design requirements reliably on demand meeting specified safety, performance and availability functional requirements under all operating and postulated accident conditions. The PBMR Qualification process has been tailored from various international nuclear plant test and qualification guidelines. It is managed for each SSC by means of a qualification programme, which is generated by following Systems Engineering process principles. The planned tests and analysis that will be required for the DPP and its systems is managed by means of a Test Evaluation Master Plan (TEMP) and the Qualification Database.

A graded approach ensures that all safety classified and FOAK SSC important to safety are qualified, subjecting all SSC that will be used in the DPP to an uniform test and evaluation process approach. Qualification Requirements, considers the complete functionality of all the SSC for all the plant phases. This programme is referred to as the DPP integrated qualification programme, which is outlined in Figure 6.

The EMP must be updated with any conditions that may be outlined in this license.
Figure 6: PBMR DPP Integrated Qualification Process
2.4 Eskom’s Environmental Management Policies and Commitments

Irrespective of the legal obligations attached to any environmental authorisation, the success of environmental management and mitigation measures strongly relies on the commitment of Eskom and its contractors to ensuring that these are adequately implemented. This section outlines the existing policies and commitments of Eskom.

2.4.1 Vision

The principles of sustainable development (namely, social equity, environmental integrity and economic growth) are expressed within the Eskom vision (Box 1).

Box 1: Eskom Vision

"Together building the powerbase for sustainable growth and development"

Together: One Eskom, unified, working together in partnership with others.
Building: Planning for the future, building South Africa’s economy.
Powerbase: Providing the electricity foundation for positive sustainable development.
Sustainable: Ensuring continued delivery on economic, environmental and social outcomes.
Growth: Empowering South Africa, its people and the economy.
Development: Securing a brighter future for all and integrating the first and second economy.

This vision aligns Eskom with the capacity expansion era and recognises that, given the major role it plays in accelerating growth in the South African economy, Eskom has a responsibility to ensure that sustainable development becomes a reality.

2.4.2 Environmental Management System (EMS)

One of Eskom’s environmental strategies is the development and implementation of an EMS. Linked to this is a requirement for the development and implementation of Environmental Management Programmes (EMProgs) for its projects. In terms of the EMProg guideline (copy included in Annexure A), EMProg’s must be developed and implemented, in terms of the relevant line division EMS, for (1) existing and future Eskom land (site, servitude); and (2) projects for which an EIA or screening was undertaken.

Moreover, Eskom’s environmental land policy requires that all Eskom land be continually managed, through the control of operations and activities that take place on it, to ensure the sustainable utilisation of the asset. It also requires that all Eskom land be managed, operated, and maintained in terms of an established EMProg.

In terms of the requirements of the EMProg guideline, an EMProg would need to be developed for the PBMR DPP as a plan of action that sets out a required environmental end state and outlines how activities that could have a negative impact on the environment will be managed and monitored, and how impacted areas will be rehabilitated.

2.4.3 Annual Report (2006)

The Eskom Director’s Annual Report for 2006 discusses, inter alia, the following related to their Environmental Management System:

“The Eskom occupational hygiene, safety and environmental policy commits the business to the implementation of appropriate management systems to address environment, safety and
occupational hygiene issues to minimise risk and ensure continual improvement. Certification to the ISO 14001 Standard continues to be implemented in Eskom, with the following divisions and subsidiaries now certified:

- Corporate divisions;
- Corporate sustainability;
- Corporate technical audit;
- Transmission division;
- Rotek Engineering (Pty) Limited; and
- Roshcon (Pty) Limited.

Where environmental risks have been identified in other parts of Eskom, self-evaluation audits and management reviews are undertaken to determine whether the environmental management system conforms to planned arrangements and has been implemented and maintained in terms of ISO 14001. As an example, the Generation division maintained compliance with the standard in 2005 through external audits.

Policy principles of Eskom’s occupational hygiene, safety and environmental policy include:

- This policy will apply wherever Eskom operations exist;
- Eskom will ensure that no operating condition, or urgency of service, can justify endangering the life of anyone or causing injury and will strive to prevent illness;
- Eskom will work with selected suppliers, customers and contractors to integrate safety, health and environment issues into their operations; and
- Contractors working under the supervision of Eskom or on Eskom premises will comply with this policy.

Eskom, as a provider of energy and associated services, will:

- Establish appropriate management systems to address environment, safety and occupational health issues to minimise risk and ensure continual improvement. This will include preventing pollution and environmental degradation, where economically viable and sustainable;
- Comply with all legislative and policy requirements and, in the absence of appropriate principles, set standards to meet the objectives of this policy;
- Promote open communication on safety, health and environment issues with employees and other stakeholders;
- Educate, train, motivate and develop employees on occupational health, safety and environment issues;
- Provide and maintain a healthy and safe work environment and protect individuals against risk to occupational health and safety arising out of Eskom’s business; and
- Contribute to sustainable development through efficient resource use, and efficient production, distribution and use of energy.”

In support of these statements, a copy of Eskom’s Safety, Health and Environment (SHE) Policy, signed by the CEO and Directors, has been included as Annexure B.

2.4.4 United Nations Global Compact

The United Nations (UN) Global Compact requests companies to embrace, support and enact nine universal principles in the areas of human rights, labour standards and the environment. Eskom, a signatory to the compact, continues to support the UN Global Compact through its sustainable practices (Table 1). Eskom is committed to aligning itself with international sustainability reporting initiatives.
Table 1: Eskom’s support for the UN Global Compact (www.unglobalcompact.org)

<table>
<thead>
<tr>
<th>UN Global Compact Principle/s</th>
<th>Practical support undertaken by Eskom</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Human Rights</strong></td>
<td></td>
</tr>
<tr>
<td>Principle 1</td>
<td>Eskom is a member of the International Labour Organisation and has programmes including:</td>
</tr>
<tr>
<td></td>
<td>- Employment equity, including gender and disability equity;</td>
</tr>
<tr>
<td></td>
<td>- Electrification;</td>
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<tr>
<td></td>
<td>- BEE; and</td>
</tr>
<tr>
<td></td>
<td>- SMMEs development and training.</td>
</tr>
<tr>
<td>Principle 2</td>
<td>Eskom has incorporated issues surrounding human rights into decision-making, and engaged in extensive public consultation and community involvement through various projects and initiatives such as the electrification programme and assisting in ensuring affordability through energy efficient lighting programmes.</td>
</tr>
<tr>
<td></td>
<td>The procurement practices in Eskom support SMMEs and large black businesses for the supply of goods and services.</td>
</tr>
<tr>
<td></td>
<td>Eskom’s policies and procedures are developed to ensure compliance with South African legislation, including the Constitution, which specifically provides for the protection of human rights.</td>
</tr>
<tr>
<td><strong>Labour Standards</strong></td>
<td></td>
</tr>
<tr>
<td>Principle 3</td>
<td>Eskom practises freedom of association and recognises the right to collective bargaining, as set out in the South African Labour Relations Act.</td>
</tr>
<tr>
<td></td>
<td>The impact of HIV/AIDS is managed through education and awareness programmes, voluntary counselling and testing, and care and support for infected and affected employees. Eskom has taken a corporate leadership and sponsorship role in the research for the development of a vaccine against HIV/AIDS.</td>
</tr>
<tr>
<td></td>
<td>Eskom continues to maintain transparency and worker consultation in decision-making through forums and agreements with employees and unions.</td>
</tr>
<tr>
<td></td>
<td>Eskom supports the involvement of labour at the highest levels of governance.</td>
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<tr>
<td></td>
<td>Employment equity policies have been implemented that are inclusive of race, gender and people with disabilities to ensure that Eskom builds an organisation that is representative of all the people of South Africa.</td>
</tr>
<tr>
<td></td>
<td>Eskom has continued to demonstrate commitment to development and transformation by investing in educating and training workers, both internal and external to Eskom.</td>
</tr>
<tr>
<td></td>
<td>Eskom has an established home ownership and rental subsidy scheme for employees, to enable them to have access to accommodation.</td>
</tr>
<tr>
<td><strong>Environment</strong></td>
<td></td>
</tr>
<tr>
<td>Principle 7</td>
<td>The Board Sustainability Committee addresses economic, environmental and social issues and is responsible for the approval and the presentation of recommendations to the Board regarding policies, strategies and guidelines in particular for safety, health, environment and nuclear issues.</td>
</tr>
<tr>
<td></td>
<td>The Chief Executive is responsible for Eskom’s overall sustainability and environmental performance. Environmental performance measures are integrated into the business units and relevant performance contracts. The overall assessment and measurement of environmental performance is managed through the operational sustainability index and the reporting on additional key environmental indicators and issues to the Sustainability Subcommittee of EXCO.</td>
</tr>
<tr>
<td></td>
<td>Environmental award presentations have been held on an annual basis to reward superior performance in the organisation.</td>
</tr>
<tr>
<td></td>
<td>Continual improvement in environmental performance is achieved through the development and implementation of environmental management systems based on ISO14001. Many parts of Eskom have received ISO14001 certification, while the remainder of the organisation demonstrated compliance through third party audits.</td>
</tr>
<tr>
<td></td>
<td>Research, development and demonstration focuses on supporting sustainable development.</td>
</tr>
</tbody>
</table>
3 ENVIRONMENTAL SPECIFICATIONS

3.1 Overview: Legislation and policy

All construction and operation activities shall observe and obey any relevant environmental legislation, and therefore shall be undertaken in a manner that will minimise impacts on the surrounding environment and society, including adjoining landowners. The Contractor shall absolve the Employer of any and all risk or liability in terms of compliance with all relevant statutory obligations.

The Contractor and Operator shall construct and/or implement all the necessary environmental protection measures in each area before any works can proceed. Works may be suspended at any time in terms of the Conditions of Contract should the Contractor or Operator fail to implement, operate or maintain any of the environmental protection measures adequately.

The following is a summary of the applicable environmental legislation for the establishment of the PBMR DPP and associated infrastructure:

<table>
<thead>
<tr>
<th>APPLICABLE LEGISLATION IN EFFECT AT DATE OF THIS EMP</th>
<th>National Legislation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Constitution of South Africa (Act No. 108 of 1996)</td>
<td></td>
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<tr>
<td>Environment Conservation Act (Act No. 73 of 1989)</td>
<td></td>
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<tr>
<td>National Environmental Management Act (Act No. 107 of 1998)</td>
<td></td>
</tr>
<tr>
<td>National Energy Regulator Act (Act 40 of 2004)</td>
<td></td>
</tr>
<tr>
<td>National Nuclear Regulator Act (Act 47 of 1999)</td>
<td></td>
</tr>
<tr>
<td>Nuclear Energy Act (Act 46 of 1999)</td>
<td></td>
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<tr>
<td>Electricity Generation Act (Act 4 of 2006)</td>
<td></td>
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<tr>
<td>Transportation of Dangerous Goods and Substances (GNR 103 of 2001)</td>
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<tr>
<td>National Road Traffic Act (Act No. 93 of 1996)</td>
<td></td>
</tr>
<tr>
<td>Atmospheric Pollution Prevention Act (Act No. 45 of 1965)</td>
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<tr>
<td>National Water Act (Act No. 36 of 1998)</td>
<td></td>
</tr>
<tr>
<td>Sea-Shore Act, 1935 (Act No. 21 of 1935)</td>
<td></td>
</tr>
<tr>
<td>The Conservation of Agricultural Resources Act, 1983 (Act No. 43 of 1983)</td>
<td></td>
</tr>
<tr>
<td>National Environmental Management: Air Quality act (Act No. 39 of 2004)</td>
<td></td>
</tr>
<tr>
<td>The Maritime Zones Act, 1994 (Act No. 15 of 1994)</td>
<td></td>
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<tr>
<td>Petroleum Pipelines Act (Act No. 60 of 2003)</td>
<td></td>
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<tr>
<td>National Environmental Management: Biodiversity Act (Act No. 10 of 2004)</td>
<td></td>
</tr>
<tr>
<td>National Heritage Resources Act (Act No. 25 of 1999)</td>
<td></td>
</tr>
<tr>
<td>Hazardous Substances Act (Act No. 15 of 1973)</td>
<td></td>
</tr>
<tr>
<td>Non Proliferation of Weapons of Mass Destruction Act, 1993 (Act No. 87 of 1993)</td>
<td></td>
</tr>
<tr>
<td>The National Key Points Act, 1980 (Act No. 102 of 1980)</td>
<td></td>
</tr>
</tbody>
</table>

The detailed discussion of this legislation has been included in the final EIR (refer to Chapter 6 and the Legal Review Annexure).

In addition to the above legislation, a number of policies and strategies in South Africa have relevance to this project (refer to Chapter 6 of the Final EIR). These are summarised below:

- Nuclear Energy Policy and Strategy For the Republic of South Africa (DME, 2007);
• Radioactive Waste Management Policy and Strategy for the Republic of South Africa (DME 2005);
• DEAT-NNR Co-operative Governance Agreement;
• Integrated Energy Plan (IEP) (2003);
• National Integrated Resource Plan;
• Integrated Strategic Electricity Plan (ISEP);
• DME Energy Efficiency Strategy (2005);
• Energy Security Master Plan – Electricity (2007-2025);
• National Response to South Africa’s Electricity Shortage (2008);
• National Nuclear Disaster Management Plan (DME, 2005);
• Nuclear Non-Proliferation Treaty;
• National Spatial Biodiversity Assessment and National Biodiversity Strategy Action Plan (NBSAP);
• Draft National Strategy for Sustainable Development;
• Western Cape Provincial Sustainable Development Implementation Plan (PSDIP);
• Western Cape Provincial Growth and Development Strategy Green Paper; and
• City of Cape Town Metropolitan Municipality Integrated Development Plan (IDP).

3.2 Applicable environmental guidelines and standards

3.2.1 Air Quality

Air quality guidelines and standards are fundamental to effective air quality management, providing the link between the source of atmospheric emissions and the user of that air at the downstream receptor site. The ambient air quality limits are intended to indicate safe daily exposure levels for the majority of the population, including the very young and the elderly, throughout an individual's lifetime. Such limits are given for one or more specific averaging periods, typically 10 minutes, 1-hour average, 24-hour average, 1-month average, and/or annual average.

The ambient air quality guidelines and standards for pollutants relevant to the current project are presented in subsequent subsections. Air quality limits issued nationally by the DEAT and SABS are reflected together with limits published by the WHO, EC, World Bank, UK, Australia and US-EPA.

(a) Suspended Particulate Matter

The impact of particles on human health is largely depended on (i) particle characteristics, particularly particle size and chemical composition, and (ii) the duration, frequency and magnitude of exposure. The potential of particles to be inhaled and deposited in the lung is a function of the aerodynamic characteristics of particles in flow streams. The aerodynamic properties of particles are related to their size, shape and density. The deposition of particles in different regions of the respiratory system depends on their size.

The nasal openings permit very large dust particles to enter the nasal region, along with much finer airborne particulates. Larger particles are deposited in the nasal region by impaction on the hairs of the nose or at the bends of the nasal passages. Smaller particles (PM\(_{10}\)) pass through the nasal region and are deposited in the tracheobronchial and pulmonary regions. Particles are removed by impacting with the wall of the bronchi when they are unable to follow the gaseous streamline flow through subsequent bifurcations of the bronchial tree. As the airflow decreases near the terminal bronchi, the smallest particles are removed by Brownian motion, which pushes them to the alveolar membrane (CEPA/FPAC Working Group, 1998; Dockery and Pope, 1994).
Air quality guidelines for particulates are given for various particle size fractions, including total suspended particulates (TSP), inhalable particulates or PM$_{10}$ (i.e. particulates with an aerodynamic diameter of less than 10 µm), and respirable particulates of PM$_{2.5}$ (i.e. particulates with an aerodynamic diameter of less than 2.5 µm). Although TSP is defined as all particulates with an aerodynamic diameter of less than 100 µm, and effective upper limit of 30 µm aerodynamic diameter is frequently assigned. PM$_{10}$ and PM$_{2.5}$ are of concern due to their health impact potentials. As indicated previously, such fine particles are able to be deposited in, and damaging to, the lower airways and gas-exchanging portions of the lung.

PM$_{10}$ limits and standards issued nationally and abroad are documented in Table 2. In addition to the PM$_{10}$ standards published in schedule 2 of the Air Quality Act, the Act also includes standards for total suspended particulates (TSP), viz. a 24-hour average maximum concentration of 300 µg/m³ not to be exceeded more than three times in one year and an annual average of 100 µg/m³.

**Table 2: Air quality standard for inhalable particulates (PM$_{10}$)**

<table>
<thead>
<tr>
<th>Authority</th>
<th>Maximum 24-hour Concentration (µg/m³)</th>
<th>Annual Average Concentration (µg/m³)</th>
</tr>
</thead>
<tbody>
<tr>
<td>SA standards (Air Quality Act)</td>
<td>180(a)</td>
<td>60</td>
</tr>
<tr>
<td>RSA SANS limits (SANS:1929,2004)</td>
<td>75(b)</td>
<td>40(d)</td>
</tr>
<tr>
<td>Australian standards</td>
<td>50(c)</td>
<td>30(e)</td>
</tr>
<tr>
<td>European Community (EC)</td>
<td>50(f)</td>
<td></td>
</tr>
<tr>
<td>World Bank (General Environmental Guidelines)</td>
<td>70(g)</td>
<td>50(j)</td>
</tr>
<tr>
<td>World Bank (Thermal Power Guidelines)</td>
<td>150(h)</td>
<td>50(k)</td>
</tr>
<tr>
<td>United Kingdom</td>
<td>50(i)</td>
<td>40(m)</td>
</tr>
<tr>
<td>United States EPA</td>
<td>150(n)</td>
<td>50(o)</td>
</tr>
<tr>
<td>World Health Organisation</td>
<td>(p)</td>
<td>(p)</td>
</tr>
</tbody>
</table>

Notes:
(a) Not to be exceeded more than three times in one year.
(b) Limit value. Permissible frequencies of exceedance, margin of tolerance and date by which limit value should be complied with not yet set.
(c) Target value. Permissible frequencies of exceedance and date by which limit value should be complied with not set.
(d) Limit value. Margin of tolerance and date by which limit value should be complied with not yet set.
(e) Target value. Date by which limit value should be complied with not yet set.
(g) EC First Daughter Directive, 1999/30/EC [http://europa.eu.int/comm/environment/air/ambient.html](http://europa.eu.int/comm/environment/air/ambient.html). Compliance by 1 January 2005. Not to be exceeded more than 25 times per calendar year. (By 1 January 2010, no violations of more than 7 times per year will be permitted.)
(k) UK Air Quality Objectives. [www.airquality.co.uk/archive/standards/php](http://www.airquality.co.uk/archive/standards/php). Not to be exceeded more than 35 times per year. Compliance by 31 December 2004
(l) UK Air Quality Objectives. [www.airquality.co.uk/archive/standards/php](http://www.airquality.co.uk/archive/standards/php). Compliance by 31 December 2004
(m) US National Ambient Air Quality Standards [www.epa.gov/air/criteria.html](http://www.epa.gov/air/criteria.html). Not to be exceeded more than once per year.
(o) US National Ambient Air Quality Standards [www.epa.gov/air/criteria.html](http://www.epa.gov/air/criteria.html). To attain this standard, the 3-year average of the weighted annual mean PM10 concentration at each monitor within an area must not exceed 50 µg/m³.
(p) WHO (2000) issues linear dose-response relationships for PM10 concentrations and various health endpoints. No specific guideline given.
(b) Dust Deposition

Foreign dust deposition standards issued by various countries are given in Table 3. It is important to note that the limits given by Argentina, Australia, Canada, Spain and the USA are based on annual average dustfall. The standards given for Germany are given for maximum monthly dustfall and therefore comparable to the dustfall categories issued locally. Based on a comparison of the annual average dustfall standards it is evident that in many cases a threshold of ~200 mg/m²/day to ~300 mg/m²/day is given for residential areas.

Table 3: Dust deposition standards issued by various countries

<table>
<thead>
<tr>
<th>Country</th>
<th>Annual Average Dust Deposition Standards (based on monthly monitoring) (mg/m²/day)</th>
<th>Maximum Monthly Dust Deposition Standards (based on 30 day average) (mg/m²/day)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Argentina</td>
<td>133</td>
<td></td>
</tr>
<tr>
<td>Australia</td>
<td>133 (onset of loss of amenity)</td>
<td>333 (unacceptable in New South Wales)</td>
</tr>
<tr>
<td>Canada</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Alberta</td>
<td>179 (acceptable)</td>
<td></td>
</tr>
<tr>
<td>Manitoba</td>
<td>226 (maximum acceptable)</td>
<td></td>
</tr>
<tr>
<td>Germany</td>
<td></td>
<td>350 (maximum permissible in general areas)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>650 (maximum permissible in industrial areas)</td>
</tr>
<tr>
<td>Spain</td>
<td>200 (acceptable)</td>
<td></td>
</tr>
<tr>
<td>USA:</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Hawaii</td>
<td>200</td>
<td></td>
</tr>
<tr>
<td>Kentucky</td>
<td>175</td>
<td></td>
</tr>
<tr>
<td>New York</td>
<td>200 (urban, 50 percentile of monthly value)</td>
<td>267 (urban, 84 percentile of monthly value)</td>
</tr>
<tr>
<td></td>
<td>300 (urban, 84 percentile of monthly value)</td>
<td>183 (residential areas)</td>
</tr>
<tr>
<td>Pennsylvania</td>
<td>366 (industrial areas)</td>
<td></td>
</tr>
<tr>
<td>Washington</td>
<td>167 (residential areas)</td>
<td>333 (industrial areas)</td>
</tr>
<tr>
<td>Wyoming</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Locally dust deposition is evaluated according to the criteria published by the South African Department of Environmental Affairs and Tourism (DEAT). In terms of these criteria dust deposition is classified as follows:

- SLIGHT: less than 250 mg/m²/day
- MODERATE: 250 to 500 mg/m²/day
- HEAVY: 500 to 1200 mg/m²/day
- VERY HEAVY: more than 1200 mg/m²/day

The Department of Minerals and Energy (DME) uses the 1200 mg/m²/day threshold level as an action level. In the event that on-site dustfall exceeds this threshold, the specific causes of high dustfall should be investigated and remedial steps taken. "Slight" dustfall is barely visible to the naked eye. "Heavy" dustfall indicates a fine layer of dust on a surface, with "very heavy" dustfall being easily visible should a surface not be cleaned for a few days. Dustfall levels of > 2000 mg/m²/day constitute a layer of dust thick enough to allow a person to "write" words in the dust with their fingers.

A perceived weakness of the current dustfall guidelines is that they are purely descriptive, without giving any guidance for action or remediation (SLIGHT, MEDIUM, HEAVY, VERY HEAVY). It has recently been proposed (as part of the SANS air quality standard setting processes) that dustfall rates be evaluated against a four-band scale, as presented in Table 4. Proposed target, action and alert thresholds for ambient dust deposition are given in Table 5.
According to the proposed dustfall limits an enterprise may submit a request to the authorities to operate within the Band 3 ACTION band for a limited period, providing that this is essential in terms of the practical operation of the enterprise (for example the final removal of a tailings deposit) and provided that the best available control technology is applied for the duration. No margin of tolerance will be granted for operations that result in dustfall rates in the Band 4 ALERT.

Table 4: Bands of dustfall rates proposed for adoption

<table>
<thead>
<tr>
<th>BAND NUMBER</th>
<th>BAND DESCRIPTION LABEL</th>
<th>DUST-FALL RATE (D) (mg m⁻² day⁻¹, 30-day average)</th>
<th>COMMENT</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>RESIDENTIAL</td>
<td>D &lt; 600</td>
<td>Permissible for residential and light commercial</td>
</tr>
<tr>
<td>2</td>
<td>INDUSTRIAL</td>
<td>600 &lt; D &lt; 1 200</td>
<td>Permissible for heavy commercial and industrial</td>
</tr>
<tr>
<td>3</td>
<td>ACTION</td>
<td>1 200 &lt; D &lt; 2 400</td>
<td>Requires investigation and remediation if two sequential months lie in this band, or more than three occur in a year.</td>
</tr>
<tr>
<td>4</td>
<td>ALERT</td>
<td>2 400 &lt; D</td>
<td>Immediate action and remediation required following the first exceedance. Incident report to be submitted to relevant authority.</td>
</tr>
</tbody>
</table>

Table 5: Target, action and alert thresholds for ambient dustfall

<table>
<thead>
<tr>
<th>LEVEL</th>
<th>DUST-FALL RATE (D) (mg m⁻² day⁻¹, 30-day average)</th>
<th>AVERAGING PERIOD</th>
<th>PERMITTED FREQUENCY OF EXCEEDANCES</th>
</tr>
</thead>
<tbody>
<tr>
<td>TARGET</td>
<td>300</td>
<td>Annual</td>
<td>Three within any year, no two sequential months.</td>
</tr>
<tr>
<td>ACTION RESIDENTIAL</td>
<td>600</td>
<td>30 days</td>
<td>Three within year, not sequential months.</td>
</tr>
<tr>
<td>ACTION INDUSTRIAL</td>
<td>1 200</td>
<td>30 days</td>
<td>Three within year, not sequential months.</td>
</tr>
<tr>
<td>ALERT THRESHOLD</td>
<td>2 400</td>
<td>30 days</td>
<td>None. First exceedance requires remediation and compulsory report to authorities.</td>
</tr>
</tbody>
</table>

3.2.2 Blasting Regulations and Standards

Wherever blasting activity is required on the site, the Contractor will rigorously adhere to the relevant statutes and regulations that control the use of explosives. These regulations include inter alia the regulations as laid out in the Explosives Regulations, 2002 as published in Government Gazette No. 24272 on 17 January 2003.

3.2.3 Control of vegetation

In terms of Government Notice R1048, the following regulations are applicable with regards to the control of invasive alien vegetation and declared weeds:

- It is illegal to have declared weed species or invasive alien vegetation on one’s property.
- The landowner must immediately take steps to eradicate them by using the methods prescribed in the regulations, namely: uprooting or the application of a suitable chemical weed-killer (herbicide), or any other method of permanent eradication other than burning.
- One may not uproot or remove such plants and dump or discard them elsewhere to re-grow or allow their seeds to be spread or blown onto other properties.
• If the landowner does not comply with requirements above, a person may be found guilty of a criminal offence.

3.2.4 Waste

IAEA (2007) defines radioactive waste as material, whatever its physical form, remaining from practices or interventions for which no further use is foreseen:

• that contains or is contaminated with radioactive substances and has an activity or activity concentration higher than the level of clearance from regulatory requirements; and
• exposure to which is not excluded from the IAEA Basic Safety Standards published in IAEA (1996).

An application for a nuclear installation license requires, amongst others, the development of a Radioactive Waste Management Programme (RWMP). This is consistent with the NNR Basic Licensing Requirements for the Pebble Bed Modular Reactor (NNR, 2007a) and the NNR Guideline for Applying for a Nuclear Authorisation (NNR, 2007b).

Measures pertaining to a RWMP include the need to ensure that the resultant radioactive waste meets the requirements for safe handling, transport, processing, storage, and disposal, as applicable to national regulations, and international requirements and recommendations. More specifically, the RWMP should make provision for (IAEA, 2002):

• keeping the generation of radioactive waste to the minimum practicable, in terms of both activity and volume, by using suitable technology;
• reusing and recycling materials to the extent possible;
• classifying and segregating waste appropriately, and maintaining an accurate inventory for each radioactive waste stream, with account taken of the available options for clearance and disposal;
• collecting, characterizing and storing radioactive waste so that it is acceptably safe;
• providing adequate storage capacity for anticipated radioactive waste arisings;
• ensuring that radioactive waste can be retrieved at the end of the storage period;
• treating and conditioning radioactive waste in a way that is consistent with safe storage and disposal;
• handling and transporting radioactive waste safely;
• controlling effluent discharges to the environment;
• carrying out monitoring for compliance at source and in the environment;
• maintaining facilities and equipment for waste collection, processing and storage in order to ensure safe and reliable operation;
• monitoring the status of the containment for the radioactive waste in the storage location;
• monitoring changes in the characteristics of the radioactive waste, in particular if storage is continued for extended periods, by means of inspection and regular analysis;
• initiating, as necessary, research and development to improve existing methods for processing radioactive waste or to develop new methods, and to ensure that suitable methods are available for the retrieval of stored radioactive waste.

While the national nuclear regulatory framework does not provide specific requirements for the management of radioactive waste, from generation to disposal, it does require the establishment, implementation, and maintenance of a RWMP.

The RWMP for the PBMR DPP is still being compiled and will form part of the SAR submitted to the NNR in support of the application for nuclear authorisation (NNR, 2007b) in terms of the National Nuclear Regulator Act (Act No. 47 of 1999). While the NNR Licensing requirements for the PBMR do not contain specific requirements of what should be included in the RWMP, the RD 0018 licensing agreement (Appendix D) and Radioactive Waste Management Policy
and Strategy for the Republic of South Africa (DME 2005) (Appendix E), provide further specifications to be complied with.

3.2.5 Noise control regulations

In accordance with SANS 10328, the predicted impact that noise emanating from a proposed development would have on surrounding land is assessed by determining whether the rating level, $L_{req,T}$, of the predicted ambient noise would exceed the residual noise or exceed the acceptable rating level of noise on that land as indicated in Table 6 relating this excess to the probable response of a community to the noise as indicated in Table 7.

**Table 6: SANS 10103, Table 2 — Acceptable rating levels for noise in districts**

<table>
<thead>
<tr>
<th>Type of district</th>
<th>Equivalent continuous rating level ($L_{req,T}$) for noise, dBA</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Outdoors</td>
</tr>
<tr>
<td></td>
<td>$L_{R,dn,a}$</td>
</tr>
<tr>
<td>RESIDENTIAL DISTRICTS</td>
<td></td>
</tr>
<tr>
<td>a) Rural districts</td>
<td>45</td>
</tr>
<tr>
<td>b) Suburban districts with little road traffic</td>
<td>50</td>
</tr>
<tr>
<td>c) Urban districts</td>
<td>55</td>
</tr>
<tr>
<td>NON RESIDENTIAL DISTRICTS</td>
<td></td>
</tr>
<tr>
<td>d) Urban districts with some workshops, with business premises, and with main roads</td>
<td>60</td>
</tr>
<tr>
<td>e) Central business districts</td>
<td>65</td>
</tr>
<tr>
<td>f) Industrial districts</td>
<td>70</td>
</tr>
</tbody>
</table>

**NOTE 1** If the measurement or calculation time interval is considerably shorter than the reference time intervals, significant deviations from the values given in the table may result.

**NOTE 2** If the spectrum of the sound contains significant low frequency components, or when an unbalanced spectrum towards the low frequencies is suspected, special precautions should be taken, and specialist attention is required. In this case the indoor sound levels may significantly differ from the values given in columns 5 to 7. See also annex B.

**NOTE 3** Residential buildings, e.g. dormitories, hotel accommodation, residences etc. may only be allowed in non-residential districts on condition that the calculated or anticipated indoor $L_{req,T}$ values given in column 3 of table 1 are not exceeded.
Table 7: SANS 10103, Table 5 — Categories of community/group response

<table>
<thead>
<tr>
<th>Excess $\Delta L_{req,T}$ dBA</th>
<th>Estimated community/group response</th>
<th>Category</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>0 – 10</td>
<td></td>
<td>Little</td>
<td>Sporadic complaints</td>
</tr>
<tr>
<td>5 – 15</td>
<td></td>
<td>Medium</td>
<td>Widespread complaints</td>
</tr>
<tr>
<td>10 – 20</td>
<td></td>
<td>Strong</td>
<td>Threats of community/group action</td>
</tr>
<tr>
<td>&gt;15</td>
<td></td>
<td>Very strong</td>
<td>Vigorous community/group action</td>
</tr>
</tbody>
</table>

1. Calculate $\Delta L_{req,T}$ from the appropriate of the following:
   1) $\Delta L_{req,T} = L_{req,T}$ of ambient noise under investigation MINUS $L_{req,T}$ of the residual noise (determined in the absence of the specific noise under investigation).
   2) $\Delta L_{req,T} = L_{req,T}$ of ambient noise under investigation MINUS the maximum rating level for the ambient noise given in table 1.
   3) $\Delta L_{req,T} = L_{req,T}$ of ambient noise under investigation MINUS the acceptable rating level for the applicable district as determined from table 2.
   4) $\Delta L_{req,T} = $ Expected increase in $L_{req,T}$ of ambient noise in an area because of a proposed development under investigation.

NOTE: Overlapping ranges for the excess values are given because a spread in the community reaction may be anticipated.

SANS 10103 contains the statement that the acceptable rating levels for ambient noise are essentially in line with the recommendations of the World Health Organisation (WHO) for community exposure.

### 3.3 Approach to addressing environmental specifications: EPCM EMPs

Sections 3.1 and 3.2 highlight a wide variety of key legislation, policy and standards that must be incorporated into the construction and operation phases of the PBMR DPP.

Mitigation measures for the project are detailed in section 3.4, however it is important to emphasise that the Contractor and EPCM are the recognized specialists regarding construction techniques and operation practices, respectively. Therefore, Contractors are required to develop EMPs which would cover environmental aspects, impacts and mitigation measures. To ensure alignment between the various contractors, a template is developed and issued to contractors with the environmental specification at the tender phase of the project. The EMPs will be submitted in a written form for approval, covering those activities that are identified (in this document and/or by the Environmental Control Officer (ECO)) as being potentially harmful to the environment.

The EMP must cover applicable details with regard to:

- Construction and/or Operation procedures,
- Materials and equipment to be used,
- Movement of the equipment to and from site,
- How the equipment/ material will be moved while on site,
- How and where material will be stored,
- The containment (or action to be taken if containment is not possible) of leaks or spills of any liquid or material that may occur,
- Timing and location of activities,
- Compliance/ non-compliance with the Specifications, and
- Any other information deemed necessary by the Environmental Control Officer.

There are rigorous requirements in terms of the provision of EMPs and the commencement of the activities they cover:
• Any EMP required by the Environmental Control Officer or the specification must be produced within the timeframes specified by the Environmental Control Officer or the specification (typically two weeks);
• The Contractor/Project Manager may not commence the activity covered by the EMP until it has been approved, except in the case of emergency activities and then only with the consent of the Environmental Control Officer;
• The Environmental Control Officer may require changes to an EMP if the proposal does not comply with the specification or if the proposed methodology carries an unreasonable risk of excessive damage to the environment;
• Approved EMPs must be readily available on the site and must be communicated to all relevant personnel;
• Due to changing circumstances, it may be necessary to modify EMPs. In such cases, the proposed modifications must be indicated and agreed upon in writing between the Environmental Control Officer and Project Manager;
• The Contractor/EPCM is required to carry out the activities covered by the EMP in accordance with the proposed approach; and
• Approval of the EMP does not absolve the Contractor/EPCM from their obligations or responsibilities in terms of the Contract.

The following are typically required EMPs, which will be called for by the Environmental Control Officer:

• Location, layout and preparation of the construction camp and materials storage areas;
• Location, layout and preparation of cement/concrete batching facilities including the methods employed for the mixing of concrete and the management of runoff water from such areas;
• Contaminated water management plan, including the containment of runoff and polluted water;
• Emergency construction plans (including details of methods for fuel spills and clean up operations);
• Rehabilitation of disturbed areas and re-vegetation after construction is complete; and
• Solid waste management and removal of waste from site.

Annexure C provides a template EMP sheet as a guide for the compilation of the PBMR DPP EMPs.

3.4 Mitigation of environmental issues

3.4.1 General: Construction and Operation issues

(a) Legal and other requirements

• Eskom and the Contractor must commit themselves to comply with the relevant provisions of the applicable environmental legislation and associated regulations promulgated in terms of these laws, through all phases of the project.
• The client must enter into agreement with the Local Authority concerning any requirements directed towards protecting the environment. Contractors will be required to respect and comply with such agreements.

(b) Social Interaction

• A Community Liaison Officer/Communications Practitioner from Eskom will deal with community needs and complaints.
• Open liaison channels with nearby residents and Interested and Affected Parties (I&APs) must be developed, to facilitate communication and field concerns or complaints.
• Health and Safety Management Plans should be in place and effectively communicated, including an Emergency Response Plan with mechanisms for communicating potential risk, health and safety information to affected communities as part of pro-active risk communication strategy.
• A comprehensive awareness creation campaign is to include the dissemination of information about energy generation, and nuclear and other technologies.
• The construction camp, if any, must be planned in detail, such that affected parties do not feel threatened by the presence of construction workers.
• Contractors must prevent and prohibit their employees from entering neighbouring land and homes. Movement of construction personnel on site, outside of the demarcated site and construction laydown areas, must be strictly controlled.
• Access to the construction camp must be controlled and gates will be locked after hours and over weekends.
• The Contractor must construct and maintain adequate fencing around the site and ensure that materials used for construction on the site do not blow on or move outside the site and environs, in as far as is reasonably practicable.
• All construction activities must take place within the demarcated footprint. If it is necessary for activities to take place outside of this area, permission must be obtained from the Environmental Control Officer.
• It is common practice for local informal vendors (notably women providing cooked food) to enter construction areas, given the new business opportunity provided by the construction workers. Due to requirements for security, it is believed that the PBMR construction site will not readily lend itself to this practice. Nonetheless the possibility to allow this practice through the allocation of a designated area where vendors could ply their trade, will be considered by Eskom. An additional area for informal trading will be provided on the East side of the R27 at the proposed laydown area.

(c) Labour

• The contractor must employ labour with appropriate qualifications and experience from the surrounding areas, as far as possible.
• Construction time limits must be implemented for noisy construction activities. Surrounding communities must be informed of the timing of such noisy activities.
• Night-time activities must be limited as far as possible, and construction activities must be contained to reasonable hours during the day and early evening. Construction outside working hours must be approved by the Community Liaison Officer/SHE Officer and the affected community must be informed accordingly.
• The Contractor must inform all adjacent landowners of any other activity that could cause a nuisance.
• Restrictions or constraints will be placed on the construction, operation and maintenance staff, including:
  o No indiscriminate disposal of rubbish or rubble;
  o No littering of the servitude and substation areas and the surrounding areas;
  o No collection of firewood;
  o No interference with any wildlife, fauna or flora;
  o No poaching of any description; and
  o No use of facilities other than the toilets provided.

(d) Employment

• The Contractor will give employment preference to residents of the Project Area, and of South Africa, in accordance with approved agreements and procedures.
• Where skilled workmen, artisans and operators are not available locally, they will be employed from non-local sources.
• A labour skills, grading and assessment centre should be established to provide specific and relevant information on the available employment; this will include number and type of jobs, skill requirements for the jobs, duration of the jobs, remuneration scales, hours of work, conditions of work, procedures for the application
of jobs, procedures for selecting job applicants, and training and certification available on the job.

- The Contractor will operate in liaison with the labour centre, and will consider aptitude, health, previous training and expertise.
- No casual job seekers outside the construction site will be selected.
- The Contractor will maintain and submit records of allhirings, including dates of hiring and work commencement, the names and details of the applicants hired.
- An HIV/AIDS programme shall be implemented based on Eskom’s policy and practices.
### 3.4.2 Construction issues

#### 3.4.2.1 Contractor selection and performance

- **Eskom** must ensure that this EMP forms part of any contractual agreements with sub-contractors for the execution of the proposed project.
- The contractor must monitor the performance of the construction team from time to time to ensure compliance with the requirements of this EMP.

**Responsible Individual/s**: Project Manager  
**Frequency**: As new contractors are appointed

#### 3.4.2.2 Site Monitoring, Auditing and Reporting

- Records shall be kept on site in accordance with the standard Eskom site documentation. The documentation shall be signed by all parties to ensure that such documents are legal. The following documentation, at a minimum, shall be kept on site:
  1. Physical access plan;
  2. Complaints register;
  3. Site daily diary;
  4. Records of all remediation / rehabilitation activities;
  5. Copies of two-weekly reports to the Environmental Control Officer;
  6. Copy of the Construction Environmental Management Plan;
  7. Environmental Incident Log;
  8. ECO inspection audit reports; and
  9. The Record of Decision issued for the project

- A radiological environmental surveillance programme shall be implemented by Eskom at least two years prior to fuel on site, in terms of the GOR and RD0018 licensing conditions.
- All records relating to monitoring and auditing shall be made available for inspection to any relevant authority, or Eskom’s Environmental Audit Team, in respect of the development.
- DEAT reserves the right to monitor and audit the development throughout its full life cycle to ensure compliance with the RoD as well as mitigation measures in the final Environmental Impact Report and the this EMP.

**Responsible Individual/s**: Contractor / ECO  
**Method Statement Required**: Continuous

**Responsible Individual/s**: Eskom  
**Method Statement Required**: As necessary
3.4.2.3 Environmental Induction Training

- An initial environmental awareness training session is required prior to any work commencing.
- The contractor shall ensure that all site staff are aware of, and understand the contents and conditions of the EMP, the key environmental issues and the consequences of non-compliance. All site staff shall therefore attend induction training on the EMP and a record must be kept of all attendees.
- The EPCM will provide an environmental module for induction training to any new employees coming onto site, to his subcontractors, causal labourers and to his suppliers.
- Induction training shall be undertaken in a language that is understood by site staff and must include at least the following topics:
  - Key potential or actual environmental construction related impacts on site and related environmental precautions, which need to be taken to avoid or mitigate these impacts,
  - Key mitigation measures to be implemented during construction activities;
  - Emergency responses to issues on site;
  - Roles and responsibilities of all staff on site; and
  - The benefits of achieving conformance with, and consequences of transgressions of environmental specifications or requirements of the EMP.
- The ECO will ensure compliance with ISO 14001, EMS, and EMP conditions.

<table>
<thead>
<tr>
<th>ECO</th>
<th>When new staff are contracted</th>
</tr>
</thead>
<tbody>
<tr>
<td>Contractor</td>
<td>As necessary</td>
</tr>
<tr>
<td>Contractor / ECO</td>
<td>As necessary</td>
</tr>
<tr>
<td>Contractor</td>
<td>As necessary</td>
</tr>
</tbody>
</table>

3.4.2.4 Safety and security

- Clearly mark dangerous areas and restrict access to these areas.
- Erection of scaffolding must be undertaken by a competent practitioner/certified scaffolding erector.
- The workers’ right to refuse to work in unsafe conditions must be respected.
- Ensure compliance with the Occupational Health and Safety Act (No 85 of 1993).
- Ensure that no person under the influence of alcohol or narcotic substances is permitted to work on the site.
- Ensure adequate safety signage is provided along the major roads and at the entrance of the construction site.
- All symbolic safety signage shall conform to the requirements SANS 1186 – Symbolic Safety Signs.
- In terms of construction worker safety, safety management plans must be implemented.

<table>
<thead>
<tr>
<th>CM / Contractor</th>
<th>Continuous</th>
</tr>
</thead>
<tbody>
<tr>
<td>ECO &amp; EPCM</td>
<td>As necessary</td>
</tr>
</tbody>
</table>
• Community safety & community safety concerns are to be addressed by the Contractor.
• Staff shall wear the necessary personal protective equipment at all times while working. No one must be allowed on site unless wearing appropriate safety equipment.
• First Aid facilities must be on hand at all times in accordance with international practice.
• The Contractor’s name or logo must be clearly visible on the overall along with the name of the person and their designation.
• Identity tags complete with a photograph must be issued to all individuals that are to be present on site for more than 3 consecutive calendar days.
• Casual visitors must be required to sign a register at the security checkpoint and must be issued with a visitor’s permit. A responsible person must endorse this permit before leaving the security area.
• Eskom should work closely with the local police department in order to ensure that there is sufficient policing in the area during the construction phase.
• If required, food preparation must only be done in areas assessed and accepted by the ECO.
• Eskom to issue the contractor a construction Health and Safety Specification and the contractor will develop a Health and Safety Plan. A site operating Security Management procedure will be in place for the entire life-span of the plant, beginning from the construction phase.

Contractor
CM / Contractor
CM / Contractor
CM / Contractor
CM / Contractor
CM / Contractor

Eskom
ECO
Eskom / CM
### 3.4.2.5 Access to Site

- The site and associated infrastructure and equipment shall be off-limits to the public.
- All construction vehicles using public roads shall be in a roadworthy condition.
- Vehicle speeds shall not exceed 40km/h along untarred roads. When traversing unconsolidated and non-vegetated areas, the speed limit shall be reduced to 20km/hr. Where required, speed limits shall be indicated on the roads.
- Access routes shall be planned in conjunction with the Contractor, Eskom and Landowners. All agreements reached shall be documented in writing and no verbal agreements should be made.
- Where in the opinion of the CM and/or PM, in conjunction with the MRSLN Environmental Coordinator inordinate and irreparable damage would result from the development of access roads, the Contractor shall use alternative construction methods compatible with the access and terrain, as agreed with the PM.
- Exceptionally heavy loads should be transported on weekdays during non-peak periods on the northern sections of the R27 from 06:00 to 10:00 and 11:00 to 18:00 and from 08:00 to 16:00 on the southern sections.
- A site-access operating procedure for accessing the plant during the construction phase will be in place.
- All access to the DPP site shall be from the Owner Controlled Area (OCA) access point off the R27 (Wets Coast Road) and no access will be allowed through the Duynefontein residential road.

### 3.4.2.6 Demarcation of the Site

- Construction site (the laydown area on the east of the R27) shall be fenced and working areas secured before construction can proceed.
- “No-go” areas shall be demarcated by fences consistent with National Key Point requirements, and personnel and equipment shall not be permitted within these areas.
- An area of the laydown and construction sites shall be dedicated to the storage of materials and plant equipment.

<table>
<thead>
<tr>
<th></th>
<th>Contractor</th>
<th>Continuous</th>
</tr>
</thead>
<tbody>
<tr>
<td>CM</td>
<td>As necessary</td>
<td></td>
</tr>
<tr>
<td>PM</td>
<td>Prior to construction</td>
<td>Yes</td>
</tr>
<tr>
<td>ECO</td>
<td>As necessary</td>
<td></td>
</tr>
<tr>
<td>Contractor</td>
<td>Continuous</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th></th>
<th>Contractor</th>
<th>Continuous</th>
</tr>
</thead>
<tbody>
<tr>
<td>CM</td>
<td>Prior to construction</td>
<td>Yes</td>
</tr>
<tr>
<td>ECO</td>
<td>Continuous</td>
<td></td>
</tr>
<tr>
<td>Contractor</td>
<td>Continuous</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th></th>
<th>Contractor</th>
<th>Once off</th>
</tr>
</thead>
<tbody>
<tr>
<td>CM</td>
<td>Continuous</td>
<td></td>
</tr>
<tr>
<td>ECO</td>
<td>Once off</td>
<td></td>
</tr>
<tr>
<td>Contractor</td>
<td>Once off</td>
<td></td>
</tr>
</tbody>
</table>
3.4.2.7 Planning and Site Preparation

- All work must be undertaken in an environmentally sensitive manner.
- A precautionary approach must be adopted with any works deviating from specifications being approved by both the EPCM and ECO.
- Laydown and construction site establishment including proposed layout and location must be approved prior to commencement of construction. A method statement shall be supplied by the contactor for campsite establishment and shall be approved by the ECO.
- The footprint of the campsite and access roads shall be kept to a minimum to ensure the least environmental impacts.
- The laydown and construction sites are to be located a minimum horizontal distance of 200m from any watercourse or above the 1:50 year floodline.
- Operation of heavy machinery and construction equipment known to produce high noise levels shall be limited. Silent compressors shall be used. Noise generated by employees shouting or whistling shall also be limited.
- Appropriate safety and precaution signs shall be erected prior to the start of construction.
- During early works chemical toilets may be used until such time that fence is up and ablution facilities can be erected.
- The Contractor shall supply a wastewater management system that will comply with legal requirements. The ECO and Eskom shall approve this.
- Storm water control berms (trench and/or earth barriers) shall be constructed to divert rainwater around the laydown and construction sites and to contain any dirty water running from the campsite.
- No site preparation shall occur prior to the approval of an Integrated Storm Water Management Plan (ISWMP) for the main site and laydown area.

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3.4.2.8 Visual

- The construction of temporary sack-cloth screens during construction around related working areas and laydown areas, the large laydown area on the R27, in particular.
- The use of a light grey for the large structures including the stack (chimney).
- The design of lighting of the structures and areas to be done by a suitably experienced person with the objective to reduce “light spill” (i.e. down lighting, lighting colour, extent of necessary illumination, light fitting to direct the light and block light from sensitive adjacent land uses such as residential areas).

| Contractor | Continuous | Yes |
### 3.4.2.9 Site Clearance

- Removal of any vegetation shall be avoided until such time as soil stripping is required, and similarly exposed surfaces shall be re-vegetated or stabilised as soon as is practically possible.
- All earthworks and excavations shall be undertaken in such a manner so as to minimise the extent of impacts caused by such activities.
- Disturbance of vegetation shall be limited to areas of construction, and the size of areas subjected to land clearance will be kept to a minimum.
- Where species will be lost to development, a search and rescue operation will be carried out for those species deemed important (rare or of use) and which can be translocated into the Koeberg Nature Reserve. Prime focus should be placed upon the dune thicket/sand plain fynbos transition, sand plain fynbos, and any wetland.
- The removal or picking of any protected or unprotected plants shall not be permitted and no horticultural specimens (even within the demarcated working area) shall be removed, damaged or tampered with unless agreed by the ECO.
- The Contractor shall not deface, paint, damage or mark any natural features (e.g. rock formations) situated in or around the Site for survey or other purposes unless agreed beforehand.
- Where applicable, the topsoil (i.e. the top 30-50 cm of soil) shall be stockpiled in a suitable place in order to be replaced on top of the exposed subsoil during rehabilitation.
- Soil stockpiles shall not exceed 10 metres in height.
- Erosion damage to soil stockpiles shall be prevented with soil conservation works such as deflection berms etc.
- Topsoil stockpiles older than 6 months should be upgraded/enriched before use to ensure the effectiveness of the topsoil.
- After completion of construction, the site should be properly cleared of all excavated material (rocks, excess soil etc.) and construction rubble, waste, litter etc. and properly rehabilitated/revegetated.

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### 3.4.2.10 Fauna Protection

- It is illegal to interfere with any wildlife or other fauna. All fauna occurring on-site shall be protected. Hunting and snaring shall not be permitted.
- The construction site and laydown areas shall be fenced off to prevent wildlife from entering the site, and no domestic animals are to be brought on-site.

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Contractor / ECO
### 3.4.2.11 Ablution Facilities

- Abluting anywhere other than in the toilets shall not be permitted.
- Toilets shall be secured to prevent them from blowing over.
- A service provider shall be appointed and shall empty toilets regularly. The number of toilets provided shall be based on a minimum ratio of 30 people to one toilet.
- Suitable toilets will be provided for the staff at strategic points at which workmen that are carrying out duties under the contract will be able to easily access.
- Chemicals and waste from toilet cleaning operations shall not be spilled on the ground at any time.

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### 3.4.2.12 Effluent and Storm Water Management

- Storm water shall be effectively captured and led well away from all structures.
- No mechanical plant or equipment shall be washed on site, unless in an area equipped for such a purpose.
- Pollutants such as cement, concrete, lime, chemicals and fuels shall not be discharged into any water source.
- Water from ablation facilities and the Contractor’s camp shall be discharged into a sewer, or where such sewer is not available into a conservancy tank for removal from the site.
- Where dewatering is required, pumps shall be placed over a drip tray in order to contain fuel spills and leaks. The Contractor shall take all reasonable precautions to prevent spillage during the refuelling of these pumps. The Contractor shall ensure that none of the water pumped during any dewatering activities, is released into the environment without approval.
- A Stormwater Management Plan must be compiled for the PBMR DPP facility.

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### 3.4.2.13 Erosion and Sedimentation Control

- Areas susceptible to erosion shall be protected by installing temporary and permanent drainage works.
- Stabilise and manage cleared areas to prevent and control erosion. The method of stabilisation shall be determined in consultation with the ECO / CM.
- Storm water management plan should outline measures to be implemented to protect the construction site from erosion by stormwater.
- Impact on dune and wetland areas of the site managed to prevent degradation and/or siltation.

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**ESKOM PBMR DPP EIA**

Environmental Management Plan

3-18  Version 1.0 / September 2008
### 3.4.2.14 Waste management

- An on-site waste management plan to prevent the spread of refuse within and beyond the site shall be developed and implemented.
- Sufficient bins with secure lids for domestic waste disposal purposes shall be provided. These bins must be emptied regularly.
- Skips will be provided for disposal of concrete waste, steel and wood. These skips will be emptied regularly. Where possible, construction wastes on site must be reused or recycled.
- A daily clean-up of the site must be instituted.
- No waste shall be buried or burned on site. All solid waste collected on site shall be disposed of off site at an appropriate permitted landfill site. Where a permitted landfill site is not available in proximity to the construction site, the Contractor must provide a method statement with regard to waste management.
- Disposal of waste must be in accordance with relevant legislative requirements.
- The Contractor shall collect all litter and dispose thereof in terms of the approved waste management plan.
- Refuse generated from the construction area, storage area or any other area shall be collected and placed in skips and bins on a daily basis.
- A skip, with a cover, shall be used to contain refuse from campsite bins, rubble and other construction material.
- Once full and on a regular basis, the contents of the skip shall be disposed of at a licensed commercial facility.
- Material that may harm humans or animals shall not be left on site.
- The piling of any material that could rot and release unpleasant smells into the air shall not be permitted.
- Surplus concrete may not be dumped indiscriminately on site, but shall be disposed of at a licensed landfill site, or in designated areas agreed by the ECO.
- Concrete trucks shall not be washed on site after depositing concrete into foundations. Any spilled concrete shall be cleaned up immediately.
- All hazardous substances at the site shall be adequately stored and accurately identified, recorded and labelled. All waste hazardous substances shall be disposed of at an appropriate licensed disposal site.

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### 3.4.2.15 Air Quality

- A waste/dust control plan should be produced that includes as a minimum the following best practice procedures, to reduce impact on air quality:
  - Identify the waste types that are likely to be produced.
  - Do not burn waste but plan another means for disposal.
  - Reduce the amount of waste by ensuring that there are adequate and controlled storage areas.
  - Control access to storage to minimise risk of theft or damage.
  - Store any materials away from sensitive areas.
- The production of dust from areas cleared of vegetation and soil stockpiles shall be avoided. Stockpiles shall be located in areas where they are exposed to the minimum erosive effects of wind. Untarred roads will be sprayed with water from a water cart to limit dust generation by construction vehicles. Where spraying of water on roads is not adequate for dust control, environmentally benign binding agents will be used to limit dust generation.
- Excavation, handling and transport of erodable materials must be undertaken using appropriate mitigation measures for high wind conditions.
- All machinery and equipment to be used on site shall be properly serviced and in good working order to avoid excessive smoke and exhaust fumes.

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### 3.4.2.16 Archaeology / Heritage

- If any heritage/archaeological sites/objects not mentioned in the Heritage Specialist Study are discovered during the construction or operational processes, the ECO or other relevant person on site should note the location of the sites/objects and ensure that such sites/objects are not disturbed/destroyed. The South African Heritage Resources Association (SAHRA) must be contacted immediately.
- Any sites identified by specialists as having heritage significance shall be demarcated with wire fencing with a radius of at least 30m. Construction teams shall not be allowed access to these sites.
- Where possible, no construction activities shall be allowed within 50m of all identified archaeological sites.
- The collection of heritage/archaeological objects/artifacts at identified sites shall not be allowed.
- Any destruction of a site can only be allowed once a permit is obtained from SAHRA and the site has been mapped and noted. Permits shall be obtained from the SAHRA should the proposed construction of the PBMR affect, destroy or alter any heritage sites.

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### 3.4.2.17 Wet Areas / Wetlands

- Vehicular traffic shall not be allowed in permanently wet areas.
- No damage shall be caused to wet areas and an appropriately shaped and planted buffer (of at least 80m, or 50m if an approved ISWMP is in place) will be developed for wetland areas on the site, except where these wet areas are to form part of the ISWMP as agreed with the freshwater ecology and applicable authorities.
- No excess groundwater will be pumped into the wetlands.
- Wet areas will be monitored for adverse effects of construction activities.
- Measures to limit the extent of drawdown of the water table to the area in the immediate vicinity of the PBMR DPP construction site, and to prevent drawdown (and subsequent saline intrusion) affecting the seasonal wetlands to the south need to be developed. It is recommended that the proposed cut-off wall should be used in preference open excavation which would require significant dewatering. The cut-off wall would need to be lined with a material that assists to prevent drawdown of the water table beyond this point.
- Provision should be made for active removal of invasive terrestrial plant species from wetlands that are temporarily affected by unnatural lowering of the water table.
- The storm water management plan, including infrastructure required for each phase of the project, should be implemented prior to any earthworks commencing. Infrastructure should be able to cater for a 1:50 year flood event. The final ISWMP will set the requirements in this regards.
- Any work or access near or in a permanent drainage system may have implications in terms of the National Water Act 1998 (Act No. 36 of 1998), and therefore may well require the application of a Water Use License. Therefore, the contractor must in consultation with the ECO, assess all areas of construction well in advance in order to ensure the relevant Water Use License is applied for where required.

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### 3.4.2.18 Vegetation removal

- The removal or picking of any protected or unprotected indigenous plants shall not permitted.
- The establishment and regrowth of alien vegetation shall be controlled after the removal of grass.
- All declared aliens shall be identified and managed in accordance with the Conservation of Agricultural Resources Act, 1983 (Act No 43 of 1983).

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### 3.4.2.19 Landscaping, stabilisation and soil stockpiling

- Exposed and/or destabilised areas should be landscaped to blend in with the surrounding area.
- Erosion of rehabilitated areas shall be prevented.
- Cement, building sand, topsoil and subsoil must also be stockpiled separately in their designated areas.
- Overburden will be taken off site to a recognised spoil area.

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### 3.4.2.20 Re-vegetation

- Areas where soils have been compacted shall be rehabilitated once construction is completed.
- Exposed areas with slopes less than 1:3 should be rehabilitated with a grass mix that blends in with the surrounding vegetation.
- Re-vegetated areas showing inadequate surface coverage (less than 30% coverage, 8 months after re-vegetation) should be prepared and re-vegetated from scratch. Damage to re-vegetated areas should be repaired promptly.
- Exotic weeds and invaders that might establish on the re-vegetated areas shall be controlled to allow the indigenous vegetation to properly establish.
- Weed control methods should be confirmed with the PM to prevent any undesirable secondary impacts.

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### 3.4.2.21 Infrastructure

- Where pipelines are found within the construction area, the depth of the pipes under the surface shall be determined to ensure that proper protection is afforded to such structures.
- All pipelines shall be clearly marked and protected.
- Any damage to pipelines shall be repaired immediately.
- Parameters are to be used as design input for determining the Safe Shutdown Earthquake Ground Motion (SSEGM) while the site is active as well the regulatory period after its decommissioning.
- Facility is designed to withstand the maximum expected Peak Ground Acceleration (PGA) and earthquake magnitude.
- Foundations of the facility to be sunk into solid bedrock, where possible.

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### 3.4.2.22 Batching Plants

- Concrete shall not be mixed directly on the ground.
- The concrete batching activity shall be located in an area of low environmental sensitivity. The site for the batch plant shall be indicated on the site layout plan.
- All wastewater resulting from batching of concrete shall be disposed of via the wastewater management system.
- Bags of cement shall be stored in an area protected from the weather.
- The use of local water for concrete shall first be negotiated with the appropriate authorities. Such water is to be analysed and accepted by the Project Manager before use.
- Upon completion of works, the ground of the batching plant area shall be rehabilitated and the site cleaned and left as it was found and to the satisfaction of the CM and landowner.

| Contractor / ECO | Continuous |
| Contractor / ECO | Once-off |
| Contractor | Continuous |
| Contractor | Continuous |
| Contractor / PM / ECO | Prior to batching |
| Contractor | Upon completion |

Yes
### 3.4.2.23 Materials Use, Handling, Storage and Transport (Cement, Fuel [Petrol, Diesel] and Oils)

- Procedures for material handling shall be discussed with and approved by the ECO.
- Relevant national, regional and local legislation regarding the transport, use and disposal of hazardous waste must be adhered to at all times.
- An emergency procedure to deal with accidents and incidents (e.g. spills) arising from hazardous substances shall be compiled and implemented.
- All mechanical equipment used in construction activities shall be clean and free of oil, petrol, and diesel leaks.
- Vehicle or machinery shall only be refuelled at a purposely designed and designated refuelling area on site.
- Spills of hazardous substances, in excess of 10 litres shall be reported to the ECO immediately and the appointed Eskom Environmental Advisor. A register for spills and incidents involving hazardous materials shall be maintained.
- Soil or yard stone, which has been contaminated, shall be removed and disposed of at an approved waste disposal site. Alternatively, contaminated soil can be treated on site through bioremediation. Should a person experienced in bioremediation not be available on site, a specialist contractor shall be used.
- Such spills shall be cleaned and remediated to the satisfaction of the ECO. A method statement is required from the Contractor that details the procedure to be followed in dealing with leaks or spills.
- A complete emergency spill kit shall be available on site at all times. The Contractor shall also ensure that relevant staff members are trained to use the emergency spill kit and on the manner in which to deal with spills of hazardous substances (oils, diesel or petrol).
A concrete platform with a bund wall shall be allocated to accommodate fuel, oil paint, bitumen, herbicide and insecticides to guard against infiltration of hazardous substances into the soil. Fuel tanks shall be bunded to hold 110% of the contents of the tank. The tanks shall be housed in a roofed area so that no water will collect within the bund wall.

All staff handling hazardous waste shall be trained accordingly.

All necessary approvals with respect to fuel storage and dispensing shall be obtained from the appropriate authorities.

Areas of fuels storage and other flammable materials shall comply with standard fire safety regulations and will require the approval of the Site Supervisor and the Municipal Fire Prevention Officer.

No smoking shall be allowed in the vicinity of the stores and adequate fire-fighting equipment shall be accessible at fuel storage area and areas in the vicinity of the storage area. NO smoking” and “Danger” signs shall be erected at hazardous substance storage areas.

All empty and externally dirty tanks shall be sealed and stored on an area where the ground has been protected.

Construction related vehicles use is limited to off-peak periods only, or must make use of designed lay-by areas along the route to allow traffic past.

Vehicles transporting materials such as sand, rock and pipes off the main site shall be covered to prevent their contents falling or blowing off, causing traffic hazards.

### 3.4.2.24 Servicing of vehicles

Only emergency repairs shall be allowed on site and a drip tray shall be used to prevent oil spills.

All vehicles shall be serviced in the designated area inside the Contractors camp.

In the event of a breakdown in the on site, any oil spills shall be cleaned up and the following shall apply:

- All contaminated soil shall be removed and be placed in containers.
- Contaminated soil can be taken to one central point at the Contractors campsite where bio-remediation can be done.
- Smaller spills can be treated on site.
- A specialist contractor shall be used for the bio-remediation of contaminated soil.
- The area around the fuel storage drum at the Contractor’s campsite shall also be re-remediated upon completion of the contract.
- All oil spills shall be reported to the ECO and Site Supervisor.
### 3.4.2.25 Fire Prevention

- No open fires shall not be allowed on site under any circumstance (The Forest Act, No 122 of 1984). The use of open fires for cooking of food etc. by construction and maintenance personnel shall be strictly prohibited.
- Accidental fires shall be prevented through proper sensitisation of the contractors and their workers towards the associated risks, dangers and damage of property.
- The Contractor shall have fire-fighting equipment for each construction team readily available on site, especially during the winter months. The fire fighting equipment shall be regularly checked and shall be approved by the ECO.
- An emergency preparedness plan should be in place in order to fight accidental veld fires should they occur. The adjacent land owners/users/managers should also be informed and/or involved.
- Use of branches of trees and shrubs for fire making purposes shall be strictly prohibited. Penalties for the unnecessary removal and/or destruction of any plant for any reason (firewood, medicinal use, collector’s value etc) shall be agreed upon beforehand and be included in the contract.
- In situations where fire breaks (temporary or permanent) are constructed to prevent accidental fires spreading from the site, as well as fires entering the site from adjacent land, these shall be constructed in accordance with the Veld and Forest Fires Act and in direct consultation and approval from Koeberg.

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<td>Contractor / ECO</td>
<td>Continuous</td>
<td></td>
</tr>
<tr>
<td>Contractor / ECO</td>
<td>Continuous</td>
<td></td>
</tr>
<tr>
<td>Contractor</td>
<td>Continuous</td>
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</tr>
<tr>
<td>Contractor / ECO</td>
<td>Prior to construction</td>
<td></td>
</tr>
<tr>
<td>Contractor / ECO</td>
<td>As necessary</td>
<td></td>
</tr>
</tbody>
</table>

### 3.4.2.26 Additional infrastructure (Power lines and road modifications)

- Plan the placing of transmission towers so as to avoid impacts on wetlands.
- Place specially designed markers (e.g., bird “flappers”) on the power lines to improve their visibility. Markers to be placed along the entire length of that part of the lines which runs roughly north-south. Monitor the area beneath the power lines for dead birds to determine whether fatal collisions are occurring, and improve visibility further, if necessary.
- Confine all construction and disturbance to a minimum area. Let the road diversion follow, as far as possible, the route of an existing fire break, so as to minimize disturbance to natural habitats.
- The construction of a temporary slipway for heavy loads will be on the western side of the Modder River bridge, leaving the eastern side undisturbed.
- Do not dump building material such as laterite, anywhere within, or near, the course of the Modder River, as this will degrade wetland habitats and encourage the spread of alien invasive vegetation.
- Leave only natural substrates on the surface after rehabilitation of affected areas

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</table>
### 3.4.2.27 Emergency Procedures

- Emergency procedures shall be set up prior to the commencement of work. It shall include but not be limited to fires, spills, and contamination of ground and surface water, accidents to employees and damage to services.
- Construction staff for the PBMR DPP will impact on the transient population numbers especially in the 0 – 5km and 0 – 20km concentric sector around the Station. This must be communicated to the Koeberg Nuclear Power Station so that the additional population can be incorporated into their Emergency Response Plan and communicated with the relevant players (e.g. emergency teams and liaison committees).
- Key staff shall be trained in emergency response and all staff made aware of the emergency procedures.
- A register of all environment-related incidents, accidents, etc. must be maintained, which includes the action taken after the event has occurred. The ECO must be informed of the event.
- The site and all operations shall comply with all Occupational Health and Safety Standards and other relevant national, regional and local regulations.
- The Contractor is liable for any expenses incurred by any organisations called to assist with fighting fires and any cost relating to the rehabilitation of burnt areas/and/or properties and persons should the fire be the cause of the Contractor’s activities on site.

<table>
<thead>
<tr>
<th>Schedule</th>
<th>Responsible Party</th>
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<tbody>
<tr>
<td>Once-off</td>
<td>Contractor / ECO</td>
</tr>
<tr>
<td>As necessary</td>
<td>Contractor</td>
</tr>
<tr>
<td>Continuous</td>
<td>Contractor / ECO</td>
</tr>
<tr>
<td>Continuous</td>
<td>Contractor</td>
</tr>
<tr>
<td>As necessary</td>
<td>Contractor</td>
</tr>
<tr>
<td>As necessary</td>
<td>Contractor</td>
</tr>
</tbody>
</table>

### 3.4.2.28 Water consumption

- Create awareness and encourage the construction workforce to use water sparingly such that there is no water wastage.
- Ensure that no natural water sources (i.e. streams, rivers) are used for construction activities or for domestic purposes by the construction workforce.
- Negotiate the use of water for any purpose with the appropriate authorities and obtain written approval.
- The contractor will not make use of/collect water from any other source than those pointed out to them as suitable for use.

<table>
<thead>
<tr>
<th>Schedule</th>
<th>Responsible Party</th>
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<tbody>
<tr>
<td>Continuous</td>
<td>Contractor / ECO</td>
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<tr>
<td>Continuous</td>
<td>Contractor</td>
</tr>
<tr>
<td>Continuous</td>
<td>Contractor / ECO</td>
</tr>
<tr>
<td>Continuous</td>
<td>Contractor</td>
</tr>
</tbody>
</table>
### 3.4.2.29 Water quality

- Provision shall be made for the drilling and construction of boreholes for monitoring before construction of the facility commence. The locality of the boreholes will be determined by the site-specific geological and geohydrological information.
- Provision for at least six monitoring boreholes shall be made. At least three boreholes shall be placed upstream and three downstream. Two are to be drilled on the centre line (in the direction of groundwater flow) of the structure, the remaining boreholes are to be located adjacent to the structure but far enough to detect and monitor the pluming effect of any contamination.
- Care must be taken when drilling monitoring holes that no contamination of the primary aquifer occurs. Therefore boreholes drilled into the secondary aquifer should be sealed off, as leakage into the primary aquifer can cause flow and alter flow patterns in the primary aquifer.
- The water level in the monitoring boreholes should be recorded weekly for at least one full hydrological cycle to establish the impact of the rainy and dry seasons on the water level.
- Water sampling should be taken monthly for quality and stable isotopes. Tritium level in the monitoring boreholes as baseline data is absolutely vital and only need to be sampled annually.
- At least one rainwater sample per season should be collected for environmental isotope analysis to serve as background value. Combined samples of a period of rainfall will be preferable. This should be taken in consultation with the isotopes laboratory.

### 3.4.2.30 Noise control

- Noise control measures must be implemented. All noise levels must be controlled at the source, and noise from vehicles and on-site powered machinery and equipment will not exceed the manufacturer's specifications, based on the installation of noise attenuation measures.
- The Contractor will respond timeously in the event of any complaints by local residents or others about disturbing noise. An explanation of the noise and why the activity must be done should be provided, as well as information on when the noise will stop.
- If possible, large buildings of the proposed plant such as the turbine/generator building should be located in line with the primary existing noise sources, namely the oil coolers. Oil coolers and other potential sources of noise should be placed on the northern side of the new turbine/generator building.
### 3.4.3 Operational issues

**3.4.3.1 Compliance with legislation, policies and procedures**

- All legislation, policies and procedures applicable to the development must be strictly enforced.
- The operation, maintenance and management of the PBMR demonstration module activities will be undertaken in terms of general operating rules (GOR) to ensure the plant is operated in accordance with its safety design basis and in terms of the nuclear licensing requirements. The GOR prescribe the interface between the PBMR plant design and the actual operating practices. They establish a series of plant-specific rules of operation, compliance with which provides assurance that in any operating state – normal or abnormal – the plant stays within the envelope of its design bases.
- Eskom will need to ensure that similar physical security to the Koeberg Nuclear Power Station is enforced for the PBMR DPP.

<table>
<thead>
<tr>
<th>Management Action</th>
<th>Responsible Party</th>
<th>Frequency</th>
<th>Method Statement Required</th>
</tr>
</thead>
<tbody>
<tr>
<td>All legislation, policies and procedures applicable to the development must be strictly enforced.</td>
<td>RE</td>
<td>Continuous</td>
<td>Continuous</td>
</tr>
<tr>
<td>The operation, maintenance and management of the PBMR demonstration module activities will be undertaken in terms of general operating rules (GOR) to ensure the plant is operated in accordance with its safety design basis and in terms of the nuclear licensing requirements.</td>
<td>RE</td>
<td>Continuous</td>
<td>Continuous</td>
</tr>
<tr>
<td>Eskom will need to ensure that similar physical security to the Koeberg Nuclear Power Station is enforced for the PBMR DPP.</td>
<td>RE</td>
<td>Continuous</td>
<td>Continuous</td>
</tr>
</tbody>
</table>

**3.4.3.2 Site Monitoring, Auditing and Reporting**

- All records relating to monitoring and auditing shall be made available for inspection to any relevant authority, or Eskom’s Environmental Audit Team (EAT) (lead by the appointed Environmental Advisor), in respect of the PBMR plant.
- DEAT reserves the right to monitor and audit the development throughout its full life cycle to ensure compliance with the RoD as well as mitigation measures in the final scoping report and the OEMP.
- The planned groundwater, air quality/dust and noise monitoring programme results should be used to inform management decisions on site.

<table>
<thead>
<tr>
<th>Management Action</th>
<th>Responsible Party</th>
<th>Frequency</th>
<th>Method Statement Required</th>
</tr>
</thead>
<tbody>
<tr>
<td>All records relating to monitoring and auditing shall be made available for inspection to any relevant authority, or Eskom’s Environmental Audit Team (EAT) (lead by the appointed Environmental Advisor), in respect of the PBMR plant.</td>
<td>PM / RE</td>
<td>As necessary</td>
<td></td>
</tr>
<tr>
<td>DEAT reserves the right to monitor and audit the development throughout its full life cycle to ensure compliance with the RoD as well as mitigation measures in the final scoping report and the OEMP.</td>
<td>DEAT</td>
<td>Continuous</td>
<td></td>
</tr>
<tr>
<td>The planned groundwater, air quality/dust and noise monitoring programme results should be used to inform management decisions on site.</td>
<td>Specialist</td>
<td>Continuous</td>
<td></td>
</tr>
</tbody>
</table>

**3.4.3.3 Demarcation of areas**

- Drop-off and pick-up zones shall be clearly demarcated.
- “No-go” areas shall be appropriately demarcated and personnel and equipment shall not be permitted within these areas.
- Areas for the storage of hazardous substances including hazardous waste and industrial effluent shall be clearly demarcated.

<table>
<thead>
<tr>
<th>Management Action</th>
<th>Responsible Party</th>
<th>Frequency</th>
<th>Method Statement Required</th>
</tr>
</thead>
<tbody>
<tr>
<td>Drop-off and pick-up zones shall be clearly demarcated.</td>
<td>RE</td>
<td>Continuous</td>
<td></td>
</tr>
<tr>
<td>“No-go” areas shall be appropriately demarcated and personnel and equipment shall not be permitted within these areas.</td>
<td>RE</td>
<td>Continuous</td>
<td></td>
</tr>
<tr>
<td>Areas for the storage of hazardous substances including hazardous waste and industrial effluent shall be clearly demarcated.</td>
<td>RE</td>
<td>Continuous</td>
<td></td>
</tr>
</tbody>
</table>
### 3.4.3.4 Occupational Health and Safety

<table>
<thead>
<tr>
<th>Requirement</th>
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</thead>
<tbody>
<tr>
<td>Appropriate safety and precaution signage shall be erected in applicable areas.</td>
</tr>
<tr>
<td>All maintenance and repair contractors shall be informed of the hazards on the site. Suitable training on what to do in an emergency shall be provided and used by the contractor must be equipped with the applicable PPE before they are to be permitted access to the site.</td>
</tr>
<tr>
<td>The PBMR DPP radiation protection programme will be consistent with the existing Koeberg Nuclear Power Station requirements and in fact mirror the radiation protection programme in terms of policies and standards.</td>
</tr>
<tr>
<td>The PBMR DPP will use the Koeberg Nuclear Power Station radiological records system, but will have its own facilities for the remainder of the radiation protection aspects of operation.</td>
</tr>
</tbody>
</table>

### 3.4.3.5 Training

<table>
<thead>
<tr>
<th>Requirement</th>
</tr>
</thead>
<tbody>
<tr>
<td>The Plant Manager shall ensure that all site staff are aware of, and understand the contents and conditions of the EMP, the key environmental issues and the consequences of non-compliance.</td>
</tr>
<tr>
<td>All site staff shall attend induction training on the EMP and a record shall be kept of all attendees.</td>
</tr>
<tr>
<td>Staff shall be trained in all aspects relating to the site’s operations including health and safety aspects;</td>
</tr>
<tr>
<td>New staff shall be informed of the hazards of the DPP and be trained in the relevant provisions of the On-Site Emergency Response Procedure; and</td>
</tr>
<tr>
<td>Records of staff training shall be maintained.</td>
</tr>
</tbody>
</table>

### 3.4.3.6 Fire prevention

<table>
<thead>
<tr>
<th>Requirement</th>
</tr>
</thead>
<tbody>
<tr>
<td>No open fires shall be allowed on site under any circumstances. The use of open fires for cooking of food etc. by maintenance personnel shall be strictly prohibited. Temporary enclosed areas (windshield) for food preparation shall be provided. Eskom shall supply fuel for fires.</td>
</tr>
<tr>
<td>The Plant Manager shall have fire-fighting equipment available on all vehicles working on site, especially during the winter months. The fire fighting equipment shall be regularly checked and shall be approved by the ECO / Safety and Health Officer on site.</td>
</tr>
</tbody>
</table>

### 3.4.3.7 Fauna Protection

<table>
<thead>
<tr>
<th>Requirement</th>
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<tbody>
<tr>
<td>It is illegal to interfere with any wildlife or other fauna. All fauna occurring on-site shall be protected. Hunting and snaring shall not be permitted.</td>
</tr>
<tr>
<td>The DPP site shall be fenced off to prevent wildlife from entering the site, and no domestic animals are to be brought on-site.</td>
</tr>
</tbody>
</table>
### 3.4.3.8 Emergency response

- The current emergency response infrastructure and systems for the Koeberg Nuclear Power Station will be updated. Emergency response required in terms of the nuclear licence will be established prior to the receipt of nuclear fuel for the PBMR DPP. An integrated Emergency Plan will exist for the Koeberg Site.
- Emergency evacuation procedures will have to be updated to include the additional 150 staff members, visitors and shift workers during the operational phase, amongst aspects of emergency planning that is required in terms of the nuclear licence. Key staff shall be trained in emergency response and all staff made aware of the emergency procedures.
- Contact details of emergency personnel shall be readily available on-site.
- A register of all incidents, accidents etc. shall be maintained, which includes the action taken after the event has occurred. The ECO shall be informed of the event.
- Eskom will be responsible for immediately notifying the DEAT, should any serious incident occur which is likely to have detrimental effects on the environment. A record of these incidents shall be kept.
- Eskom will be responsible for rehabilitating any damage caused to the environment due to any event caused by negligence occurring on site.

### 3.4.3.9 Waste

- Radioactive waste management practices for the PBMR DPP are consistent with the IAEA guidelines for a Radioactive Waste Management Programme for nuclear power stations, from generation to disposal.
- The RD 0018 requirements on radioactive waste will be complied with.
- The PBMR DPP will minimize production of all solid, liquid, and gaseous radioactive waste, both in terms of volume and activity content, as required for new reactor designs.
- Liquid waste released from the PBMR DPP under Normal Operational conditions is routed to the same points as the Koeberg Nuclear Power Station liquid discharges, before it is discharged out to sea. Only treated liquid releases will be diverted to the seawater discharge of the KNPS. The design ensures that all releases to the environment are controlled and monitored. No liquid waste is released during Accident Conditions.
### 3.4.3.10 Hazardous substances

- During maintenance, should any oils spills or leaks occur from maintenance vehicles, the contaminated soil shall be remediated immediately; and
- Repairs to damaged maintenance vehicles shall be undertaken on a drip tray to avoid any oil or other hazardous substances from reaching the ground.
- The PBMR DPP’s low to medium radioactive waste will be transported as part of the Koeberg Nuclear Power Station’s current waste consignments.
- A set of procedures will be followed to ensure that during normal operation, all releases of radioactive substances are within the limits of the PBMR DPP operational technical standards. The procedures indicate the methodologies to determine the amount of the releases and the nuclide contents.

| RE | As and when necessary | Continuous |
| RE | Continuous |
| RE | Continuous |
| RE | Continuous |

### 3.4.3.11 Vehicles and transportation

- All maintenance vehicles using public roads shall be in a roadworthy condition.
- Only qualified/trained personnel shall operate equipment and vehicles.
- Drip trays to prevent oil or fuel spills shall be utilised whenever vehicle or equipment maintenance is undertaken.
- Access for vehicles shall be through existing established gateways. No deviation from approved access roads or transportation routes will be allowed.
- No member of the workforce will be permitted to drive a vehicle under the influence of alcohol or narcotic substances.
- No persons shall be transported at the back of open bakkies on the Koeberg site.

| HV PM | Continuous |
| HV PM | Continuous |
| RE | Continuous |
| HV PM | Continuous |
| RE | Continuous |

### 3.4.3.12 Storm water / Erosion

- An integrated approach to stormwater management will ensure that water quality and quantity aspects are taken into account in the detailed design of stormwater management systems.
- Prevent storm water contamination through regular inspection and maintenance of the storm water management system.
- All drainage structures shall be regularly inspected and cleared of organic and inorganic debris.
- Storm water shall be effectively captured and led well away from all structures.
- No ponding of surface water shall occur adjacent to tower foundations.

| RE | Continuous |
| RE | Continuous |
| RE | Daily – Quarterly depending on season |
| RE | |
| RE | |
### 3.4.3.13 Wet Areas / Wetlands

- Vehicular traffic shall not be allowed in permanently wet areas.
- No damage shall be caused to wet areas and buffers (of at least 50m) will be developed for wetland areas on the site.
- Any work or access near or in a permanent drainage system may have implications in terms of the National Water Act 1998 (Act No. 36 of 1998), and therefore may well require the application of a Water Use License. Therefore, the contractor must in consultation with the ECO, assess all areas of construction well in advance in order to ensure the relevant Water Use License is applied for where required.
- The vital (seasonal) supply of water will not be removed from the wetlands by isolating local wetland catchments or any other means.

### 3.4.3.14 Destruction of vegetation

- All declared aliens shall be identified and managed in accordance with the Conservation of Agricultural Resources Act, 1983 (Act No 43 of 1983); and
- The establishment and re-growth of alien vegetation shall be controlled after the removal thereof.

### 3.4.3.15 Heritage resources

- Any heritage/archaeological sites/objects are discovered during the operational phase, the relevant person on site shall note the location thereof and ensure that such sites/objects are not disturbed/destroyed. SAHRA shall be contacted immediately to report the archaeological/heritage find.

### 3.4.3.16 Noise

- Adjacent landowners shall be notified prior to maintenance activities that will produce noise.
- Eskom will ensure that, from a noise perspective, silencer units on vehicles and equipment in good working order.
### 3.4.3.17 Materials Use, Handling, Storage and Transport (Cement, Fuel [Petrol, Diesel] and Oils)

- Procedures for material handling shall be discussed with and approved by the ECO.
- Relevant national, regional and local legislation regarding the transport, use and disposal of hazardous waste must be adhered to at all times.
- An emergency procedure to deal with accidents and incidents (e.g. spills) arising from hazardous substances shall be compiled and implemented.
- All mechanical equipment used in construction activities shall be clean and free of oil, petrol, and diesel leaks.
- Spills of hazardous substances, in excess of 10 litres shall be reported to the ECO immediately and the appointed Eskom Environmental Advisor.
- A register for spills and incidents involving hazardous materials shall be maintained.
- Soil or yard stone, which has been contaminated, shall be removed and disposed of at an approved waste disposal site. Alternatively, contaminated soil can be treated on site through bioremediation. Should a person experienced in bioremediation not be available on site, a specialist contractor shall be used. Such spills shall be cleaned and remediated to the satisfaction of the ECO. A method statement is required from the Contractor that details the procedure to be followed in dealing with leaks or spills.
- A complete emergency spill kit shall be available on site at all times. The Contractor shall also ensure that relevant staff members are trained to use the emergency spill kit and on the manner in which to deal with spills of hazardous substances (oils, diesel or petrol).
- A concrete platform with a bund wall shall be allocated to accommodate fuel, oil paint, bitumen, herbicide and insecticides to guard against infiltration of hazardous substances into the soil. Fuel tanks shall be bunded to hold 110% of the contents of the tank. The tanks shall be housed in a roofed area so that no water will collect within the bund wall.
- All staff handling hazardous waste shall be trained accordingly.
- All necessary approvals with respect to fuel storage and dispensing shall be obtained from the appropriate authorities.

<table>
<thead>
<tr>
<th></th>
<th>RE</th>
<th>Continuous</th>
<th>As necessary</th>
<th>Yes</th>
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<tbody>
<tr>
<td></td>
<td>Once-off</td>
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<tr>
<td></td>
<td>As necessary</td>
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- Areas of fuels storage and other flammable materials shall comply with standard fire safety regulations and will require the approval of the SS/CM and the Municipal Fire Prevention Officer.

- No smoking shall be allowed in the vicinity of the stores and adequate fire-fighting equipment shall be accessible at fuel storage area and areas in the vicinity of the storage area. NO smoking” and “Danger” signs shall be erected at hazardous substance storage areas.

- All empty and externally dirty tanks shall be sealed and stored on an area where the ground has been protected.

<table>
<thead>
<tr>
<th>3.4.3.18 Re-vegetation</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Exposed areas with slopes less than 1:3 shall be rehabilitated with a grass mix that blends in with the surrounding vegetation. The grass mix should consist of indigenous vegetation adapted to the local environmental conditions.</td>
</tr>
<tr>
<td>• Re-vegetated areas shall be monitored every 4 months for the first 12 months and once a year thereafter for the maintenance period of two years. Re-vegetated areas showing inadequate surface coverage (less than 30% within 8 months after re-vegetation) shall be prepared and re-vegetated from scratch.</td>
</tr>
<tr>
<td>• Damage to re-vegetated areas shall be repaired promptly.</td>
</tr>
<tr>
<td>• Weed control methods shall be confirmed with Eskom’s Environmental Advisor to prevent any undesirable secondary impacts.</td>
</tr>
</tbody>
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<table>
<thead>
<tr>
<th>3.4.3.19 Cooling water</th>
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<tbody>
<tr>
<td>• Either measures be implemented to enable cooling of intake water should it exceed 22ºC, or design modifications be made to the PBMR DPP to increase the maximum allowable temperature of intake water.</td>
</tr>
<tr>
<td>• Measures will be taken to minimise exposure of cooling water intake pipes, damage to cooling water intake pipes, sedimentation within the mouth of the intake basin and blockage of cooling water intake pipes by sand, oil slicks, debris or marine fauna and flora, which threaten the supply of seawater for cooling purposes.</td>
</tr>
<tr>
<td>• Operation of the PBMR DPP must always take place in tandem with that of the Koeberg Nuclear Power Station, as cooling water released by the proposed development alone will be significantly hotter than that released by both stations together. Alternatively, cooling water originating from the proposed PBMR DPP should be cooled to at least 28ºC before being released back into the sea.</td>
</tr>
</tbody>
</table>
### 3.4.3.20 Landscaping, stabilisation and soil stockpiling

<table>
<thead>
<tr>
<th>Activity</th>
<th>Responsible</th>
<th>Frequency</th>
<th>Status</th>
</tr>
</thead>
<tbody>
<tr>
<td>In the event that additional landscape and stabilisation is necessary during the operational phase then exposed slopes and/or destabilised areas shall be landscaped to blend in with the surrounding area.</td>
<td>RE</td>
<td>As and when necessary</td>
<td>Yes</td>
</tr>
<tr>
<td>In exposed areas with slopes steeper than 1:3, re-vegetation shall not be used as the primary means of stabilisation. Such slopes shall rather be stabilised by suitable structures, which can be enhanced by re-vegetation to facilitate blending with the environment.</td>
<td>RE / ECO</td>
<td>RE</td>
<td></td>
</tr>
<tr>
<td>Rehabilitated areas that are susceptible to erosion due to their position in the landscape shall be adequately protected by soil conservation measures.</td>
<td>RE</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Activities on or nearby coastal dunes shall include the preparation of coastal set back lines (100m from the high water mark), with a buffer zone (25 m), and the rehabilitation of primary dune systems.</td>
<td>RE</td>
<td></td>
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</tbody>
</table>

### 3.4.3.21 Maintenance of visual intrusion mitigation aspects

<table>
<thead>
<tr>
<th>Activity</th>
<th>Responsible</th>
<th>Frequency</th>
<th>Status</th>
</tr>
</thead>
<tbody>
<tr>
<td>To ensure that all visual intrusion aspects dealt with during the construction stage are/remain effective, a quarterly assessment of all rehabilitated areas is required.</td>
<td>RE</td>
<td>Quarterly</td>
<td></td>
</tr>
<tr>
<td>All of the visual mitigation methods also relate to landscape impact mitigation such as erosion control and water runoff management. In the event that these fail, they will have a negative visual implication on the landscape. Areas that show failure shall be repaired immediately. Rehabilitation progress shall be monitored and where necessary, different techniques shall be applied until stability of land is achieved.</td>
<td>RE</td>
<td>As necessary</td>
<td></td>
</tr>
</tbody>
</table>

### 3.4.3.22 Air Quality

<table>
<thead>
<tr>
<th>Activity</th>
<th>Responsible</th>
<th>Frequency</th>
<th>Action</th>
</tr>
</thead>
<tbody>
<tr>
<td>Stack monitoring will be undertaken to verify the emissions from the process.</td>
<td>RE</td>
<td>Continuous</td>
<td></td>
</tr>
</tbody>
</table>

### 3.4.3.23 Audits

<table>
<thead>
<tr>
<th>Activity</th>
<th>Responsible</th>
<th>Frequency</th>
<th>Status</th>
</tr>
</thead>
<tbody>
<tr>
<td>Quarterly audits are to be undertaken by the ECO. Audit reports are to be supplied to the DEAT on a quarterly basis for their records.</td>
<td>ECO</td>
<td>Quarterly</td>
<td>Upon request</td>
</tr>
</tbody>
</table>
4 IMPLEMENTATION AND MANAGEMENT PROCEDURES

4.1 Organisational structure

4.1.1 Construction

The organisational structure below identifies and defines the responsibilities and authority of the various key role-players (individuals and organisations) involved in the project’s construction phase. All instructions and official communications regarding environmental matters shall follow the organizational structure shown in Figure 6. The organisational structure reflected in Figure 6 has been developed to ensure that there are clear channels of communication and an explicit organisational hierarchy so that potential conflicting or contradictory instructions are avoided.

**Figure 6: Organisational Structure – Construction Phase**

In terms of the defined organisational structure reflected in Figure 6, all instructions that relate to environmental matters will be communicated to the Contractor via the Construction Manager. The exception to this rule would be in an emergency (defined as a situation requiring immediate action and where failure to intervene timeously would, in the reasonable opinion of the Environmental Control Officer (ECO), result in unacceptable environmental degradation), where instructions may be given directly to the Contractor. The detailed roles and responsibilities of the various role-players identified in the organisational structure are outlined in Section 4.2.1.
4.1.2 Operation

The organisational structure below identifies and defines the responsibilities and authority of the various key role-players (individuals and organisations) involved in the project’s operational phase. All instructions and official communications regarding environmental matters shall follow the organizational structure shown in Figure 7. Similar to in the construction phase, the organisational structure has been developed to ensure that there are clear channels of communication and an explicit organisational hierarchy so that potential conflicting or contradictory instructions are avoided.

![Organisational structure – Operational/Maintenance Phase](image)

Figure 7: Organisational structure – Operational/Maintenance Phase

4.2 Roles and Responsibilities

4.2.1 Construction

<table>
<thead>
<tr>
<th>Function</th>
<th>Responsibility</th>
</tr>
</thead>
</table>
| Project Manager (PM) – Eskom Client Office | The overall management of the project and implementation, administration and enforcement of the EMP. The PM shall:  
- Ensure that this EMP specifications are included in all tender documents issued for the development works and activities on site, and shall ensure that the prospective Tenderers/Sub-Contractors abide by the provisions thereof;  
- Appoint an ECO to monitor implementation of and compliance with this EMP for the duration of the works. The CM may be required to fulfil this function when the ECO is not available;  
- Be liable/accountable, to the relevant authority, DEAT, for any contravention/non-compliance by any Contractor under their supervision; and  
- Through the CM, issue fines or stop works orders for contravention of this EMP and give instruction regarding corrective action. |
<p>| Construction Manager (CM) – Eskom Client | Oversees site works, liaison with Contractor, PM and ECO. The CM will be responsible for monitoring, reviewing and verifying compliance with the EMP by the Contractor when the ECO is not available. The CM’s |</p>
<table>
<thead>
<tr>
<th>Function</th>
<th>Responsibility</th>
</tr>
</thead>
<tbody>
<tr>
<td>Office</td>
<td>duties, over and above his contractual obligations, will include the following:</td>
</tr>
<tr>
<td></td>
<td>• Comply with the contents of this EMP specifications to ensure that the requirements of this EMP are met;</td>
</tr>
<tr>
<td></td>
<td>• Monitor and verify that this EMP is adhered to at all times and take action if the specifications are not followed;</td>
</tr>
<tr>
<td></td>
<td>• Monitor and verify that environmental impacts are kept to a minimum;</td>
</tr>
<tr>
<td></td>
<td>• Review construction/EPCM EMPs in conjunction with the ECO;</td>
</tr>
<tr>
<td></td>
<td>• Assist the Contractor in finding environmentally responsible solutions to problems with input from the ECO;</td>
</tr>
<tr>
<td></td>
<td>• Keep records of all activities/incidents concerning the environment in the site diary;</td>
</tr>
<tr>
<td></td>
<td>• Inspect the site and surrounding areas on a weekly basis with regard to compliance with this EMP;</td>
</tr>
<tr>
<td></td>
<td>• Order the removal of, or issuing spot fines for, person(s) and/or equipment not complying with the specifications; and</td>
</tr>
<tr>
<td></td>
<td>• Issue penalties for contravention of this EMP.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Environmental Control Officer (ECO)</th>
<th>Implementation of this EMP, liaison between Eskom, Contractor and landowners, and monitoring, reviewing and verifying compliance with this EMP by the Contractor. In particular, the ECO shall:</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>• Be appointed by the PM to monitor all activities on site;</td>
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<tr>
<td></td>
<td>• Visit/inspect the site on a monthly basis, to ascertain the level of compliance of works, as well as attend Contractor’s meetings when necessary and monthly site meetings with the project management team and report back on the environmental issues;</td>
</tr>
<tr>
<td></td>
<td>• Maintain inspection audit reports on file;</td>
</tr>
<tr>
<td></td>
<td>• Assist the CM in ensuring that necessary environmental authorisations and permits have been obtained;</td>
</tr>
<tr>
<td></td>
<td>• Monitor and verify that this EMP is adhered to at all times and take action if the specifications are not followed;</td>
</tr>
<tr>
<td></td>
<td>• Monitor and verify that environmental impacts are kept to a minimum;</td>
</tr>
<tr>
<td></td>
<td>• Review and approve construction/EPCM EMPs together with the CM;</td>
</tr>
<tr>
<td></td>
<td>• Assist the Contractor in finding environmentally responsible solutions to problems;</td>
</tr>
<tr>
<td></td>
<td>• Keep records of all activities/incidents concerning the environment on site in the Site Diary;</td>
</tr>
<tr>
<td></td>
<td>• Keep a register of complaints in the Site Office (to be situated in proximity to where the works are taking place) and deal with any community comments or issues;</td>
</tr>
<tr>
<td></td>
<td>• Monitor the undertaking by the Contractor of environmental awareness training for all new personnel coming onto site or present environmental awareness courses themselves;</td>
</tr>
<tr>
<td></td>
<td>• Provide material/manuals and assistance for the environmental awareness courses;</td>
</tr>
<tr>
<td></td>
<td>• Advise on the removal of person(s) and/or equipment not complying with the specifications (done via the CM);</td>
</tr>
<tr>
<td></td>
<td>• Recommend the issuing of fines for transgressions of site rules and penalties for contravention;</td>
</tr>
<tr>
<td></td>
<td>• Maintain a photographic record of the site before, during and after construction.</td>
</tr>
<tr>
<td></td>
<td>• Ensure that activities on site comply with legislation of relevance to the environment;</td>
</tr>
<tr>
<td></td>
<td>• Complete checklists as necessary; and</td>
</tr>
<tr>
<td></td>
<td>• Internally review the implementation of this EMP and submit a \</td>
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<td></td>
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</tr>
<tr>
<td>Function</td>
<td>Responsibility</td>
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<td>------------------------------</td>
<td>-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------</td>
</tr>
<tr>
<td>Contractor (C) - PBMR</td>
<td>Implementation and compliance with recommendations and conditions of this EMP. The Contractor shall:</td>
</tr>
<tr>
<td></td>
<td>• Ensure that the environmental specifications of this document (including any revisions, additions or amendments) are effectively implemented. This includes the on-site implementation of steps to mitigate environmental impacts;</td>
</tr>
<tr>
<td></td>
<td>• Ensure that all employees and sub-contractors employed comply with the requirements and provisions of this EMP;</td>
</tr>
<tr>
<td></td>
<td>• Prepare construction/EPCM EMPs for submission to the ECO;</td>
</tr>
<tr>
<td></td>
<td>• Monitor environmental performance and conformance with the specifications contained in this document during daily site inspections;</td>
</tr>
<tr>
<td></td>
<td>• Discuss implementation of and compliance with this document with staff at routine site meetings;</td>
</tr>
<tr>
<td></td>
<td>• Be responsible for sub-contractors preparing sites and erecting the towers;</td>
</tr>
<tr>
<td></td>
<td>• Report progress towards implementation of and non-conformances with this document at site meetings with the ECO;</td>
</tr>
<tr>
<td></td>
<td>• Keep Copies of two-weekly reports to the Eskom Environmental Advisor;</td>
</tr>
<tr>
<td></td>
<td>• Notify the ECO of the anticipated programme of works and fully disclose all details of activities involved;</td>
</tr>
<tr>
<td></td>
<td>• Ensure that suitable records are kept and that the appropriate documentation is available to the ECO;</td>
</tr>
<tr>
<td></td>
<td>• Notify the ECO of all incidents, accidents and transgressions on site with respect to environmental management as well as requirements of the EMP and corrective actions/remedial action taken;</td>
</tr>
<tr>
<td></td>
<td>• Report and record all accidents and incidents resulting in injury or death to PM;</td>
</tr>
<tr>
<td></td>
<td>• Inform the ECO of problems arising when implementing this EMP and recommend ways of improving it;</td>
</tr>
<tr>
<td></td>
<td>• Inform the ECO of any complaints received; and</td>
</tr>
<tr>
<td></td>
<td>• Appoint a dedicated person (Contractor Environmental Control Officer) to work with the ECO.</td>
</tr>
<tr>
<td>Contractor Environmental Control Officer (CECO)</td>
<td>• Appointed by the contractor for the implementation of this EMP, landowner interaction, environmental control of site actions, remediation and rehabilitation work; and</td>
</tr>
<tr>
<td></td>
<td>• Be available to investigate all problems arising on the work sites concerning the landowners.</td>
</tr>
<tr>
<td>Eskom Environmental Advisor</td>
<td>• Environmental advice and auditing.</td>
</tr>
</tbody>
</table>
## 4.2.2 Operation

<table>
<thead>
<tr>
<th>Function</th>
<th>Responsibility</th>
</tr>
</thead>
</table>
| Project Manager (PM)      | The overall management of the project and implementation, administration and enforcement of the EMP. The PM shall:  
- Ensure that the EMP specifications are included in all operational documents and procedures for the development works and activities on site; and  
- Appoint an ECO to monitor implementation of and compliance with the EMP for the duration of the works.                                                                                                                                                                                                                                                                                                                                                     |
| HV Plant Manager (HV PM)  | The Plant Manager will be responsible for monitoring, reviewing and verifying compliance with this EMP. The duties of the Plant Manager will include:  
- Implementation this EMP, ensuring compliance with the contents of this document and any other environmental policies and procedures which may be applicable to the project;  
- Monitor and verify that this EMP is adhered to at all times and take action if the specifications are not followed;  
- Monitor and verify that environmental impacts are kept to a minimum;  
- Review operational EMPs in conjunction with the Resident Process Engineer and Cluster SHEQ Manager (if applicable);  
- Monitor the undertaking of environmental awareness training by all new personnel coming onto site;  
- Inspect the site and surrounding areas regularly with regard to compliance with the EMP;  
- Reporting on the progress of the EMP; and  
- Ensure that the necessary environmental authorisations and permits have been obtained.                                                                                                                                                                                                                                                                                                                          |
| Resident Engineer (RE)    | The Resident Engineer (RE) will assist with monitoring, reviewing and verifying compliance with this EMP. In particular, the RE shall:  
- Be appointed by Eskom to monitor all engineering related activities on site;  
- Inspect the site regularly, to ascertain the level of compliance with applicable legal, procedural, engineering and administrative requirements that impact on environmental issues;  
- Maintain inspection reports on file;  
- Monitor and verify that environmental impacts are kept to a minimum; and  
- Assist Eskom in finding environmentally responsible solutions to problems.                                                                                                                                                                                                                                                                                                                                  |
<table>
<thead>
<tr>
<th>Function</th>
<th>Responsibility</th>
</tr>
</thead>
<tbody>
<tr>
<td>Environmental Control Officer</td>
<td>Appointed by the HV PM for the implementation of this EMP, the ECO will be responsible for the overall implementation, administration and enforcement of this EMP. This includes interaction, environmental control of site actions, re-mediation and rehabilitation work. In particular, the ECO is responsible for:</td>
</tr>
<tr>
<td>(ECO)</td>
<td>- Ensuring that this EMP specifications are included in all future tender documents issued for activities on site, and shall ensure that the prospective Tenders/Contractors abide by the provisions thereof;</td>
</tr>
<tr>
<td></td>
<td>- Inform the relevant authority, DEAT, of any contravention/non-compliance by any Contractor under their supervision;</td>
</tr>
<tr>
<td></td>
<td>- Monitor and verify that this EMP is adhered to at all times and take action if the specifications are not followed;</td>
</tr>
<tr>
<td></td>
<td>- Take action against contraventions of this EMP and give instruction regarding corrective action;</td>
</tr>
<tr>
<td></td>
<td>- Keep records of all activities/incidents concerning the environment;</td>
</tr>
<tr>
<td></td>
<td>- Keep a register of complaints received;</td>
</tr>
<tr>
<td></td>
<td>- Provide material/manuals and assistance for environmental awareness;</td>
</tr>
<tr>
<td></td>
<td>- Complete checklists as necessary; and</td>
</tr>
<tr>
<td></td>
<td>- Continually review this EMP and submit reports to the PM.</td>
</tr>
<tr>
<td>Eskom Environmental Advisor</td>
<td>The Environmental Advisor will be responsible for:</td>
</tr>
<tr>
<td></td>
<td>- Auditing compliance with the requirements of this EMP during annual audits;</td>
</tr>
<tr>
<td></td>
<td>- Advising the HV PM regarding applicable legal requirements and compliance with these requirements; and</td>
</tr>
<tr>
<td></td>
<td>- Advising the HV PM and ECO regarding compliance with the requirements of this EMP.</td>
</tr>
</tbody>
</table>

4.3 Awareness and competence

4.3.1 Induction of staff

It is important to ensure that all personnel have the appropriate level of environmental awareness and competence to ensure continued environmental due diligence and ongoing minimisation of environmental harm.

To achieve effective environmental management, it is important that employees, Contractors and Subcontractors are aware of the responsibilities in terms of the relevant environmental legislation and the contents of this EMP. Environmental training must include the following:

- Employees must have a basic understanding of the key environmental features of the construction site and the surrounding environment;
- Employees will be thoroughly familiar with the requirements of the EMP and the environmental specifications as they apply to the construction of the power station;
- Employees must undergo training for the operation and maintenance activities associated with a PBMR DPP and have a basic knowledge of the potential environmental impacts that could occur and how they can be minimised and mitigated;
- Basic training in the identification of archaeological artefacts, and rare and endangered flora and fauna that may be encountered on the site; and
• Awareness of any other environmental matters, which are deemed to be necessary by the ECO.

The training must include a system of certification and/or accreditation related to training, to ensure all the workers have proof of work performed for future job applications. Records must be kept of those that have completed the relevant training. Training must include the environment, health and safety as well as basic HIV/AIDS education.

Training can be done either in a written or verbal format but will be in an appropriate format for the receiving audience. Where training has been done verbally, persons having received training must indicate in writing that they have attended a training session and have been notified in detail of the contents and requirements of the EMP.

4.3.2 Communication and liaison with stakeholders

Eskom must ensure that the public and surrounding communities are informed and updated throughout the construction and operational phases.

Sufficient signage should be erected at the site entrance, informing the public of the construction activities taking place. A single board will be erected with project name, client, and detail of EPCM contractor.

A Liaison Committee should be established to ensure that relevant information can be reported to National DEAT as well as interested and affected parties. The objectives of an environmental liaison committee include the following:

- To facilitate proper communication and co-operation between Eskom, the surrounding community, and other interested and affected parties;
- To facilitate discussion on various issues pertaining to labour, safety, health, environmental, social and other community related issues and concerns;
- To serve as an advisory forum to the proponent during the construction and operational phases of the PBMR DPP;
- To provide a platform where day-to-day community concerns around the project can be raised and addressed;
- To ensure that the community and other stakeholders understand the various legal obligations imposed on the project, and Eskom’s strategy to meet these obligations; and
- To provide a platform where Eskom’s performance on issues relating to safety, health, environmental, and social aspects can be discussed.

The representatives that constitute the environmental liaison committee will include at a minimum National DEAT, interested and affected parties, Eskom and PBMR.

4.3.3 Public Safety Information Forum

Regulation 299 of the NNR Act makes provision for the establishment of a Public Safety Information Forum. The following section highlights the responsibilities of the holder of a nuclear installation licence in this regard as well as the functioning of such a forum.

(a) Responsibilities of holders of a nuclear installation licence

A holder of a nuclear installation licence must:

- establish a public safety information forum in order to inform the persons living in the relevant municipal area in respect of which an emergency plan has been established in terms of section 38(1) of the Act on nuclear safety and radiation safety matters (including emergency planning) related to the relevant nuclear installation;
- provide a venue and facilities for meetings of the forum;
- provide a secretariat to facilitate the proper functioning of the forum;
• provide information to the forum, with due regard to section 51 of the Act, on nuclear/radiation safety matters, including but not limited to nuclear incidents/accidents, and
• cover the costs related to the establishment and management of the forum.

(b) Functioning of the Public Safety Information Forum

• At the first meeting of each calendar year, or as the need may be, a Chairperson and Deputy Chairperson must be elected by open ballot from the members of the public living in the relevant municipal area, and whoever elected shall perform their duties without payment.
• The ballot contemplated must be cast by the members of the public present at that meeting.
• The public safety information forum must:
  o conduct all meetings open to the public at a minimum frequency of one meeting per quarter;
  o communicate the date, time and venue of meetings of the forum within the relevant municipal area not less than 14 days prior to each meeting;
  o keep minutes of all meetings as a record, which must be distributed to all attendees and any other interested parties, and
  o invite the National Nuclear Regulator, and the relevant municipality as well as relevant provincial and national government departments as appropriate, to all meetings.

The above-mentioned forums, will ensure that the public are made aware of the principal mitigation, management, monitoring and emergency measures that are proposed for the construction and operation of the PBMR DPP.

4.4 Compliance, non-conformance and corrective actions

4.4.1 Assurance

Eskom’s Safety, Health and Environment (SHE) Policy has detailed the following policy principles:

• Eskom is committed to safety, health and environmental excellence and will conduct business with respect and care for people and the environment and in doing so, will ensure that adequate resources are available for SHE management;
• Eskom believes that all injuries and occupational illness’s as well as safety and environmental incidents, are preventable, and their goal for all is zero;
• Eskom will engage key stakeholders including employees and organised labour on all elements of SHE issues;
• Eskom will continuously appraise SHE performance with the objective of continuous sustainable improvement;
• Eskom will ensure that SHE is an integral part of operations and that no operating condition, or urgency of service, can justify endangering the life of anyone or cause injury or damage to the environment;
• Management in each business will be responsible for educating, training and motivating employees and contractors in relation to SHE;
• Eskom will work with suppliers and customers to integrate SHE issues into their operations, and contractors working under Eskom’s supervision, or on Eskom premises will comply with the policy;
• This policy will apply wherever Eskom operations exist or Eskom operates including subsidiaries;
• This policy will apply during the evaluation of all contract, projects and proposals; and
Eskom will establish appropriate management systems to address safety, occupational health and environmental issues with a view to minimising risk and assuring duty of care and the management of pollution and environmental degradation, performance monitoring and continuous improvement.

The SHE Policy details the following roles and responsibilities:

- The Chief Executive, as the chief safety officer of Eskom, has the accountability to ensure that this policy is implemented;
- Managing Directors shall be responsible and accountable for the development, implementation, and the performance of the appropriate SHE management systems in their respective divisions;
- The General Manager Corporate Sustainability (GMCS) shall establish mechanisms to ensure an Eskom co-ordinated and aligned approach to SHE management and shall ensure that issues relating to HSE performance are monitored and recorded;
- All areas of the organisation shall report on sustainability issues and the GMCS shall complement the assurance function;
- Each Business Unit Manager shall provide his / her Managing Director with the assurance that all SHE issues that are appropriate to his / her business are being addressed;
- Each Managing Director will, in turn, provide the Chief Executive with a letter of assurance to this effect;
- Supervisors shall be responsible for SHE issues at work;
- This primarily means the prevention of accidents and injury to staff, contractors, and visitors and prevention of damage to the environment;
- It shall be the Supervisor’s responsibility to issue clear and explicit working instructions and to ensure, through good supervision, that work is carried out in accordance with SHE rules, practices, and instructions;
- Supervisors who are responsible for SHE at a work site shall be trained accordingly;
- Managers shall satisfy themselves that this training is adequate and that the Supervisors knowledge regarding SHE management is kept up to date;
- Employee’s have a duty of care as a condition of employment to reasonably care for their own safety and health and safety and occupational health of their fellow workers and other persons who may be affected by their work;
- Employees and contractors shall report all incidents, near misses, unhealthy situations, unsafe acts and or conditions, dangerous occurrences, legal contraventions, risks, pollution, etc. that comes to their attention;
- Employees, contractors and visitors shall wear all necessary personal protective equipment provide and ensure that it is kept in good condition;
- Each Business Unit Manager is to ensure that inspections and audits are conducted in the work place to ensure SHE systems success and to monitor effectiveness of safety programmes and continuous improvement.

A copy of the SHE policy has been included in Appendix B.

Based on the above assurance is provided that all principle mitigation, management, monitoring and emergency measures proposed shall be implemented. These will be done in an efficient and effective manner.

### 4.4.2 Monitoring

A monitoring programme will be put in place not only to ensure conformance with the EMP through the contract/work specifications, but also to monitor any environmental issues and impacts which have not been accounted for in the EMP that are, or could, result in significant environmental impacts for which corrective action is required. As part of the contract or work specifications, Eskom will stipulate the period and frequency of monitoring required in consultation with relevant stakeholders and authorities. The Project Manager will ensure that the monitoring is carried out.
The aim of the monitoring and auditing process would be to check the implementation of the environmental specifications routinely, in order to:

- Monitor and audit compliance with the prescriptive and procedural terms of the environmental specifications;
- Ensure adequate and appropriate interventions to address non-compliance;
- Ensure adequate and appropriate interventions to address environmental degradation;
- Provide a mechanism for the lodging and resolution of public complaints;
- Ensure appropriate and adequate record keeping related to environmental compliance;
- Determine the effectiveness of the environmental specifications and recommend the requisite changes and updates based on audit outcomes, in order to enhance the efficacy of environmental management on site; and
- Aid communication and feedback to the relevant authorities.

The Environmental Control Officer appointed to ensure compliance with this EMP will carry out monitoring activities. The Environmental Control Officer must have the appropriate experience and qualifications to undertake the necessary tasks. The Environmental Control Officer will report to the Construction Manager should any non-compliance be evident or corrective action necessary. Only in severe cases of non-compliance, or repeated offences, will the Environmental Control Officer be required to report to the Project Manager.

All instruments and devices used for the measurement or monitoring of any aspect of this EMP must be calibrated and appropriately operated and maintained.

4.4.3 Documentation and reporting

The following documentation must be kept on site in order to record compliance with the EMP:

- Record of Complaints;
- Monitoring Results; and
- Notification of Emergencies and Incidents.

The Contractor will report incidents involving Contractor employees and/or the public that could potentially cause negative sentiment and perception towards the project:

- Report incidents involving Contractor employees and/or the public that could potentially cause negative sentiment and perception towards the project and/or Eskom.
- Report environmental complaints and correspondence received from the public to the Project Manager or the Environmental Control Officer.
- Record and report incidents that cause harm or may cause harm to the environment to the Environmental Control Officer.
- Record all hazardous materials used on site.
- Maintain a record of all Hazardous Waste Disposal Manifests detailing the nature of the hazardous waste disposed of, the hazardous waste classification and the location of the site to which such waste was sent.

The above records will form an integral part of the Contractors’ Records. These records will be kept with the EMP, and will be made available for scrutiny if so requested by the Project Manager or his delegate and the Environmental Control Officer.

The Environmental Control Officer will put in place an Environmental Register to document:

- All environmental complaints and correspondence received from the public, Eskom or the construction workforce;
- Incidents of non-compliance with the EMP;
- Any other environmental incidents related to the construction phase of the project; and
• Results of routine and non-routine monitoring completed on site.

The Environmental Control Officer will also ensure that the following information is recorded for all complaints/incidents:

• Nature of complaint/incident;
• Causes of complaint/incident;
• Party/parties responsible for causing complaint/incident;
• Immediate actions undertaken to stop/reduce/contain the causes of the complaint/incident;
• Additional corrective or remedial action taken and/or to be taken to address and to prevent reoccurrence of the complaint/incident;
• Timeframes and the parties responsible for the implementation of the corrective or remedial actions;
• Procedures to be undertaken and/or penalties to be applied if corrective or remedial actions are not implemented; and
• Copies of all correspondence received regarding complaints/incidents.

4.4.4 Addressing non-compliance

The Project Manager, in consultation or on the advice of the ECO, shall issue spot fines if the Contractor infringes environmental specifications. The Contractor shall be advised in writing of the nature of the infringement and the amount of the spot fine. The Contractor shall be liable for the fine and it is his responsibility to recover the fine from the relevant employee. The Contractor shall also take the necessary steps (e.g. training) to prevent a recurrence of the infringement.

The Contractor is also advised that the imposition of spot fines does not replace any legal proceedings the authorities, landowners and/or members of the public may institute against the Contractor. Spot fines shall be between R500.00 and R1 000.00, depending upon the severity of the infringement. The decision on how much to impose will be made by the ECO in consultation with the Construction Manager, CECO and the Contractor in question, and will be final. A proper guideline should be established to specify the various categories of infringements. It should also be stipulated what will happen to the funds.

In addition to the spot fine, the Contractor shall be required to make good any damage caused as a result of the infringement, at his own expense.

The Project Manager shall retain records for fines issued. Monies for the spot fines will be deducted from the Contractors monthly certificate. The Project Manager, on recommendation from the ECO, may also order the Contractor to suspend based on a specific category of infringement, part or all the works if the Contractor repeatedly causes damage to the environment by not adhering to the EMP (i.e. more than 3 cases of infringements). The suspension will be enforced until such time as the offending actions, procedure or equipment is corrected. No extension of time will be granted for such delays and all costs will be borne by the Contractor.

The type and extent of the corrective measures required to address non-compliance would depend on the nature of the transgression and the Contractor’s history in terms of compliance with their environmental obligations.

When deciding on the nature of any punitive actions, however, it is important to recognise that the effective implementation of the environmental specification is highly dependant on the quality of the working relationships that develop between the key role-players, specifically between the Project Manager, the Contractor and the ECO. Accordingly, an excessive response to non-compliance, particularly for a minor or unintentional transgression, may cause significant environmental degradation in the long term due to its effect in eroding the Contractor commitment to meeting their environmental responsibilities. Other mechanisms, like an expanded environmental induction programme, may prove more effective than purely punitive measures in controlling non-compliance in the long term.
5 CONCLUSION

This EMP is aimed at meeting the requirements of the EIA Regulations and the guidelines issued in respect thereof as a minimum. This EMP builds on the environmental processes that have preceded it (Scoping Report and Environmental Impact Report) including the input of the various specialists that have participated in the relevant studies and assessments.

This process facilitated the identification of relevant and implementable mitigation measures, which may now be used by Eskom to draw up and respond to Tender documentation. It is thus key to this process that this document be included during tendering to allow all potential bidders for this work to seriously consider and cost for such mitigation. This will ensure that the document receives the necessary buy-in that it requires right from the outset of any further work.

The document provides a good indication as to what a contractor needs to consider before moving into the construction area, which is obviously critical to managing the identified environmental aspects.

Penalties to be imposed for the transgression of environmental specifications are also noted along with the roles and responsibilities of all stakeholders such as Eskom Generation, the Environmental Auditing Team, the Environmental Control Officer, Project Manager, Construction Manager, the Contractor and EPCM Sub-contractors, landowners, interested and affected parties and the relevant environmental and project specialists.

In order to ensure environmental compliance, all parties taking part in the construction and operation of the PBMR DPP facility shall be fully acquainted with the contents of this EMP. This will ensure that potential negative impacts are identified, avoided or mitigated.
Annexure A

Eskom EM Programme Guide
This document should be read in conjunction with the Eskom Environmental Procedure, EPC 32-96.

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2.4 Determine the environmental impacts and their significance 6
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1 Introduction

One of Eskom's environmental strategies is the development and implementation of an environmental management system (EMS). Linked to this is a requirement for the development and implementation of environmental management programmes (EMPs). Furthermore, Eskom's environmental land policy requires that all Eskom land be continually managed, through the control of operations and activities that take place on it, to ensure the sustainable utilisation of the asset. It also requires that all Eskom land be managed, operated, and maintained in terms of an established EMP.

An EMP is a plan of action that sets out a required environmental end state and sets out how activities that could have a negative impact on the environment will be managed and monitored and how impacted areas will be rehabilitated.

The main Eskom Environmental Procedure, EPC 32-96, should be consulted for all elements relating to the scope, normative references, etc.

2 Requirements

2.1 General

2.1.1 An EMP shall be developed and implemented, in terms of the relevant line division EMS for:

a) existing and future Eskom land (site, servitude); and

b) projects for which an environmental impact assessment (EIA) or screening was undertaken.

Applicable significant environmental issues are to be included in an EMP (see 2.12 for general environmental aspect). In the development and implementation of an EMP for existing Eskom land (site/servitude) or for a proposed project, the procedures in 2.2 to 2.11 should be followed to ensure compliance with Eskom's Environmental Land Policy and national environmental legislation.

2.1.2 Each Eskom division and subsidiary should establish key performance indicators (KPIs)/EMS for the development and implementation of EMPs. These indicators and actual performance figures should be reported for inclusion in Eskom's Annual Report where appropriate.

2.1.3 The line business unit (BU) managers shall be accountable for the coordinated development and implementation of the environmental management programmes in their respective areas in line with the set KPIs/EMS.
2.2 Collect environmental baseline data

a) This step involves the collection of baseline data or background information on:

1) the proposed project (technical and project management programme);
2) the existing land (site/servitude) and operations (technical and operational practices); and
3) the environment (and surrounding environment) of the proposed project of existing land (site/servitude) and operation.

b) Collection of data should start with obtaining existing information from:

1) past EIAs;
2) operational and maintenance records (including inspection reports);
3) incident investigation and audit reports;
4) geographical information systems (GIS); and
5) landowners and government departments.

c) Thereafter, gaps in data would have to be filled through specialist studies and field
sampling. For a power line route, this could involve a specialist on vegetation, bird interactions with power lines, soil types, and national heritage sites. For a site, specialist studies would be needed for soil types, vegetation control, and technical aspects of the site (that is, maintenance practices, oil traps, etc.).

d) This information should be collated in a format that will allow it to be stored and utilised in a convenient manner.

e) If an EIA had already been undertaken for the route or site, much of this baseline information can be obtained from that EIA report.

f) See Annex B for a generic list of baseline information required for specific sites.

g) Background information on the environment (land, air, water, local communities, and other interested and affected parties) should include issues that are applicable to the project or the existing site, and associated environmental impacts. It should cover the physical, biological, and social environments that could be or are adversely affected by the development or operation, respectively.

h) This baseline information is required to identify changes, through monitoring, as a result of the project or operational impacts. Baseline information studies will provide the “control” records against which all monitoring can be measured. The information will also be used in the development of EMP actions to avoid impacts or to restore areas.

2.3 Identify and/or predict the environmental aspects (Aspects Register)

2.3.1 Identify the environmental aspect (waste, oil spills, soil erosion, air and water emissions, vegetation control, landowner requirements, etc.) that need to be addressed, managed, controlled, or avoided through the adequate control of that activity resulting in the aspect.

2.3.2 For new developments and projects requiring an EIA, relevant statutory requirements shall be adhered to.

2.3.3 For an existing operation or site, the assessment to identify environmental issues could be from:

a) incident investigations and past experience (maintenance records, investigation reports, etc.);

b) a life-cycle assessment (LCA);

c) an EIA (for upgrades or changes to plant);

d) routine maintenance inspections/audits;

e) environmental due diligence;

f) an environmental risk assessment (ERA); and

g) an audit of the plant, site, or route.

2.3.4 A checklist, matrix, or some other assessment tool should be used to record the issues that were identified (see Annex C).

2.3.5 For both new projects and existing sites, a process of public participation should be undertaken to ensure that the concerns of interested and affected parties are taken into
consideration when compiling and implementing the EMP.
2.4 Determine the environmental impacts and their significance

2.4.1 The environmental impacts associated with each identified environmental aspect should be determined (that is, an oil spill is an environmental aspect, and its impact is the contamination of soil and water). Significance involves a value judgement by society concerning the importance of the effects of human activities. The primary concerns of the public are human health and safety. Thereafter, it is the concern for potential losses of important commercial species or commercially viable production and a high priority on species and areas of major recreational or aesthetic importance.

2.4.2 The significance of each impact that is predicted or identified should be quantified. The significance should be rated as high, medium, or low. In the determination of what is significant, techniques should be adopted that remove the subjectivity from the determination.

2.4.3 Significance can be determined with regard to:

a) the nature of the proposed or existing activity with regard to the causes of the effect;

b) the extent of the activity regarding whether the impact will be or is local or regional;

c) the duration of the activity's impact (short, medium, long, or even permanent);

d) the intensity of the activity's impact, classified in terms of the following: low – natural or social functions and processes are not affected; medium – the environment is altered, but the natural and social functions are able to continue in a modified way; and high – natural or social functions or processes are altered to such an extent that they will temporarily or permanently stop; and

e) the probability that the impact will actually occur in terms of the following: improbability – due to design or historical experience, the chance of impact occurring is very low; probable – where there is the possibility that the impact could occur; highly probable – in the case where it is more than likely that the impact will occur; and definite – here the impact will occur regardless of any preventative measures being implemented.

2.4.4 The criteria for significance should include the level of public concern and legal implications and impact on image should the impact occur.

2.4.5 The significance of the environmental impact could be to use it in conjunction with the cost benefit analysis (CBA) approach, which seeks to express impacts in monetary terms.

2.5 Identify the activity or root cause associated with the significant impact

2.5.1 Once all the significant environmental aspects have been identified based on the significance of their impacts, the activity that causes them should be identified. This is, in a sense, determining the root cause of the problem, and it is the root cause that one needs to manage and control to ensure that corrective and preventative measures are implemented through the EMP.

2.5.2 An impact is the result of a failure of plant/procedures/personnel to perform as expected (that is, no bund wall, wrong use of herbicides, uncontrolled management of storm water, ash and slurry plant inefficiency, personnel not trained, no operational procedure in place, etc.).

2.6 Set objectives and targets to address root cause

When downloaded from the EDS database, this document is uncontrolled and the responsibility rests with the user to ensure it is in line with the authorised version on the database.
2.6.1 After identifying, determining, and quantifying the environmental aspects and their associated activities (the root causes) that need to be addressed in the EMP, translate them into specific management objectives and specific measurable targets.

2.6.2 When these objectives and targets have been set, ensure that they conform to statutory requirements.

2.6.3 The objectives and targets set should be based on a combination of the legal requirements, the significance of the identified environmental aspect and its impacts, technological options, alternatives, financial limitations, business requirements, and the views of interested and affected parties.

2.6.4 The objectives should be specific and the targets measurable. These objectives and targets should address the identified root cause as identified in 2.5.

2.6.5 When objectives and targets are set, they should be linked to measurable environmental key performance indicators (KPIs) for measuring, monitoring, and auditing purposes.

2.7 Determine actions to be taken to meet objectives and targets – project or operational actions

2.7.1 The action required to achieve the set objective and targets in order to address the root cause should be established. Solutions to problem areas should be quantified, that is, Eskom procedures or standards, specialists’ reports and recommendations, and past successful solutions. The project actions could be one of the following:

a) **Plant:** that is, waste disposal site, storm water system, hazardous material store, rehabilitation of soil erosion areas, water treatment equipment, an oil trap, storm water berms, waste collection and separation site, new plant, screening vegetation and other forms of landscaping, etc. (This should include the actual location of plant and construction and operational procedures.)

b) **Procedures:** that is, the development of specific operational procedures for the carrying out of certain activities: to preserve archaeological sites, bush clearing, herbicide application, waste minimisation, water conservation, dust suppression, noise minimisation, etc. (The procedure should include responsibilities, reporting, monitoring, and conformance with permit requirements.)

c) **Personnel:** that is, training and skills development, awareness, incentives, penalties, etc.

2.7.2 The project actions are the key aspect of the EMP in that they are the actions taken that will achieve the required end state.

2.8 Integrate into project/operational systems, documentation, contracts

2.8.1 The actions in 2.7 should be integrated into applicable existing processes, systems, and documentation that are part of either the project for the development or of the existing operation.
2.8.1.1 For new development projects: the EMP action requirements should be integrated into the scope of work or work description as part of tender documents and subsequent contracts. A register (see Annex D) should be maintained identifying the EMP requirements and where they can be located within the contract documentation, that is, design specifications, procedures, work instructions, etc.

2.8.1.2 For existing sites: the EMP action requirements should become individual projects or specific responsibilities of an individual or team. For projects, the EMP shall be integrated into the scope of work or work description as part of the tender documents and subsequent contracts. A register (see Annex D) should be maintained identifying the EMP requirements and where they can be located within the operation.

2.8.2 In some cases, an EMP could be represented in a single document, but for full effectiveness, it should be integrated into the appropriate project or operational systems and documentation.

2.9 KPIs

2.9.1 Link performance of the EMP to existing business performance measures and reporting practices.

2.10 Implement EMP action

2.10.1 Once the EMP has been formulated, accountabilities set, and resources made available, the EMP should be implemented. This may, for a new project, be in terms of a single contract or many contracts with contractors and subcontractors.

2.10.2 For an existing site, it may be action undertaken by the responsible BU or individuals. It may also be in the awarding of contracts to undertake a specific project or part of operational and maintenance practices.

2.11 Monitoring and audit

2.11.1 Monitoring: the EMP will only be effective if there are mechanisms to measure and report on the KPIs. Together with the KPIs, there should be a monitoring programme in place to not only measure the EMP requirements, but also the environmental variables – that is, to measure not only conformance, but also environmental aspects and impacts that have not been accounted for in the EMP that are or could result in significant environmental impacts for which corrective action is required.

2.11.2 The monitoring should include evaluation of compliance with statutory and other legal (contract) requirements. The results of monitoring should be analysed and used to identify areas of good performance as well as those requiring corrective and preventive action.

2.11.3 Audit: to ensure the undertaking and conformance with the EMP requirements, an audit should be undertaken to close the EMP cycle. The audit can be used to identify non-conformances for which corrective action should be taken. The audit can also be used to identify findings that can be used to improve other EMPs.

2.11.4 Audit findings should result in updating baseline information and the assessment techniques used in the identification of environmental issues and impacts.

2.12 General environmental aspects to be addressed in an EMP

(Refer to respective division or Eskom subsidiary needs for specific aspects.)
2.12.1 Air quality

2.12.1.1 The negotiated CAPCO registration certificate requirements for power stations shall be adhered to.

2.12.1.2 The regulations issued in terms of the Conservation of Agricultural Resources Act, 1983 (Act 43 of 1983), section 6 (j) in respect of burning veld shall be adhered to.

2.12.1.3 In situations where firebreaks must be constructed to prevent fires spreading from the site as well as fires entering the site from adjacent land, these shall be constructed in accordance with the National Veld and Forest Fires Act, Act No 101 of 1998.

2.12.1.4 Vehicle drivers shall drive at moderate speed on site access roads to minimise or eliminate dust pollution. In urban areas, access roads shall be treated to reduce dust pollution (tar, concrete, chipstone, etc.).

2.12.1.5 Fumes (black smoke) emitted from vehicles and equipment/appliances shall be monitored and action taken to avoid causing a nuisance to the public.

2.12.1.6 Burning of waste material such as vegetation and old cleaning materials resulting from maintenance activities at a site is strictly prohibited.

2.12.1.7 Ash disposal areas shall be managed (rehabilitated) to minimise their potential for dust pollution.

2.12.2 Water quality

2.12.2.1 In accordance with the requirements of the Water Act, surface or groundwater shall not be polluted (oil, petrol, cleaning materials, herbicides, power station “dirty water” and ash, etc.) under any circumstances. Storm water shall be managed to ensure that it does not become polluted.

2.12.2.2 An adequate sewage facility (big enough capacity, no leaks, and emptied regularly in the case of a septic tank) shall be established, and the permit requirements of treatment equipment shall be adhered to.

2.12.2.3 Proper toilet facilities (possibly portable) shall be provided for field staff.

2.12.2.4 All hazardous substances at the site shall be adequately stored and accurately identified, recorded, and labelled (that is, polychlorinated biphenyls – PCB/Askarel). All waste to be disposed of at an appropriate waste facility.

2.12.3 Land management

2.12.3.1 The boundaries of the Eskom site shall be clearly identified and demarcated to ensure that the whole site is addressed in the EMP (the site usually extends far beyond the security fence).

2.12.3.2 The site’s title deed or deed of servitude shall be obtained, and the conditions contained therein shall be adhered to.

2.12.3.3 All bush clearing shall be undertaken in terms of an EMP and in conformance with legislation and Eskom policy and standard requirements.

2.12.3.4 Protected or endangered plant and animal species occurring on Eskom sites and servitudes shall be identified and protected from Eskom’s activities or plant. Permits shall be obtained from the relevant authority for the clearing of protected trees (see Environmental
2.12.3.5 Eskom shall adhere to the legal requirements in terms of herbicide usage.

2.12.3.6 Fences and gates of property owners shall not be damaged when gaining access to the site. The condition of Eskom gates and locks shall be regularly monitored to ensure that they are secure (that is, to prevent animals getting in or out as well as to prevent access to the site by unauthorised personnel). Gates shall always be kept closed.

2.12.3.7 Access roads and site ground shall be monitored for deterioration and possible erosion. Soil erosion shall be prevented at all times. Proactive measures shall be implemented to curb erosion and to rehabilitate eroded areas.

2.12.3.8 During construction of new sites/power lines, concrete dumping/washing is to be done on the piles of ground removed from the foundation excavations, which shall then be placed back into the foundation excavations.

2.12.3.9 Weeds shall not be allowed to grow or spread. Invasive plants and weeds shall be identified and controlled to prevent their spreading.

2.12.3.10 All animal fatalities due to the site infrastructure such as bird collisions and small mammal electrocutions shall be identified, and appropriate action shall be implemented to minimise or eliminate the problem. Wildlife interactions shall be reported, recorded, and investigated in compliance with BU procedure, and after action has been implemented to solve the problem, they shall be followed up to assess the effectiveness of the remedial measures taken.

2.12.3.11 No fires shall be made for waste destruction. Firebreaks shall be constructed to prevent fires from spreading from or into the site. Regulations in respect of veld burning issued under the Conservation of Agricultural Resources Act, Act No 43 of 1983, section 6 (j) shall be adhered to. These shall align with the Forest Act, Act No 122 of 1984 and the National Veld and Forest Fires Act, No 101 of 1998.

2.12.3.12 A plan/programme for the landscaping of the site shall be considered. This shall cover the aesthetics of the site (screening of site using embankments, walls, and/or vegetation) and rehabilitation.

2.12.4 Community issues

2.12.4.1 A list of the neighbouring properties, property owners’ names, addresses, and telephone numbers, and land use shall be drawn up.

2.12.4.2 A plan of action shall be concluded with the neighbouring property owners and the relevant authorities in the case of an emergency (veld fire, oil spillage, water contamination, etc.). Eskom contact names and telephone numbers shall be given to all neighbours, and vice versa.

2.12.4.3 Property owners and local residents shall be treated with respect and courtesy at all times.

2.12.4.4 The culture and lifestyles of the communities living in close proximity to the site and work sites shall be respected.

2.12.4.5 Removal (pilfering) of agricultural products (sugar cane, fruit, vegetables, stock, firewood, etc.) and poaching are prohibited. Receipts shall be obtained for any merchandise purchased or received from landowners.
2.12.4.6 Environmental clauses shall be included in contract documents for all contractors (the services of contractors with proven track records of sound environmental performance shall be used).

2.12.4.7 Graves, archaeological sites, and sites of historical interest (as defined in the National Heritage Resources Act, Act No 25 of 1999) in close proximity to an Eskom site or other work sites shall be protected and treated with respect.

2.12.4.8 All complaints shall be reported, recorded, and investigated in compliance with the BU/procedure.

2.12.4.9 Eskom sites shall be evaluated in terms of their contribution to noise pollution, and actions shall be implemented to ensure conformance with legal requirements and taking into consideration the views of adjacent land users/landowners.

3 Supporting clauses

3.1 Scope

The purpose of this document is to ensure that:

a) there is a process to identify existing negative environmental impacts or to predict potential negative environmental impacts;

b) objectives and targets are set to ensure that negative impacts are mitigated and existing impacts rehabilitated;

c) resources and responsibilities are allocated to each target;

d) actions are implemented to mitigate the identified negative environmental impacts; and

e) monitoring programmes are developed to track the actions that have been implemented to ensure the effectiveness of the actions.

This procedure is applicable to Eskom Holdings (Pty) Limited and its divisions and wholly owned subsidiaries.

3.2 Definitions and abbreviations

For general definitions, refer to the Environmental Procedure. Definitions specific to this document are repeated below

BU Business unit
CAPCO Chief Air Pollution Control Officer
EIA Environmental impact assessment
EMP environmental management programme

Environmental management programme A programme that seeks to achieve a required environmental end state and describes how activities that could have a negative impact on the environment will be managed and monitored and impacted areas rehabilitated.

3.3 Normative references

The following documents contain provisions that, through reference in the text, constitute requirements of this procedure. Latest versions apply.
3.4 Implementation date

The implementation date will be 1 January 2007.

3.5 Monitoring process

Reporting on EMP implementation is included in Eskom’s Annual Report. This information is subject to internal and external audit.

3.6 Related documents

Environmental Land Policy EPL 32-97

Environmental Procedure – Land – Procedure for vegetation clearance and maintenance within overhead power line servitudes and on Eskom-owned land EPC 32-96

3.7 Authorisations

This document has been seen and accepted by the ELC and duly authorised by the General Manager Corporate Sustainability.

3.8 Revisions

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<td>Dec 2005</td>
<td>2</td>
<td>Dave Lucas</td>
<td>Revised totally in terms of policy review process.</td>
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4 Annexes

Annex A
(Informative)

There are three main categories of documentation that one should have access to for EMP development. These three sets of documents provide the link between Eskom’s activities and the legal requirements that have to be complied with.

- Eskom Legal Register that links Eskom activities to the relevant legal requirements
- Specific pieces of legislation as made mention of in the Legal Register above
- The relevant Eskom control documentation that is based on ensuring compliance with legislation through controlling how activities need to take place

The link to relevant Eskom environmental documentation and legislation can be found at the following link: http://teknowrep/cs/.

A.1 Eskom-controlled documentation

Many of the standards and procedures are being combined into an overall Control Document for the Environmental Procedure. It contains all supporting documentation and clauses required for environmental procedures in Eskom and should be referenced in all documentation forming part of the procedure. All requirements and clauses shall apply to all supporting documentation unless specifically mentioned.

Access to the relevant environmental documentation can be gained through the following link: http://teknowrep/cs/.

Eskom environmental documentation

- SHE Policy
- Environmental Liaison Committee (ELC) Reporting Procedure
- ELC Terms of Reference
- Air Quality Management Policy
- Water Management Policy
- Climate Change Policy
- Environmental Land Policy
- Environmental Procedure, containing sections on the following:
  - Environmental management system
  - Environmental management programme
  - Waste management
  - Land management
  - Electro and magnetic fields
  - Due diligence
  - Reporting on environmental expenditure
Annex A
(Continued)

A.2 Environmental statutory requirements

Eskom Environmental Legal Register

These environmental legal registers have been developed based on the activities of Eskom and, in particular, those activities that have an impact on the environment. They are based on the relevant divisional aspect registers, which identify the aspects of the division's activities that have a significant impact on the environment.

The registers have been developed by Imbewu Legal Consultants to fulfill the ISO 14001 Environmental Management System Standard requirements for all divisions in Eskom.

The Eskom environmental legal registers can be found at http://teknowrep/cs/legal/.

The Eskom Environmental Legal Register consists of the following:

- Eskom Group Environmental Legal Register
- Corporate Sustainability (SHE) Legal Register
- Generation Environmental Legal Register
- Distribution Environmental Legal Register
- Finance Environmental Legal Register
- Transmission Environmental Legal Register
- Abbreviation Index and the Environmental Legal Commentary

All of these may be accessed directly from this main index or from the index of each of the registers.

The legal registers cover all South African national legislation and regulations and also refer to relevant international conventions, which are discussed in further detail in the Eskom Environmental Legal Commentary. Relevant Eskom policy documents have been referred to in the tables. It is important to note that the register covers generic legal obligations and that each facility will need to investigate its own site-specific legal requirements, for example, provincial legislation, local by-laws, permits, contracts, etc., to ensure that all legal obligations that are applicable to the particular facility are covered.

At the beginning of each aspect table, the generally applicable legal requirements that apply to that aspect are set out, for example, the requirements that are applicable to air emissions generally. Legal obligations relevant to particular components of the aspect, for example, carbon dioxide or dust emissions, are then dealt with separately.

The best way to access the applicable legal obligations is to select the aspect that one wishes to investigate by first going to the index of aspects in the Environmental Register, double-clicking on that aspect, and then perusing the legal obligations and guidelines set out in the table relating to that aspect. All of the phrases underlined in the tables on legal obligations (that is, the main source of the legal obligation, set out in abbreviated form, for example, NEMA for National Environmental Management Act) indicate that the text has been linked by Eskom to the relevant section of the particular Act or regulation included in the Eskom environmental legislation database.

A brief description of the essence of the legal provision and its relevance to Eskom is provided. Where further information has been included in the Legal Commentary on the particular obligation listed in the table, a link is provided under the obligation directly to that point in the Legal Commentary.
Annex A

(Concluded)

The Legal Commentary should be read in conjunction with the tables summarising the applicable legal obligations. It is important to note that although hard copies of the Legal Register have been provided for ease of reference, the register has been specifically compiled for electronic use and so that the legal obligations could be directly linked to the actual legislation contained in the Eskom environmental database.

The legislation database is updated on a regular basis, depending on the nature and extent of changes in relevant legislation. The legal registers have been prepared to assist Eskom with compliance with generally applicable legal obligations and are intended as a guideline only. The legal registers are not a substitute for detailed legal advice on specific issues and do not cover all legal obligations. Should you require more detailed legal advice or have any queries in regard to the content or application of the registers, kindly contact Catherine Warburton at IMBEWU Enviro-Legal Specialists (Pty) Ltd on (011) 325-4928.

Environmental legislation

Eskom has access to a legal database ([http://teknowrep/cs/legal/](http://teknowrep/cs/legal/)) to access relevant environmental legislation. This database only covers national legislation, provincial legislation, and some local legislation. Please consult your local authority to get by-laws applicable to your business unit.

Relevant external legal links

<table>
<thead>
<tr>
<th>ECOLEX: Gateway to Environmental Law</th>
<th>A gateway to environmental law, (international site by UNEP, looking at international treaties, national legislation, court decisions, and literature)</th>
<th>This site has a good search engine.</th>
</tr>
</thead>
<tbody>
<tr>
<td>SA Government</td>
<td>Official government documents</td>
<td>Sometimes difficult to find specific document.</td>
</tr>
<tr>
<td>Acts Online</td>
<td>Access to South African Acts</td>
<td>Simple to access specific acts; not sure how up to date the site is.</td>
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**Annex B**
(Normative)

**B.1 Checklist for required power line baseline data**

Power line name: .....................................................................................................................................................

Responsible person/BU: ...........................................................................................................................................

Assessor’s name: .......................................................... Unique no: .......................

Assessment date: .....................................................................................................................................................

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<th>No</th>
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<tr>
<td>1</td>
<td>1:50,000 map with annotated power lines and towers</td>
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<td>2</td>
<td>Spanning plans/profiles</td>
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<td>3</td>
<td>Vegetation types</td>
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<td>4</td>
<td>Soil types</td>
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<td>5</td>
<td>General climate</td>
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<tr>
<td>6</td>
<td>Vegetation control procedures/standards</td>
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<td>7</td>
<td>Herbicide procedures/standards</td>
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<td>Herbicide Register</td>
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<td>9</td>
<td>Bird Interaction Register</td>
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<td>10</td>
<td>Sections of power line fitted with bird markers/protectors/shields/guards</td>
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<td>Vegetation control contracts in place</td>
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<td>Affected landowners’ property details, names, addresses, telephone numbers, and land use</td>
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<tr>
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<td>Lightning frequency</td>
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<td>Sensitive environmental areas</td>
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<td>Line slope analysis (slope and soil type and rainfall)</td>
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Annex B
(Continued)

B.2 Checklist for baseline data required for land, substation, and radio repeater sites

Site name: .................................................................

Responsible person: ..........................................................

Assessor's name: ...................................................... Unique no: ....................

Assessment date: ..........................................................

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<th>Action</th>
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<td>1</td>
<td>Map showing extent of Eskom property (servitude or property diagram)</td>
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<tr>
<td>2</td>
<td>Layout map showing site layout on Eskom property</td>
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<tr>
<td>3</td>
<td>Plans showing water supply, sewage discharge, oil traps/bund walls/canals/holding dams, storm water drains, fire hydrants</td>
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<tr>
<td>4</td>
<td>Register of All Hazardous Substances and their hazardous data sheets</td>
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<tr>
<td>5</td>
<td>Waste Register (domestic, medical, hazardous, garden, building rubble)</td>
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<tr>
<td>6</td>
<td>Herbicide Register</td>
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<tr>
<td>7</td>
<td>Register of Legal Requirements</td>
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<td>8</td>
<td>Register of Operational Policies, Standards, Procedures, and Work Instructions</td>
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<tr>
<td>9</td>
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<td>10</td>
<td>Register of All Contracts in Place</td>
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<tr>
<td>11</td>
<td>Soil type</td>
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<td>Problematic vegetation</td>
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<tr>
<td>13</td>
<td>Adjacent property descriptions, landowners' names, addresses, telephone numbers, and land use</td>
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<td>15</td>
<td>Title deeds of property</td>
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<tr>
<td>16</td>
<td>Special conditions in terms of land use zoning and landowners' &quot;special agreements&quot;</td>
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<tr>
<td>17</td>
<td>Firebreak statutory requirements and programme</td>
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Annex B
(Continued)

B.3 Checklist for baseline data required for power station sites

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<tr>
<td>1</td>
<td>Map showing extent of Eskom properties (property diagrams)</td>
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<td>CAPCO registration certificate</td>
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<td>3</td>
<td>Water quality requirements (permits)</td>
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<td>4</td>
<td>Registration certificate of waste site</td>
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<td>Copies of title deeds of properties</td>
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<td>All lease contracts of Eskom land with third parties</td>
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<td>7</td>
<td>Special conditions in terms of land use zoning and landowners’ “special agreements”</td>
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<td>8</td>
<td>Layout map showing site layout on Eskom property and associated plant and activities</td>
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<td>9</td>
<td>Plans/schematic drawings showing coal stockyard, coal bunkers and mills, coal conveyors, dumping of coal discards</td>
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<td>10</td>
<td>Plans showing location and drainage at precipitators, hoppers, ash and slurry plant, ash pipelines/conveyors, ash disposal areas</td>
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<td>11</td>
<td>Plans showing location and drainage at turbine lubricating store and processing plant, transformer oil purification and processing plant, bulk oil and lighting up plant, clean and dirty oil stores</td>
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<td>12</td>
<td>Plans showing water systems, that is, potable water treatment plant, demineralisation plant, condensate polishing plant, chemical laboratories and stores, storm water drainage system, blowdowns, dirty water effluent dam/station drain dams, clean water dams, intermediate/emergency dams, storm water disposal systems, sewage plant, raw water reservoir, diversion of streams</td>
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Annex B

(Concluded)

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<tr>
<td>13</td>
<td>Plans showing plantations, nursery yard, rehabilitated and landscaped areas, recreational areas, degraded areas</td>
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<tr>
<td>14</td>
<td>Plans showing power lines, airstrip, roads, parking areas, boundary fences, security fences, firebreaks, fire station and training area, medical centre, buildings, workshops, accommodation, leased areas, surrounding land use, waste collection and disposal areas</td>
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<td>15</td>
<td>Register of All Hazardous Substances and their hazardous data sheets</td>
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<td>Waste Register (domestic, medical, hazardous, garden, building rubble, oil, metals)</td>
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<td>Herbicide Register</td>
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<td>Register of All Operations Taking Place on the Site that Affect Environmental Performance</td>
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<td>Register of All Contracts in Place</td>
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<td>Soil type</td>
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<td>26</td>
<td>Firebreak statutory requirements and programme</td>
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<td>27</td>
<td>Climate and weather</td>
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<td>All environmentally-related permits and certificates and correspondence</td>
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<td>Environmental monitoring results, reports, and performance indicators</td>
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Annex C
(Normative)

C.1 Checklist for identification of environmental aspects and impacts on power line routes

Site name: ………………………………………………………………………………………………..

Responsible person: ……………………………………………………………………………………

Assessor’s name: …………………………….. Unique no: ……………

Assessment date: ………………………………………………………………………………………

From tower no: ………………… To tower no: ………………

(Environmenat issues identified shall be marked up on a sketch or map of power line.)

Checklist for issues to be identified

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<td>Access road:</td>
<td>Bird interactions</td>
<td>Storm water drainage</td>
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<tr>
<td>• Centre line</td>
<td>• Collisions</td>
<td>• Natural</td>
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<td>• Other</td>
<td>• Electrocutions</td>
<td>• Berms</td>
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<td>• Pollution</td>
<td>• Channels</td>
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<td>• Nests</td>
<td>• Pipes</td>
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<td>• Need for remedial action</td>
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<tr>
<td>Soil erosion</td>
<td>Eskom gates</td>
<td>Social activities under power line</td>
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<tr>
<td>• Tower position</td>
<td>• General condition</td>
<td>• Houses</td>
</tr>
<tr>
<td>• Access road</td>
<td>• Closed and locked</td>
<td>• Farming</td>
</tr>
<tr>
<td>• River crossing</td>
<td>• Locks</td>
<td>• Structures</td>
</tr>
<tr>
<td>• Other</td>
<td></td>
<td>• Mining</td>
</tr>
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<td></td>
<td>• Airfields</td>
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<td>• Power lines</td>
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<td></td>
<td>• Telephone lines</td>
</tr>
<tr>
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<td></td>
<td>• Other</td>
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<tr>
<td>Bush encroachment</td>
<td>Construction material</td>
<td>Visual impact</td>
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<tr>
<td>• Clearance</td>
<td>• Concrete</td>
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<td>• Fire risk</td>
<td>• Steel works</td>
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<td>• Insulators</td>
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<td>• Conductor</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• General</td>
<td></td>
</tr>
<tr>
<td>Alien/invader vegetation</td>
<td>Fence crossings</td>
<td>Soil type</td>
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<tr>
<td>• Access</td>
<td>• General condition</td>
<td>• Sandy</td>
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<td>• Fire risk</td>
<td>• Spread</td>
<td>• Clay</td>
</tr>
<tr>
<td>• Clearance</td>
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<td>• Rocks</td>
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<td>• Spread</td>
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<td>• Wet</td>
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<td>Protection of natural vegetation</td>
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<td>Lightning</td>
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<tr>
<td>Archaeological/historical/natural heritage/cultural sites</td>
<td>River crossings</td>
<td>Complaints or requests from landowners</td>
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<tr>
<td>Noise complaints</td>
<td>Risk to airfields and flight paths (crop spraying and game management)</td>
<td>Radio/TV interference</td>
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</table>

When downloaded from the EDS database, this document is uncontrolled and the responsibility rests with the user to ensure it is in line with the authorised version on the database.
C.2 Field checklist to identify environmental aspect to be corrected

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<td></td>
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<td></td>
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Annex C
(Continued)

C.3 Checklist for identification of environmental aspects and impacts at Eskom sites, land, substation, and radio repeater sites

Site name: ..........................................................................................................................

Responsible person: ...........................................................................................................

Assessor’s name: .............................................. Unique no: ......................

Assessment date: ..............................................................................................................

(Environmental aspect identified should be marked up on this sketch.)

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<td>Erosion</td>
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<tr>
<td>• HV yard</td>
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</tr>
<tr>
<td>• Security fences</td>
<td></td>
<td></td>
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<tr>
<td>• Storm water</td>
<td></td>
<td></td>
</tr>
<tr>
<td>• Access road</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Vegetation control</td>
<td></td>
<td>N/A</td>
</tr>
<tr>
<td>• HV yard</td>
<td></td>
<td></td>
</tr>
<tr>
<td>• Security fences</td>
<td></td>
<td></td>
</tr>
<tr>
<td>• Outside fence area</td>
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<tr>
<td>• Firebreak</td>
<td></td>
<td></td>
</tr>
<tr>
<td>• Other</td>
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<td></td>
</tr>
<tr>
<td>Storm water</td>
<td></td>
<td>N/A</td>
</tr>
<tr>
<td>• Outlet</td>
<td></td>
<td></td>
</tr>
<tr>
<td>• HV yard</td>
<td></td>
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<tr>
<td>• Terraces</td>
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### Impact

<table>
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<th>Description</th>
<th>N/A</th>
<th>High</th>
<th>Med</th>
<th>Low</th>
</tr>
</thead>
</table>
| Leaching of herbicides | • Security fences  
  • Outside Eskom property | | | | |
| Oil spills | • HV yard  
  • Oil dam  
  • Storage area | | | | |
| Littering | • General  
  • Maintenance  
  • Construction | | | | |
| Waste disposal | • Waste separation  
  • Bins  
  • Site disposal  
  • Contract for disposal | | | | |
| Water | • Municipal  
  • Storm water collection  
  • Borehole | | | | |
| Sewerage | • Municipal  
  • Septic tank  
  • French drain | | | | |
| Hazardous material store | • Register  
  • Data sheets  
  • Ventilation  
  • Storage | | | | |
| Security of oil dam | • Security fence  
  • Shade netting | | | | |
| Animal interactions | • Security fence  
  • HV yard (pollution/nests)  
  • Oil dam | | | | |
| PCB labelling | | | | | |
| Firebreak | | | | | |
| Oil trap | | | | | |
| Landscaping | | | | | |
| Visual impact | | | | | |
| Complaints and requests by landowners | | | | | |
| Noise pollution and complaints | | | | | |
| Eskom fences and gates | • General condition | | | | |
| · Closed and locked  
| · Locks     |
C.4 Checklist for identification of environmental aspects and impacts at power station sites

Site name: .................................................................

Responsible person: ...........................................................

Assessor’s name: ........................................... Unique no: ...........

Assessment date: .................................................................

(Environmental aspect identified should be marked up on a site plan.)

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<td>General site</td>
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<tr>
<td></td>
<td>Security fences</td>
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<td>Storm water</td>
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</tr>
<tr>
<td></td>
<td>Access roads</td>
<td></td>
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<td>Vegetation control</td>
<td>General site</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Security fences</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Outside fence area</td>
<td></td>
</tr>
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<td></td>
<td>Firebreak</td>
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### Annex D

*(Normative)*

**EMP Register**

**D.1 Environmental Management Programme Register**

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Annexure B

Eskom SHE Policy
Safety, Health and Environment (SHE) Policy

Guiding principles by which we operate

• We are committed to safety, health and environmental excellence and will conduct business with respect and care for people and the environment and, in so doing, will ensure that adequate resources are available for SHE management.

• We will ensure that SHE is an integral part of our operations and that no operating condition, or urgency of service, can justify endangering the life of anyone or cause injury or damage to the environment.

Compliance to this policy and applicable regulations shall be the responsibility of every employee and contractor.

This statement is an extract from the Eskom Safety, Health and Environment (SHE) Policy: No 33.94, Rev 1 - August 2007

Jacob Maroga
Chief Executive

Eskom
With Energy, Anything is Possible
Content

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6 Development team ............................................................................................... 7
7 Distribution .......................................................................................................... 7
1 Introduction

The strategic intent of Eskom Holdings Limited is to build the powerbase for sustainable growth and development – generating a sustainable foundation for growth and creating value for stakeholders and society, while reducing the safety, health, and environmental impact of our operations. Through this policy, we commit ourselves to excellence in safety, health, and the environment and confirm to all employees, contractors, visitors, stakeholders, and the public that we will conduct our business in a caring, responsible manner. We will implement sustainable strategies to develop and manage the entire electricity value chain so as to deliver high-quality, affordable electricity in a changing business, social, natural, and political environment, without compromising future sustainability.

We will continuously advance our business practices in line with international best practice, legislative requirements, and corporate best practice innovations. The implementation of this policy will be measured progressively to ensure sustainable excellence in safety, health, and environmental management. Accountability for safety, occupational health, and environmental management will be held by the Board of Directors, including the Chief Executive. Compliance with the Safety, Health, and Environment Policy and applicable regulations shall be the responsibility of every employee and contractor.

2 Policy statement

2.1 Policy principles (guiding principles by which we operate)

- We are committed to safety, health, and environmental excellence and will conduct business with respect and care for people and the environment and, in so doing, will ensure that adequate resources are available for SHE management.

- We believe that all injuries and occupational illnesses, as well as safety and environmental incidents, are preventable, and our goal for all is zero. We will also promote off-the-job safety for all our employees.

- We will engage key stakeholders, including employees and organised labour, on all elements of SHE issues.

- We will continuously appraise our SHE performance with the objective of continuous sustainable improvement.

- We will ensure that SHE is an integral part of our operations and that no operating condition, or urgency of service, can justify endangering the life of anyone or cause injury or damage to the environment.

- Management in each business will be responsible for educating, training, and motivating employees and contractors in relation to SHE issues.

- We will work with suppliers and customers to integrate SHE issues into their operations, and contractors working under our supervision, or on Eskom premises, will comply with this policy.

- This policy will apply wherever Eskom operations exist or Eskom operates, including subsidiaries.

- This policy will apply during the evaluation of all contracts, projects, and proposals.

2.2 Policy

Eskom, as a provider of energy and associated services, will:

1. establish appropriate management systems to address safety, occupational health, and environmental issues with a view to minimising risk and ensuring duty of care and the management of pollution and environmental degradation, performance monitoring, and continuous improvement;
2. comply with all legislative and policy requirements and, in the absence of appropriate principles, set standards to meet the objectives of this policy;

3. promote open communication on SHE issues with employees and all stakeholders;

4. educate, train, motivate, and develop its employees in terms of occupational health, safety, and environmental issues;

5. provide and maintain a safe and healthy work environment and protect individuals against risk associated with occupational health and safety arising out of Eskom’s business; and

6. contribute towards sustainable development through cost-effective resource use and efficient production, distribution, and use of energy.

Details relating to the implementation of these elements are included in Annexure A.

2.3 Supporting documents

Additional policies and procedures may be developed in support of the aims and objectives of this document and are seen as equal in stature. Provisions of this document will apply to all policies developed in terms of this clause, except where specifically stated. Controlled documents developed in terms of this clause are listed in Annexure B.

3 Supporting clauses

Index of supporting clauses

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3.1 Scope

3.1.1 Purpose

This policy serves as the basis for environmental, occupational health, and safety management in the Eskom Group inside and external to South Africa and relevant subsidiaries and to ensure uniformity in the application thereof in all applicable operations.

3.1.2 Applicability

This policy shall apply throughout Eskom Holdings Limited and its divisions, subsidiaries, and entities wherein Eskom has a controlling interest, including identified contractors, suppliers and service providers, and customers of Eskom and Eskom subsidiaries, where significant impacts and risks may occur.
Where Eskom has significant influence in entities and/or operations, including instances where Eskom may be contractors, this policy will be applied in those areas directly under the control of Eskom, and due process will be followed to influence the entity or operation to comply with the requirements of this document.

3.2 Normative/informative references

Parties using this policy shall apply the most recent edition of the documents listed below:

- The United Nations Global Compact
- International Conventions, including but not limited to Basel, Kyoto, etc.
- National legislation, including but not limited to NEMA, OHSA, and COID
- SANS 14001: 2005, Environmental management systems – Specification with guidance for use

3.3 Definitions

3.3.1 Compliance audit: any audit designed in such a way that it will measure/evaluate compliance with legal and Eskom requirements, including identified good practices.

3.3.2 Contractor: registered business or employer to whom a contract is awarded to conduct business on behalf of Eskom.

3.3.3 Controlling interest:
   a) the ownership or control (directly or indirectly) of more than 50% (fifty per cent) of the voting share capital of the relevant undertaking;
   b) the ability to direct the casting of more than 50% (fifty per cent) of the votes exercisable at general meetings of the relevant undertaking on all, or substantially all, matters; or
   c) the right to appoint or remove directors of the relevant undertaking holding a majority of the voting rights at meetings of the Board on all, or substantially all, matters.

3.3.4 Incident: "incident" means an unexpected sudden occurrence, including a major emission, fire, or explosion, leading to serious danger to the public or potentially serious pollution of, or detriment to, the environment, whether immediate or delayed.

3.3.5 Environment: the surroundings within which humans exist and that are made up of:
   i) the land, water, and atmosphere of the earth;
   ii) micro-organisms and plant and animal life;
   iii) any part or combination of (i) and (ii) and the interrelationships among and between them;

   and the physical, chemical, aesthetic, and cultural properties and conditions of the foregoing that influence human health and well-being.

3.3.6 Event: SHE happenings reported by BUs to groups and ELC, including all media and occurrences and issues in contravention of legislation and within legal parameters.

3.3.7 Hazard: means a source of, or exposure to, danger.

3.3.8 Incident: undesired accidental event that results in injury, damage, or loss.

3.3.9 Occupational health and safety: includes occupational hygiene, occupational safety, occupational medicine, fire safety, and public safety and emergency preparedness.

3.3.10 Pollution: means any change in the environment caused by:
   i) substances;
   ii) radioactive or other waves; or
   iii) noise, odours, dust, or heat;
emitted from any activity, including the storage or treatment of waste or substances, construction, and the provision of services, whether engaged in by any person or an organ of state, where that change has an adverse effect on human health or well-being or on the composition, resilience, and productivity of natural or managed ecosystems or on materials useful to people, or will have such an effect in the future.

3.3.11 Risk: the probability that injury or damage will occur.

3.3.12 Safety: the management and control of associated risks to provide an environment that is safe for people to work in.

3.3.13 Significant influence: the power to participate in the financial and operating policy decisions of the entity, but not control over those policies.

3.3.14 Subsidiary: Eskom Enterprises and the line divisions, should they become incorporated, or any other company in which Eskom Holdings Limited is a holding company controlling a majority of the votes (that is, more than 50%).

3.3.15 Sustainability: the integration of sustainable development into business strategy, practices, and operations.

3.3.16 Sustainable development: meeting the needs of the present without compromising the ability of future generations to meet their own needs. Sustainable development is also defined as the integration and consideration of three pillars, namely, economic, social, and environmental issues.

3.4 Abbreviations

3.4.1 BSC: Board Sustainability Committee
3.4.2 COID: Compensation for Occupational Injuries and Disease
3.4.3 ELC: Environmental Liaison Committee
3.4.4 ExCo SSC: Executive Committee Sustainability Sub-committee
3.4.5 GMCS: General Manager Corporate Sustainability
3.4.6 EXCO: Executive Management Committee
3.4.7 OHSA: Occupational Health and Safety Act
3.4.8 OHS LC: Occupational Health and Safety Liaison Committee
3.4.9 SHE: Safety, Occupational Health, and Environment
3.4.10 SLC: Sustainability Liaison Committee
3.4.11 CTAD: Corporate Technical Audit Department
3.4.12 BUs: Business Units

3.5 Roles and responsibilities

3.5.1 The Chief Executive, as the Chief Safety Officer of Eskom, has the accountability to ensure that this policy is implemented.

3.5.2 Managing Directors shall be responsible and accountable for the development, implementation, and performance of the appropriate SHE management systems in their respective divisions.

3.5.3 The General Manager Corporate Sustainability (GMCS) shall establish mechanisms to ensure an Eskom coordinated and aligned approach to SHE management and shall ensure that issues relating to SHE performance are monitored and recorded. All areas of the organisation shall report on sustainability issues, and the GMCS shall complement the assurance function provided by CTAD to the SLC, ExCo SSC, and the BSC.
3.5.4 Each business unit manager shall provide his/her Managing Director with the assurance that all SHE issues that are appropriate to his/her business are being addressed. Each Managing Director will, in turn, provide the Chief Executive with a letter of assurance to this effect.

3.5.5 Supervisors shall be responsible for SHE issues at work. This primarily means the prevention of accidents and injury to staff, contractors, and visitors and prevention of damage to the environment. It shall be the supervisors’ responsibility to issue clear and explicit working instructions and to ensure, through good supervision, that work is carried out in accordance with SHE rules, practices, and instructions.

3.5.6 Supervisors who are responsible for SHE at a work site shall be trained accordingly. Managers shall satisfy themselves that this training is adequate and that the supervisors’ knowledge regarding SHE management is kept up to date.

3.5.7 Employees have a duty as a condition of employment to reasonable care for their own safety and health and the safety and occupational health of their fellow workers and other persons who may be affected by their work.

3.5.8 Employees and contractors shall report all incidents, near misses, unhealthy situations, unsafe acts and/or conditions, dangerous occurrences, legal contraventions, risks, pollution, etc. that come to their attention.

3.5.9 Employees, contractors, and visitors shall wear all necessary personal protective equipment provided and ensure that it is kept in good condition.

3.5.10 Each BU manager is to ensure that inspections and audits are conducted in the workplace to ensure SHE system success and to monitor effectiveness of safety programmes and continuous improvement.

3.6 Implementation

The implementation date is 1 January 2007.

3.7 Process for monitoring

Detailed monitoring requirements are through CTAD, the Environmental Liaison Committee, and the Occupational Health and Safety Liaison Committee.

3.8 Related documents

This policy works in conjunction with the Eskom Sustainability Strategy ESG 32-167. It supersedes the following documents:

- ESKPBAAD6, *Environmental Management Policy*
- ESKPBABN0, *Eskom Occupational Health and Safety Policy*
4 Authorisations

This policy has been seen and accepted by:

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</tr>
<tr>
<td>EN Matya</td>
<td>Managing Director (Generation Division)</td>
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<tr>
<td>PJ Maroga</td>
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<tr>
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<tr>
<td>Dr SJ Lennon</td>
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<tr>
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<tr>
<td>PD Mbonyana</td>
<td>Managing Director (Corporate Division)</td>
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<tr>
<td>BA Dames</td>
<td>Managing Director (Enterprises Division)</td>
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5 Revisions

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<td>January 1995</td>
<td>5</td>
<td>Original number EVD1011. A policy with reference number ESKPBAAD6 was developed and published on the Eskom Documentation System.</td>
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<tr>
<td>November 1997</td>
<td>6</td>
<td>ESKPBAAD6 was revised and published.</td>
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<td>March 2001</td>
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<td>ESKPBAAD6 was revised and published.</td>
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<td>A directive with reference number ESKADAAQ9 was developed and published on the Eskom Documentation System.</td>
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<td>ESKADAAQ9 was converted into a policy, allocated a new reference number ESKPBABN0, developed, and published.</td>
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<td>The contents of policies ESKPBAAD6 and ESKPBABN0 were revised and incorporated into one policy, which was reallocated reference number 32-94 in accordance with the Eskom documentation requirements.</td>
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6 Development team

This document has been developed on behalf of the Environmental Liaison Committee, the Occupational Health and Safety Liaison Committee, and the Sustainability Liaison Committee, members of which have contributed at all levels of development.

7 Distribution

This policy is a public document and shall be published on the Eskom external website. Copies of the single-page summary of this policy, signed by the Chief Executive and Managing Directors, shall be displayed in strategic places.
Annexure A

Strategies for the implementation of the Safety, Health, and Environment (SHE) Policy

1 Establishing appropriate management systems to address safety, occupational health, and environmental issues with a view to minimising risk and ensuring continual improvement. This will include the prevention of pollution and environmental degradation and, where sustainable, will be supported by:

- ensuring compliance with SANS ISO 14001 or other appropriate quality standards;
- integrating SHE issues into all aspects of the organisation;
- determining, managing, and measuring the SHE impacts of Eskom activities;
- monitoring, managing, and reporting incidents, accidents, and events;
- setting and reviewing SHE performance targets;
- ensuring that compliance audits are conducted;
- ensuring the thorough investigation of accidents and incidents and taking appropriate corrective actions in case of deviations to prevent recurrence of similar incidents;
- researching and instituting ways to improve SHE operations and impacts;
- including environmental and safety considerations in procurement processes;
- reporting on performance in terms of this policy;
- benchmarking performance against other utilities; and
- divisions will establish and implement procedures for identifying significant risks and impacts along the extended electricity value chain, as appropriate, in order to communicate and encourage continual improvement in SHE practices beyond the traditional boundaries of the Eskom group, for example, with contractors.

2 Complying with all legislative and policy requirements and, in the absence of appropriate principles, setting standards to meet the objectives of this policy will be supported by:

- ensuring that all legally required occupational health and safety and environmental factors and modern practices are taken into account in the design, construction, operation, and maintenance of all plant, machinery, equipment, and places of work;
- taking best practice and local needs and conditions into account when setting standards;
- while operating outside of South Africa (SA), local legislation or other mandatory standards will be applied if these exceed Eskom policy, without derogating from the local laws;
- while operating outside of SA, where standards imposed by local legislation are lower than those specified by Eskom, Eskom standards and policies and SA legislation will be used, without derogating from the local laws;
- in the absence of local legislative requirements while operating outside of SA, applying Eskom policy and South African legislative requirements to operations;
- ensuring that the required statutory appointments are in place and that these appointees fulfil their duties in terms of the relevant legislation and standards; and
- ensuring that incidents and events are reported to the necessary authorities as required by legislation and when appropriate.
Annexure A
(concluded)

3 Promoting open communication on SHE issues with employees and other stakeholders will be supported by:
   • communicating with employees, communities, and other concerned parties and stakeholders about Eskom’s SHE programmes and performance; and
   • publishing verified SHE-related information, including major incidents or legal contraventions, in the Eskom Annual Report.

4 Educating, training, motivating, and developing its employees about safety, occupational health, and environment issues will be supported by:
   • ensuring that employees are aware of safety, occupational health, and environmental standards, rules, procedures, regulations, codes, and guidelines;
   • communicating on lessons learnt from incidents from a SHE perspective and revising procedures or policy where appropriate;
   • encouraging staff to develop a sense of SHE responsibility; and
   • giving due recognition to individuals and business units for exemplary occupational health, safety, and environmental performance.

5 Providing and maintaining a healthy and safe work environment and protecting individuals against risk to occupational health and safety arising out of Eskom’s business will be supported by:
   • providing, evaluating, and maintaining all operational procedures and methods of work in the light of experience and new knowledge to proactively improve the management of occupational health, safety, and environmental risks;
   • ensuring that all the risks are identified and that measures are taken and implemented as may be reasonably practicable to eliminate or mitigate any hazard or potential hazard to employees before resorting to personal protective equipment;
   • maintaining discipline; and
   • ensuring that managers are accountable.

6 Contributing to sustainable development through efficient resource use and efficient production, distribution, and use of energy will be supported by:
   • striving for cost-effective and efficient production, transport, and use of energy, by monitoring performance, setting targets, and highlighting the impact of inefficient operations;
   • promoting the efficient use of materials, products, and services; and
   • sharing lessons learnt and striving for continual improvement.
Annexure B

Supporting documents

Following are policies and procedures developed in terms of paragraph 2.3:

Policy/procedure

- Climate Change Policy
- Renewable Energy Policy
- Land Policy
- Environmental Procedure
- Health and Safety documents
Annexure C

Template for Method Statements
INFORMATION FOR CONSTRUCTION / EPCM EMPS

- Construction/EPCM EMPs are to be completed by the person undertaking the work (i.e. the Contractor). The Construction/EPCM EMP will enable the potential negative environmental impacts associated with the proposed activity to be assessed.

- The Construction/EPCM EMP can only be implemented once approved by the Environmental Control Officer and Project Manager.

- The Contractor (and, where relevant, any sub-contractors) must also sign the Construction/EPCM EMP, thereby indicating that the works will be carried out according to the methodology contained in the approved Construction/EPCM EMP.

- Changes to the way the works are to be carried out must be reflected by amendments to the original approved Construction/EPCM EMPs; amendments require the signature of the Environmental Control Officer and the Project Manager, denoting that the changed methodology or works are necessary for the successful completion of the works, and are environmentally acceptable. The Contractor will also be required to sign the amended Construction/EPCM EMP thereby committing him/herself to the amended Construction/EPCM EMP.

- This Construction/EPCM EMP must contain sufficient information and detail to enable the Environmental Control Officer and the Project Manager to apply their minds to the potential impacts of the works on the environment. It should also show that the Contractor thoroughly understands what is required of him/her to undertake the works, and must make the necessary links to the relevant sections of the EMP for the PBMR DPP.

- The Contractor must realise that the time taken to provide a comprehensive, detailed Construction/EPCM EMP is well spent. Insufficient detail will result in delays to the works while the Method Statement is completed to the Environmental Control Officer’s and Project Manager’s satisfaction.

Overleaf is a suggested template for a Construction/EPCM EMP sheet, to be completed for each activity requiring a Construction/EPCM EMP in terms of this EMP (or as per the discretion of the Environmental Control Officer and Project Manager).
CONSTRUCTION/EPCM EMPS

Contract: ................................................................. Date: ......................

Proposed Activity: (give title of the Construction/EPCM EMP and reference page of this EMP)

Work to be undertaken: (give a brief description of the works)

Location/Site where the work will be undertaken: (where possible, give an annotated plan and a full description of the extent of the work)

Start and End Date of the Work for which the Construction/EPCM EMP is required:
Start Date: .................................  End Date: .................................

Description of the work will be undertaken: (provide as much detail as possible, including annotated maps and plans where possible, of how the work will be completed. Use additional pages as required.)
DECLARATIONS

1) Contractor

I understand the contents of this Construction/EPCM EMP and the scope of work required of me. I further understand that this Construction/EPCM EMP may be amended on application to other signatories and that the Environmental Control Officer and Site Agent will audit my compliance with the contents of the Construction/EPCM EMP.

_________________________   _______________________ ___
(signed)     (print name)

Dated: _____________________

2) Environmental Control Officer

The work described in this Construction/EPCM EMP, if carried out according to the methodology described, is satisfactorily mitigated to prevent avoidable environmental harm.

_________________________   _______________________ ___
(signed)     (print name)

Dated: _____________________

3) Project Manager

The works described in this Construction/EPCM EMP are approved.

_________________________   _______________________ ___
(signed)     (print name)

_________________________
(designation)

Dated: _____________________
Annexure D

RD 0018 requirements
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Figure 2: National Radioactive Waste and Potential radioactive waste management model.
VISION

The management of radioactive waste in South Africa shall be in accordance with national objectives and recognized international principles as set out in Government Policy.

PURPOSE OF THE DOCUMENT

To ensure the establishment of a comprehensive radioactive waste governance framework by formulating, additional to nuclear and other applicable legislation, a policy and implementation strategy in consultation with all stakeholders.
MINISTERIAL FOREWORD

The development of a lasting solution to radioactive waste management is one of the critical issues for the future of nuclear applications. Wastes have arisen from activities associated with nuclear power as well as those associated with other programmes, some of which have been discontinued. In the past, owing to a lack of consultation, secrecy was commonly associated with certain activities. As a result, a waste policy could not be developed, because this would have entailed an indication of the scale of activities being undertaken. Since 1994, Government has committed itself to transparency, a culture of consultation and structured stakeholder participation. In our Energy Policy White Paper we undertook to develop a waste management policy.

Radioactive waste in South Africa is currently being managed without a common framework, which this policy and strategy will direct. It is clear that the bulk of the waste was generated during a period that was characterized by a need to ensure self-sufficiency at any cost. The global village in which we live has since reached consensus against such practices. As a result of the curtailment of most of the front-end activities in the nuclear fuel cycle and modern waste management practices, it is unlikely that huge volumes of waste would again be generated over such a short period.

The National Radioactive Waste Management Policy and Strategy lays down options to be considered for managing used fuel and high-level waste. The latter is the main concern among all the different classes of waste. The low volumes of this kind of waste produced by South Africa makes these decisions even more challenging. Nevertheless, with the participation of all stakeholders, the various options will be discussed and Government will then make an informed decision on the most suitable management option.

As one studies the document, one’s mind should shift from considering only disposal and/or reprocessing to considering what option would be best for safe management, as that is what the objective of the policy will be. I trust that you will find this document as an indication of the direction Government intends taking in addressing radioactive waste management.

Minister of Minerals and Energy
DEPUTY MINISTER’S FOREWORD

The Radioactive Waste Management policy and strategy outlines government's thinking in relation to Radioactive Waste management. This document sets out the main policy principles that the Department of Minerals and Energy will endeavour to implement through its institutions in order to achieve the overall policy objective. This policy gives us a formidable framework to interact with the world, and our own past, present and future.

This is a bold policy with a broad vision founded on respect for all the relevant principles for the safe management of radioactive waste. Chief among these is the protection of human health and the commitment to protect future generations in its implementation. Another of its great achievements is its participatory process that produced it and the continued partnerships among government departments.

The radioactive waste management policy is founded on the belief that all nuclear resources of South Africa are a national asset and the heritage of its entire people, and should be managed and developed for the benefit of present and future generations in the country as a whole.

It is the objective of the radioactive waste management policy to improve the overall contribution from the nuclear industry to this belief. Since nuclear is a relatively small sector within the national economy, its contribution will remain modest when measured in terms of macro-economic significance.

Radioactive waste management is not the exclusive preserve of government. The private sector and civil society have a crucial role to play in the implementation of the policy. The fostering of partnerships between government and the private sector is a prerequisite for sustainable and effective radioactive waste management to take place. Similarly, the spirit of partnerships and co-operative governance between organs of state is equally important due to the crosscutting nature of radioactive waste management.

Monitoring and collection of information on waste generation are crucial for the implementation of waste reduction measures. Moreover, the sharing of such information and creating awareness about the issues will enable all stakeholders, including communities, to gain a better understanding of the relation between radioactive waste management and the quality of life.

Deputy Minister of Minerals & Energy
1 INTRODUCTION AND SCOPE

This radioactive waste management policy and strategy serves as a national commitment to address radioactive waste management in a coordinated and cooperative manner.

Most human enterprises produce waste, some of which is radioactive. Radioactive waste contains materials that emit ionising radiation, which has been recognised as a potential hazard to human health since the beginning of the 20th century. The safe management of radioactive waste is therefore essential to ensure the protection of human health and the environment, in the present and future.

Radioactive waste is produced during the operational and decommissioning phases of facilities associated with the following activities:

- 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, education and defence.
- The extraction, processing and combustion of raw materials containing naturally occurring radioactive materials.
- Environmental restoration programmes associated with any of the above.

Radioactive waste may occur in a gaseous, liquid or a solid form that may range from low radioactivity, for example medical and laboratory waste, and certain mining wastes, to highly radioactive waste, for example used fuel and certain spent radioactive sources. The physical and chemical characteristics of the various wastes e.g. the activity concentration, half-life (rate of decay), mixture of radioactive nuclides, chemical toxicity and radio-toxicity, varies widely. Radioactive waste may also occur together with other hazardous chemical or biological materials. The levels of radiation associated with radioactive waste should be seen in perspective to the natural background radiation to which everyone is exposed in everyday life.

Radioactive wastes generated by facilities, range from low volumes, such as spent radioactive sources, to large and diffuse volumes, such as tailings from the mining and milling of ores that contain uranium and thorium, and their radioactive decay products.

The emphasis of this policy and strategy document is on the nuclear industry in South Africa within which the management of radioactive waste is a national responsibility assigned to the Minister of Minerals and Energy as per the Nuclear Energy Act of 1999. 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.

Whilst the Nuclear Energy Act is the leading legislation with regard to the governance of radioactive waste it is recognised that waste containing un-concentrated natural occurring radioactive materials from the mining industry, minerals processing industries and the combustion of coal will also be managed as set out in the Integrated Pollution & Waste Management policy of the Department of Environmental Affairs and Tourism and other relevant legislation.
A. NATIONAL RADIOACTIVE WASTE POLICY FRAMEWORK

2. INTERNATIONAL RADIOACTIVE WASTE MANAGEMENT POLICY PRINCIPLES

The international community through the International Atomic Energy Agency (IAEA) has developed a comprehensive set of principles for the safe management of radioactive waste. These basic principles are applicable to all countries and can be applied to all types of radioactive waste, regardless of its physical and chemical characteristics or origin.

As a member state of the IAEA, and in accordance with National and International objectives, it is Government’s policy to deal with radioactive waste in a manner that protects human health and the environment, now and in the future in accordance with the following principles:

1. **Protection of Human Health:** Radioactive waste shall be managed in such a way as to secure an acceptable level of protection for human health.

2. **Protection of the Environment:** Radioactive waste shall be managed in such a way as to provide an acceptable level of protection of the environment.

3. **Protection Beyond National Borders:** Radioactive waste shall be managed in such a way as to assure that possible effects on human health and the environment beyond national borders will be taken into account.

4. **Protection of Future Generations:** Radioactive waste shall be managed in such a way that predicted impacts on the health of future generations will not be greater than relevant levels of impact that are acceptable today.

5. **Burden on Future Generations:** Radioactive waste shall be managed in such a way that will not impose undue burdens on future generations.

6. **National Legal Framework:** Radioactive waste shall be managed within an appropriate national legal framework, including clear allocation of responsibilities and provision for independent regulatory functions.

7. **Control of Radioactive Waste Generation:** Generation of radioactive waste shall be kept to the minimum practicable.

8. **Radioactive Waste Generation and Management Interdependencies:** Interdependencies among all steps in radioactive waste generation and management shall be appropriately taken into account.

9. **Safety of Facilities:** The safety of facilities for radioactive waste management shall be appropriately assured during their lifetime.

3 NATIONAL RADIOACTIVE WASTE MANAGEMENT POLICY PRINCIPLES

The above-mentioned principles tie-in with the objective of sustainable development, which is development that meets the needs of the present without compromising the ability of future generations to meet their own needs. In addition to the internationally accepted principles, waste management in South Africa shall be managed in accordance with the following policy principles:
1. **Polluter pays principle:** The financial burden for the management of radioactive waste shall be borne by the generator of that waste.

2. **Transparency regarding all aspects of radioactive waste management:** All radioactive waste management activities shall be conducted in an open and transparent manner and the public shall have access to information regarding waste management where this does not infringe on the security of radioactive material.

3. **Sound decision-making based on scientific information, risk analysis and optimisation of resources:** Decision-making shall be based on proven scientific information and recommendation of competent national and international institutions dealing with radioactive waste management.

4. **Precautionary principle:** Where there are threats of serious irreversible damage, lack of full scientific certainty shall not be used as a reason for postponing cost-effective measures to prevent environmental degradation (Rio Principle 15).

5. **No Import nor Export of Radioactive waste:** In principle South Africa will neither import nor export radioactive waste.

6. **Co-operative governance and efficient national co-ordination:** Due to their crosscutting nature all activities involving radioactive waste management shall be managed in a manner that prevents duplication of effort and maximises coordination.

7. **International cooperation:** The government recognises that it shares a responsibility with other countries for global and regional radioactive waste management issues. Its actions shall follow the principles in this policy and in relevant regional and international agreements.

8. **Public Participation:** Radioactive waste management shall take into account the interests and concerns of all interested and affected, when decisions are being made.

9. **Capacity building and education:** The government shall create opportunities to develop people’s understanding, skills and general capacity concerning radioactive waste management.

The government will use these principles to develop, test and apply its policy. The government will also use the principles for decision making and where necessary amending laws and regulations.

In implementing the national policy for radioactive waste management due cognisance must be taken of the requirement to comply with the prescripts of the "White Paper on integrated pollution and waste management for South Africa".
4 APPLICABLE NATIONAL LEGISLATION

Radioactive waste shall be managed under such Authority as provided for in the Nuclear Energy Act and in a co-operative manner as provided for in the Constitution, the National Environmental Management Act and the National Nuclear Regulator Act.

The governance and regulation of radioactive waste management shall be in accordance with the provisions of international agreements to which South Africa is a signatory and the following acts:

4.1 Nuclear Energy Act, 1999 (Act No. 46 of 1999)

- **Section 45:** The authority over the management of radioactive waste and the storage of irradiated nuclear fuel vests in the Minister of Minerals and Energy. The Minister, in consultation with the Minister of Environmental Affairs and Tourism and the Minister of Water Affairs and Forestry, may make regulations prescribing the manner of management, storage and discarding of radioactive waste and irradiated nuclear fuel. The Minister must perform this function with due regard to the provisions of the National Nuclear Regulator Act, 1999. The previous arrangements and responsibilities regarding radioactive waste management related to the South African Nuclear Energy Corporation (for example Vaalputs and Thabana) continue by virtue of section 60 of Act 46 of 1999.

- **Section 46:** Discarding of radioactive waste and storage of irradiated nuclear fuel require the written permission of the Minister and are subject to any conditions that the Minister, in concurrence with the Minister of Environmental Affairs and Tourism and the Minister of Water Affairs and Forestry, deems fit to impose. The conditions so imposed will be additional to any conditions contained in a nuclear authorization as defined in the National Nuclear Regulator Act, 1999.

- **Section 50:** The responsibility for the Republic’s institutional nuclear obligations vests in the Minister. The management of nuclear waste disposal on a national basis is one of these obligations as defined in section 1(xii) of the Act.

- **Section 34(1)(s):** In terms of the responsibilities of the Minister of Minerals and Energy regarding nuclear non-proliferation, authorisation is required to dispose of, store or reprocess any radioactive waste or irradiated fuel.

4.2 National Nuclear Regulator Act, 1999 (Act No. 47 of 1999)

- **Section 5:** The responsibility of the National Nuclear Regulator is to provide for the protection of persons, property and the environment against nuclear damage through the establishment of safety standards and regulatory practices and to exercise regulatory control related to safety over the siting, design, construction, operation, manufacture of component parts and decontamination, decommissioning and closure of nuclear installations and other actions to which this Act applies. These would include radioactive waste management facilities associated with nuclear power stations, nuclear fuel cycle facilities and those facilities that mine and process radioactive ores and minerals.
• **Section 6:** The Regulator must conclude co-operative governance agreements with every relevant organ of state, as defined in section 239 of the Constitution, on which functions in respect of the monitoring and control of radioactive material or exposure to ionising radiation are conferred.

• **Section 7(1)(h):** For the purposes of Act 47 of 1999, the National Nuclear Regulator acts as the national competent authority in connection with the International Atomic Energy Agency's Regulations for the Safe Transport of Radioactive Material.

4.3 **Hazardous Substances Act, 1973 (Act No. 15 of 1973)**

- The Hazardous Substances Act provides for the control of Group IV hazardous substances (radioactive material not at nuclear installations or not part of the nuclear fuel cycle, for example fabricated radioactive sources, medical isotopes) and Group III hazardous substances (involving exposure to ionising radiation emitted from equipment). Radioactive waste arising from activities authorized under this Act falls under the regulation of the Department of Health's Directorate of Radiation Control. In practice, the Department of Health does not regulate naturally occurring radioactive material.

• For the purposes of Act 15 of 1973, the Department of Health's Directorate of Radiation Control acts as the national competent authority in connection with the International Atomic Energy Agency's Regulations for the Safe Transport of Radioactive Material.

4.4 **Mine Health and Safety Act, 1996 (Act No. 29 of 1996)**

- Act 29 of 1996 makes provision for the protection of the health and safety of employees and other persons at mines. Any hazardous materials, including waste that is radioactive, therefore also fall under the inspection and enforcement tasks of the Mine Health and Safety Inspectorate.

4.5 **Mineral and Petroleum Resources Development Act, 2002 (Act No. 28 of 2002)**

- The holder of a prospecting or mining right is required to manage all environmental impacts in accordance with an approved environmental management programme/plan, must as far as it is reasonably practicable rehabilitate the affected environment, describe the manner of compliance with prescribed waste standards and make the prescribed financial provision for rehabilitation.


- NEMA makes provision for co-operative environmental governance.


- Section 19 provides for measures to prevent any pollution of a water resource from occurring, continuing or recurring. This includes activities on land, which may pollute groundwater. Section 27 provides for the issuing of licences.

4.8 **Dumping at Sea Control Act, 1980 (Act No. 73 of 1980)**

- The Dumping at Sea Act falls under the administration of the Minister of Environmental Affairs and Tourism. This Act prohibits the dumping at sea of "high-level radioactive waste or other high-level
radioactive matter prescribed by regulation with the concurrence of the Minister of Minerals and Energy”.

5 RESPONSIBILITIES

5.1 Government

Government is responsible for:

- Policy making
- Establishing and implementing a legal framework
- Establishing regulatory bodies
- Ensuring co-operative governance
- Radioactive waste management where the generator no longer exists (Ownerless radioactive waste)
- The provision of institutional control over closed disposal facilities and the funding thereof
- Ensuring a nationally co-ordinated approach to radioactive waste management
- Fulfilling national obligations in terms of international agreements where applicable
- Reviewing and updating of the national policy and strategy for radioactive waste management
- Ensuring adequate national competence and capacity
- Ensuring compliance with this policy
- Ensuring the implementation of the strategy

The responsibilities for radioactive waste management are clearly provided for in the national legislation as set out in the "Status of radioactive waste management in South Africa”. The Minister of Minerals and Energy is the responsible line Minister with the authority over radioactive waste in terms of the Nuclear Energy Act, 1999, which is administered by the Department of Minerals and Energy. The Minister must exercise these responsibilities in consultation with the Minister of Environmental Affairs and Tourism and the Minister of Water Affairs and Forestry. The Minister of Minerals and Energy will also exercise these responsibilities after consultation with the Minister of Health, as appropriate.

5.2 Regulatory bodies

Regulatory bodies shall work in a co-operative manner and be responsible to enforce compliance with legal requirements and advising government as appropriate. The responsible regulators are:

- Minister of Minerals and Energy in concurrence with the Minister of Environmental Affairs and Tourism and the Minister of Water Affairs and Forestry (Nuclear Energy Act, 1999)
- National Nuclear Regulator (National Nuclear Regulator Act, 1999)
- Department of Health, Directorate Radiation Control (Hazardous Substances Act, 1973)
- Department of Minerals and Energy (Mineral and Petroleum Resources Development Act, 2002)
- The Department of Water Affairs and Forestry (National Water Act, 1998)
5.3 Generators and operators

Generators of radioactive waste, or operators of radioactive waste disposal facilities, as the case may be, shall be responsible for:

- The technical, financial and administrative management of such wastes within the national regulatory framework and within any applicable co-operative governance arrangements.
- Development and ongoing review of site / industry specific Waste Management Plans which are to be based on the national radioactive waste management policy & strategy.
- Execution of Waste Management Plans by the establishment of appropriate waste management facilities and processes and the development of site / industry specific waste management systems.
- Site / industry waste management in accordance with waste management systems to reflect sustainable development and principles such as continued improvement and Best Available Technology Not Entailing Excessive Cost (BATNEEC) and other elements of the national strategy.

It should be noted that all importers of ores which are processed in South Africa are deemed to be generators of radioactive waste and shall comply with all the provisions of this policy and specifically the submission of Waste Management Plans. In considering such plans the NCRWM shall determine if any of the relevant management options (paragraph 10) would be acceptable or if the radioactive waste must be returned to the country of origin.

The responsibility of the generators of radioactive waste, or operators of radioactive waste disposal facilities, as the case may be, will be terminated upon closure of the disposal facility at which time institutional control (where required) will commence.

6 DEFINITION AND CLASSIFICATION OF RADIOACTIVE WASTE

For the purposes of implementing a national policy and establishing a national strategy for radioactive waste management, South Africa shall follow the guidelines of the International Atomic Energy Agency regarding the definition and classification of radioactive waste, unless deviations there from can be justified.

Consistent with internationally acceptable practice “radioactive waste for legal and regulatory purposes may be defined as material that contains or is contaminated with radio-nuclides at concentrations or activities greater than clearance levels as established by the regulatory body, and for which no 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 negligible).”

Radioactive material which could satisfy requirements for clearance, reuse, reprocessing or recycling is considered as Potential Radioactive Waste, for example contaminated metal and used nuclear fuel.

Ownerless radioactive waste is radioactive waste where the generator no longer exists or cannot be identified through reasonable means or does not have the resources to manage such waste.
B. NATIONAL RADIOACTIVE WASTE MANAGEMENT STRATEGIC FRAMEWORK

7  PRINCIPLES APPLICABLE TO RADIOACTIVE WASTE MANAGEMENT STRATEGY

The following principles apply and render the strategic point of reference (not in the order of priority).

1. It is regarded as essential by formulation of recommendations to the relevant decision makers to legitimise a decision to proceed with a particular primary course of action (e.g. deep geological disposal) on the basis of the principle of reasonable consensus.
2. The guiding principles for the development of a new course of action:
   - Openness;
   - Involvement of stakeholders;
   - A deliberative and accessible process;
   - Commitment to participative peer review of the technical basis; and
   - Provision of adequate time for the resolution of issues
3. Final disposal is regarded as the ultimate step in the radioactive waste management process although a step-wise waste management approach is acceptable. Long-term storage of certain types of wastes e.g. HLW, LLW and spent sources may be regarded as one of the steps in the management process.
4. The aim shall be to achieve a maximum degree of passive safety in storage and disposal.
5. The establishment, operation, decommissioning and closure of waste generating and disposal facilities shall be in accordance with all applicable regulatory requirements.
6. The following hierarchy of waste management options shall be followed where practicable.
   - Waste Avoidance and Minimisation
   - Re-use, Reprocessing and Recycling
   - Storage
   - Conditioning and Disposal
7. The national radioactive waste management strategy shall cover the total life cycle of waste management, from generation to institutional control over closed radioactive waste disposal facilities.
8. Although some measure of institutional control in respect of some facilities may be required for an indefinite period, the relevant regulatory body must specify the period for which an active institutional control should be assumed for purposes of safety assessments.
9. 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 retrievability will be possible. The Minister of Minerals and Energy shall determine such a period on the recommendation of the National Committee on Radioactive Waste Management (NCRWM).
10. Measures aimed at enhancing retrievability should not compromise the operational and long-term safety of a disposal option.
11. The transfer of waste among generators shall be considered provided all issues pertaining to ownership and liability and safety are addressed.
12. To minimise the burden on future generations, decommissioning and closure of facilities should be implemented as soon as practicable.
13. The deliberate dilution of radioactive waste is not acceptable, however in the case of NORM waste the dilution of higher concentration material with lower concentration material will be considered provided that all relevant regulatory concerns are addressed.
8 MANAGEMENT STRUCTURES FOR RADIOACTIVE WASTE

8.1 National Committee on Radioactive Waste Management (NCRWM)

Government shall establish a National Committee on Radioactive waste Management which will oversee the implementation of this policy and strategy and which shall be independent from the generators of radioactive waste.

To ensure that this policy and strategy is translated into practice, the Department of Minerals and Energy, as the government’s lead agent for nuclear matters, will consult with other government departments and regulatory bodies to develop and maintain a national action plan.

To give effect to the responsibilities of the Minister of Minerals and Energy in terms of the Nuclear Energy Act, the Committee shall be chaired by a representative from the Department of Minerals and Energy who shall report to the Minister via the DME line management.

To give effect to Cooperative Governance as per the constitution of the Republic, the following Government Departments shall be represented: The Department of Environmental Affairs and Tourism, The Department of Health (Directorate Radiation Control), the Department of Water Affairs and Forestry. The National Nuclear Regulator shall also be a member of the NCRWM.

8.1.1 The Main Objectives of NCRWM

The Objectives of NCRWM will be as follows:

- Co-ordination of radioactive waste management on a national level.
- Review and recommendation to the Minister of Minerals and Energy for approval of site/industry specific Radioactive Waste Management Plans required in terms of this document
- Monitor the implementation of Radioactive Waste Management Plans
- Recommend to the Minister of Minerals and Energy the issuing of management directives to NRWMA as appropriate
- Coordinate radioactive waste management research and development activities of national interest.
- The NCRWM shall, as and when appropriate, publish a report in respect of radioactive waste management on the basis of information received, validated and processed by the various NCRWM members.

Waste management plans required to be submitted through other legal mechanisms (DEAT, DWAF) in the areas of mining, minerals processing and the combustion of coal may be reviewed and commented on by the NCRWM, where considered appropriate.

8.2 National Radioactive Waste Management Agency (NRWMA)

Government shall within 5 years establish an independent Radioactive Waste Management Agency by statute.

Under the provision of section 55(2) of the Nuclear Energy Act, 1999, the Minister assigns the management of radioactive waste disposal on a national basis (institutional obligation) to the NRWMA. The NRWMA will not be a regulatory body.
8.2.1 Terms of reference of NRWMA:

- Reports to the Minister of Minerals and Energy.
- Ring-fenced budget allocated by DME (The funds shall be sourced from the Radioactive Waste Management Fund and/or other DME allocations as appropriate)
- The Board and CEO of the Agency will be appointed by the Minister of Minerals and Energy.

8.2.2 Functions of NRWMA:

- Operation of the Vaalputs site.
- Site, design, construct and operate new national radioactive waste disposal facilities.
- Implement any radioactive waste management directives from the Minister.
- Management of ownerless waste on behalf of the Government, including the development of radioactive waste management plans for such waste.
- Establish waste acceptance criteria.
- Define and conduct Research and Development programs for long-term waste management with regard to long-term storage and disposal.
- Assist generators of small quantities of radioactive waste in all aspects related to management of such waste. The cost of providing such assistance shall be borne by the generator.
- Implementation of institutional control, including radiological monitoring and maintenance as appropriate on behalf of Government.
- Maintain a national radioactive waste database and publish on an annual basis the inventory and location of all radioactive waste in South Africa.
- Advise nationally on radioactive waste management.

9 NATIONAL PROCESS FOR IMPLEMENTING THE RADIOACTIVE WASTE MANAGEMENT STRATEGY

9.1 Radioactive waste stream/category specific waste management plans per site/industry shall be based on an evaluation process and authorization as described in this document. The elements for the process are:

- Identification and nature of site specific radioactive waste stream/categories and associated waste management issues.
- Consideration and listing of realistic options for the long-term management of specific radioactive waste management streams/categories.
- Systematic evaluation of the merits and disadvantages of each option (Multi-attribute analysis or any other suitable methodology covering cost-effectiveness, technological status, operational safety, social and environmental factors).
- Identification of the Best Available Technology Not Entailing Excessive Cost (BATNEEC)
- Acceptance of BATNEEC as waste stream/category specific strategy.
- Review mechanisms of industry/site specific waste management plans.

9.2 Site / industry specific radioactive waste management plans (action plans) shall be developed in accordance with the process described in this document and submitted to
the NCRWM for acceptance and approval or comment as appropriate (where covered by other legal mechanisms).

9.3 Framework for the development of site / industry specific radioactive waste management plans

- The development and submission of plans shall be scheduled with the NCRWM. Separate plans and proposals may be submitted for specific waste streams/categories and scheduled according to the anticipated time required for the development of plans.

- Plans shall cover all radioactive waste streams / categories on a site or in a specific industry.

- Plans shall identify all radioactive waste management options as well as the applicable pre-disposal management steps required for a specific option, and the details thereof.

- The merits and disadvantages of each of the listed options shall be evaluated in a balanced and systematic way using a multi-attribute analysis approach. The methodology for evaluation and selection of an option (BATNEEC) shall be described and justified per site / industry. This should be submitted to the NCRWM prior to the submission of waste management plans for concurrence on methodology. It should be noted that all regulatory requirements must be met.

- Approved waste management plans shall be reviewed and re-submitted at a frequency determined by the institutional organisation.

- The development process and associated considerations of the radioactive waste management plan are indicated in Figure 1.
Figure 1: Radioactive waste management plan development process

CONSIDERATIONS
- Historic and current waste streams
- Waste streams able to be categorised i.t.o. similar properties and class
- All the waste processing and characterisation steps associated with long term waste management solutions as indicated in the waste management model
- Capability of current science and technology to provide solutions which are likely to be acceptable and safe
- Cost effectiveness
  - Life cycle cost of waste
- Technological status / benefit
  - Existing or new technology
  - International practice
  - Waste prevention potential
  - Waste minimization potential
  - Waste quality
  - Regulatory implications
- Safety
  - Worker safety impact
  - Public safety impact (operational)
  - Transport minimization / prevention
  - Accident risk
  - ALARA
- Social and environmental (sustainability)
  - Public safety impact (long term)
  - Perceived risk and social acceptability
  - Benefit to the community in relation to the "no action" option
  - Environmental impact
  - Continual improvement potential
- Approved multi-attribute analyses and option selection technique
- Consultation
  - Public safety information forum
  - Public participation
## 10. NATIONAL RADIOACTIVE WASTE CLASSIFICATION SCHEME

<table>
<thead>
<tr>
<th>Waste Class</th>
<th>Waste Description</th>
<th>Waste type / Origin</th>
<th>Waste Criteria</th>
<th>Generic waste treatment / conditioning requirements (1)</th>
<th>Disposal / Management Options</th>
</tr>
</thead>
</table>
| 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/m².  
2 Long-lived alpha, beta and gamma emitting radionuclides at activity concentration levels > levels specified for LILW-LL  
3 Long-lived alpha, beta and gamma emitting radionuclides at activity concentration levels that could result in 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 the order of 100 years). The waste form shall be solid with additional characteristics as prescribed for a specific repository. | 1 (a) Regulated deep disposal (100's of metres).  
(b) Reprocessing, Conditioning and Recycling  
(c) 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 Un-irradiated uranium (nuclear fuel production).  
3 Fission and activation products (nuclear power generation and isotope production)  
4 Sealed sources. | 1 Thermal power (mainly due to short-lived radio nuclides (T ½ < 31 y) < 2 kW/m³)  
AND  
2 Long-lived radio nuclides (T ½ > 31 y) concentrations.  
  - Alpha: < 4000 Bq/g  
  - Beta and gamma: < 40000 Bq/g  
  (Maximum per waste package up to 10x the concentration levels specified above).  
3 Long-lived alpha, beta and gamma emitting radionuclides at activity concentration levels that could result in 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 the order of 50 years). The waste form shall be solid with additional characteristics as for a specific repository. | 1 Regulated medium depth disposal (10's of metres).  
2 Managed as NORM-E waste (un-irradiated uranium) |
<table>
<thead>
<tr>
<th>Waste Class</th>
<th>Waste Description</th>
<th>Waste type / Origin</th>
<th>Waste Criteria</th>
<th>Generic waste treatment / conditioning requirements (^{(1)})</th>
<th>Disposal / Management Options</th>
</tr>
</thead>
</table>
| 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).                                    | 1 Thermal power (mainly due to short-lived radio nuclides \((T \frac{1}{2} < 31 \text{ y}) < 2 \text{ kW/m}^3\). \text{ AND} \text{ 2 Long-lived radio nuclide} \((T \frac{1}{2} > 31 \text{ y}) \text{ concentrations.}
\[\checkmark \text{ Alpha: } < 400 \text{ Bq/g} \]
\[\checkmark \text{ Beta and gamma: } < 4000 \text{ Bq/g} \]
(Maximum per waste package up to 10x the concentration levels specified above). 3 OR Long-lived alpha, beta and gamma emitting radionuclides at activity concentration levels that could result in 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 the order of 10 years). The waste form shall be solid with additional characteristics as for a specific repository. | 1 Regulated near surface disposal (< 10 metres). 2 Managed as NORM-E waste (un-irradiated uranium) |
<p>| 4 VLLW      | Radioactive waste containing very low concentration of radioactivity.             | 1 Contaminated or slightly radioactive material originating from operation and decommissioning activities. | 1 Clearance 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 |
| 5 NORM-L    | Potential Radioactive waste containing low concentrations of NORM.               | 1 Mining and minerals processing.                                                    | 1 Long-lived radio nuclide concentration: (&lt; 100 \text{ Bq/g.})                                                                                                                                               | Unpackaged waste in a miscible waste form.                                                                                   | 1 Re-use 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 |</p>
<table>
<thead>
<tr>
<th>Waste Class</th>
<th>Waste Description</th>
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<tr>
<td></td>
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<td></td>
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<td>impoundment</td>
</tr>
</tbody>
</table>
| 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 Dilute and re-use as underground backfill material in an identified underground area.  
2 Extraction of any economically recoverable minerals, followed by dilution and disposal in an identified mine tailings dam or other sufficiently confined surface impoundment  
3 Regulated deep or medium depth disposal. |

(1) Treatment and conditioning requirements are mainly dependant on specific waste type in a waste class.
11 FINANCIAL PROVISION FOR RADIOACTIVE WASTE

Government shall within five years following approval of this policy, establish a Radioactive Waste Management Fund (RWMF) by statute. The funds paid into the RWMF shall not be subject to tax. In keeping with the polluter pays principle, the contributions to the fund will be from the generators of radioactive waste. The contributions shall be managed in an equitable manner, without cross-subsidization and amongst others be based on classification of the waste as well as the volumes.

The purpose of the fund shall be to ensure that there are sufficient provisions for the long-term management options of the various waste forms. These shall include:

- Fees for disposal activities
- Research and Development activities including investigations into waste management/disposal options
- Capacity building initiatives for radioactive waste management/disposal
- Fees for other activities related to radioactive waste management/disposal

The manner of the management of the fund shall be determined by Government and shall be reported upon annually. The fund shall be managed and administered by National Treasury (and DME) on behalf of Government. The funds shall be managed in accordance with accepted investment and accounting principles. The reports of the fund shall be subject to the Auditor General’s examination.

Each of the generators shall enter into an agreement with the RWMF for managing long-term provisions for institutional control measures.

The Government (responsible line Departments) shall set aside funds through the RWMF for the management of radioactive waste from its institutions.

12 NATIONAL RADIOACTIVE WASTE MANAGEMENT MODEL

The model, as schematically presented in Figure 2, indicates the radioactive waste management process from radioactive waste generation to the main waste management end-points and institutional control. Although not all the steps may apply to all the waste streams / categories, the listed predisposal management steps should be considered.

12.1 Radioactive Waste Generation

Radioactive waste, used nuclear fuel and materials that are potential radioactive waste are continuously generated during the execution of regulated activities. Radioactive waste may also exist due to previous activities and / or historic processing of radioactive materials.
12.2 Pre-disposal Management of Radioactive Waste

Pre-disposal management of radioactive waste is required to ensure:
- Waste prevention and waste minimization.
- The selection of suitable waste management options.
- A waste package that meets acceptance criteria for handling, transportation, storage and disposal.
- Waste or material that is suitable for authorized disposal / discharge, authorized re-use / recycling and clearance from regulatory control.

During the generation of radioactive waste the emphasis shall be on the control of waste generation and minimization. Unavoidable radioactive waste shall be classified to enable category specific waste management.

The options for disposal of each waste category shall be evaluated in a systematic way as a multi attribute analysis. The outcome of the multi attribute analysis is regarded as the Best Available Technology Not Entailing Excessive Cost (BATNEEC).

The extent of the waste processing (the remainder of the pre-disposal management steps) shall depend on the waste acceptance criteria for regulated disposal and the anticipated acceptance criteria and storage period in the case of regulated storage. Category specific waste processing namely pre-treatment, treatment and conditioning shall be performed to obtain waste packages, that are suitable for storage and / or disposal.

Waste characterization shall be conducted throughout the pre-disposal management steps. Waste category specific characterization 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 a waste package for storage and disposal. Waste characterization data and records shall be used for verification and quality assurance purposes.

Transportation of waste may be required in between the various pre-disposal management steps and may include on and off-site transportation.

In the case of regulated disposal, radioactive waste packages shall be stored temporarily and transported to a radioactive waste repository. In the case of regulated storage the radioactive waste and / or waste packages shall be stored for an authorized period for future processing and / or disposal.
12.3 Radioactive Waste management options

The main radioactive waste management options are:
- Regulated disposal;
- Authorized disposal / discharge;
- Authorized re-use / recycling;
- Regulated reprocessing (used nuclear fuel);
- Regulated storage and
- Clearance.
(The above terms are defined in the waste management glossary.)

In the case of authorized disposal / discharge, re-use / recycling and clearance, the following category specific factors are specified:
- Pre-treatment and treatment requirements;
- Conditions and criteria for disposal / discharge / re-use / recycle and clearance; and
- Criteria and condition verification methodology.

12.4 Radioactive Waste management end-points

The main radioactive waste management end-points correspond with the waste management options and may be regarded as the outcome of a specific waste management option. Regulated disposal requires continued regulation of the disposal site for a predetermined duration where after the site shall be placed under institutional control.
Figure 2: National Radioactive Waste and Potential Radioactive Waste Management Model

Waste generation
- Regulated activities
- Other RA Waste

Main Pre-disposal management steps
- Control of RA Waste generation (Minimization)
- Waste categorization
- Best Practicable Means (BPM)

Waste streams/categories
- Main Waste management options
- Reprocessing
- Clearance
- Authorized reuse/recycle disposal/discharge
- Regulated Storage
- Regulated Disposal

Anticipated endpoint and acceptance criteria
- Disposal acceptance criteria

Pre-treatment
- Treatment
- Conditioning
- Storage
- Transportation

Main Waste management end-points
- Clearance
- Authorized disposal/discharge
- Regulated Disposal

Institutional Control

WASTE CHARACTERIZATION

WASTE CHARACTERIZATION
13. LONG-TERM RADIOACTIVE WASTE MANAGEMENT ISSUES

There are two long-term radioactive waste management options employed in South Africa at present

1. Above ground disposal in engineered facilities for the bulk of the mining waste.

2. Near surface disposal for Low and Intermediate Level Waste at Vaalputs in the Northern Cape.

Disposal of high level waste presents the most challenges and it is an area where coordination is of utmost importance.

One site shall be developed for each of the waste classes (excluding NORM waste, which is disposed of on site in bulk). This is to maximise benefits from economies of scale for all activities associated with disposal waste management.

**Vaalputs shall continue to be used as a National Disposal Site for Low and Intermediate Level Waste.**

The Government shall initiate investigations into the best long-term option for the management of Used Fuel. The process of selecting a site for long-term (HLW) waste management shall involve a public participation process.

13.1 USED NUCLEAR FUEL AND HIGH LEVEL WASTE MANAGEMENT

Two mechanisms (Dry and Wet storage) are currently in use in South Africa. Koeberg Used Fuel is currently stored in authorised used fuel pools on the site as well as in Casks designed and constructed for storage of used fuel. There is enough storage capacity for the current operational lifetime of Koeberg. The Used Fuel from SAFARI Research Reactor is currently stored at an authorised dry storage facility on the Pelindaba site as well as in the Reactor pool.

**In the interim Used Nuclear Fuel is and shall continue to be stored in authorised facilities within the generator’s sites.**

The storage on these sites is finite and the practice of storing used fuel on a reactor site is not sustainable indefinitely. Government shall ensure that investigations are conducted within set timeframes to consider the various options for safe management of used fuel and high level radioactive wastes in South Africa. Included in the options for investigation shall be the following:

A. LONG-TERM ABOVE GROUND STORAGE ON AN OFF-SITE FACILITY LICENSED FOR THIS PURPOSE

The size of the industry dictates that this be a consideration although it may not be in line with some of the principles for Radioactive Waste Management.
The strength of this option is that if more appropriate technologies are developed in future, then the waste can be dealt with using those technologies.

Storing above ground indefinitely may result in an undue burden on future generations.

**B. REPROCESSING, CONDITIONING AND RECYCLING**

An investigation commissioned by the Department of Minerals and Energy has concluded that it would not be advisable to exclude the reprocessing, conditioning and recycling of used fuel. This option is sometimes associated with proliferation concerns however as South Africa has concluded the IAEA Safeguards Agreements and the Additional Protocol, this should not be an issue for South Africa.

**In South Africa**
This option will require dedicated specialised facilities and the cost implication of building facilities could mitigate against reprocessing in South Africa. This option will however be amongst the options to be investigated

**In a Foreign Country**
There are available reprocessing facilities in some countries and the option of sending South Africa’s Used Fuel for reprocessing shall be investigated and compared to the other options.

**C. DEEP GEOLOGICAL DISPOSAL**

Deep geological disposal is currently the most internationally pursued option and as such will require very careful consideration. Internationally this option has been under investigation for the best part of a decade and as such investigations in South Africa should commence as soon as possible. **If chosen as a preferred option in South Africa, geological disposal of radioactive waste shall take place with an option for retrieving the waste.** (The reason for this is not to rule out the possibility of the use of future technology for better management options)

**D. TRANSMUTATION**

A fourth option (Transmutation) has been - and continues to be - investigated in a number of countries, however it has not been proven to be a workable solution and also requires major investment in technology. **The Government shall continue to monitor developments internationally. However this option will not be investigated in South Africa.**

The choice of the most suitable option shall take due cognisance of the policy principles and shall clearly demonstrate how the option satisfies the national policy objectives. All conclusions on investigations shall be subject to public scrutiny.

END
REFERENCES

## ANNEXURE A: RADIOACTIVE WASTE MANAGEMENT TERMINOLOGY

<table>
<thead>
<tr>
<th>TERM</th>
<th>EXPLANATION OF TERM</th>
</tr>
</thead>
<tbody>
<tr>
<td>Activity</td>
<td>The number of spontaneous nuclear disintegrations occurring in a given quantity of material during a suitable small interval of time divided by that interval of time. The SI derived unit of activity is the becquerel (Bq). 1 Bq = 1 disintegration per second.</td>
</tr>
<tr>
<td>Activity concentration</td>
<td>The activity of a radionuclide per unit mass (or per unit volume) of a material.</td>
</tr>
<tr>
<td>Authorized discharge</td>
<td>Planned and controlled release of radioactive material to the environment in accordance with an authorization from the regulator.</td>
</tr>
<tr>
<td>Authorized disposal</td>
<td>Disposal of radioactive waste in accordance with an authorization issued by the Regulator for disposal on a site that is not regulated in respect of the radioactive properties of the waste and where the radioactivity concentration levels are sufficiently low that post disposal regulatory control is not required.</td>
</tr>
<tr>
<td>Closure</td>
<td>The term closure refers to the status of, or an action directed at, a disposal facility at the end of its operating life. A disposal facility is placed into closure usually after completion of waste emplacement, by covering of a near surface disposal facility, by backfill and/or sealing of a geological repository and the passages leading to it, and termination and completion of activities in any associated structures.</td>
</tr>
<tr>
<td>Conditioning</td>
<td>Those operations that produce a waste package suitable for handling, transportation, storage and/or disposal. Conditioning may include the conversion of the waste to a solid waste form, enclosure of the waste in containers and, if necessary, provision of an overpack.</td>
</tr>
<tr>
<td>Decommissioning</td>
<td>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.</td>
</tr>
<tr>
<td>Discharge</td>
<td>A planned and controlled release of radionuclides into the environment. Such releases should meet all restrictions imposed by the regulatory body.</td>
</tr>
<tr>
<td>Disposal</td>
<td>The emplacement of waste in an approved specified facility (for example, near surface or geological repository).</td>
</tr>
<tr>
<td>Geological disposal</td>
<td>Isolation of radioactive waste, using a system of engineered and natural barriers at depths up to several hundred meters in a geologically stable formation.</td>
</tr>
<tr>
<td>High level waste (HLW)</td>
<td>(a) The radioactive liquid containing most of the fission products and actinides originally present in used fuel –</td>
</tr>
</tbody>
</table>
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/m³).

<table>
<thead>
<tr>
<th>Institutional control</th>
<th>Control of a waste site (for example, disposal site) by an authority or institution designated under the laws of a country or state. This control may be active (monitoring, surveillance, remedial work) or passive (land use control) and may be a factor in the design of a nuclear facility (for example, near surface disposal facility).</th>
</tr>
</thead>
<tbody>
<tr>
<td>Long lived waste (LLW)</td>
<td>Radioactive waste containing long-lived radionuclides having sufficient radio toxicity in quantities and/or concentrations requiring long-term isolation from the biosphere. The term &quot;long lived radio nuclide&quot; refers to half-lives usually greater than 31 years.</td>
</tr>
<tr>
<td>Low and intermediate level waste (LILW)</td>
<td>Radioactive wastes in which the concentration of or quantity of radio nuclides above clearance levels established by the regulatory body, but with a radio nuclide 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.</td>
</tr>
<tr>
<td>Natural occurring radioactive material (NORM)</td>
<td>Material containing no significant amounts of radionuclides other than naturally occurring radionuclides.</td>
</tr>
<tr>
<td>Near surface disposal</td>
<td>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.</td>
</tr>
<tr>
<td>Nuclear fuel cycle</td>
<td>All operations associated with the production of nuclear energy, including mining, milling, processing and enrichment of uranium or thorium; manufacture of nuclear fuel; operation of nuclear reactors; reprocessing of nuclear fuel; decommissioning; and any action for radioactive waste management and any research or development action related to any of the foregoing.</td>
</tr>
<tr>
<td>Ownerless waste</td>
<td>Ownerless radioactive waste is radioactive waste where the generator no longer exists or cannot be identified through reasonable means or does not have the resources to manage such waste.</td>
</tr>
<tr>
<td>Potential Radioactive Waste</td>
<td>Radioactive material which could satisfy requirements for clearance, reuse, reprocessing or recycling</td>
</tr>
<tr>
<td>Pre-disposal</td>
<td>Any waste management steps carried out prior to waste disposal such as: - Pre-treatment, treatment, conditioning,</td>
</tr>
<tr>
<td><strong>Term</strong></td>
<td><strong>Definition</strong></td>
</tr>
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<td>-------------------------</td>
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</tr>
<tr>
<td>Storage, transportation activities.</td>
<td></td>
</tr>
<tr>
<td>Pre-treatment</td>
<td>Any or the entire operations prior to waste treatment, such as: Collection, segregation, chemical adjustment, and decontamination.</td>
</tr>
<tr>
<td>Regulated disposal</td>
<td>Disposal of radioactive waste in a facility licensed by the Regulator for disposal of a specific waste class.</td>
</tr>
<tr>
<td>Repository</td>
<td>A nuclear facility (for example, geological repository) where waste is emplaced for disposal. Future retrieval of the waste from the repository is not intended. (See also disposal.)</td>
</tr>
<tr>
<td>Reprocessing</td>
<td>A process or operation, the purpose of which is to extract radioactive isotopes from used fuel for further use.</td>
</tr>
<tr>
<td>Used fuel</td>
<td>Nuclear fuel removed from a reactor following irradiation, which is no longer usable in its present form because of depletion of fissile material, poison build-up or radiation damage.</td>
</tr>
<tr>
<td>Spent sources</td>
<td>Sources of which the useful lifetime have lapsed.</td>
</tr>
<tr>
<td>Storage</td>
<td>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.</td>
</tr>
<tr>
<td>Transmutation</td>
<td>The conversion of one nuclide into another through one or more nuclear reactions, and more specifically, the conversion of an isotope of one element into an isotope of another element through one or more nuclear reactions. For example, 238U is converted into 239Pu by neutron capture followed by the emission of two beta particles.</td>
</tr>
<tr>
<td>Transportation</td>
<td>Operations and conditions associated with and involved in the movement of radioactive material by any mode on land, water or in the air. The terms 'transport' and 'shipping' are also used.</td>
</tr>
<tr>
<td>Treatment</td>
<td>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, change of composition. After treatment, the waste may or may not be immobilized to achieve an appropriate waste form.</td>
</tr>
<tr>
<td>Waste acceptance criteria</td>
<td>Those criteria relevant to the acceptance of waste packages for handling, storage and disposal.</td>
</tr>
<tr>
<td>Waste category</td>
<td>Waste/waste package identifiable in terms of waste stream, waste type, waste sub-type, waste class and waste endpoint.</td>
</tr>
<tr>
<td>Waste characterization</td>
<td>The determination of 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.</td>
</tr>
<tr>
<td>Waste class</td>
<td>Waste grouping based on the radiological characteristics of the waste package (Radioactive waste classification scheme)</td>
</tr>
<tr>
<td>------------------------</td>
<td>---------------------------------------------------------------------------------------------------------------</td>
</tr>
<tr>
<td>Waste package</td>
<td>The product of conditioning that includes the waste form and any container(s) and internal barriers (e.g. absorbing materials and liner), as prepared in accordance with requirements for handling, transportation, storage and/or disposal</td>
</tr>
<tr>
<td>Waste processing</td>
<td>Any operation that changes the characteristics of a waste, including waste pre-treatment, treatment and conditioning.</td>
</tr>
<tr>
<td>Waste stream</td>
<td>Waste which may consist of one or more waste types that originate from a specific process, for example uranium conversion, uranium enrichment or isotope production.</td>
</tr>
<tr>
<td>Waste type</td>
<td>Waste from a specific waste stream collected on the basis of similar radiological and physical properties.</td>
</tr>
</tbody>
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### ANNEXURE B: ACRONYMS

<table>
<thead>
<tr>
<th>Acronym</th>
<th>Description</th>
</tr>
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<tbody>
<tr>
<td>ALARA</td>
<td><strong>As Low As Reasonably Achievable</strong></td>
</tr>
<tr>
<td>BATNEEC</td>
<td><strong>Best Available Technology Not Entailing Excessive Cost</strong></td>
</tr>
<tr>
<td>DEAT</td>
<td><strong>Department of Environment and Tourism</strong></td>
</tr>
<tr>
<td>DME</td>
<td><strong>Department of Minerals and Energy</strong></td>
</tr>
<tr>
<td>DOH</td>
<td><strong>Department of Health</strong></td>
</tr>
<tr>
<td>DWAF</td>
<td><strong>Department of Water Affairs and Forestry</strong></td>
</tr>
<tr>
<td>EMP</td>
<td><strong>Environmental Management Programme</strong></td>
</tr>
<tr>
<td>HLW</td>
<td><strong>High Level Waste</strong></td>
</tr>
<tr>
<td>IAEA</td>
<td><strong>International Atomic Energy Agency</strong></td>
</tr>
<tr>
<td>LILW</td>
<td><strong>Low and intermediate level waste</strong></td>
</tr>
<tr>
<td>LILW (I) – LL</td>
<td><strong>Low and intermediate level waste – long lived – intermediate dose rate</strong></td>
</tr>
<tr>
<td>LILW (I) – SL</td>
<td><strong>Low and intermediate level waste – short lived – intermediate dose rate</strong></td>
</tr>
<tr>
<td>LILW (L) – LL</td>
<td><strong>Low and intermediate level waste – long lived – low dose rate</strong></td>
</tr>
<tr>
<td>LILW (L) – SL</td>
<td><strong>Low and intermediate level waste – short lived – low dose rate</strong></td>
</tr>
<tr>
<td>LLW</td>
<td><strong>Long Lived Waste</strong></td>
</tr>
<tr>
<td>NACRWM</td>
<td><strong>National Advisory Committee on Radioactive Waste Management</strong></td>
</tr>
<tr>
<td>NEA</td>
<td><strong>Nuclear Energy Act</strong></td>
</tr>
<tr>
<td>NCRWM</td>
<td><strong>National Committee on Radioactive Waste Management</strong></td>
</tr>
<tr>
<td>NECSA</td>
<td><strong>South African Nuclear Energy Corporation</strong></td>
</tr>
<tr>
<td>NNR</td>
<td><strong>National Nuclear Regulator</strong></td>
</tr>
<tr>
<td>NORM</td>
<td><strong>Naturally Occurring Radioactive Material</strong></td>
</tr>
<tr>
<td>NORM-E</td>
<td><strong>Naturally Occurring Radioactive Material Enhanced activity</strong></td>
</tr>
<tr>
<td>NORM-L</td>
<td><strong>Naturally Occurring Radioactive Material Low activity</strong></td>
</tr>
<tr>
<td>NRWMA</td>
<td><strong>National Radioactive Waste Management Agency</strong></td>
</tr>
<tr>
<td>VLLW</td>
<td><strong>Very Low Level Waste</strong></td>
</tr>
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</table>
Annexure E

Radioactive Waste Management Policy and Strategy for the Republic of South Africa
### Requirements Document

<table>
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**Approved:**

M Magugumela  
Chief Executive Officer

**Date of issue:** 18/01/2007

**Revision Date:** 18/01/2008
## APPROVAL RECORD

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<tr>
<td>T Pather</td>
<td>Manager: NTWP</td>
<td>[Signature]</td>
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</tr>
<tr>
<td>A Botha</td>
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<td>[Signature]</td>
<td>11/1/2007</td>
</tr>
<tr>
<td>G A Clapson</td>
<td>Senior Manager: PRD</td>
<td>[Signature]</td>
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<tr>
<td>P Bester</td>
<td>Manager: PBMR Programme</td>
<td></td>
<td></td>
</tr>
<tr>
<td>B Kuckartz</td>
<td>Consultant</td>
<td></td>
<td></td>
</tr>
<tr>
<td>I Coe</td>
<td>Consultant</td>
<td></td>
<td></td>
</tr>
<tr>
<td>J Joubert</td>
<td>Assessment Group PBMR Coordinator</td>
<td></td>
<td></td>
</tr>
<tr>
<td>T Hill</td>
<td>Manager: PBMR Programme</td>
<td></td>
<td></td>
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1 INTRODUCTION

In terms of the provisions of section 21 of the National Nuclear Regulator Act, Act No. 47 of 1999 (hereinafter referred to as the NNRA), the siting, construction, operation, decontamination or decommissioning of any nuclear installation as defined in section 1(xviii) of the NNRA must be authorised by way of a nuclear installation license granted by the National Nuclear Regulator (NNR).

Application for the granting of a nuclear installation licence must be made to the Chief Executive Officer of the NNR in the prescribed format and the applicant must provide such information as the Board of Directors of the NNR may require.

The legislation authorises the inclusion in the nuclear installation licence of any conditions deemed necessary by the NNR to ensure the protection of persons, property and the environment against nuclear damage or for the rehabilitation of the site.

The principles that must be met to ensure safety in any nuclear installation are presented in the Regulations on Safety Standards and Regulatory Practices published as Regulation No. R388 dated 28 April 2006 (hereinafter referred to as the RSRP) [1]. The Basic Licensing Requirements (BLR) for the Pebble Bed Modular Reactor (PBMR), as presented in this Requirements Document (RD), are based on and are established to fulfil these principles.

2 PURPOSE

This RD details the Basic Licensing Requirements of the NNR for the PBMR, in line with the NNRA and RSRP [1].

3 OBJECTIVES

The objectives of this RD are:

- In Section 5 to list and describe the Licensing Process and Licensing Stages for the PBMR.
- In Section 6 to set down the principal radiation protection and nuclear safety requirements as formulated in Section 3 of [1], for their application to the PBMR.
- In Section 7 to define the BLR for the PBMR (based on the principal safety requirements) that inter alia include the Dose and Risk limits applicable to the PBMR.
- In Section 8 to specify the processes which the applicant/licensee and the constructor must undertake to demonstrate compliance with the BLR.

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4 SCOPE

The document is applicable to the design of a PBMR facility that is planned, under construction, in operation or being decommissioned under a nuclear installation application or licence as per the NNRA.

The applicant/licensee and its constructor responsible for design, construction and operation of the PBMR are required to develop, implement and maintain a design fulfilling the requirements of this RD.

Additional licensing requirements and regulatory guidelines relevant to the PBMR covering specific areas (e.g. Quality and Safety Management, Fuel Qualification, etc.) are stipulated in additional Regulatory Requirements and Guidance Documents as identified by the NNR.

5 LICENSING STAGES FOR THE PBMR

(1) 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 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 to the NNR.

(2) The combinations of licensing stages need to be established with a view to streamlining and scheduling of the licensing process. Allowance must be made for assessments that may prove to be time-consuming.

(3) The applicant is required to produce a safety case for each licensing stage or combination of licensing stages of the PBMR.

(4) Based on the applicant’s proposal for combination of licensing stages the NNR may impose hold or witness points. The applicant must not proceed beyond an imposed hold or witness point without prior NNR approval.

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6 PRINCIPAL SAFETY REQUIREMENTS

The Principal Safety Requirements formulated in the RSRP [1] form the basis for the stipulation of the BLR for the PBMR which are given in Section 7 of this RD. Although all the relevant requirements formulated in [1] are applicable to the design, construction, operation and subsequent decommissioning of the PBMR, some specific Principal Safety Requirements of Section 3 of [1] are elaborated further in terms of their particular application to the PBMR:

(5) The facility must be designed, constructed, commissioned, operated, maintained and decommissioned according to good engineering practice.

(6) In line with the Principal Safety Requirements of [1], the principles of Defence-in-Depth (DiD) must be applied to the PBMR in a manner consistent with the DiD processes described in the appropriate international safety standards and related documents (e.g. Safety Reports produced by the IAEA) so that there are multiple layers of PBMR Functions provided by the Structures, Systems and Components (SSC), and procedures, (or a combination thereof) to ensure that the Fundamental Safety Functions (FSF) of Heat Removal / Reactivity Control / Confinement of Radioactivity are met. Event prevention and event mitigation are natural consequences of the DiD principle. The application of the DiD Principle to the design and operation of the PBMR is elaborated further in Appendix C.

(7) In line with the Principal Safety Requirements of [1] the ALARA (As Low As Reasonably Achievable) principle must be adopted in a manner consistent with the ALARA processes described in the appropriate international guides (e.g. reports produced by the ICRP.) The application of the ALARA principle is required for selection of design and operational features that provide an adequate minimisation of radiological doses and thus the optimum level of safety in terms of radiological risks. The application of the ALARA principle to the design and operation of PBMR is elaborated further in Appendix D.

(8) In line with section 3.1 of [1] the facility design and its proposed operation must meet the dose and risk limits as defined in Annexure 2 and 3 of [1] respectively.
For licensing of the PBMR, it must be demonstrated that the following Basic Licensing Requirements (BLR) derived from the Principal Safety Requirements of Section 6 of this RD are met. Additional licensing requirements and recommendations covering specific areas are stipulated in the other Regulatory Requirements and Guidance Documents developed by the NNR.

Normal Operation and initiating events (IE) either singly or in combination are grouped into three categories (categories A, B and C) which are defined in terms of annual frequency of occurrence. Combinations of IEs or IEs defined to cover several IEs are referred to as Postulated Initiating Events (PIE). The frequency of events either singly or as combined events must be assessed accordingly and allocated to the appropriate category. For each of the three categories, safety requirements and numerical dose and risk limits are stipulated.

7.1 Selection of Events

The BLR apply to IE or combinations of IE, which lead or could potentially lead to exposure of the plant personnel and/or members of the public.

(9) For licensing it must be demonstrated that the BLR are met during the life cycle of the PBMR. For this purpose an enveloping set of IE and PIE needs to be selected and categorised. The approach on IE and PIE that must be adopted is defined in section 8 of this RD.

7.2 Category A

Category A comprises potential exposures from Normal Operation as well as from Anticipated Operational Occurrences (AOO) which are IE or PIE, which occur with a frequency of more than one in one hundred years (≥10^-2 y^-1).

(10) It is anticipated that these events will occur during the life cycle of the facility and, thus, a representative set of AOOs must be considered. Category A events must not lead to category B events without occurrence of additional control failures of any type.

7.2.1 Radiation Dose to Plant Personnel

(11) In respect of the dose to plant personnel, the following criteria must be applied in consideration of both design and all phases of operation of the facility, including decommissioning:
- Compliance with the operational annual accumulated individual design dose limit of 20 mSv in any single year.
- In addition, all radiation doses must be optimised by the application of the ALARA principle and the design provisions for category A events must be part of the DiD application.
7.2.2 Radiation Dose to Members of the Public

(12) In respect of the dose to members of the public, the following criteria must be applied in consideration of both design and all phases of operation of the facility, including decommissioning:

- Compliance with the annual individual design dose limit of 250 $\mu$Sv as a consequence of category A for an individual of the most exposed critical group considering all actions authorised by a nuclear installation licence as well as a representative set of AOOs.
- In addition, all radiation doses must be optimised by the application of the ALARA principle and the design provisions for category A events must be part of the DiD application. The ALARA target for category A events must be at a trivial level similar to internationally agreed values for such doses.

7.3 Category B

Category B events are those which potentially lead to exposure and which could occur with a frequency of less than one in one hundred years ($<10^{-2}$ y$^{-1}$) and more than one in one million years ($\geq 10^{-6}$ y$^{-1}$). The category B events lead to consequences and conditions that are considered for the design basis of the PBMR but are beyond the range of category A. Category B events are not expected to occur during the life cycle of the facility.

(13) Category B events must not lead to consequences more severe than the category B criteria without occurrence of failures of active or passive safety functions additional to those already assumed as part or consequence of the category B events.

7.3.1 Radiation Dose to Plant Personnel

(14) In respect of the dose to plant personnel, the following criteria must be applied in consideration of both design and all phases of operation of the facility:

- Compliance with the radiation design dose limit of 50 mSv per category B event for the individual dose to plant personnel outside of exclusion areas.
- In addition all radiation doses must be optimised by the application of the ALARA principle and the design provisions for category B events must be part of the DiD application.
- The ALARA targets to be defined for the individual dose resulting from category B events must be staged in the probability range of category B in compliance with the category C risk limit for plant personnel.
- Compliance with the operational dose limits as defined in Annexure 2 of [1] for the plant personnel in case of emergencies or for life saving actions.

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Note: For recovery actions after category B events, the category A dose limits apply. The doses to plant personnel already received during the category B event must be taken into account in assessing the remaining dose that may be received during recovery.

7.3.2 Radiation Dose to Members of the Public

(15) In respect of the dose to members of the public, the following criteria must be applied in consideration of both design and all phases of operation of the facility:

- Compliance with the total individual radiation design dose limit of 50 mSv accumulated as a consequence of a category B event for the dose to an individual of the most exposed critical group of the public. Dose constraints must be defined for the individual dose resulting from category B events and must be staged in the probability range of category B in compliance with the category C risk limit for the public.
- In addition, all radiation doses must be optimised by the application of the ALARA principle and the design provisions for category B events must be part of the DiD application.
- The ALARA targets to be defined for the individual dose resulting from category B events must be consistent with the defined dose constraints.
- If the effective dose to the public resulting from a category B event can potentially exceed 1 mSv, emergency measures consistent with subsection 8.6 have to be taken into account, to keep the resulting dose ALARA.

7.4 Category C

Category C events are all possible events that potentially could lead to exposure, including those which are demonstrated to be extremely unlikely. As such, category C events include category A and B events as well as those events that occur with an annual frequency of less than $10^{-6}$ per year (beyond category B events).

(16) In this range events must be considered as part of the design where there are significant uncertainties on the related probability values and as a result of the required provision against larger accidents.

7.4.1 Limitation of Risk to Plant Personnel

(17) In respect of risk limitation to plant personnel, the following criteria must be applied in consideration of both design and all phases of operation of the facility:

- $5 \times 10^{-5}$ peak individual risk per year,
- $1 \times 10^{-5}$ average risk per year
- Provisions against beyond category B events so that no cliff edge effects are to be expected to plant personnel. This must take emergency response actions into account.

Classification: Unrestricted
• In addition, risks must be optimised by the application of the ALARA principle.

7.4.2 Risk to Members of the Public

(18) In respect of risk limitation to members of the public, the following criteria must be applied in consideration of both design and all phases of operation of the facility:

• \(5 \times 10^{-6}\) peak individual risk per year,
• \(1 \times 10^{-8}\) risk per facility per year
• Provisions against beyond category B events so that no cliff edge effects are to be expected.
• In addition, risks must be optimised by the application of the ALARA principle.
### 7.5 Summary

The Basic Licensing Requirements for the PBMR are summarised in the following table:

<table>
<thead>
<tr>
<th>INITIATING EVENT</th>
<th>SAFETY REQUIREMENTS</th>
<th>LIMITS</th>
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<tbody>
<tr>
<td><strong>Category A</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Category A comprises Normal Operation as well as Anticipated Operational Occurrences (AOO) which are events that potentially lead to exposure and which could occur with a frequency of more than one in one hundred years ($\geq 10^{-2}$ y$^{-1}$).</td>
<td>The design must be such to ensure that under anticipated conditions or occurrences of normal operation, there is no radiation dose to the plant personnel and the members of the public above the category A limits. Normal operation exposure must consider exposures resulting from minor incidents and misjudgements during operation, maintenance and decommissioning. For dose calculation a representative set of AOO needs to be considered. In addition, all radiation doses must be kept ALARA for the plant personnel and at a trivial level for the public, according to internationally agreed practice for such doses. The design provisions for category A events must be part of the DiD application.</td>
<td>Plant Personnel: - annual individual accumulated design dose limit of 20 mSv in any single year. and Members of the Public (critical group): - annual individual design dose limit of 250 μSv (per facility)</td>
</tr>
<tr>
<td><strong>Category B</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Category B events are those which potentially lead to exposure and which could occur with a frequency of less than one in one hundred years ($&lt; 10^{-2}$ y$^{-1}$) and more than one in one million years ($\geq 10^{-6}$ y$^{-1}$).</td>
<td>The design must be such to prevent and mitigate potential failures and to withstand externally or internally originating events which could give rise to radiation doses to plant personnel and members of the public in excess of the category B limits. The analysis performed to demonstrate compliance with this requirement must be deterministic and give results demonstrably conservative with respect to the event frequencies and the resulting radiation doses. In addition radiation doses must be kept ALARA and the defined dose constraints must be staged in the probability range of category B in compliance with the cat C risk limits. Regarding the dose to the public, emergency measures have to be taken into account if the expected dose to the public can exceed 1 mSv per event to keep the resulting dose ALARA. The provisions for category B events must be part of the DiD application.</td>
<td>Plant Personnel (outside of exclusion areas): - 50 mSv individual design dose limit for the total accumulated exposure after one single event and Members of the Public (critical group): - 50 mSv individual design dose limit for the total accumulated exposure after one single event</td>
</tr>
<tr>
<td><strong>Category C</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Category C events are all events that potentially can lead to exposure except maintenance. As such, category C events include category A events (AOOs) and category B events as well as beyond category B events which occur with an annual frequency of less than $10^{-6}$ ($&lt;10^{-6}$y$^{-1}$).</td>
<td>The design must be demonstrated to respect the Risk Limits for plant personnel and members of the public considering all events [2]. The analysis performed to demonstrate compliance with this requirement may use best estimate data provided it is supported by an appropriate uncertainty and sensitivity analysis. The analysis must also demonstrate provisions against very low frequency events in the range below $10^{-9}$ per year. In addition risks associated with these events must be kept ALARA.</td>
<td>Limitation of risk to the values set by the risk criteria: Plant Personnel: - $5 \times 10^{-5}$ y$^{-1}$ peak individual risk and - $10^{-5}$ y$^{-1}$ average risk per facility Members of the Public: - $5 \times 10^{-6}$ y$^{-1}$ peak individual risk (critical group), and - $10^{-5}$ y$^{-1}$ average risk per facility</td>
</tr>
</tbody>
</table>

**Table 1: Basic Licensing Requirements for the PBMR**

Classification: Unrestricted
8 DEMONSTRATION OF COMPLIANCE WITH THE BASIC LICENSING REQUIREMENTS

8.1 Basic Requirements for Demonstration of Compliance

(19) The applicant / licensee must provide the NNR with a Safety Case in support of the licence application, which must demonstrate the adequacy of the facility design and operational procedures against the requirements of this document (which may include others as indicated in Section 4). The scope and content of a typical Safety Case are defined in the NNR Licensing Guide document LG-1041 [3].

(20) The extent and significance of any design changes after definition of the Safety Case must be identified and analysed in order to ensure the consistency and applicability of the Safety Case for licensing.

(21) Compliance with the BLR must be demonstrated by way of formalised safety analyses with reference to proven technology and in accordance with international practice (INSAG-12 [7] (154)). Such analyses must include both deterministic analyses and probabilistic risk assessment. Conservative safety analyses must be applied for demonstration of compliance with the design dose limits for category A and B events, best estimate analyses can be applied for demonstration of compliance with ALARA targets and the probabilistic risk assessment of category C events.

(22) The safety analyses must cover all categories of events (A, B and C) in a structured and enveloping way so that all the potential radiological consequences of PIE are covered.

8.2 Demonstration of Compliance for Category A Events

8.2.1 General Requirements

(23) An operational radiation protection programme must be designed and put in place to ensure that all radiological exposures associated with normal operations are identified and quantified with a view to the implementation of control measures to ensure compliance with the dose limits. Normal operation includes exposures resulting from minor incidents and misjudgements in commissioning, operation, maintenance and decommissioning. The operational radiation protection programme must be consistent with the design analysis. The entire life cycle, including retrofitting and decommissioning, must be addressed by both the design analysis and the operational radiation protection programme.

(24) A prospective design analysis must be performed which:

- Demonstrates a definite compliance with the annual dose limits to both the plant personnel and members of the public as required in section 7 and the respective dose constraints defined by the applicant.

Classification: Unrestricted
• Includes the establishment of ALARA design targets for annual individual and collective dose and must demonstrate compliance with these ALARA targets through quantitative analysis using best estimate data.

(25) A prospective design analysis must be performed which estimates all normal operational annual radiological releases from the facility and associated doses to the highest exposed group of individuals from all pathways under conservative assumptions, taking into account all operational modes of the facility and potential facility considerations. This must include provision to demonstrate that radiological releases are ALARA and that adequate defence-in-depth has been included in the design of systems that collect, store, process, monitor and discharge radiological releases. The entire life cycle, including retrofitting and decommissioning, must be addressed.

8.2.2 Radiation Protection Requirements

With this objective, the following requirements apply:

Control of Radiation Exposure, Radiation Monitoring and Radioactivity Release Management

(26) Radiation exposure must be minimised by using appropriate design, confinement, shielding, radiation monitoring, personal protective equipment and zoning of the facility. Exclusion areas must be defined for areas where the ALARA targets or the radiation dose limits could be potentially violated.

(27) Appropriate dose monitoring must be provided for all individuals entering controlled areas of the facility where doses are expected to exceed the natural background radiation. Monitoring must allow for dose assessment in terms of the dose limits defined in this RD and [1] and the ALARA targets defined by the licensee.

(28) An operational radioactive release management programme must be defined that is consistent with the category A design dose limits and the ALARA targets. The programme must include a system to quantify the radionuclides discharged to the environment from all pathways.

(29) Limits must be defined that the design is required to meet the BLR in respect of direct radiation and radiological discharges. Such limits would necessarily imply the use of conservative data for the derivation of dose conversion factors in order to de-couple the design requirements from facility considerations.

(30) Appropriate monitoring / instrumentation must be provided at all pathways of radioactive discharge from the facility.

(31) A prospective radiological analysis must be performed, which demonstrates compliance with these limits in respect of direct radiation, discharge control, radioactive waste management and transport of radioactive material. Requirements in respect of dose limitation must be considered both in the design
of the Structures Systems and Components (SSC) and operation, including the execution of operational programmes.

(32) The specifications must include the establishment of design ALARA targets for annual individual dose to the plant personnel and the highest exposed group of individual members of the public and must demonstrate compliance with these targets through radiological analysis. *Best estimate data* may be used.

**Radioactive Waste Management**

(33) A prospective analysis must be performed which classifies and quantifies the normal operational annual radioactive waste quantities from the *facility*, under conservative assumptions, taking into account all operational modes of the *facility*. The lifecycle of the *facility*, including retrofitting and decommissioning, must be addressed.

(34) An operational radioactive waste management programme, including decommissioning waste, must be defined consistent with the prospective analysis and the conditions defined in [1]. The programme must include a system to quantify the radionuclides in all radioactive wastes and must make particular provision for quantification of radionuclides that are of a long-lived nature.

(35) Design targets must be defined for the annual quantity of radioactive waste produced and compliance with these targets must be demonstrated through quantitative analysis. *Best estimate data* may be used. This must include provision to demonstrate that radioactive waste quantities are kept ALARA and that confinement of radioactivity is ensured by adequate design of the SSC that collect, store, process, condition and package radioactive waste.

**Transport of Radioactive Material**

(36) The prospective analysis must demonstrate that, for all radioactive waste and materials that it is intended to ship from the *facility*, the engineered package designs comply with the appropriate requirements of IAEA Regulations for Safe Transport of Radioactive Material.

(37) The operational programme must ensure that the shipment process complies with the requirements of the appropriate IAEA Regulation for Safe Transport of Radioactive Material.

**8.3 Demonstration of Compliance for Category B Events**

(38) According to the DiD principle, PBMR *Safety Functions* separate to the operational control and limitation functions must be identified and measures provided to cope with the consequences of category B events and to ensure that the *FSF* are not violated. No credit must be taken in the analyses for category B events from *early operator actions* or *Event Management*.

Classification: Unrestricted
(39) Design criteria and appropriate requirements must be established for the category B events to meet the BLR and to balance the design margins with the probability and the consequences of the category B events taking the ALARA principle into account.

(40) Deterministic analyses must be performed which demonstrate compliance with the BLR in design and operation using conservative assumptions (pessimistic with regard to the resulting source terms and the BLR). These deterministic analyses must cover all PIE arising from inside or outside the facility and determine the resulting source terms causing exposures to the personnel and the public. The PIE selection must be based on a comprehensive list of IE derived according to subsection 8.4.2.

(41) The deterministic framework resulting from the provisions against category B events must be balanced in a way that the staged dose constraints, to be defined in the frequency range of category B, are met. In the lower range of the category B frequencies, where the uncertainties can be high, the degree of conservatism of deterministic analysis may be justified on a case by case basis.

(42) The most limiting Single Failure must be applied to the functional systems of SSC providing the required safety functions and taken credit for in the analyses. Any exception to the application of the Single Failure Criterion needs detailed and individual justification.

(43) Exclusion areas must be defined to ensure that the plant personnel will not be exposed to doses above the design dose limit in case of a category B event.

(44) In order to keep the resulting dose ALARA, emergency measures consistent with section 8.6 have to be defined for events where the potential dose consequences to the public can exceed the annual effective dose of 1 mSv resulting from a category B event.

8.4 Demonstration of Compliance for Category C Events

8.4.1 Design Considerations

Category C envelopes the range of all events (category A, B and beyond category B events) that can potentially lead to exposure down to IE probabilities of less than $10^{-6}$ (Beyond category B Events). Events or combination of events with an annual frequency $\geq 10^{-6}$ (category A and B events) must be considered in order to provide a deterministic frame for the design measures that are necessary to meet the BLR of category A and B.

(45) All events or combination of events, including those with an annual frequency $< 10^{-6}$ (beyond category B events), have to be assessed probabilistically in order to assess the total risk imposed by the facility and to identify those events or combination of events that are major contributors to risk. The demonstration for the Probabilistic Risk Assessment of category C events may be carried out using best estimate analysis and data.

Classification: Unrestricted
Design criteria and appropriate design requirements for the category C events need to be established and adjusted to the probabilities of the events to meet the different BLR for category A, B and C.

### 8.4.2 Initiating Events

#### 8.4.2.1 Internal Events

(47) All IE originating from within the facility boundary (and possible combinations of them) must be identified and considered. They must include but are not limited to:

- Failures of pipes, vessels, tanks, pumps and valves,
- Transients (e.g. of the reactor core and the power conversion unit),
- Air and water ingress to the core,
- Loss of power supply,
- Flooding,
- Internal missiles,
- Load drop,
- Internal explosion,
- Internal Fires,

Their contribution to the radiological consequences must be included in the probabilistic risk assessment.

#### 8.4.2.2 External Events

(48) All IE potentially originating from outside the facility boundary (and possible combinations of them) must be identified and considered. They must include but are not limited to:

**Natural hazards:**
- seismic events,
- weather phenomena,
- precipitation and external flooding,
- other natural hazards as water pollution, coastal erosion, tsunami, etc.

**Man made hazards:**
- aircraft crashes,
- explosion pressure waves,
- toxic, corrosive or combustible gases,
- external fires,
- terrorist attacks

Their contribution to the radiological consequences and risk must be included in the probabilistic risk assessment.
8.4.3 Probabilistic Risk Assessment

(49) As indicated above the overall safety analysis must include both a deterministic analysis of category A and B events as well as a probabilistic risk assessment (PRA) of category C. With specific emphasis on the PRA, this analysis must:

- Provide a systematic analysis giving confidence that the design will comply with the BLR for category C events,
- Demonstrate that a balanced design has been achieved such that no particular feature or event makes a disproportionately large or significantly uncertain contribution to the overall risk,
- Provide confidence that the design will prevent sudden escalation in the consequences of any event,
- Provide an assessment of the frequency and consequences of internal IE,
- Provide an assessment of the frequency and consequences of external IE, in particular those unique to the facility,
- Identify SSC for which design improvements or operational procedures could reduce the frequency of beyond category B events or mitigate their consequences,
- Provide an assessment of the beyond category B events with larger consequences,
- Provide input in the determination of the emergency preparedness requirements, check compliance of the applied data with established probabilistic data.

(50) The probabilistic risk assessment must be reasonably balanced and supported through the use of deterministic arguments that allow judgements to be made about the degree of confidence to be given to these estimates and the assumptions.

(51) The applicant must demonstrate compliance with the risk limits in accordance with the requirements of the Regulatory document LD1091: “Requirements on Licensees of Nuclear Installations regarding Risk Assessment and Compliance with the Safety Criteria of the NNR” [2].

8.4.4 Provision against Beyond Category B Events (risk aversion criterion)

(52) The $10^{-8}$ y-1 average risk per facility criterion for category C events for members of the public in table 1 covers all events. The required provision against beyond category B events, referred to in table 1, serves to ensure that the probability of events with larger accidental consequences is more remote than could be allowed by the average population risk criterion.

**Note:** The required provision against larger consequence events is imposed as a result of the assumption that the annual average frequency, $f(N)$, of events resulting in more than N fatalities, be less than $A \left( N^{-1} - N_p^{-1} \right)$, where $A$ is a constant determined by limiting the individual fatality risk per annum (i.e. the fatalities/year, averaged over the population) to $10^{-3}$ in the range $1 < N < N_p$, where $N_p$ is an acceptable projection of the national population.
8.5 Verification and Validation of Safety Analyses, and Quantification of Uncertainties

(53) All quantitative techniques used for the individual safety analyses like computer codes must be appropriately verified and validated. The definitions and requirements are given in [5].

(54) It must be ensured that the quantitative techniques used for the deterministic and probabilistic analyses take into account all the potential uncertainties that exist so that an estimate can be made of the confidence level to be ascribed to the quantitative results and the demonstration of the level of conservatism that exists in them. Comprehensive and systematic sensitivity studies and uncertainty analyses must be performed to determine those uncertainties that are most important in each case. The definitions and requirements are given in [5].

8.6 Emergency Preparedness

(55) In addition to the engineered safety features of the facility, emergency or remedial measures must be considered where there is a potential for the off-site annual individual effective doses to the public to be more than 1 mSv. In selecting the events where this may apply, consideration must be given to the mitigation of the consequences arising from those events that have been identified in the safety analysis. The requirements stipulated in [4] apply.

(56) In the event of an emergency or when responding to an event, measures are to be defined that may cause a dose in excess of the annual dose limit, to plant personnel, for the purpose of saving life or preventing serious injury or if undertaking actions intended to avert a large collective dose or if undertaking actions to prevent the development of catastrophic conditions. The dose limits for such actions are stipulated in [1].

(57) The extent of the emergency response plan must be commensurate with the radiological consequences predicted for these event sequences. In determining the extent of the emergency response plan, the following must be considered:

- The specification and justification of a zone around the facility in which urgent protective actions, based upon facility conditions and releases, would be implemented. The size of this zone must be based upon a best estimate analysis of the consequences arising from a reference event.

- The specification and justification of a zone in which protective actions would be implemented following a radioactive release potentially causing exposures above the individual effective public dose of 1 mSv. The size of this zone would represent a judgement of the extent of detailed planning necessary to effectively implement the required protective actions for the affected group of the public.

The specification and justification of a zone where, following a radioactive release, longer-term protective actions such as relocation, resettlement and...
industrial or agricultural countermeasures may be required. This requirement must be considered for all events potentially causing exposures above the individual effective public dose of 1 mSv.

8.7 Decommissioning

(58) In line with section 5.1.1 of [1] a decommissioning strategy must be submitted as part of the prior safety assessment and must be updated throughout the operation of the authorised action as a basis for detailed decommissioning planning.

(59) In line with section 5.1.2 of [1] a decommissioning plan must be submitted as a basis for authorisation of specific actions or phases of decommissioning.
9. References


[2] LD-1091: Requirements on Licensees of Nuclear Installations regarding Risk Assessment and Compliance with the Safety Criteria of the NNR.


[5] RD-0016: Requirements for licensing submissions involving computer software and evaluation models for safety calculations


[8] IAEA TECDOC-1366 “Considerations in the development of safety requirements for innovative reactors: Application to modular high temperature gas cooled reactors”
### APPENDICES

**Appendix A: TERMS, ABBREVIATIONS AND DEFINITIONS SPECIFIC TO THE PBMR**

Overall terms and definitions are given in [1]. Additional definitions are given in [6]. Terms, abbreviations and definitions specific for this RD are given below.

<table>
<thead>
<tr>
<th>Term / Abbreviation</th>
<th>Definition</th>
</tr>
</thead>
<tbody>
<tr>
<td>Anticipated Operational Occurrences (AOO)</td>
<td>An operational process deviating from <em>normal operation</em> which is expected to occur at least once during the operating lifetime of a facility but which, in view of appropriate design provisions, does not cause any significant damage to items important to safety nor lead to category B conditions.</td>
</tr>
<tr>
<td>Applicant</td>
<td>Applicant for a nuclear installation licence to site, construct, operate and decommission a pebble bed modular reactor.</td>
</tr>
<tr>
<td>Basic Licensing Requirements (BLR)</td>
<td>The BLR are the dose and risk limits to be complied with for the plant personnel and the public as defined for the event categories A, B and C. The application of the ALARA and DiD principles are part of the BLR. The BLR are based on the Principal Safety Requirements. Other licensing requirements for the PBMR, covering specific areas are stipulated in additional Regulatory Requirements and Guidance Documents as developed by the NNR.</td>
</tr>
<tr>
<td>Best estimate analysis / assumptions / data / results</td>
<td>An analysis that is performed on the basis of the mechanistic behaviour of systems and processes, providing most probable assumptions and values where uncertainties exist and avoiding over-conservative assumptions. For such analyses justified representative input data are used with the purpose of arriving at a realistic and representative set of best estimate results.</td>
</tr>
<tr>
<td>Beyond category B Events</td>
<td>Beyond category B events are events which give rise to conditions more severe than those anticipated for the design basis of the PBMR. They are events (or combination of events) with a frequency (&lt; 10^{-6} \text{y}^{-1}) which extend the design and safety analysis of the facility beyond the category A and B events to demonstrate that no cliff edge effects occur. Appropriate design rules and criteria must be set for beyond category B events, which may differ from those for category A and B events. Beyond category B events must be included (along with the category A and B events) in the Safety Analyses of the category C events to demonstrate that the BLR are met. Note: Beyond category B events that have no impact to the average population risk taking the risk aversion criterion explained in Appendix B into account, need not to be considered for design.</td>
</tr>
<tr>
<td>Cliff Edge Effect</td>
<td>IAEA definition in INSAG-12, [7] (52): Effects which might permit small deviations to precipitate grossly abnormal facility behaviour and cause damage.</td>
</tr>
<tr>
<td>Conservative safety analysis / assumptions / data / results</td>
<td>The deterministic safety approach requires adequate margins. This is achieved through analyses using conservative assumptions and input data without the introduction of a final margin. For such analyses input data pessimistic in terms of the analytical results are used with the purpose of arriving at a set of safety analysis results that are demonstrably pessimistic in comparison with any likely result.</td>
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Classification: Unrestricted
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<thead>
<tr>
<th>Term / Abbreviation</th>
<th>Definition</th>
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<tbody>
<tr>
<td>Design Basis</td>
<td>The range of conditions and events taken explicitly into account in the design of the PBMR according to established design criteria, such that the facility can withstand them without exceeding authorized limits.</td>
</tr>
<tr>
<td>Design dose limit</td>
<td>Dose limit to individuals that must not be exceeded and must be complied with by the facility design provisions.</td>
</tr>
<tr>
<td>Deterministic framework</td>
<td>The deterministic framework of the facility is defined by the designed functional provisions that are required to cope with the design challenges presented by the PIE. The functional provisions that are required, are an outcome of a deterministic functional analysis approach.</td>
</tr>
<tr>
<td>Early operator actions</td>
<td>Early operator actions are considered to be any intervention by the operator in the facility operation with the aim of event mitigation at a time after the occurrence of an IE when reliability of the actions is too limited. According to international practice, no credit must be taken from operator actions for at least the first half of an hour after occurrence of an incident.</td>
</tr>
</tbody>
</table>
| Event management                  | The taking of a set of actions during the evolution of an event:  
- to prevent the escalation of the event;  
- to mitigate the consequences of an event; and  
- to achieve a long term safe stable state.  
No credit must be taken for Event Management measures for category A and B events in meeting the BLR.                                                                                                                   |
| Exclusion areas                   | Exclusion areas are those radiologically controlled areas where access must be prevented during operation, depending on the operational mode and state of the facility and any local to facility requirements to avoid uncontrolled exposures.                                                                                               |
| Functional systems of SSC         | Functional systems of SSC are defined as a specific and complete configuration of structures, systems and components all of which, working together, provide a required specific safety function. A functional system of SSC usually comprises more than one facility system and includes all the SSC, including support functions, that are necessary to achieve and monitor the safety function. |
| Fundamental Safety Functions (FSF)| The Fundamental Safety Functions to be ensured for a nuclear reactor are defined as  
- Reactivity Control  
- Heat Removal  
- Confinement of Radioactivity  
The FSF are provided by single or combinations of the PBMR Safety Functions.                                                                                                                                                                                                 |
| Good Engineering Practice         | Practices or rules usually applied for a purpose by experienced practitioners and verified by frequent successful application in similar situations.                                                                                                                                                                                                 |
| ICRP                              | International Commission on Radiological Protection                                                                                                                                                                                                                                                                                         |
| Internal / External events        | Internal and external events are events that originate within or outside the facility with the potential to cause adverse conditions or even damage to safety important structures, systems or components. These effects can potentially lead to a common cause failure within the systems used to reach or to maintain the facility in a safe state.  
The objective of the design provisions against internal and external events is to ensure that the safety functions of the structures, systems or components, which are required to bring or maintain the facility in the safe shutdown state are not unduly affected to ensure that the Fundamental Safety Functions are maintained. |
<table>
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<tr>
<th>Term / Abbreviation</th>
<th>Definition</th>
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<tbody>
<tr>
<td>Normal Operation</td>
<td>Operation within specified operational limits and conditions. This includes starting, power operation, shutting down, shutdown, maintenance, testing and refuelling. Category A includes Normal Operation and AOO.</td>
</tr>
<tr>
<td>PBMR Safety Functions</td>
<td>The PBMR Safety Functions are those safety functions (or combinations thereof) specific to the PBMR design that are provided by the SSC that must ensure that the FSF are met.</td>
</tr>
<tr>
<td>Postulated Initiating Events (PIE) / Initiating Events (IE)</td>
<td><strong>PIE</strong> are the enveloping Initiating Events – covering one or several IE and combinations of IE – but excluding mitigation activities. Based on justified frequencies – taking uncertainties into account – the PIE are to be allocated to the event categories A, B and C. The comprehensive set of PIE forms the basis for the Safety Analysis (deterministic and probabilistic).</td>
</tr>
<tr>
<td>Principal Safety Requirements</td>
<td>The Principal Safety Requirements are overall radiation protection and nuclear safety requirements that are stipulated as having to be met as part of the Basic Licensing Requirements (BLR) for the PBMR.</td>
</tr>
<tr>
<td>Probabilistic Risk Assessment (PRA)</td>
<td>A comprehensive, structured approach for deriving numerical estimates of risk. The PRA must cover the category C events and demonstrate that the BLR are met for category C.</td>
</tr>
<tr>
<td>Safety Case</td>
<td>A collection of arguments and evidence in support of the safety of a facility or activity. This will normally include the findings of a safety assessment and PRA and a statement of the confidence in these findings. The Safety Analysis Report (SAR) is part of the Safety Case. The safety case may relate to a given stage in the development of a facility. In such cases the safety case must acknowledge the existence of any unresolved issues and provide a strategy to resolve these issues in future development stages.</td>
</tr>
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</table>
APPENDIX B: Explanation of the applied risk criteria and the provision against larger risks (Risk Aversion criterion)

B-1 Risk to members of the public due to nuclear facilities

Risk criteria are expressed for both individuals and to the whole population in terms of annual probability of fatality among members of the public. The limit of $10^{-7}$ fatalities per person per annum refers to the average risk criterion for the national population due to all nuclear facilities and -sites. This figure is based on comparisons with other risks imposed on society by industry and various natural disasters.

Based on the assumption of there being not more than 10 major nuclear sites in South Africa during the lifetime of the specific facility, a factor of 0.1 has been applied to this figure to obtain the risk limit of $10^{-8}$ fatalities per person per annum for each nuclear site. The risk to the public is to be computed using acceptable projections on the relevant site-specific data (e.g. demographic, meteorological, agricultural, farming practices, food consumption data).

A peak-to-average ratio of 50 has been adopted to ensure an equitable variation in risk in the country. Adoption of this value provides an upper risk limit for an individual of $5 \times 10^{-6}$ fatalities per annum. It is intended to limit the risk to any individual or representative group of individuals.

B-2 Risk to plant personnel due to nuclear facilities

Similar considerations apply to the risk due to events to the workforce on a site, resulting in a limit on the average risk of $10^{-5}$ fatalities per annum, and a maximum individual risk of $5 \times 10^{-5}$ fatalities per annum. The latter has been based on a maximum peak to average value of 5 for the workforce of a site.

B-3 Explanation on the Provision against larger risks (Risk Aversion criterion)

The risk aversion criterion, is derived as follows:

The probability density function, $F(N)$, for having $N$ fatalities per annum is chosen with the following form:

$$F(N) = \frac{A}{N^2}.$$

The parameter, $A$, is independent of $N$ and is derived below. The number of fatalities, $N$, serves as a measure of the magnitude of beyond category B events. The form of $\frac{A}{N^2}$ for $F(N)$ effects the provision against beyond category B events by suppressing $F(N)$ for large $N$.

Historical data on risks to which society is subject and which it apparently tolerates, correspond to a form for $F(N)$ of $\frac{A}{N^2}$ with $x = 1.5$ but, due to imprecision in the data, $x$

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could be considered to fall in the range $1 \leq x \leq 2$. The choice of the $x = 2$ extreme is conservative as far as events with larger consequences are concerned as it increases the provisions against such events. Let

$N_p$ ≡ Acceptable projection of the population

The average annual population risk (i.e. the fatalities/a, averaged over the population) is then given by:

$$< N > = \frac{1}{N_p} \int F(N)NdN$$

$$= \frac{1}{N_p} \int_1^{N_p} A \frac{N}{N} dN$$

$$= A \frac{\ln N_p}{N_p}$$

The annual frequency of events in which $N$ is equal or exceeded is given by:

$$f(N) = \int_1^{N_p} F(N^')dN'$$

$$= A \left( \frac{1}{N^'} - \frac{1}{N_p} \right)$$

The quantity $A$, is determined by the condition:

$$< N > = C$$

where $C$ is average population risk criterion of $10^{-8} \text{y}^{-1}$ per facility, i.e.:

$$A = \frac{CN_p}{\ln N_p}$$
Appendix C: Explanation of the Defence in Depth (DiD) Principle for the PBMR

C-1 Safety functions

The DiD approach has to be implemented in respect of the *Fundamental Safety Functions* (FSF):

- Reactivity control
- Heat removal
- Confinement of radioactivity.

Sufficient PBMR *safety functions* must be provided to ensure that the FSF are maintained and to provide the required levels of DiD.

As a result of the adoption of the DiD principle, the PBMR must be designed so that DiD can be substantiated for the PBMR by the provision of:

- Sufficient independent reactivity control functions
- Sufficient independent heat removal functions
- Sufficient independent barriers for confinement of fission and activation products

C-2 Levels of defence in depth

The defence in depth concept as described in the IAEA documents: e.g. [7] and [8].

The DiD principle requires that various lines of defence are provided by design and appropriate procedures to ensure the FSF.

Detailed analysis and assessment of the design of the facility and the various systems and procedures are required to ensure that the lines of defence or barriers are of satisfactory quality and independence, taking into account all the facility provisions and operating procedures.

The safety philosophy is aimed primarily at the prevention of events but also gives attention to the mitigation of the consequences of events that could give rise to radioactive releases. The aim is to reduce both the probabilities of the events and their associated radiological consequences (inside and outside the facility).

The use of the following well established principles of defence in depth is required:

- Prevention of deviation from *normal operation*
- Detection of deviations from *normal operation* and provision of means to prevent such deviations leading to category B events.
- Provision of engineered safety features (active and passive to control and mitigate the category B events.
- Prevention and mitigation of *beyond category B events* through the consideration of events or combinations of events with an annual frequency \(<10^{-6}\). Emphasis

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must be put on prevention of beyond cat B events. Realistic assumptions and best estimate methods may be used to analyse these conditions.

- Mitigation of radiological consequences of significant releases of radioactive materials by means of off-site emergency response.

C-3 Barriers

A second complementary aspect of the defence in depth principle is the concept of multiple, independent physical barriers to the uncontrolled release of radioactive material to the environment. The demonstration of the adequacy of these barriers is an important part of the safety analysis.

These barriers must be designed on the basis of the facility’s lifetime, both for steady states and transients occurring in any operational conditions and accident conditions.

The facility must be designed so that:

- Sufficient independent barriers for confinement of fission products are provided.
- The confinement of the fission products is ensured by these barriers with sufficient margins for all category A events.
- The integrity of nuclear fuel is maintained for all category A and B events and fuel failures due to accidental conditions are minimised even for beyond category B events.
- The integrity of the Primary Pressure Boundary (PPB) is maintained for all category A and B events except for the failure assumptions to be set for the PPB itself.
- The overall radioactivity confinement function of the civil structures forming the confinement functional design must be ensured with sufficient margins for all category A events.
- The integrity of the civil structures forming the confinement functional design of the building must be ensured for the category B events. Provisions must be made to minimise the damage of the civil structures for beyond category B events.
- For beyond category B events at least one confinement function must be adequately maintained in such a way that no cliff edge effects occur.

C-4 Accident prevention

The importance of prevention of accidents as the main basis of the safety is emphasised.

The primary objective of nuclear power facility designers is to provide a sound and balanced design. The SSC of the facility must have the appropriate characteristics, specifications and material composition and must be combined and laid out in such a way as to meet the facility specifications. These specifications must be consistent with the requirement to meet the safety objectives, the specified duty in terms of electrical output, availability, projected lifetime, and the operations necessary to meet system demands. In respect of the principle of defence-in-depth [7] (46-55) and accident prevention [7] (56-62, and 159), the design must ensure that exposures to the personnel and the public exceeding the category A dose criteria are unlikely to occur during the lifetime of the facility.

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Fuel element design, fabrication and inspection, and the conditions under which the fuel is operated must be such as to ensure a high degree of integrity.

The integrity of the reactor coolant system as well as that of the systems connected to it must be ensured by the design with adequate margins.

The design must aim to provide a facility that is simple to operate and maintain. At the design stage, consideration must be given to the performance capabilities of the personnel who will operate and maintain the facility. The designer must supply information and recommended practices for incorporation into operating procedures. The design must aim for simplicity, adequate margins and forgiving characteristics to minimise the consequences of operator errors.

Experience feedback from nuclear operating power facilities and, as applicable, from other industrial facilities must be extensively and systematically used in the design process. Proven components are to be preferred unless alternatives provide clear advantages in one or more specific areas (e.g. safety, cost, reliability) without significantly affecting the others.

Attention must be paid to the requirements for inspections, testing, on-line monitoring and maintenance, also in their potential to prevent accidents.

The controls must maintain the reactor within the parameters set for normal operation. The objective must be to reduce the number of challenges to the reactor protection system.

If deviations from normal operation conditions occur which cause specific limits to be exceeded, the operational control systems must detect such conditions and prevent them from leading to category B or beyond category B events.

C-5 Accident mitigation

Notwithstanding all preventive features to prevent radiological consequences of events, mitigative measures must be provided to minimise the radiological consequences through the barriers.

For the design basis the confinement system of the building must be designed to meet the radiological targets specified to meet the BLR. The maximum allowable source terms from the confinement (including leakage rates and depressurisation) must be defined to satisfy the BLR for the various PIE, and the means to monitor and maintain such leak rates and releases must be provided.

The engineered safety features providing the PBMR Safety Functions to control the development of accidents must be shown to meet the BLR.

The use of inherent characteristics and the simplification of systems are seen as important design aims. Passive safety features must be used where appropriate and of overall safety benefit. Adequate time scales are required for any operator actions.

Classification: Unrestricted
Simplification of systems design should facilitate elimination of adverse system interactions.

Measures must be addressed to prevent fuel damage or to mitigate the consequences of event sequences that go beyond the deterministic framework of category B, using appropriate design rules. Such measures must be implemented taking account of probabilistic safety analyses where such sequences make a significant contribution to risk.
Appendix D: Description of the General Principles of the ALARA approach

D-1 Protection Principles

In 1990 the International Commission on Radiation Protection issued a set of recommendations detailing a system of radiological protection for practices based on the following three general principles:

- **Justification**
  
  No practice involving exposures to radiation should be adopted unless it produces sufficient benefit to the exposed individuals or to society to offset the radiation detriment it causes.

- **Optimisation**
  
  In relation to any particular source within a practice, the magnitude of individual doses, the number of people exposed, and the likelihood of incurring exposures where these are not certain to be received, should all be kept as low as reasonably achievable (ALARA), economic and social factors being taken into account.

- **Limitation**
  
  The exposure of individuals resulting from the combination of all the relevant practices should be subject to dose limits.

The aim of these recommendations is to avoid doses without benefit on the one hand, and not to reduce doses at all costs on the other hand. In all cases, doses are to be kept below the dose limits.

D-2 Implementation of the ALARA principle in the design stage

D-2.1 General

The first principle is a very general one that encompasses the usual engineering process (i.e. justification of the practice; here, justification of electricity generation using nuclear power facility). However, it has a practical application in the ALARA methodology when questioning the usefulness of a task to be performed for the operation and maintenance of a nuclear power station.

The second principle requires the implementation of an optimisation process at the design stage. The engineering process should be such that a balance between the cost of protection dispositions (reduction of sources, shielding, use of robotics...) and the corresponding savings in doses are achieved.

The third principle sets the boundary conditions for the exposure of workers. Design guidelines have to be established for facility layout, system and equipment engineering at the beginning of the project.
This approach makes it possible to implement necessary provisions already from the start of the design work when there is generally a lack of parameters allowing ALARA studies.

The resulting facility design based on guidelines allows optimisation in terms of the ALARA principle. Individual features e.g. component design alternatives or individual shielding provisions are questioned. Design modifications should also be justified by analysing the impact on the personnel exposure.

D-2.2 Occupational radiation exposure target

Even though there is no limit imposed by regulation on the collective dose, a part of the process to perform radiation protection optimisation is to set a target value. It implies the verification of the possibility to fulfil the objectives throughout the design phases.

D-2.3 Respect of the individual dose limits

In the early stage of the design, it is not possible to carry out detailed studies of individual doses, which have to be based on realistic assumptions. The problem is solved by the general dispositions that are aimed at providing low dose rates at work sites and an ergonomic working environment. These dispositions that can be described as "passive protection" ensure that further optimisation of individual doses will be possible.

D-2.4 Approach to the design targets

The ALARA activities accompanying the project evolution reflect the actual engineering stage. They must be conducted following a stepwise approach. The first step corresponds to the engineering documents of a basic engineering phase, describing general principles of dose and source term optimisation and justifying the target value for the individual and collective dose based on operating experience feedback.

A more detailed investigation on doses based on an analysis of maintenance tasks must correspond to the engineering documents of a detailed design.

Means necessary to reach the collective dose target must be implemented at design level. These means cover the various contributors to collective dose: sources, installation and maintenance program. As regards maintenance, some aspects are operational: preparation of work, training of personnel, organisation minimising number of persons and time spent in active zones; other aspects depend on design features: accessibility, separation in the layout, handling easiness, in-service inspectability, decontamination facility, use of robotics or automation. Only design aspects need to be dealt within a basic engineering phase.

Classification: Unrestricted
D-2.4.1 Source term optimisation

Among factors determining the source term, special attention must be given in the design to the choice of materials. In order to avoid hot spots, components and piping in activity containing systems must be designed so that deposits are limited, e.g. corners, gaps and dead zones of flow must be avoided, a sufficient flow velocity in pumps, blowers, compressors valves, piping must be chosen.

D-2.4.2 Layout aspects

Layout features that contribute to the collective dose through features such as e.g. accessibility, separation, shielding, handling, setdown areas, dress-out provisions, must be considered.

D-2.4.3 Maintenance and in-service inspection

In addition to source term optimisation and layout considerations, attention must be given to various component design features, e.g.

- tanks, vessels, and heat exchangers are designed to avoid radioactive deposits or at least to remove them easily,
- adequate access and space is given to welds and parts to be inspected or maintained,
- components are made as reliable as possible.

Experience feedback shows that not all maintenance work has the same importance in terms of individual and collective dose. Work areas giving the most important contribution to the exposure doses must be selected to be the subject of design recommendations, including possible use of remotely controlled means.

D-2.4.4 Facility management strategy

In addition to the design features of the facility, operational and maintenance aspects contribute to the reduction of the collective dose. Consideration must be given to:

- optimisation of operating procedures to minimise transients,
- use of thermal insulation and scaffolding elements with short installation and dismantling times in order to reduce man-hours under radiation exposure,
- restrictive control of stay-time of personnel during outages and during power operation inside the controlled area.

D-2.5 ALARA results at the concept design phase

It is recognised that during the initial engineering design phase only fundamental aspects of radiation protection can be dealt with. Therefore no definitive statement about the expected total exposure is expected.

Classification: Unrestricted
D-2.6 Provisions to maintain risk ALARA

Accident management should include pre-planned and ad hoc operational practices, which, in circumstances in which the design basis specification of the facility is exceeded, would make optimum use of existing facility equipment to restore control. This applies to prevention of core damage and mitigation of beyond cat B events.

Accident management procedures and equipment should be provided which would allow the facility to be restored to a safe shutdown state, with continued fuel cooling assured and radioactive material confined.

Sufficient instrumentation the operability of which must be demonstrated under the relevant conditions must be provided to allow the necessary actions to be carried out and the response monitored.

Attention must also be given to the actions that operators may be asked to perform during and after accidental conditions. Equipment accessibility and proper evaluation of radiation dose rate where the presence of the operator is required must be carried out.
### CLIENT:
Eskom Holdings Limited – Generation Division

### PROJECT:
Environmental Impact Assessment for the proposed Pebble Bed Modular Reactor Demonstration Power Plant (PBMR DPP)

### TITLE:
Environmental Management Plan (EMP)

### PROJECT NO:
J27196

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