5th National Report

Convention on Nuclear Safety

September 2010

SOUTH AFRICA

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The numbering of the Articles of the Convention has been used
as the basis of the paragraph numbering system adopted in this report.

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INTRODUCTION TO THE REPORT

This report provides an update of the South African activities in compliance with the Articles of the convention of nuclear safety since the last National Report was compiled in September 2007 and presented at the 4th Convention Review Meeting in April 2008. Although duplication from the last report has been avoided as much as possible, it is inevitable that for continuity in reporting, some reporting is carried over. Furthermore each Article is preceded by a summary of the major changes included since the last report compiled in September 2007.

In updating the report the following aspects were considered:

(i) Information to be provided from changes in the national situation such as changes in the legislative and regulatory framework, safety improvements implemented at the nuclear installations, etc. applicable to each article, which have occurred since the compilation of the 4th South African National Report,

(ii) Information to be provided emanating from the 4th Review Meeting of the CNS as contained in the observations of the summary report of the previous CNS review meeting,

(iii) Information to be provided stemming from comments and suggestions made at the 4th CNS Review Meeting in April 2007 on the 4th South African National Report.These comments and suggestions are indicated below in a) Challenges and b) Planned Measures to Improve Safety. Reference has been made to the sections of this report where these aspects are covered.

a) CHALLENGES – SOUTH AFRICA

- There is a development project going on to review the internal processes of the regulatory body and to develop a state of the art Quality Management System (QMS) on the basis of IAEA guidance. Also the regulators' internal self-assessment review on the basis of IAEA IRRS-model is ongoing. [Reported under Articles 6 and 13]

- NNR should clarify further the use of result of PRA level 3 in the assessment process. [Reported under Article 14.2]

- There is a development project for a new type of reactor going on in South Africa, that is, to construct the Pebble Bed Modular Reactor (PBMR). For the regulatory body, the challenges are training and familiarization with the completely new technology, and specifically, the licensing of this new type of reactor. [Reported under Article 18]

- Skills attraction and retention is a challenge. With the foreseeable expansion of the nuclear programme in the country, as well as the safety optimization of some existing ageing nuclear installations, this challenge will grow. [Reported under Article 8.3]

b) PLANNED MEASURES TO IMPROVE SAFETY – SOUTH AFRICA

- As a result of the first Periodic Safety Review (PSR) in 1995-99, plant improvements (79 issues already done) are ongoing. The National Report states that those with medium importance will be closed during the units refueling outages scheduled in 2009. However, some less important improvements will be implemented later, after the beginning of the second PSR in 2008. French Safety Case for CP-1 family has been used as an international reference and for the PSR IAEA practices have been adopted including ageing management. [Reported under Article 14.3, and 18.2.1]

- The following operational safety related improvements are ongoing or recently finalized: Development of Operational Limits and Conditions for shutdown states is ongoing. The Upgraded Operational Limits and Conditions will be developed before the end of 2008. The Safety Related Surveillance Manual will be developed before the end of 2008. Emergency Operating Procedures have been further developed. [Reported under Articles 18 and 19]

- Finalization of the implementation of the safety improvements at the Koeberg Nuclear Power Station (KNPS) identified during the 1st Periodic Safety Review and Continuation of the KNPS alignment to the French CP-1 family of plants. [Reported under Article 14.3]

- Implementation of measures in response to the WANO peer review. [Reported under Article 6]

- 2nd Periodic Safety Review of KNPS. [Reported under Article 14.3]

- Replacement of plant systems such as Rod Control system (RGL) and Turbine Control system (GRE) with new technology. [Covered under Article 14.3 on overall scope]

- Installation of a 3rd train of spent fuel pool cooling at the Koeberg NPS. [Reported under Article 18.2 and 19.9]

The following items are not referred to as they have not been progressed by the South African Electric Utility- Eskom:

- Steam Generators (SG replacement) at the Koeberg NPS and possible power upgrade (scheduled for 2015).

- Relocation of dedicated off-site power supply to the Koeberg NPS (ACACIA).

- Installation of second plant simulator for Koeberg and construction of additional training facilities.

ARTICLE 6: EXISTING NUCLEAR INSTALLATIONS

Each Contracting Party shall take the appropriate steps to ensure that the safety of nuclear installations existing at the time the Convention enters into force for that Contracting Party is reviewed as soon as possible. When necessary, in the context of this Convention, the Contracting Party shall ensure that all reasonably practicable improvements are made as a matter of urgency to upgrade the safety of the nuclear installation. If such upgrading cannot be achieved, plans should be implemented to shut down the nuclear installation as soon as practically possible. The timing of the shut-down may take into account the whole energy context and possible alternatives as well as the social, environmental and economic impact.

Summary of changes

(I) Section 6.2.1 has been updated to reflect the overall findings of the WANO Peer Reviews conducted at the Nuclear Installations in2008.

(iii) Section 6.3.5 has been updated to provide overall information of the Koeberg Nuclear Power Station 2nd Periodic Safety Review

6.1 EXISTING NUCLEAR INSTALLATIONS

There is no change in the existing nuclear installations. South Africa has one operating twin-reactor unit nuclear power plant (the nuclear installation) consisting of:

Reactor PRIS code:	ZA-1
Reactor Name:	Koeberg Unit 1
Reactor Type:	PWR
Capacity MW (e) Net:	921
Capacity MW (e) Gross:	965
Operator:	Eskom
NSSS Supplier:	Framatome
Construction Start:	1976-07-01
First Criticality:	1984-03-14
Grid connection:	1984-04-04
Commercial Operation:	1984-07-21

Reactor PRIS Code:	ZA-2
Reactor Name:	Koeberg Unit 2
Reactor Type:	PWR
Capacity MW (e) Net:	921
Capacity MW (e) Gross:	965
Operator:	Eskom
NSSS Supplier:	Framatome
Construction Start:	1976-07-01
First Criticality:	1984-07-07
Grid Connection:	1984-07-25
Commercial Operation:	1985-11-09

Neither of the above nuclear installations was found, by assessment, to require any significant corrective actions under Articles 10 through 19 of this Convention. However safety improvement initiatives have been and still are being implemented at the nuclear installations indicated above since South Africa ratified the Convention in 1996 and its entry in force on 24 March 1997. These safety improvement initiatives are reported in the various Articles 6-19 of this report.

6.2 OVERVIEW AND MAIN RESULTS OF SAFETY ASSESSMENTS PERFORMED

6.2.1 WANO Peer Review

A World Association of Nuclear Operators (WANO) team, comprising experienced nuclear professionals from three WANO regions, conducted a peer review at the Koeberg Nuclear Power Station in November 2008. The purpose of the review was to determine strengths and areas in which improvements could be made in the operation, maintenance, and support of the nuclear units at the Koeberg Nuclear Power Station.

As a basis for the review, the team used the *Performance Objectives and Criteria for WANO Peer Reviews*; Revision 3 dated January 2005. These were applied and evaluated in light of the experience of team members and good practices within the industry.

The team spent two weeks in the field observing selected evolutions, including surveillance testing and normal plant activities.

The following was noted:

- WANO credited Koeberg for the progress that had been made since the last WANO review of 2006 but also identified gaps in performance in several areas, specifically in the areas of Plant Status Controls and Situational Awareness (i.e. conventional safety). Whilst these gaps have not resulted in an unacceptable situation as regards nuclear safety, it has been recognised by Koeberg that a step change in management actions and in the focus on their resolution is required in order to avoid a repeat area for improvement (AFI) in these areas and to bring the station back in line with industry best practice. The utility has developed action plans to address the areas for improvement.

6.3 OVERVIEW OF PROGRAMMES AND MEASURES FOR SAFETY UPGRADES

6.3.1 The overall modification control process

One of the conditions of the nuclear installation licence (refer 9.1) granted to the nuclear installation, is that a valid plant description and configuration be maintained, and that a modification control process be in place to ensure that modifications to the installation are controlled in an acceptable manner.

It is further a condition of the nuclear installation licence that a valid and updated safety assessment, including a risk assessment, be maintained of the installation demonstrating continuing compliance to the safety criteria imposed by the NNR. The risk assessment should include dose and risk criteria as well as compliance to the conditions of the nuclear installation licence.

6.3.2 The licence holder's modification process

Modifications to the installation were implemented by the licence holder from the design to the commissioning stages according to a well-structured and documented process. As part of this process, the impact of the modification on all the elements of the existing plant safety assessment, which forms an integral part of the nuclear installation licensing basis, must be evaluated, for example: design bases contained in the Safety Analysis Report, the plant General Operating Rules (Operating Technical Specifications (OTS), maintenance and inspection programme, operating principles, etc.). This detailed safety assessment is summarised in a safety case, which must include a quantitative risk assessment to demonstrate that the installation, with the modification, still complies with the risk criteria of the NNR.

The modification package, which is subject to a comprehensive review process, must also address all the required changes to the applicable documentation, including operating documentation of the installation, for example: OTS, operating procedures, maintenance programme, radiological protection programme, etc.

6.3.3 The modification review/approval process of the Regulator

As an integral part of the licence holder's modification control process, any modifications to the nuclear installation that could affect the safety case require approval by the Regulator before being implemented. The process to be followed by the licence holder in order to meet the licensing requirements is detailed in a Licence Document, referenced in a condition of the nuclear installation licence. The process can be summarised as follows:

- Any such proposed modification is reported to the NNR at the conceptual stage. A preliminary assessment of the effect of the modification on the current approved safety assessment is presented together with some preliminary information of the modification concept.

- Following its preliminary review of the modification concept, the NNR indicates to the licence holder whether a detailed safety case regarding the modification must be made for further regulatory review. If so, such a case must be made giving details of the design, expected performance and fitness-for-purpose of the system, sub-system or component.

- All the licence documentation affected by the modification must be identified in the modification package, and the relevant changes must be submitted for review and approval by the NNR before final approval for implementation of the modification is given.

The review process of the NNR mainly concentrates on ensuring that all aspects related to the licensing basis have been satisfactorily addressed in the licence holder's submission.

6.3.4 Modifications implemented at the Nuclear Installation

Most of the modifications which have resulted in safety improvements at the nuclear installation, fall mainly within the scope of the Koeberg plant alignment to the French CP-1 nuclear power plants family resulting from the Koeberg Safety Re-assessment Project (refer to Article 14).

6.3.5 Periodic Safety Review of Nuclear Installations

The on-going process of modification control at the nuclear installation is augmented by Periodic Safety Re-assessments every ten years.
The status of the 1St Safety Re-assessment, completed in 1998, is summarised under Article 14 of this report. The subsequent periodic safety review commenced in 2008 and is due for completion towards the end of 2010.

6.4 REGULATORY POSITION

The readiness to identify, accept and undergo international peer reviews and evaluations is a clear indication of South Africa's commitment to nuclear safety.

ARTICLE 7: LEGISLATIVE AND REGULATORY FRAMEWORK

1. Each Contracting Party shall establish and maintain a legislative and regulatory framework to govern the safety of nuclear installations.

2. The legislative and regulatory framework shall provide for:

   (i) The establishment of applicable national safety requirements and regulations
   (ii) A system of licensing with regard to nuclear installations and the prohibition of the operation of a nuclear installation without a licence
   (iii) A system of regulatory inspection and assessment of nuclear installations to ascertain compliance with applicable regulations and the terms of licences
   (iv) The enforcement of applicable regulations and of the terms of licences, including suspension, modification or revocation

Summary of changes

Changes to this Article from the last national report include the following:

1. Section 7.1 has been updated to include a broader description of the legislative and regulatory framework of the nuclear industry in South Africa and also to indicate the change of Ministry from the previous Ministry of Minerals and Energy.

2. Section 7.2 has been updated to include:

a) The publishing of the Nuclear Energy Policy for the Republic of South Africa
b) The establishment of the National Radioactive Waste Disposal Institute (NRWDI)
c) The publishing of the draft Regulations, for public and stakeholders comments, on the Siting of New Nuclear Installations
d) Additional details related to the regulatory framework to govern the safety of nuclear installations
e) Reference to Regulations published during the period covered by the previous report were removed.

7.1 DESCRIPTION OF THE NATIONAL LEGISLATIVE AND REGULATORY FRAMEWORK

The nuclear sector in South Africa is mainly governed by the Nuclear Energy Act, Act No 46 of 1999 and the National Nuclear Regulator Act (NNRA), Act No 47 of 1999. Both these Acts supersede the previous Nuclear Energy Act (Act 131 of 1993) and are administrated by the Minister of Energy (hereinafter, referred to as the Minister), through the Department of Energy (DoE), as a result of the South African Government re-organisation which took place in August 2009 when the former Department of Minerals and Energy (DME) was split into the Department of Energy (DoE) and the of Department of Mineral Resources (DMR).

Additionally the Department of Health: Radiation Control Directorate administers the Hazardous Substances Act, Act 15 of 1973, related to group III and Group IV hazardous substances (which include all radioactive material intended to be used for medical, scientific, agricultural, commercial or industrial purposes).

The South African Regulatory Body, the National Nuclear Regulator (NNR), as established by the NNRA is mandated to *inter alia* exercise regulatory control related to safety over:

(i) the siting, design, construction, operation, manufacture of component parts, and decontamination, decommissioning and closure of any nuclear installation;

(ii) vessels propelled by nuclear power or having on board radioactive material capable of causing nuclear damage;

(iii) other actions, to which the NNRA applies (as defined in section 2 of the NNRA), through the granting of nuclear authorizations.

7.2 SUMMARY OF LAWS, REGULATIONS, ETC. TO GOVERN THE SAFETY OF NUCLEAR INSTALLATIONS

The establishment, objects and functions of the NNR are encapsulated in chapter 2 of the NNRA which covers, *inter alia*, its regulatory functions and the functionality of the National Nuclear Regulator. The Regulatory Body is considered in more detail under Article 8. Hereinafter, it is referred to as the NNR.

Those activities which require a nuclear authorization and conditions of authorization are contained in chapter 3 of the NNRA.

Liability for nuclear damage and the provisions with regard to financial security are dealt with in chapter 4 of the NNRA. Safety and emergency measures as well as the powers and duties of inspectors are embodied in chapter 5 of the NNRA.

With regard to the regulation of nuclear installations, section 20 (1) of the NNRA places a prohibition on the construction or use of a nuclear installation by any person except under the authority of a nuclear installation licence granted, as per section 21 of the NNRA, to such person by the NNR on application.

Section 23 of the NNRA empowers the NNR to impose such conditions as it deems necessary or desirable for the purpose of the safeguarding of persons and the environment against nuclear damage when granting a nuclear installation licence.

In order to ensure compliance with the conditions contained in the nuclear installation licence, the NNRA provides for the appointment of inspectors. The provisions of the NNRA confer the necessary authority and powers in order for the inspector to, *inter alia*, gain access to sites as well as to information and documentation. The provisions relating to inspectors are comprehensively set out in section 41 of the NNRA.

Offences and the appropriate sanction for the commission of such offences are contained in the provisions of section 52 of the NNRA.

The NNR may, in terms of the provisions of section 27 of the NNRA, revoke a nuclear authorization at any time. Furthermore, it is empowered to impose such conditions, as it deems necessary for preventing nuclear damage, upon the holder of the relevant nuclear installation licence, during his period of responsibility as defined.

As reported in the previous national report, Regulations on National Safety Standards and Regulatory Practices (SSRP) were published on 28 April 2006 and these regulations are being enforced on all nuclear authorizations holders and applicants for nuclear authorizations in the country. These regulations are based on international safety standards and regulatory practices.

In support of these Regulations the NNR has developed many Regulatory Requirements/Licensing Documents, which are entrenched in the various nuclear authorizations granted to the nuclear facilities regulated by the NNR, as well as Regulatory Guidance documents.

Other national legislation, policies, regulations, related to the nuclear sector implemented since the last South African report to the Convention, include the following:

- The Nuclear Energy Policy for the Republic of South Africa was published in June 2008. The document presents a policy framework within which prospecting, mining, milling and use of nuclear materials as well as the development and utilisation of nuclear energy for peaceful purposes by South Africa shall take place. The document covers the prospecting and mining of uranium ore and any other ores containing nuclear materials, as well as the nuclear fuel cycle in its entirety, focusing on all applications of nuclear technology for energy generation. One of the 16 principles of this Policy is that Nuclear Energy shall be used as part of South Africa's diversification of primary energy sources and to ensure security of energy supply.
- The National Radioactive Waste Disposal Institute (NRWDI) was established by the National Radioactive Waste Disposal Institute Act (Act No 53 of 2008). This Act applies to all radioactive waste in the Republic of South Africa destined to be disposed of in an authorized waste disposal facility. Transitional arrangements have been put in place to ensure that radioactive waste is properly managed until the Institute is fully established, staffed, etc.
- Drafts Regulations on the Siting of New Nuclear Installations, as recommended by the NNR were published, for public and stakeholder review and comments. Comments from various stakeholders were received and these are being evaluated as part of the process for finalizing these Regulations. Refer to Article 17.1.
- Regulations are in the process of being published on monitoring and control of developments in the vicinity of Koeberg Nuclear Power Station to ensure the effective implementation of the emergency plan. These regulations include the specific requirements applicable to the vicinity of Koeberg and will replace the regulations published in March 2004, which were generic and applicable to all nuclear installations.

As already stated in the previous four national reports to the Convention, the South African National legislative and regulatory framework and associated laws, regulations, and regulatory requirements address and comprehensively comply with the provisions of Article 7 of the Convention on Nuclear Safety in governing the safety of nuclear installations.

ARTICLE 8: REGULATORY BODY

1. Each Contracting Party shall establish or designate a regulatory body entrusted with the implementation of the legislative and regulatory framework referred to in Article 7, and provided with adequate authority, competence and financial and human resources to fulfill its assigned responsibilities.

2. Each Contracting Party shall take the appropriate steps to ensure an effective separation between the functions of the NNR and those of any other body or organisation concerned with the promotion or utilization of nuclear energy.

Summary of changes

The main changes to this Article, since the last report, are as follows:

1. Section 8.2 has been updated to reflect the changes in the organizational structure of the NNR.
2. Section 8.3 has been updated to reflect the NNR's initiatives related to organizational staffing and capacity building initiatives.
3. Section 8.6 related to the development of the NNR's Quality Management System (QMS) has been updated.
4. Section 8.7 provides updated information on the NNR self–assessment which was undertaken and new information on conducting the IAEA Self Assessment using the IRRS Guidelines.
5. Section 8.10 was updated to provide new information related to international cooperation.
6. Section 8.11 was updated to reflect strengthening of the NNR communication with stakeholders.

8.1 MANDATE, AUTHORITY, RESPONSIBILITIES, COMPETENCE, FINANCIAL AND HUMAN RESOURCES, AND INDEPENDENCE OF THE REGULATORY BODY

The National Nuclear Regulator (NNR) is the national authority responsible for exercising regulatory control over the safety of nuclear installations, radioactive waste, irradiated nuclear fuel, and the mining and processing of radioactive ores and minerals.

The NNR, established as an independent juristic person by the NNRA, is comprised of a Board of Directors, a Chief Executive Officer and staff. Its mandate and authority are conferred through sections 5 and 7 of this Act, which set out the objectives and functions of the NNR.

The NNR is mandated by the NNRA to provide for the protection of persons, property and the environment against nuclear damage. Its mandate is further strengthened by section 23 of the above mentioned Act which empowers it to impose any condition in a nuclear installation licence that it considers necessary for the purpose of achieving its objectives.

The powers of the NNR under the NNRA embrace all actions aimed at providing the public with confidence and assurance that the risks arising from the undertaking of actions involving radioactive material to which the NNRA applies, remain within acceptable safety limits. In practice this has led to the NNR establishing safety standards and regulatory practices including doses and risk limits, as well as derived operational standards, conducting proactive safety assessments, determining conditions of authorisation and obtaining assurance of compliance thereto.

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

The independent authority of the NNR is "de jure" entrenched in the NNRA.
The NNR operates independently of the government in terms of carrying out its mandate to ensure that public health is assured for all South Africans that are exposed to the hazards of

nuclear and radiation hazards. The purpose of this independence is established in order to ensure that regulatory decisions are made free of other interest that may conflict with safety.

The NNRA makes provision for a comprehensive appeals process and specifically forbids any representative of an authorisation holder or political structure from being appointed as a director of the Board.

The NNR is directly accountable to parliament through the Minister of Energy on nuclear and radiation safety issues and operates independently of Government, to the extent that it is able to carry out its mandate without undue influence.

8.2 ORGANISATION OF THE REGULATORY BODY

8.2.1 The Structure of the Regulator

(i) The Board of Directors

The Executive of the NNR reports to a Board of Directors, which is appointed by the Minister of Energy. The Board consists of up to twelve Directors including an official from the Department of Energy, an official from the Department of Environmental Affairs, a representative of organised labour, a representative of organised business, a representative of communities which may be affected by nuclear activities and up to seven other Directors who hold office for a period not exceeding three years, although they are eligible for re-appointment.

A person is disqualified from being appointed or remaining a director of the Board if he or she, *inter alia,* is a holder of a nuclear authorization or an employee of such holder.

(ii) The Chief Executive Officer

The Chief Executive Officer is appointed by the Minister of Energy and is also a Director of the Board. The Chief Executive Officer is the accounting officer of the Board and has the responsibility of ensuring that the functions of the NNR are performed in accordance with the NNRA and the Public Finance Management Act. The Chief Executive Officer holds office for a period not exceeding three years as specified in the letter of appointment and may be re-appointed upon expiry of that term of office.

(iii) The Staff of the NNR

The approved staff complement of the NNR is 122 but as of August 2010 the complement comprises 94 staff members (73 as reported in the last report in August 2007- an increase of 21 mainly in technical areas).

Following a business optimization process the NNR Board approved, in August 2008, a new organizational structure which is presented in figure 8.2.1. The following core Divisions/functions constitute the structure:

- **The Technical Division**:

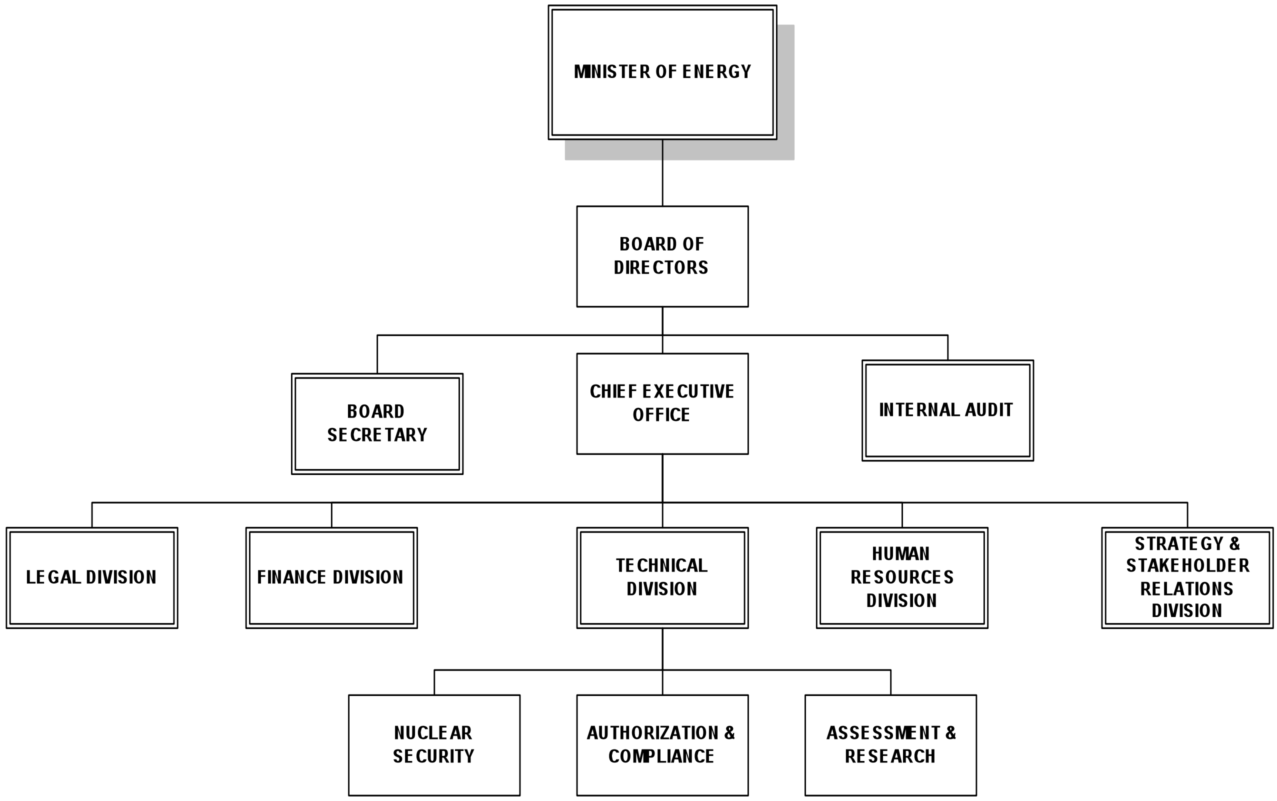
This Division is responsible for overseeing all aspects of technical operations to enable the NNR to deliver on its mandate. It is further broken down into three groups:

  - Authorisation and Compliance: responsible for the authorisation of facilities and actions of compliance assurance, as well as for enforcement.
  - Assessment and Research: responsible for assessment and research technical support to the authorisation and compliance group.
  - Nuclear Security Management: this function was recently introduced in the technical Division and is responsible for the overall management of nuclear security, both internal to the NNR and to the regulatory oversight of nuclear facilities.

- **The Finance Division:** responsible for procurement, financial accounting and information technology.
- **The Human Resources Division:** responsible for talent management, capacity and capability building as well as employee wellbeing.
- **The Strategy and Stakeholders Division:** responsible for strategic planning, performance monitoring, stakeholder relationship management and business process management.
- **Legal function:** responsible for providing legal advice.
- **Board secretariat:** responsible for providing advice on corporate governance, as well as administrative support to the Board.
- **Internal audit:** responsible for the review of corporate governance, risk management and an internal control system.

Figure 8.2-1

ORGANOGRAM OF THE EXECUTIVE STAFF OF THE NATIONAL NUCLEAR REGULATOR



8.3 MAINTAINING COMPETENT AND MOTIVATED STAFF

8.3.1 Organisational Staffing

(i) Introduction

As indicated in the Nuclear Energy Policy for the Republic of South Africa, nuclear energy shall be used as part of the diversification of primary energy resources and to ensure security of energy supply. This has put the spotlight on the nuclear industry, as one of the key contributors to fulfilling the country's growing need for energy. The NNR therefore plays a central role in ensuring the regulation of the nuclear industry and the maintenance of high safety standards. The recent developments in the nuclear sector, and the ensuing competition for skilled and experienced personnel, have crucial implications for the recruitment, retention and development of trained staff members within the nuclear regulatory function. This situation, coupled with the realisation that Human Resources is central in supporting the NNR's overarching strategy, has resulted in the repositioning of Human Resources as a value-adding, mainstream business partner within the organisation, as well as in the development of a comprehensive Human Resources Strategy, which places greater focus on talent acquisition, development and retention.

Although the NNR managed to increase its technical staff complement it is still challenged in sustaining an appropriate level of in-house technical capacity (engineers and scientists) to deliver on its core business. In some technical areas, where in house expertise is not readily available, the NNR has to make use of external Technical Support Organisations (TSOs) both locally and internationally.

With the envisaged expanding nuclear programme in the country, as well as the safety optimisation of some existing ageing nuclear installations, this challenge will grow, bringing increased competition for scarce skills.

(ii) Talent acquisition

With the envisaged expansion of the South African nuclear programme, the demand for talented employees is on the increase. The success in meeting this demand depends upon the NNR's ability to recruit and retain people with the necessary skills and experience. The NNR undertook a process of optimization of its remuneration packages, so as to facilitate greater salary-package flexibility, competitiveness in the market, as well as payment of an equitable rate for services rendered. This strategy has been and is currently of assistance in recruiting and retaining talent, by giving employees the choice to structure their remuneration packages according to their personal needs.

(iii) Training and development

NNR training expenditure increased significantly, in order to combat the lack of competent and capable people. Skills development is driven by personal development plans, in order to increase the competency levels of all employees. A comprehensive skills audit was undertaken to ascertain the extent of the lack of the skills required, by measuring it against those skills that are actually available within the organisation. In addition, a competency framework was also developed. Both were utilised as facilitators with regard to personal development plans.

As reported in the previous National Report to the Convention, the NNR has been participating in and continues to participate in the training offered by ARECSA Human Capital (Pty) Ltd. – a company, which is a joint venture between the South African Nuclear Energy Corporation (Necsa) and AREVA of France, formed in response to government's commitment to address the lack of nuclear skills. The overall objective of ARECSA is to provide training in the Republic of personnel, students or other identified people in the field of nuclear, mining, and associated high technologies. Over 50 NNR staff members have participated in this initiative since the last report to the Convention.

In spite of challenges facing the NNR, the organisation continues to develop the skills and knowledge of its staff members. In support of the Capacity building Strategy, the NNR runs an internship programme and offers bursaries, with the objective of addressing the challenge of the inadequate supply of appropriate technical capacity to deliver on its core business.

Bursary scheme

In order to develop skills outside of the organisation to prepare the NNR for succession and replacement of departing expertise, the NNR has continued to provide bursaries to students during the reporting period. All the bursaries were granted to students from the previously disadvantaged group.

Internship Programme

The NNR has continued to implement its internship programme. The main purpose of this programme is to provide interns with a nuclear energy safety regulation and protection-based learning experience that combines structured learning with on-the-job experience, thus integrating learning with real-life working experiences.

The programme helps interns to acquire the experience and skills they need to enter and duly participate in the labour market.

It is a programme that the NNR uses to contribute to the creation of a national skills pool in nuclear regulation and control matters in South Africa. Some of these interns have been offered permanent positions at the NNR. The interns cover areas of engineering, radiation protection, and physics. They have attended various local training programmes and been seconded to the internal Divisions of the NNR to gain practical regulatory experience.

(iv) Retention of staff

A Talent Management Framework was developed and implemented, where mission-critical positions were identified and a pool of prospective successors was created. These identified employees will be developed systematically to prepare them to fill these positions. This will assist with the reduction of the organisation's reliance on international consultants.

A leadership enhancement programme was also initiated for managers, with the objective of enhancing the NNR's leadership capability, so as to be better equipped in dealing with current and future challenges facing the organisation.

8.4 REGULATORY STRATEGY

The NNR regulatory strategy which recognizes both deterministic and probabilistic principles for the regulatory control and the assessment and verification of safety of the nuclear installations is detailed in Article 14.

8.5 TECHNICAL SUPPORT TO THE NNR BY EXTERNAL SUPPORT ORGANISATION (TSO)

As indicated above in Section 8.2 the technical safety assessment function of the NNR is carried out internally within the organization by the Assessment and Research Group. The NNR is not supported by an external Technical Support Organisation (TSO) as is the case, for example, in some Contracting Parties regulatory authorities.

However, in some cases the NNR technical safety assessment staff does not have the required expertise or/and capacity to carry out specific safety assessments and in these cases the NNR contracts the support of consultant companies (both locally and internationally) to provide technical support. The NNR is very sensitive to the issue of conflict of interest and, as such, in the selection process, requests to be provided with the assurance and evidence that the companies are not connected with any other organizations e.g. licence holders etc. which could result in a potential conflict of interest. The use of external consultants does not relieve the NNR of any of its responsibilities in its regulatory decision making process.

One major area in which the NNR has made extensive use of international consultants for technical support is in the licensing activities of the prospective Pebble Bed Modular Reactor (PBMR). Two international companies have been providing technical services, including capacity building, to the NNR for the review of the PBMR safety submissions.

In addition, the NNR also has access to wider technical support on other reactor technologies such as PWRs, due to bi-lateral agreements entered into with several other regulatory authorities (refer 8.10 below).

8.6 QUALITY MANAGEMENT SYSTEM

The NNR has initiated a project to review and strengthen its current internal processes with the objective of implementing a state of the art Integrated Management System (IMS). In conducting this Project the NNR has taken cognizance of the IAEA guidelines for management systems, International Management System Standards (e.g. ISO 9001) as well as investigating the approaches and experiences of nuclear regulatory authorities of other countries such as those from the NERS regulators network.

As part of this development the NNR has finalized and implemented the NNR Management System Manual and mandatory ISO 9001 procedures. This includes important documented processes for the Development, Review, Approval, Issuance, Control and Revision of NNR Administrative and Technical Documents, Records Management, Internal Auditing, Corrective Action, Preventive Action and Management Review.

Core and support processes were identified, mapped, process owners identified and an approval matrix established. All required process documentation (Policies and Procedures) have been identified, some have been established and implemented. Although some policies and procedures still need to be developed, the Management System (MS) in general has therefore been established.

The NNR has initiated a project to strengthen its current Records Management and Knowledge Management processes through the implementation of an Electronic Document Management System (SharePoint Intranet). The Intranet systems design has been completed and the various Departmental Intranet sites established. Upon completion of the Validation and testing of the system, data migration and publication of existing / historic documents will be conducted.

Awareness, buy-in and implementation of the MS requirements and processes are not satisfactory at all levels of the organisation. A Change Management project will be initiated to ensure effective implementation and buy in of staff at all levels of the organisation.

8.7 REGULATOR INTERNAL SELF-ASSESSMENT

(i) NNR Self Assessment

As part of the need to ensure that the NNR employs international best practices in its processes, the NNR conducted an internal self assessment of its regulatory infrastructure and practices with the assistance of an external service provider. This self-assessment was based on the International Atomic Energy Agency's Integrated Regulatory Review Service (IRRS) guidelines. Due to the extensive nature of the exercise, several phases were planned. Three phases, covering the regulatory oversight of the Koeberg Nuclear Power Station, the Pebble Bed Modular Reactor and nuclear facilities of the nuclear fuel cycle, including mining and minerals processing facilities, were completed. The review highlighted findings and observations and recommendations for improvements. These are mostly related to the need for consistency of practices and approaches across all divisions of the NNR and the need for clearer procedures for processes related to authorizations, enforcement, inspections, review plans, training/induction programmes.

Implementation of the recommendations arising from the self assessment commenced in the 2007/08 financial year. Most of these recommendations have been taken up in a wider Project initiated by the NNR for the Optimisation of the Regulatory framework which is further discussed under Section 9.1.1 below.

(ii) National Regulatory Self Assessment – IAEA Project

The AFRA Project on Self Assessment of Regulatory Infrastructure for Radiation Safety and Networking of Regulatory Bodies has been initiated by the IAEA to develop and sustain national regulatory infrastructures for nuclear and radiation safety on the African continent.

Self-assessment compatible with the IAEA methodology is widely adopted and implemented in participating African countries for continuous improvement of performance Regulatory Bodies. As such, a core team of national personnel should be trained in Self Assessment methodology and tools, Self Assessment should be conducted and reports generated, and actions plans should be developed and improvement actions initiated. In addition, at least 20 self-assessment reports, 20 action plans and at least 10 Member States should request IRRS missions during this period.

In South Africa, both regulatory bodies, namely the National Nuclear Regulator (NNR) and the Directorate Radiation Control (RADCON) in the Department of Health (DoH) have agreed to participate in the project RAF/9/038 "Promoting Self Assessment of Regulatory Infrastructures for Safety and Networking of Regulatory Bodies in Africa". A NNR member of staff was appointed as national project coordinator in early 2009. The South African response, analysis and report writing phases are to be done over one year, and will be completed by December 2010. The project has been fast tracked for completion by July 2010 specifically for the NNR as the outcome of the Self Assessment will also be used to inform the organizational and, particularly the technical division strategy.

The scope of the self-assessment matches the organisational functions. It has considered the NNR goals and objectives, size and scope, competency to conduct self-assessment, weaknesses already identified during previous self-assessment(s), suggestions and recommendations from external review or appraisal events, areas of improvement identified during the QMS improvement or implementation, changes in the NNR's organisation, activities, management governmental framework, and stakeholder feedback. IAEA GS-R-1 requirements are being used as the first level of Self Assessment questions and criteria. The IAEA electronic Self-Assessment Tool (SAT) is being used to facilitate the self-assessment process. The main aspects/modules to be considered for the 2009/10 NNR self-assessment include:

- Legislative and Government Responsibilities
- Responsibilities and functions of the Regulatory Body
- Organisation of the Regulatory Body
- Authorisation by the Regulatory Body
- Review and Assessment by the Regulatory Body
- Inspection and Enforcement by the Regulatory Body
- Development of Regulation and Guides of the Regulatory Body
- Management System for the Regulatory Body
- Radioactive Waste management and Decommissioning

The self-assessment process will be part of the Regulatory Body's management system and used as a tool for periodic self-improvement. Therefore, a set of dedicated guides and procedures will be developed for future self-assessments. A Project Management Team and a Steering Committee have been established.

Staff members participating in the project have been selected to ensure the self-assessment answers and their evaluated outcomes will be pertinent and coherent across the regulatory body. A national train-the-trainer course on the self-assessment methodology was presented by the IAEA and further in-house training workshops were conducted.

The three phases of the Self Assessment project include an Answering Phase where descriptive responses to an agreed self-assessment questionnaire along with all relevant documentary evidence are provided by a Respondent Team. An Analysis of Responses Phase will be a documented comparison of how the answers given correspond to the criteria used as measures of excellence or compliance, and will identify the strengths and weaknesses of the regulatory body and its current performance relative to the assessment criteria. In the Action Planning Phase, upon completion of the self-assessment analysis phase, a national action plan will be developed by the Senior Management to improve the performance, effectiveness and efficiency of the regulatory bodies and undertakes to be responsible for its implementation.

Following the completion of the national Self Assessment project, it is anticipated that South Africa will request a thorough peer review of regulatory infrastructure for nuclear and radiation safety through an IAEA Integrated Regulatory Review Service (IRRS) mission.

8.8 INTERFACES WITH GOVERNMENT

Section 6 of the NNRA requires co-operative governance agreements between the NNR and other relevant organs of state, with functions in respect of the monitoring and control of radioactive material or exposure to ionising radiation. These agreements are critical to the pursuance of the NNR's responsibilities in fulfilling its mandate as well as to avoid duplication of efforts in ensuring the effective monitoring and control of the nuclear hazard.

Agreements have been completed and implemented with several organs of state with such functions.

8.9 INTERFACES WITH OTHER NATIONAL INSTITUTIONS

Within South Africa there are currently several organisations and one professional institution with interests in the promotion and utilization of nuclear energy. The main organisations are: Eskom Holdings Limited (the national electricity utility), the South African Nuclear Energy Corporation (Necsa), the PBMR (Pty) Ltd, the Nuclear Fuels Corporation (NUFCOR); the main professional institution being the Nuclear Industry Association of South Africa (NIASA) in which the NNR is not represented, although interaction takes place as required on specific topics.

Eskom Holdings Limited (the nuclear installation licence holder) owns and operates Koeberg Nuclear Power Station (KNPS) (the nuclear installation), the only nuclear power station within South Africa and on the African continent. Eskom Holdings Limited is also responsible for identifying and investigating options for future power generation, including nuclear energy options. The decision to implement any options rests with Government, and will be consistent with South Africa's National Nuclear Energy Policy.

Necsa is a statutory body established by the Nuclear Energy Act and formerly known as the Atomic Energy Corporation (AEC), whose mandate is essentially the development, promotion and commercial exploitation of nuclear and related technologies, management of radioactive waste (until this function is taken over by the NRWDI once fully established as indicated in Section 7.2 above) and implementation of safeguards.

The PBMR (Pty) Ltd is the company involved in the development of the Pebble Bed Modular Reactor.

NUFCOR is a commercial company engaged in the final processing and marketing of uranium concentrates. It is a private South African company whose major shareholders consist of different mining entities involved in the mining and extraction of uranium.

The NNR is organisationally and functionally independent of these various bodies. Eskom Holdings Limited, Necsa and NUFCOR are all holders of authorisations issued by the NNR.

8.10 INTERNATIONAL CO-OPERATION

(i) Regulators Forums

- The NNR is a member of NERS (Network of Regulators of Countries with Small Nuclear Programmes) and as such, shares experiences, etc. associated with regulators of countries having a small nuclear programme.

- The NNR has entered into several bi-lateral agreements with other nuclear safety authorities internationally such as the French ASN, the US NRC, the UK Health Safety Executive Nuclear Safety Directorate, the Argentinean (NBNR) etc.

  These bilateral agreements provide for exchange of information on different aspects of nuclear safety, visits, exchange of personnel, training, etc. and the agreement details differ for different regulators.

- The NNR is part of a group of regulators from countries in which nuclear power stations from Areva (formerly Framatome) designs are operating. This forum is named FRAREG and comprises regulatory authorities of Belgium, China, France, South Korea and South Africa. This forum meets on an annual basis with the objective to share experiences related to these nuclear power stations of similar designs operating in the "FRAREG" countries.

- The NNR has been actively involved in the establishment of the Forum of Regulatory Bodies in Africa (FNRBA) which was launched in South Africa in March 2009. The main purpose of this Forum is to strengthen the regulatory oversight of nuclear and radiation safety on the African continent by increased cooperation amongst regulatory bodies.

- The NNR participates in the Multinational Design Evaluation Programme (MDEP). The Multinational Design Evaluation Programme (MDEP) is a multinational initiative, started in 2006, to develop innovative approaches to leverage the resources and knowledge of the national regulatory authorities that will be conducting a review of new reactor power plant designs. The MDEP is being organised under the auspices of the OECD

Nuclear Energy Agency, which performs the technical secretariat function for the programme. The Regulatory Authorities of Canada, China, Finland, France, Japan, the Republic of Korea, the Russian Federation, South Africa, the United Kingdom and the United States participate in this multinational programme.

In accordance with the MDEP, nuclear regulators are aiming to enhance safety world-wide, via increased cooperation. Enhanced cooperation amongst regulators will improve the efficiency and the effectiveness of the design review process, which is aimed at an increased convergence of regulatory practices. However, the participating countries will retain their sovereign authority over all licensing and regulatory decisions at all times. The programme is directed by a Policy Group, comprising the heads of regulatory authorities of the participating countries. A Steering Technical Committee (STC), comprising senior level representatives from the ten participating regulatory authorities, was established to implement these activities.

The NNR participation in this forum is important for the licensing of the PBMR (although being scaled down) in terms of benchmarking against other new reactor designs, and also in terms of the envisaged expansion of the nuclear programme and the construction and operation of new nuclear power reactors in South Africa, which will have to be licensed by the NNR.

(ii) IAEA Initatives

- The NNR is represented in the IAEA Commission on Safety Standards (CSS) and the IAEA Safety Committees NUSSC, WASSC, TRANSSC and RASSC (main South African representation being from the Department of Health: Radiation Control Directorate).

- **International nuclear regulatory conference**

  The NNR, on behalf of the Government of South Africa, hosted the Second International Conference on Effective Regulatory Systems, as a follow up to the Moscow conference which was held in Cape Town from 14-18 December 2009. The purpose of this conference was to stress the importance of a strong, effective global nuclear safety and security regime and the responsibility that all nuclear regulators, operating organizations and vendors have in maintaining it. Conferences like this are a vital part of the global effort to have senior nuclear safety and security regulators review issues important to the global nuclear regulatory community and focus on the important role regulators play in safety and security. A regulatory system is effective when it ensures that a high level of safety, security and safeguards is maintained by licence holders/operating organizations; when it takes appropriate actions to prevent the degradation of safety and security; when it takes actions to promote safety and security improvements; when it performs its regulatory functions in an independent, transparent, timely and efficient way and it strives for the continuous improvement of itself and the industry.

The Conference was attended by 345 delegates, of whom more than 75% were international attendees, and was widely acknowledged as being very successful in achieving the objectives set for the Conference by the IAEA Programme Committee.

8.11 COMMUNICATIONS AND OUTREACH INITIATIVES OF THE NATIONAL NUCLEAR REGULATOR

The NNRA requires public participation in the authorisation processes of nuclear installations. The NNR engages, amongst other things, in a wide range of processes to ensure meaningful public participation in its review of nuclear authorisation applications as well as to strengthen its communications, liaison and outreach initiatives.

In line with the NNR's communication strategy and its policy of openness and transparency, a number of processes are established. The thrust of processes are to develop and maintain an awareness of matters related to, nuclear, radiation, transport and radioactive waste safety amongst all its stakeholders.

The stakeholder communication and engagement mechanisms of the NNR will continue to evolve. The NNR's key focus is to ensure that the engagement programme provides an effective vehicle to allow stakeholders to question the NNR, to input views into our evolving regulatory processes, legislation and for the NNR to report on its activities. The thrust of the NNR's medium-term approach is to implement proactive engagement programmes with Non-Governmental Organisations, Public interest groups and the general public. The NNR has adopted a measured approach to media relations which seeks to inform journalists about programmes and challenges via briefings, interviews and news stories. The NNR "revamped" website (www.nnr.co.za) is the primary vehicle for communication with stakeholders as well as providing a tool for online consultation. The NNR will continue to ensure it is updated regularly with timely and relevant information, and that information published is accessible.

A number of communication forums have been established independently by the NNR such as labour representatives working in authorised facilities, communities living around licensed operations as well as Civil Society forums to ensure regular interactions. Communication with the general public is done through both written and electronic media, e.g. when announcing major NNR events, etc. The NNR is also involved in the Public Safety Information Forums, established as a requirement by the NNRA, compelling holders of nuclear installation licences to establish communication forums with communities living around licensed facilities, in order to inform them about nuclear safety.

As required by section 7(j) of the NNRA the NNR produce an annual public report on the health and safety related to workers, the public and the environment associated with all sites on which a nuclear installation is situated or on which any action which is capable of causing nuclear damage is carried out.

Furthermore the NNR publishes its regulatory outcome activities in other publications including quarterly newsletters and other publications such as information brochures to all its stakeholders.

The South African legislative environment regarding the public's right to information is governed by the Public Access to Information Act. The NNR complies with the provisions of this Act.

ARTICLE 9: RESPONSIBILITY OF THE LICENCE HOLDER

Each Contracting Party shall ensure that prime responsibility for the safety of a nuclear installation rests with the holder of the relevant licence and shall take the appropriate steps to ensure that each such licence holder meets its responsibility.

Summary of changes:

1. Section 9.1.1 has been updated to remove details of the Regulations R388 on Safety Standards and Regulatory Practices (SSRP) as these were provided in the previous report and to reflect the NNR project initiated to optimize the legislative and regulatory framework.
2. Section 9.2.2 has been updated to reflect the changes to the licence holder's responsibilities.

9.1 DESCRIPTION OF THE MECHANISM BY WHICH THE REGULATORY BODY ENSURES THAT THE LICENCE HOLDER MEETS ITS PRIMARY RESPONSIBILITY FOR SAFETY

In terms of section 3.7.1 of the Regulations on Safety Standards and Regulatory Practices (SSRP) the holder of a nuclear authorisation is responsible for radiation protection and nuclear safety, including compliance with applicable requirements such as the preparation of the required safety assessments, programmes and procedures related to the design, construction, operation and decommissioning of facilities.

The NNR ensures that the licence holder meets its primary responsibility with regard to safety essentially by:

(i) the enforcement of the legislative requirements of the NNR Act

(ii) the establishment of nuclear Safety Standards and Regulatory Practices,

(iii) the granting of a nuclear installation licence and regulatory directives/letters and demonstration by the licence holder of compliance to the conditions of licence and;

(iv) by providing an independent assurance of compliance with the conditions of the nuclear installation licence through the implementation of a system of compliance inspections, the latter comprising inspections, surveillances and audits as well as various forums for interaction with the licence holder.

These mechanisms are described in more detail in sections 9.1.1 – 9.1.4, 10.4, 10.5, 14.4 and 14.5.

9.1.1 Safety Standards and Regulatory Practices

As reported in the previous National Report to the Convention, the Regulations (R388) on Safety Standards and Regulatory Practices (SSRP) were published in April 2006 (refer section 7.2 above).

The Safety Standards and Regulatory Practices in Regulations R388 are based on international safety standards and regulatory practices and are being enforced on all nuclear authorizations holders in the country. In support of these Regulations the NNR has developed many Regulatory Requirements/Licensing Documents, which are entrenched in the various nuclear authorizations granted to the nuclear facilities regulated by the NNR, as well as Regulatory Guidance documents.

In response to anticipated nuclear expansion in South Africa, and the findings of a self-assessment conducted on the basis of IRRS guidelines (as reported in section 8.7 above), the NNR initiated a project to optimize the legislative and regulatory framework. This project aims to improve the regulatory documentation on nuclear safety requirements and guidelines for assessment and inspection, which are intended to provide a more stable regulatory framework and improve corporate memory retention in this regard.

9.1.2 Nuclear Installation Licence

The implementation of the requirements of the NNR Act and those of the SSRP is carried out through the setting of conditions in the nuclear authorizations, e.g. for Koeberg Nuclear Power Station nuclear installation licence NIL-01, established by the NNR, in terms of section 23 of the NNR Act. Where appropriate the SSRP requirements are expanded further in regulatory documentation e.g. regulatory requirements or/and regulatory guides, as integrated in the conditions of the nuclear installation licence.

For the Koeberg NIL-01 nuclear installation licence the specific conditions applicable to the nuclear installation relate to the plant, the site and environs, the licence holder organization and processes, and safety related documentation. These conditions essentially amount to three types, namely, for:

(i) the documented safety case including the operational safety assessment and supporting documentation as well as all the operational safety-related programmes, limitations and design requirements which are based on the operational safety assessment,

(ii) implementation of compliance assurance related processes, and

(iii) reporting requirements.

9.1.2.1 Documented safety case

The nuclear installation licence requires the licence holder to develop and maintain a documented safety case which demonstrates compliance with the requirements specified in the NNR Act and the SSRP, and which typically includes the following:

- Detailed plant description and site description
- Scope of activities that may be undertaken
- Specifications of all systems, structures components
- Design requirements
- On-site and off-site environmental factors or components relevant to nuclear safety
- The plant operational safety assessment including associated nuclear safety rules, criteria, standards and requirements relevant to the safety assessment
- In support of the plant operational safety assessment, the safety analyses documentation addressing rules, computer codes, models, methodology, input data, analyses, results and conclusions demonstrating compliance with the nuclear safety standards which *inter alia* must demonstrate compliance with the radiation dose limits specified in the SSRP
- A probabilistic risk assessment to be carried out in accordance with the NNR requirements on risk assessment specified in the condition of the nuclear installation licence, to demonstrate compliance with the probabilistic risk criteria specified in the SSRP
- Operational safety-related programmes and limitations of operation
- Plant management documentation (i.e. management manual)
- Documented evidence of compliance with all quality objectives relevant to nuclear safety
- Technical bases of the operational safety-related programmes and limitations of operation.

The Koeberg nuclear installation licence includes a requirement that the safety case itself shall be subject to ongoing review and periodic safety reassessment using an internationally accepted reference as a benchmark.

Proposed modifications to the plant or changes to documentation referenced in the licence, with impact on nuclear safety, must be submitted to the NNR for approval prior to implementation along with a prior safety assessment of the impact of the modification on the plant operational safety assessment including a risk assessment where applicable.

9.1.2.2 Operational safety related programmes - General operating rules

The operational safety related programmes (referred to as General Operating Rules – GORs) are based on the prior and operational safety assessments such that the validity of the safety case is subject to the provisions and undertakings referred to or assumed in the safety case actually being implemented on an ongoing basis through the operational safety related programmes which, in line with section 4 of the SSRP, cover the following:

- Programme for compliance with the dose & risk limits
- Programme for optimization of radiation protection and nuclear safety applying the As Low As Reasonably Achievable (ALARA) principle
- Programme for conducting safety assessments (prior and operational)
- Programme to ensure that the nuclear installations are built and operated according to good engineering practices
- Programme to foster and maintain a safety culture
- Programmes for accident management and emergency planning, preparedness & response
- Programme for the application of the defence in depth principle during the design and operational phases of the installation
- Quality management programme
- Controls and limitations on operation
- Maintenance and inspection programme
- Staffing and qualification programme
- Radiation protection programme
- Radioactive Waste management programme
- Environmental monitoring and surveillance programme
- Programme for the transport of radioactive material
- Physical security arrangements
- System of records & reports

- Programme for the monitoring of workers
- Decommissioning programme
- Provisions for accidents, incidents and emergencies

The licence holder is required to ensure that all operational safety-related programmes are procedurised and implemented accordingly.

9.1.2.3 Compliance Reporting

In addition to the technical assessment reports referred to above, the nuclear installation licence holder is required, by the NNR Act & the SSRP regulations and through a condition of the licence, to make available reports and other information to the NNR. These include the following:

- Incidents & accidents are required to be reported in terms of section 37 of the NNR Act and in terms of section 4.10.2 of the SSRP
- In terms of section 4.10.2 of the SSRP, operational reports must be submitted to the NNR at predetermined periods and must contain such information as the NNR may require on the basis of the safety assessments.

These reports include:

- Problem notification, occurrence, quality assurance and audit reports, including close-out reports
- Environmental monitoring reports
- Reports on gaseous and liquid effluents from the plant
- Medical and psychometric testing reports
- Fuel performance reports
- Specific Reload Safety Evaluation Reports
- In-service inspection reports
- Quarterly Licence Basis compliance report

9.1.3 NNR Compliance Assurance Process

The NNR Compliance Assurance programme related to the Koeberg Nuclear Power Station is conducted by a department of Regulatory Officers (Inspectors) who are located in an NNR office near the Koeberg Nuclear Power Station. Apart from technical assessment of submissions from the licence holder, the main responsibility of this department is to provide assurance that the licence holder complies with the conditions of the nuclear installation licence. The NNR compliance assurance programme including a summary of the outcomes of the programme is described further in section 14.5.

The various monitoring processes implemented by the NNR include, *inter alia*, the following:

1. Inspections conducted in terms of the compliance inspection programme
2. Technical assessments conducted on submissions, made by the licence holder, mainly for modifications
3. Reports submitted by the licence holder in terms of licence compliance
4. The licence holder safety indicators (performance and safety indicators)
5. Periodic reviews or other proactive assessments conducted by the NNR (including international experience feedback)

9.1.4 NNR/licence holder interaction

The NNR has established various regulatory forums with the licence holder, at different organisational levels from operational to strategic executive management, at which the findings of the compliance assurance activities (inspections, surveillances, audits) described above and any other nuclear safety issues are tabled, monitored and followed up.

9.2 DESCRIPTION OF THE MAIN RESPONSIBILITIES OF THE NUCLEAR INSTALLATION LICENCE HOLDER

As reported above in section 9.1, in terms of section 3.7.1 of the Regulations (R388) on Safety Standards and Regulatory Practices (SSRP) the holder of a nuclear authorisation is responsible for radiation protection and nuclear safety, including compliance with applicable requirements such as the preparation of the required safety assessments, programmes and procedures related to the design, construction, operation and decommissioning of facilities.

9.2.1 The NNR Act places some responsibilities on a nuclear installation licence holder which *inter alia* include the following:

(i) Strict liability for any nuclear damage caused by his/her facility or activities.

(ii) Compliance with Regulations (R 388) on Safety Standards and Regulatory Practices (SSRP)

(iii) Compliance with all conditions of a nuclear authorization issued by the NNR and implementation of an inspection programme to ensure such compliance.

(iv) Provision of any information or monthly return as required by the NNR.

(v) Establishment of a public safety information forum to inform persons, living in the municipal area in respect of which an emergency plan has been established, on nuclear safety and radiation safety matters.

9.2.2 In terms of the nuclear installation licence granted by the NNR, the licence holder's responsibilities are:

(a) To operate the nuclear installation within the design and configuration descriptions set out in the licence.

(b) To conform to the approved fuel designs and performance criteria.

(c) To comply with provisions and processes regarding the control of plant design and configuration.

(d) To comply with provisions and processes in terms of modifications made to the plant or any other change which may impact on the management of or risk due to severe accidents.

(e) To regularly assess safety, including carrying out a probabilistic risk analysis.

(f) To demonstrate compliance with the safety criteria of the NNR by risk assessment.

(g) To respect the limitations of activities pertaining to transport and storage of fuel, handling and loading of fuel, operation of the reactor units, processing of material through solid, gaseous and liquid waste processes and disposal methods.

(h) To control fabricated isotopes for use at the nuclear installations.

(i) To control and limit operation in accordance with an approved Operating Technical Specifications (OTS) document and procedures approved by the NNR.

(j) To adhere to controls on the training, qualification, re-qualification and conduct of licensed operators and candidates.

(k) To provide and control medical and psychological surveillance of licensed operators and candidates.

(l) To conduct in-service inspection of components in accordance with the approved standards and programmes.

(m) To maintain and monitor the installation in accordance with a plant condition monitoring programme as approved by the NNR.

(n) To inspect, survey, test and monitor the containment structures, aseismic bearings (upper and lower raft) and soil cement sub-foundations in accordance with programmes and procedures approved by the NNR.

(o) To establish, maintain and implement an operational radiation protection programme to the satisfaction of the NNR covering inter alia:

   i) radiation dose limitation to persons on site and the public;

   ii) a radiation protection organisation structured and staffed to fulfill all the requirements of the NNR;

   iii) production of adequate radiation protection standards, procedures and documentation to cover all aspects to the satisfaction of the NNR;

   iv) maintenance of health and radiation dose registers to the standards of the NNR.

(p) To provide an environmental monitoring programme including a meteorological component to the standards of the NNR.

(q) To comply with provisions relating to the control and discharge of radioactive material in liquid and gaseous effluent.

(r) To comply with the provisions with regards to the generation, processing and disposal of radioactive waste.

(s) To establish, maintain in a state of preparedness and conduct regular reviews and audits of an emergency plan approved by the NNR for on and off-site use.

(t) To provide for the management of severe accidents and mitigative measures to be taken as a result of these in accordance with procedures approved by the NNR.

(u) To adhere to the IAEA Regulations for the safe transport of radioactive materials for transport off-site of radioactive materials and/or contaminated items.

(v) To establish, maintain and operate physical security measures to meet the requirements of the NNR.

(w) To establish decommissioning strategy and resources to meet NNR requirements.

(x) To ensure that financial security in terms of claim for compensation can be met.

(y) To establish and maintain an inspection program to ensure compliance to conditions of licence.

(z) To apply Quality Management to all activities embodied in the scope of the nuclear installation licence

(aa) To obtain written prior approval from the NNR for:

i) movement of fuel in or out of the reactor cores;

ii) approach to criticality after a refueling outage or shutdown caused by or consequent upon an accident;

iii) specific reload core designs for each reload

(bb) To submit reports in a manner and at a frequency approved by the NNR. These include, but are not restricted to:

a) accounting and records for fuel inventories, balances, movements and changes;

b) civil monitoring test reports;

c) occurrence notifications for incidents, events and quality deficiencies.

(cc) To ensure that, notwithstanding the provisions of the nuclear installation licence conditions, the licence holder shall not permit any part of the installation to be modified or any procedure to be amended which could increase the risk of nuclear damage, without the prior approval of the NNR.

In terms of the above a distinction can be made between two fundamental types of licensing approaches: a prescriptive licensing approach and a more process-based one.

A prescriptive licencing approach is one which imposes detailed technical requirements relating to nuclear safety. From the NNR regulatory experience the drawbacks are that this approach places the onus on the NNR to identify such requirements and places an unnecessary administrative burden on both the NNR and the licence holder in terms of change control and formal licence deviations, which have no real safety significance.

A process-based licencing approach on the other hand would place requirements on the licence holder's processes thereby placing the responsibility for technical details with the licence holder. The NNR would then monitor the implementation of these processes through its own compliance assurance processes. This would tend to resolve the drawbacks of the prescriptive approach, but implies considerable confidence in the licence holder's processes.

The approach adopted by the NNR for the regulatory oversight of Koeberg is a combination of these two approaches:
The SSRP places some prescriptive radiation and nuclear safety requirements on the holders and prospective applicants of nuclear authorisations. As indicated above the mean to ensure the implementation of these safety requirements is carried out through the setting of conditions in the nuclear authorization, and the implementation of a compliance assurance inspections programme to ensure compliance to these safety requirements.
The NNR put forward a set of licence conditions (refer 9.1.2). The responsibility was then put on the licence holder, Eskom, to produce the necessary processes and documentation within the framework of the conditions of licence to ensure compliance with the safety requirements.

The strategy followed by Eskom was to develop a document called the "Koeberg Licensing Basis Manual" (KLBM) which would include all relevant change control processes for modifications, waivers, procedure changes, etc., and serve as a "roadmap" of the overall safety case for Koeberg including:

- Eskom policies relating to nuclear safety.

- Statutory requirements.
- Nuclear safety criteria, codes and standards.
- Documented processes/procedures to meet these safety standards.
- Monitoring of compliance with safety requirements, including reports to NNR.

The KLBM is an integral part of all the conditions of the Koeberg nuclear installation licence and details the complete set of nuclear safety requirements for Koeberg, the principal safety documentation that demonstrates compliance with these requirements, and all nuclear safety related practices and programmes. This document defines the licensing basis and gives the key mandatory nuclear safety documents that must be complied with to control and demonstrate the nuclear safety of Koeberg. Provisions are also included to cover submission of safety cases, reports and communication standards. Interfaces with the NNR and the establishment of a process to ensure all regulatory requirements are made known, understood and complied with by all applicable personnel at the nuclear installation are also included.

In this manner the responsibilities, accountabilities and assurance mechanisms for the nuclear installation licence are documented and incorporated into an approved process with independent assurance that the nuclear installation licence requirements are complied with and that the ultimate responsibility for radiation protection and nuclear safety rests with the licence holder.

ARTICLE 10: PRIORITY TO SAFETY

Each Contracting Party shall take the appropriate steps to ensure that all organisations engaged in activities directly related to nuclear installations shall establish policies that give due priority to nuclear safety.

Summary of changes:

The main changes made since the last report are as follows:

- Section 10.2 Safety Culture was updated to remove details provided in the last report and also to provide an update of safety culture initiatives at the nuclear installation.
- Section 10.3 was updated to provide information related to the simulator upgrade at the nuclear installation.
- Section 10.4 was updated to reflect a change in the licence holder organization structure in providing independent safety assurance.

10.1 ESTABLISHMENT AND IMPLEMENTATION OF SAFETY PRINCIPLES

10.1.1 Safety Policies

Nuclear safety policy is addressed at three levels namely the national government, NNR and the operating utility as licence holder.

10.1.1.1 National Policy

At national level the policy to ensure the safety of nuclear installation is addressed in the legislation and associated regulations which have been extensively covered under Articles 7, 8 and 9 above.

10.1.1.2 Policy of the regulator

At the level of the regulator, the policy to ensure the safety of nuclear installation is addressed in the legislation, and associated regulations which have been extensively covered under Articles 7, 8 and 9 above.

10.1.1.3 Policy of the Licence Holder

Within South Africa, Eskom is the major national electricity generator owning and operating the only nuclear power station in the country. The company has adopted a corporate policy on nuclear safety and the nuclear generation Portfolio within the company has also developed a policy to comply with all its safety obligations.

At the corporate level a policy has been developed which has been set down in a corporate directive. The directive commits to compliance with regulatory requirements and openness to inspection by the NNR and international peer review groups. Good engineering practice is employed in the design and operation of the nuclear installations and in any modifications to them, with a thorough root cause analysis of failures or operational anomalies. It undertakes to maintain a valid safety case for operation of its nuclear installation and to feature quantitative risk assessment as a component of the safety case. The necessary technical support is provided and a cadre of competent staff is maintained in all relevant discipline areas. A competent informed management structure is provided with the necessary mechanisms of quality assurance. Radiation doses are maintained as low as reasonably achievable and dose limits are respected. Emergency plans to mitigate the effects of potential accidents are maintained in a state of preparedness. Information exchange and feedback of international operating experience are employed and all relevant aspects of operation are appropriately documented.

Within the generation department of the utility, a policy statement has been drawn up committing to managing the nuclear installations in line with national regulatory and corporate requirements and respecting IAEA standards for quality management. The policy requires that functional responsibilities be assigned and that all employees have a clear understanding of their responsibilities, the expectations from them and the potential impacts of their function. This policy is manifested in obligations to meet job requirements, to have systems of error prevention and corrective action, a performance standard of zero deviation and a systematic improvement process.

The scope of activities that the utility is authorised to undertake is specified in the nuclear installation licence, together with plant technical specifications and operational programmes it is obliged to implement. The regulations R388 on the SSRP as well as the nuclear installation licence detail the reports that must be made by the licence holder to the NNR.

10.1.2 National Safety Standards and Regulatory Practices

The Safety Standards and Regulatory Practices have been extensively covered above in Articles 7 and 9.

10.2 SAFETY CULTURE

One of the principal radiation protection and nuclear safety requirements of the SSRP in section 3.5 is that a safety culture must be fostered and maintained at the nuclear installations to encourage a questioning and learning attitude to radiation protection and nuclear safety and to discourage complacency.

10.2.1 Safety Culture Programmes at the nuclear installation

The NNR was involved at an early stage in the development of safety culture programmes as part of the teams formed by the IAEA to progress the International Nuclear Safety Advisory Group INSAG-4 and the Assessment of Safety Culture in Organizations Team (ASCOT) guidelines. Since 1991 this involvement has continued and NNR assistance in IAEA safety culture missions, workshops and assistance programmes has allowed the regulatory activities at the nuclear installations to benefit accordingly and to be suitably enhanced.

The licence holder, with involvement of the NNR, developed a safety culture survey tool partially based on the IAEA INSAG-4 publication, the Institute for Nuclear Power Operators (INPO) INPO TECDOC-1329 and the INPO Principles for Strong Nuclear Safety Culture. Surveys were conducted in 2006, 2007 and 2009 involving utility personnel and contracting staff. The results and the recommendations of the surveys were shared openly with the installation staff and the NNR.

10.2.2 Safety Culture Monitoring and Feedback

To aid in identifying underlying trends of safety culture, the licence holder carries out analyses of occurrences from operation, outage work and other activities. The results of these analyses are presented in graphical format for departments and groups and discussed with installation staff at safety improvement sessions and safety culture promotions. In this way, lessons learned from the nuclear installation and from nuclear installations worldwide can be communicated to the relevant staff at the nuclear installation.

Presentations have been given to the nuclear installation staff on safety culture topics and the licence holder convenes periodic nuclear safety awareness seminars, which are attended by all staff and include many safety presentations, videos and discussion groups covering a wide range of nuclear safety matters, including safety culture.

Initiatives taken by the licence holder to enhance safety culture have included the following:

(i) Establishing dialogue with worker representatives and Trade Unions of safety issues.
(ii) Promoting meetings and visits involving public and local authorities.
(iii) Improving visibility and accessibility of managers to workers.
(iv) Improving NNR/Eskom communications – NNR project concept introduced
(v) SIMON – Safe Intelligent Motivated Observant Nuclear Professional recognition system is in place.
(vi) Regular safety culture and Human Performance newsletters.
(vii) Permanent psychologist on-site.
(viii) Rewards system for recognition of safety issues.
(ix) Nuclear Safety Concern process.
(x) Human Performance drive.
(xi) Outage safety focus and dedicated safety plan.
(xii) A Safety Engineer function supporting operating shift and providing oversight to the stations safety bodies.

The principle that safety is the overriding priority is clearly stated in nuclear installation directives on the responsibility and accountability for nuclear safety. However, the ever-pressing demands for production and cost savings can influence individuals to tolerate potentially unacceptable conditions. As indicated above in Article 9, the NNR has moved to a more process-orientated licensing approach, which demands increased discipline and safety culture from staff of the nuclear installation and increased vigilance from the NNR to detect incipient weaknesses of any deterioration of safety commitment.

10.3 OPERATOR TRAINING AND EXAMINATION

One of the safety requirements in section 4.4 of the SSRP is that an adequate number of competent, qualified and trained staff must be responsible for carrying out the functions associated with radiation protection and nuclear safety and for maintaining an appropriate safety culture.

The competence of operating staff and the regulatory measures that are in place are key elements that contribute to ensuring the safe operation of the nuclear installations.

Condition 4 " Controls and limitations on operation" of the nuclear installation licence for the Koeberg Nuclear Power Station places some prescriptive requirements on the control and operations of the reactors which can only be carried out by reactors and senior reactors operators licensed by the NNR.

10.3.1 Operator training enhancement programme at Koeberg

As reported in previous National Reports to the Convention, an Operator Enhancement Programme (OEP) was implemented at the Koeberg Nuclear Power station which was followed by an international peer review of operator training.

These initiatives resulted in some improvement to the overall operator training programme at the nuclear installation which included the following:

- A Koeberg Training Manager position was introduced, reporting directly to the PSM. A senior INPO training manager occupied this position for a two year period.
- A nuclear cadet programme was introduced to address the problem of staff shortage at the non-licensed operator level, but has since been terminated.
- A Systematic Approach to Training (SAT) project was initiated to redefine the operator training needs and ensure that the training process and material were appropriate.
- Additional contract instructors were employed by Koeberg to provide the specialist resources needed to implement an improved training programme.
- Initiation of a project to prepare for and achieve international accreditation of operator training (INPO).

10.3.2 Licensing of reactors operators

In terms of the licensing of reactors and senior operators at Koeberg the NNR regulatory approach is based on that of the USNRC approach and as such a review of all aspects of the operator licensing process was undertaken using the USNRC NUREG-1021 operator evaluation methodology as a benchmark.

This review identified several recommendations which resulted in the development of a new operator initial licensing examination process based on NUREG-1021. Under the new process, the power station develops an exam plan, develops the exams and administers certain aspects of the exams. The NNR reviews and approves the exam material, performs an oversight role during the exam preparation, approves the exam outcomes and issues licenses accordingly. The Koeberg standard and procedure governing the new process was approved by the NNR and changes are subject to prior NNR approval.

Since introduction, the new licensing process has been successfully applied to both Reactor Operators (ROs) and Senior Reactor Operators (SROs) licensing groups. Some further minor improvements have since been made to the process to further clarify and improve application of the process. The examining process has been updated to align with the latest revision of NUREG-1021.The clarification of standards associated with the licensing exam process has helped to improve the preparation of candidates and the predictability of licensing results has improved significantly. The newly defined competencies for initial licensing have also positively impacted on the re-qualification training of licensed operators.

10.3.3 Implementation of System Approach to Training (SAT)

All operators' training material has been redesigned and the administrative training procedures have been rewritten to reflect the requirements and processes of the SAT-based training process. The implementation of SAT has been extended to all areas of technical training at Koeberg.

10.3.4 Operating simulator upgrade

A major project that includes new hardware, operating system and selected software models (core, reactor coolant system and steam generator models) was completed in 2004. The simulator upgrade project addresses many of the previous simulator deficiencies which compromised operator training to varying extents. The new reactor coolant system model extends the scope of simulation beyond its previous limits, covering reduced inventory operations, drain-down and refilling, and extends capability into areas of core damage during accidents that were previously not available.

The first phase of a new two-stage upgrade of the simulator modeling has been completed. This stage I upgrade has mainly improved simulation of the secondary side and provided a new instructor station interface. The second stage upgrade and a complete second simulator are planned for 2011.

10.3.5 Accreditation of operator training

At the end of 2003, Koeberg was successful in achieving accreditation for its entire operator training programmes with the USA-based Institute of Nuclear Power Operators (INPO). Koeberg has been the first nuclear power station outside of the USA to achieve this accreditation. The ongoing assessment and periodic re-accreditation provides a high level of assurance that the quality of operator training will be maintained at an international best practice level.

The South African Qualifications Authority SAQA has also independently accredited operator training at Koeberg in accordance with national requirements and standards.

10.4 COMMITMENT TO SAFETY

10.4.1 General

The licence holder's commitment to safety is a fundamental requirement for the continued operation of the nuclear installation. Policies, procedures, forums and projects have been initiated over the life of the nuclear installation, having the primary goal of enhancing safety and procuring commitment from the installation's staff. To date, the NNR has followed the practical translation of these initiatives into positive results. Where it has been seen that areas of weakness have occurred these have been addressed by consultation and co-operation between the NNR and the licence holder.

Examples of the licence holder's commitment to safety have been evidenced in the resources and time expended in the establishment of safety assurance functions, a safety assessment capability, an independent nuclear safety department and the periodic safety re-assessment.

The main initiatives implemented by the licence holder to strengthen its commitment to nuclear safety are summarised below in Sections 10.4.2 - 10.4.5.

10.4.2 Establishment of corporate safety assurance group

In 1999 Eskom established a corporate safety assurance organisation "Generation Nuclear Safety and Assurance" (GNS&A) which supplied direction, assurance, licensing and specialist services. This included the following specific services:

- Safety Assessment and Licensing
- Operations and Operations Licensing
- Engineering and Configuration
- Plant Condition Management
- Radiation protection and Emergency Planning

GNS&A also ran the Nuclear Safety Inspectorate and Quality Assurance functions of the licence holder.

In 2008 Eskom established a Nuclear Division, reporting to the Eskom Chief Officer (Generation Business). The licensing and quality assurance functions were transferred to the new division with GNS&A (now renamed as Nuclear Safety Assurance (NSA) providing independent safety assurance directly to the Chief Officer (Generation Business).

10.4.3 Safety Engineer Function

As reported in the previous report Eskom (Koeberg) has established four Safety Engineer posts based on the French EdF model. Their responsibilities are as follows:

(i) Safety Function Confirmation

This is performed on a daily basis and is a direct service to the shift manager, their duties include:

- Trending critical plant parameters during normal operation to detect early warnings of potential safety problems.
- Providing an independent level of monitoring of safety system performance and making recommendations accordingly.
- Confirming the availability of safety related systems.
- Confirming the availability of post accident mitigation equipment.
- Approving the plant work plan after a risk evaluation.
- Confirming the compliance to nuclear safety requirements before plant state changes during unplanned shutdowns.

All deviations are either reported immediately to the shift manager, or to the organization concerned, with the timing being dependent on the impact on nuclear safety.

(ii) Plant outage Safety

- Assist and advise during the outage planning phase to ensure compliance to the Operating Technical Specifications (OTS).
- Participate in deterministic risk analyses and propose mitigation methods.
- Confirmation that the equipment is correctly requalified.
- Confirm that the General Operating Rules (GOR) surveillance programme is complied with.
- Confirm compliance to nuclear safety requirements during plant state changes during the outage.
- Preparation of the outage safety plan.
- Confirmation of compliance to the outage safety plan.
- Compile and implement an outage experience feedback process for the continuous improvement of nuclear safety.

(iii) Technical Advice & Recommendations

- During normal operations, provide advice to the shift manager on operability determinations, suitable response to potential unsafe conditions and similar conditions of uncertainty and ambiguity.
- Provide post incident or accident monitoring of the critical safety functions and advise the operators of any unsafe conditions.
- Lead post trip investigations in terms of authorization for the safe restart of a unit.
- Investigate the causes of abnormal events that occur, assess any adverse effects and recommend changes to procedures or equipment to prevent recurrence.
- Provide the Operations Shift and Technical Support Centre with expert assistance regarding beyond design basis phenomena and recommend actions.
- Participate in the implementation of the Severe Accident Management Guidelines (SAMGs).

(iv) Safety Documentation Review & Assessment

- Evaluate the effectiveness of procedures in terms of terminating or mitigating accidents and make recommendations when changes are needed. This will be achieved by managing the compilation and review of the accident procedures and the SAMGs.
- Review changes to the Operating Technical Specifications (OTS) and surveillance requirements.
- Participate in the safety review of plant modifications and safety cases.
- Participate in the Koeberg Review and Safety Committees (KORC and KOSC)
- Participate in appropriate audits and evaluations.
- Provide training related to nuclear accidents and incidents, prevention and mitigation.

10.4.4 Safety Indicators

In addition to the use of World Association of Nuclear Operators (WANO) performance indicators, Koeberg has developed a comprehensive system of safety indicators, involving upper tier indicators and several hundred lower tier indicators. This system has been in use for several years and is computerized, providing a convenient database for linking the indicator levels to specific sets of findings arising from their monitoring programmes.

10.4.5 Operating Experience Feedback

The Operating Experience (OE) Group is responsible for external experience feedback and the total direction and management of the OE system. (Refer to section 12.2.5).

10.5 REGULATORY CONTROL

The NNR has a dedicated team of site inspectors and examiners within close proximity of the nuclear installation. This enables the NNR to maintain improved communication with the licence holder's staff, management and off-site bodies and to gauge the level of commitment to safety demonstrated in all aspects of installation operation. The NNR is, therefore, better informed to assure the public that the installation's staff is committed to the pursuit of safety and that the NNR is equally committed to effective vigilance and appropriate action.

The system of regulatory control to ensure that priority to nuclear safety is given and enforced at the nuclear installation has been discussed in previous Articles 7 and 9 but can be summarised as follow:

The NNR ensures that the licence holder meets its commitment to nuclear safety essentially by:

1. The enforcement of the legislative requirements of the NNR Act
2. The establishment of nuclear Safety Standards and Regulatory Practices,
3. The granting of a nuclear installation licence and regulatory directives/letters and demonstration by the licence holder of compliance to the conditions of licence and:
4. Providing an independent regulatory assurance of compliance with the conditions of the nuclear installation licence through the implementation of a system of compliance inspections. The latter comprising inspections, surveillances and audits as well as various forums for interaction with the licence holder (the compliance assurance programme of the NNR, including a summary of the outcomes of the programme, is described further in Article 14).

ARTICLE 11: FINANCIAL AND HUMAN RESOURCES

1. Each Contracting Party shall take the appropriate steps to ensure that adequate financial resources are available to support the safety of each nuclear installation throughout its life.

2. Each Contracting Party shall take the appropriate steps to ensure that sufficient numbers of qualified staff with appropriate education, training and retraining are available for all safety related activities in or for each nuclear installation throughout its life.

Summary of changes:

No major changes were made to this Article since the last report. Changes were as follows:

1. Editorial changes throughout the Articles
2. Section 11.4 was updated in respect of reactor operator licensing and also to report on the regulatory oversight of the licence holder's staffing and competencies

11.1 FINANCIAL AND HUMAN RESOURCES OF THE LICENCE HOLDER AVAILABLE TO SUPPORT THE NUCLEAR INSTALLATION THROUGHOUT ITS LIFE

Eskom is a very large electricity utility with a tried and tested financial planning process. All planning is based on the principle of Eskom being a financially viable concern. Although financial plans are inclusive of all the Eskom power plants, the nuclear installation is not planned for in isolation. However, the financial plans for the organisation as a whole are inclusive of the nuclear installation's financial requirements.

The main purpose of these plans is to determine Eskom's electricity tariffs which are based on a revenue requirement model.

All the anticipated costs of the organisation, including inflation adjusted depreciation, as well as an expected return on assets are added together to determine the revenue requirement for the organisation.

As the nuclear installation is a strategic asset and a prominent supply option in the integrated electricity production plan of Eskom, the necessary resources are allocated to support this asset now and in the future.

In view of the above, it is clear that there are and will be sufficient resources available to support the nuclear installation. However, the pressures of escalating resource costs, national demands for cheaper power, the need for an expanding nuclear installation programme and social integration will challenge the ability of Eskom to remain competitive. This in turn impacts on the NNR’s responsibility to watch for any signs of safety being affected and instituting timely measures to restore the status quo.

11.2 FINANCING OF SAFETY IMPROVEMENTS MADE TO THE NUCLEAR INSTALLATION DURING ITS OPERATION

The licence holder utilizes a technical planning process to allocate financial resources for improvements to plant. Nuclear safety modifications are in a separate category and specific provision is made for these.

All improvements to the installation are financed centrally by the licence holder's treasury department. The funding requirement of the organisation is derived from the financial plans and is determined annually and reviewed monthly.

The licence holder finances safety improvements in the same manner as any other improvement to plant. Owing to the nature of the industry, improvements are made on a continuous basis throughout the life of the installation and nuclear safety improvements are no exception.

11.3 FINANCIAL AND HUMAN RESOURCES FOR DECOMMISSIONING/ RADWASTE

Decommissioning of the nuclear installation is currently scheduled for after 2035. Financial provision for the decommissioning (and also spent fuel management) has continued to be accumulated on a monthly basis since commercial operation of the installation began in 1984. The financial provision is reflected in the annual financial statements of the licence holder. These financial statements are audited in accordance with South African national legislation.

The amount of decommissioning and spent fuel provision made each month is determined by present valuing future estimated cash flows in terms of decommissioning financial plans. These financial plans are reviewed regularly and annually adjusted with the South African inflation rate.

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

11.4 RULES/REGULATIONS AND RESOURCE ARRANGEMENTS FOR ALL TRAINING/RETRAINING – INCLUDING SIMULATOR

The training, qualification and continuing training requirements for personnel, who sit on the installation's safety review committees and who perform safety evaluations, are set by the licence holder. No direct regulatory involvement is required, as the outputs from these personnel must be approved by the NNR prior to implementation.

The training, qualification and continuing training requirements for the production support groups (maintenance, chemistry, nuclear fuel management and nuclear engineering) are set by the licence holder. It is a requirement of the nuclear installation licence that the efficacy of these training programmes is audited on a regular basis. Participation in these audits is actively undertaken by the NNR. The licence holder follows a practice of formally authorising staff to perform tasks on safety related plant systems, based on formal on-the-job training and examinations.

The minimum training and qualification requirements for radiological protection personnel and radiation workers are prescribed by the nuclear installation licence. It is also a requirement of the nuclear installation licence that the efficacy of these training programmes is audited on a regular basis. Participation in these audits is actively pursued by the NNR.

As reported above in Section 10.3, it is a condition of the nuclear installation licence that only individuals licensed by the NNR may manipulate the controls of the reactors. To obtain either a Reactor Operator (RO) or Senior Reactor Operator (SRO) licence the individual is required to qualify as follows:

- (i) to pass written examinations set by the NNR in the areas of nuclear power plant fundamental theory and in normal, abnormal and incident plant operation;
- (ii) to pass simulator examinations in normal, abnormal and incident conditions;
- (iii) to pass in-plant walk-through examinations; and, for SRO candidates;
- (iv) to pass in-plant examinations in the performance of emergency controller duties.

The licensing standards of the NNR are fully aligned to the US NUREG 1021. The content and scope of examinable subjects, for initial licensed operator training, is driven by the knowledge and abilities as required by the NUREG-1122 catalogue.

Having obtained a reactor operator's licence, it is a licence condition that the individual attends re-qualification training. The training and evaluation are performed by the licence holder; however, the programme content and standard are monitored and approved by the NNR. Full re-qualification examinations are given bi-annually. Provided that operators meet all the NNR requirements and remain fit for duty, their operating licences are re-issued for a further two year period. Any contravention of the operator licence requirements is immediately reportable to the NNR.

All initial and re-qualification training and performance evaluations are performed on a full scope replica simulator situated on site. The quality of the simulator is prescribed by the nuclear installation licence to a standard of ANSI/ANS-3.5. Failure to meet the NNR criteria for simulator fitness-for-purpose results in non-compliance with the NNR training standards and has a direct impact on operator qualification.

The nuclear installation licence requires minimum shift staffing levels and the notification of organisational changes to the NNR. Training and competency standards are monitored by means of training records, auditing, assessment of results and the analysis of occurrences for root causes. The licence holder has progressed and implemented a Systematic Approach to Training (SAT) which now covers all facets of training at Koeberg.

11.4.1 Regulatory monitoring of competency and staffing of the licence holder

In accordance with the requirements of section 4.4 of the SSRP for staffing, as requested by the NNR, the licence holder (Eskom) reported on its staffing and competency levels at the Koeberg Nuclear Power Station, including problems encountered and the skills development and retention strategies to address them. Eskom has indicated problems with high turnover of staff, particularly with regard to engineers, technicians, physicists and project managers. Intervention strategies implemented during 2008 provided a significantly improved situation. The NNR is satisfied that all safety related work is performed by competent individuals. However as this issue has the potential to impact on nuclear safety in the long run, the NNR will continue to monitor staffing and competency levels at Koeberg.

ARTICLE 12 HUMAN FACTORS

Each Contracting Party shall take the appropriate steps to ensure that the capabilities and limitations of human performance are taken into account throughout the life of a nuclear installation.

Summary of Changes

1. Minor editorial changes throughout all sections
2. Section 12.2.3 Human Reliability Assessment – updated to comment on additional HRA methodology
3. Section 12.2.5 Operating Experience Feedback - updated to comment on use made of IAEA IRS Operating Experience (OE) data
4. Section 12.4 the Role of the NNR – updated to elaborate on Medical and Psychological Surveillance and Control and SRA II Human Factors aspects

12.1 PREVENTION, DETECTION AND CORRECTION OF HUMAN ERRORS

12.1.1 Prevention

As a first line of defence toward minimizing the occurrence of random human errors, the licence holder's Reactor Operator and Senior Reactor Operator licensing process sets a very high standard of required operator competence and qualification. This is achieved through a comprehensive selection and recruitment programme, intensive training and a stringent operator re-qualification process. The selection process incorporates both medical and psychological evaluations. Training includes classroom and simulator training in both technical and “soft” skills. Operator licence re-qualification is achieved through stringent examinations that include written, simulator and plant walkthrough. The NNR exercises oversight over the process.

12.1.2 Detection

Identification of human errors and potential human errors is achieved by a combination of various methods. Operational experience is continuously investigated by means of problem report analyses concerning installation incidents and non-conformances. Safety culture assessment on the other hand provides early indications of negative influences that could produce an error- prone working climate. In the control room, on-site operator performance monitoring provides a continuous check on new potential problem areas in, for example, individual behaviour, communication and teamwork. During re-qualification training, thorough operator performance evaluations highlight any operator and/or training deficiencies that might exist. On a six-monthly basis, licensed operators undergo medical examinations and psychological monitoring interviews to identify any personal dispositions that might compromise their performance on shift.

12.1.3 Correction

The identification and implementation of appropriate corrective actions is based on the feedback of operational experience, the results of performance monitoring and upon human error analyses to management, the training department and incident investigation committees of the nuclear installation. Re-qualification training for licensed operators provides on-going correction and enhancement of operating skills.

12.2 ANALYSIS OF ERRORS, MAN-MACHINE INTERFACE, AND FEEDBACK

12.2.1 Root Cause Analysis and Trending of Human Errors

An electronic problem management system is employed by the licence holder to provide a comprehensive database containing information regarding problems, events and non-conformances. All such incidents are rated according to the International Nuclear Event Scale (INES). Various root cause analysis methodologies are used and these are applied to significant occurrences. The identified root causes are used as further inputs to the analysis of human error and safety culture. Human performance errors are analysed according to specific event codes for example, communication, management, skills, rule adherence and knowledge. Each of these is further analysed in various sub-categories to define specific areas of concern. The development of any trends based on event codes is identified. A station trend report is compiled on a quarterly basis.

12.2.2 Safety Culture Analysis

Selected human performance categories within the root cause analysis process are further scrutinised for possible influences of safety culture. Safety culture is also assessed every two years by means of surveys conducted on operating climate and prevailing culture within the installation, utilising the questionnaire method.

12.2.3 Human Reliability Assessment

The probabilistic risk assessment of the nuclear installation includes the assessment of human errors in design-basis accidents. The human reliability analysis methodology used is a three-phased approach based on a combination of the best features of two human reliability analysis techniques. These are the Handbook of Human Reliability Analysis with Emphasis on Nuclear Power Plant Applications – Final Report and the Accident Sequence Evaluation Program Human Reliability Analysis Procedure (ASEP). More recently Human Error Probabilities (HEP) are calculated using the EPRI HRA calculator and the SPAR-H method.

12.2.4 Man-Machine Interface

The discrepancies between human capabilities and the demands of the working environment are investigated and minimised by means of periodic control room design reviews. These cover evaluations of, for example, the layout and functional demarcation of control panels, lighting, and noise and air-conditioning aspects. Also, differences in these aspects between the simulator and the actual control room are identified and minimised. As a minimum requirement, the standards of NUREG 0700 are adhered to. On an installation-wide level the enhancement of user familiarity with plant equipment is actively encouraged. (Refer to Section 18.5 for a further discussion of Man-Machine Interface considerations in plant design changes).

12.2.5 Operating Experience (OE) Feedback

Significant changes have been made in terms of processes and organization affecting all groups involved with Operating Experience.
There is an OE Group responsible for external experience feedback and the management of the OE system.

This system includes:

- Endorsement by station management of all Corrective Actions (CAs) at a Corrective Action Review (CAR) Meeting.
- Tiered approach to event investigations
- Reporting of World Events to the organization

- WANO cause categorization.
- Off-site reporting guidelines
- Prioritization of all CAs.

All significant operating event reports (SOERs) received from WANO and INPO are formally tracked and generic studies by EdF processed via CAR meetings to formalize a Koeberg position.

Event reports from the NEA/IAEA Incident Reporting System (IRS) are scrutinized for lessons learnt from feedback of international operational experience.

Other improvements that have been implemented to ensure the continuous striving for excellence include the following:

- Making OE readily available to staff in a user-friendly system to facilitate inclusion in pre-job briefing, training and procedures.

- Effectiveness reviews on significant event reports like SOERs to ensure the intent of the corrective actions and recommendations are met.

- Ensure implementation of agreed changes to the OE process by conducting regular self-assessments.

12.2.6 Performance objectives & criteria

As an overview, Performance Objectives & Criteria are designed to promote excellence in the operation, maintenance, safety and support of operating nuclear electric generating stations.

Operating Experience criteria are as follows:

- Managers are appropriately involved in promoting and reinforcing the use of operating experience through activities.
- A systematic approach is used to identify and implement effective corrective actions from reviews of in-house and industry operating experience.
- Industry operating experience information is reviewed for applicability, and applicable information is distributed to appropriate personnel in a timely manner.
- Rigorous investigations are performed in response to significant in-house events.
- Operating experience that relates to human performance is effectively communicated to personnel through training, procedures, and work packages.
- Individuals at all levels of the organization use operating experience to resolve current problems and anticipate potential problems.
- Personnel reinforce the use of operating experience, through, for example, pre-job briefings, engineering design reviews, and training activities.
- Operating experience information is easily accessible to station personnel.
- An evaluation is periodically performed to determine the effectiveness of the use of operating experience information. Appropriate actions are taken to make needed improvements.
- Timely notification via Nuclear Network is provided to other utilities regarding significant in-house events and equipment problems of generic interest. Criteria for selection of significant in-house events and equipment problems are established and communicated to station personnel.
- Equipment performance and engineering data is kept up to date and in accordance with established guidance.

12.3 MANAGERIAL AND ORGANISATIONAL ISSUES

The managerial structure of the licence holder is such that the nuclear installation is obliged to operate within a defined envelope of rules and procedures. An independent corporate nuclear safety group holds the responsibility for the overall safety case and determination of the operational rules and procedures, together with a compliance assurance role. In order to fulfill these functions, the corporate group contains a review capability, which monitors indicators derived from the safety case. These include factors influencing human performance and, by way of the occurrence reporting mechanism, failures and deviations arising from shortcomings in human performance. The corporate safety group also has responsibilities in respect of feedback of international experience pertinent to nuclear safety, including human factors. Review of human factor information, both externally and internally derived, enables shortcomings to be identified and addressed as necessary.

The corporate nuclear safety group is also responsible for reporting to the licence holder's nuclear safety overview committees on a regular basis. The reporting encompasses all matters relevant to safety including aspects of human factors.

The Eskom independent corporate safety group, the Nuclear Safety Assurance (NSA) department, has been operational for approximately eleven years (previously known as the Generation Nuclear Safety and Assurance group) and through its activities has positively contributed to the enhancement of the overall licence holder nuclear safety governance and to a more efficient and focused interface with the NNR.

12.4 ROLE OF THE REGULATORY BODY AND THE LICENCE HOLDER REGARDING HUMAN PERFORMANCE ISSUES

As indicated above in sections 10.3 and 11.4, the NNR has the overall independent responsibility for the regulatory functions of licensing the licence holder's reactor and senior reactor operators to ensure that the safety and reliability aspects of their performance in the execution of required control room duties are of an acceptable level. This, in turn, involves the enforcement and control of specific operator licensing requirements. These are elaborated in several regulatory documents which are an integral part of the conditions of the nuclear installation licence. The operators are to comply with these requirements at all times.

All radiation workers, including reactor operators, are subject to the requirements of a Medical and Psychological Surveillance and Control Programme implemented at the installation. The NNR exercises oversight over the programme and utilizes the services of consultant medical and psychological experts as the need arises to provide independent advice, monitoring and evaluation of nuclear installation staff.

As part of the programme the licence holder conducts an initial psychological assessment of candidate reactor operators and ongoing psychological monitoring of licensed reactor operators. A six-monthly psychological monitoring report is produced by the licence holder and evaluated by the NNR. Annual psychological interviews may be conducted by NNR consultants with operating staff should additional assessment be necessary.

In the recent second Periodic Safety Re-Assessment (SRA II) being conducted at the Koeberg Nuclear Power Station the NNR requested a broadening of the scope of the Human Factors review to incorporate Human Factors Engineering aspects of process control and maintenance. The former requires a comprehensive Human Factors Engineering Control Room Design Review incorporating control room habitability aspects. The latter entails an assessment of the safety and reliability aspects of human performance in maintenance activities.

ARTICLE 13 QUALITY ASSURANCE

Each Contracting Party shall take the appropriate steps to ensure that quality assurance programmes are established and implemented with a view to providing confidence that specified requirements for all activities important to nuclear safety are satisfied throughout the life of a nuclear installation.

Summary of changes:

(i) Section 13.5 updated to elaborate further on the Quality Management requirements developed for the PBMR and also applicable to new nuclear installations.

(ii) Section 13.5 was also updated to include the Eskom's development of safety and management systems for preparing for the building of additional nuclear power stations.

13.1 QUALITY ASSURANCE (QA) POLICIES

13.1.1 Licence Holder

The licence holder's QA programme, including the Quality Policy Directive, is specified in the Safety and Quality Management Manual of its Nuclear Division. Oversight of the operations is provided by the QA programme of Koeberg Nuclear Power Station. This programme is based on the IAEA Safety Code 50-C/SG-Q, the NNR Licence Document LD-1023 and Eskom Nuclear Division Safety and Quality Management Manual.

The responsibility for the implementation of QA policies on the operational plant is that of the Koeberg Power Station Manager being accountable to the Senior General Manager (Nuclear Division).
The licence holder's quality management and operational QA programmes presently satisfy both the international standards and codes and those of the NNR.

13.2 IMPLEMENTATION AND ASSESSMENT OF QA PROGRAMMES

A comprehensive audit programme of planned, periodic monitoring for the nuclear installation has been established by the licence holder in conformance with NNR's licensing requirements. This programme is informed by indicators which include audit findings, inspection non-compliances, operating experience and problem reports. The audit programme is discussed with the NNR and takes into account the NNR's planned audit and inspection programme to ensure an integrated monitoring programme is established.

Achievement and maintenance of quality are verified by audits, surveillances, self-assessments and peer reviews. These are conducted in accordance with authorised procedures and are performed by certificated auditors using approved checklists.

Personnel performing monitoring activities are independent of direct responsibility for the activity being monitored.

Monitoring reports are issued and reviewed for comment by the monitored organisation. Follow up action is taken to verify that deficiencies or discrepancies have been corrected. The results of monitoring activities and management reviews are maintained as quality assurance records.

The detection, reporting, disposition and correction of non-conformances, deficiencies and deviations from quality requirements are specified in various authorized procedures. Non-conforming items are conspicuously marked and where possible segregated from other items.

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

Non-conformances for components are dispositioned as follows: use-as-is, repair, rework, or unfit-for-purpose based on review and evaluation by responsible, competent engineers. Non-conformance dispositions are reviewed and accepted by responsible management.

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

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

Vendors are classified according to a 4-tier quality level system, based on the service/materials they provide and the safety classification of the plant which requires the vendor intervention. Quality levels 1&2 vendors (highest quality classification) are assessed by the nuclear installation according to ISO 9001 and other pertinent criteria. Controls are in place to prevent inadvertent use of incorrectly classified vendors.

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

13.3 REGULATORY CONTROL ACTIVITIES

One of the principle nuclear safety requirements of the SSRP in section 3.10 is that a quality management programme be established, implemented and maintained in order to ensure compliance with the conditions of the nuclear authorisation.

This safety requirement, related to the licence holder's quality assurance responsibilities, is further entrenched in the conditions of the nuclear installation licence in a regulatory requirement document – LD 1023 'Quality management requirements for Koeberg Nuclear Power Station.' In terms of this document, the implementation of a quality management programme is required to provide adequate confidence in the validity of the operational safety assessment and safety assurance processes.

The QA monitoring programme for Koeberg Nuclear Power station is developed in accordance with the requirements of LD 1023 in consultation with the NNR. It covers, *inter alia*, the following areas:

- Radiological protection programme
- Maintenance programme
- Conformance to Operating Technical Specifications
- In-service inspection programme
- Radioactive waste management and effluent discharge control programme
- Chemistry programme
- Nuclear engineering design and modification programme
- Emergency plan
- Physical security system
- Civil works monitoring programme
- Environmental surveillance and meteorological programme
- Fuel integrity evaluation, storage, handling and transportation
- Fire prevention and protection plan
- Training/Qualification of operating and technical staff
- Quality activities and functions of the management programme (including control of deficiencies and corrective actions)
- Documentation and records system
- Compliance with risk assessment and safety criteria of the NNR

- Corporate Safety Assurance of the Nuclear Safety Assurance (GSA) oversight processes

During plant refueling outages, the licence holder generates a dedicated surveillance programme, which is designed, implemented and controlled by its Quality Assurance (QA) Department. NNR inspectors identify those surveillance activities that are of importance to monitor and observe. Results of these surveillances are reviewed by the installation's operations review committee whose duty is to identify and initiate appropriate corrective action.

The NNR has established a comprehensive compliance inspection programme covering all aspects of the nuclear installation licence for the nuclear installation (refer to Article 14), including the following compliance inspections relating specifically to the QA /Quality Control (QC) process:

- Corrective action close-out
- Incidents and problems notifications (PNs)
- Audit findings
- Non-conformance reports
- Work orders

The findings of the compliance assurance activities conducted by the NNR are classified as follows:

- Observations (based on judgment as to the adequacy of a particular system requirement)
- Findings (non-compliance or shortcomings in implementation of a QA system requirement)
- Licence Issue (non compliance to a condition of the nuclear installation licence requirement)

Audit findings and concerns are used as input to NNR safety indicators (refer Article 14), and separately to the utility's safety indicators systems. The indicators are used to prioritise future monitoring activities.

13.4 TRAINING OF AUDITORS AND NNR INSPECTORS

Eskom follows a national system of certification of auditors, which is aligned with international certification systems. A formalized training programme is in place to facilitate certification. Auditors are required to have previous experience in the core functions of the nuclear installation and/or nuclear specific training in plant operations and nuclear fundamentals. The composition of Audit teams ensures that qualified auditors are responsible for the execution whilst making allowance for training of unqualified auditors.

In terms of the requirements of the NNR Act, NNR appointed inspectors are required to be trained and certificated. This training and certification is carried out according to a modular Inspector Training programme. The modules cover the legislation and associated regulations, basic inspection techniques and reporting and a facility specific training module which is based on the functional area and discipline in which the Inspector is a technical expert.

13.5 OTHER QUALITY MANAGEMENT ACTIVITIES

As reported in the previous report to the Convention, Eskom progressed with the development of a High Temperature Gas Reactor (HTGR) Pebble Bed Modular Reactor (PBMR), which has recently been scaled down.

From the quality management, assurance and control aspects the NNR has developed a regulatory document RD-0034, which details the Quality and Safety Management Requirements of the NNR for Nuclear Installations applicable to the PBMR. Eskom, PBMR (Pty) Ltd and the suppliers responsible for design, construction and operation of the Pebble Bed Modular Reactor are required to develop, introduce and maintain an integrated QMS and SMS that complies with the requirements of this document.

This document (RD 0034) has been developed based on various international quality assurance codes and standards in order to satisfy the multi-national flavour of the potential purchasers. The IAEA Code 50-C/SG-Q, ASME ANSI NQA-1:2004, ISO 9000:2000 and a selection of other internationally recognised quality standards and codes formed the basis upon which RD 0034 was established.

The quality requirements related to the design include inter alia requirements on the identification and control of design interfaces, independent verification of design, test programmes, design changes, configuration management, selecting and reviewing the suitability of application of materials, parts, equipment and processes that are essential to the defined safety functions of Structures, Systems and Components (SSC), and verification and validation to pre-determined requirements.

Eskom is preparing for building additional nuclear power stations. As a result, within Eskom a Nuclear Division has been formed within which safety and management systems are being developed. The documentation being developed is based on ISO 9001:2008, supplemented by ASME NQA-1 and IAEA document GS-R-3. The safety and management systems will also be compliant to NNR's Requirements Document RD-0034 which details the Quality Management System (QMS) and Safety Management System (SMS) requirements of the NNR.

ARTICLE 14: ASSESSMENT AND VERIFICATION OF SAFETY

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

(i) Comprehensive and systematic safety assessments are carried out before the construction and commissioning of a nuclear installation and throughout its life. Such assessments shall be well documented, subsequently updated in the light of operating experience and significant new safety information, and reviewed under the authority of the regulatory body.

(ii) Verification by analysis, surveillance, testing and inspection is carried out to ensure that the physical state and the operation of a nuclear installation continue to be in accordance with its design, applicable national safety requirements, and with operational limits and conditions.

Summary of changes

1. Additional details provided on safety analysis requirements (Section 14.2).
2. Update provided on periodic safety re-assessment (Section 14.3).

14.1 THE NUCLEAR AUTHORISATION PROCESS

The regulatory requirements including the nuclear authorization process applicable to the operation of the Koeberg Nuclear Power Station have been extensively discussed in previous Articles.

14.2 SAFETY ANALYSIS REQUIREMENTS

The requirements for prior and operational safety assessments (Safety Analysis Report – SAR) for the Koeberg Nuclear Power Station have also been extensively discussed in previous Articles.

The National Nuclear Regulator Act stipulates that any person wishing to site, construct, operate, decontaminate or decommission a nuclear installation must apply to the National Nuclear Regulator (NNR) for a Nuclear Installation Licence.

The principles that must be met to ensure safety in any nuclear installation are legislated in the Regulations on Safety Standards and Regulatory Practices (SSRP). Requirements with respect to nuclear safety assessments for siting, design, construction, and operation are presented in Section 3.3 of the SSRP that stipulates that a prior safety assessment must be performed that is suitable to identify all significant radiation hazards and that evaluates the nature and expected magnitude of the associated risks. Measures to control the risk of nuclear damage must be determined on the basis of this safety assessment. Dose and risk limits are prescribed by this legislation.

The NNR has published a series of Licence Documents (LD) and Requirements Documents (RD) that are established to fulfill the principles contained in the SSRP. The design of the facility and the measures taken to ensure compliance to the legislated requirements are described in the Safety Analysis Report (SAR). The SAR has to comply with the contents of the various regulatory requirements documents LDs and RDs and is submitted to the NNR as part of the approval process of the Nuclear Installation License for the Operation of a new nuclear facility.

The NNR has established Principal Safety Criteria with the objective of assuring an acceptable level of safety to the public and plant personnel from radiation hazards. These criteria refer to limits on the annual risk/dose to members of the public and workers due to exposure to radioactive material as a result of accident conditions or normal operations. Protection of the environment is also implied by these standards, which include:

- Limits on risk to members of the public due to accident conditions,
- Limits on risk to workers due to accident conditions,
- Limits on dose to members of the public due to normal conditions,
- Limits on dose to workers due to normal conditions,

Specific Requirements that need to be met to demonstrate compliance with the Principal Safety Criteria include,

- The identification of normal operations and accident conditions,
- The determination of risk to the public due to accident conditions,
- The determination of dose to the public due to normal operations,
- The determination of risk to workers due to accident conditions,
- The determination of dose to workers due to normal operations,
- The calculation of the frequencies of the operating conditions and events identified, taking various appropriate factors into account,
- Acceptable statistical methods and proper treatment of data is required.

The Regulations on Safety Standards and Regulatory Practices require that an operational safety assessment must be made and submitted to the NNR at intervals specified in the nuclear authorisation and which must be commensurate with the nature of the operation and the radiation risks involved.

The operational safety assessment must be of sufficient scope and must be conducted and maintained in order to demonstrate continuing compliance with the dose limits, risk limits and other relevant conditions of the nuclear authorisation.

The operational safety assessment must establish the basis for all the operational safety-related programmes, limitations and design requirements. An installation description and documentation relating to compliance with the safety standards is provided in the Koeberg Safety Analysis Report. The safety analysis report and installation description is required to be maintained in a current state in line with international norms and practices.

The implementation of these requirements is through the conditions of the Koeberg nuclear installation licence which require that any plant and process changes affecting safety related systems, components and activities are approved by the regulatory body prior to their implementation.

Licensee's modification standards, approved by the regulatory body, are in place that require proper design, independent review, control and implementation of all permanent and temporary modifications, and require that appropriate review of the safety analyses have been performed before the installation of modifications are commenced or the changed process is implemented.

The nuclear installation licence requires that all modifications to the installation or any of the operating, maintenance and testing procedures be assessed in terms of both their impact on deterministic aspects of the safety analyses and on risk. By so doing, a dynamic risk assessment is maintained and updated on an ongoing basis. This is applied to the probabilistic safety assessment and to the deterministic aspects of demonstrating compliance with design and operational requirements.

14.3 PERIODIC SAFETY RE-ASSESSMENT

As an integral part of the operational safety assessment in addition to the ongoing assessment, which focuses on immediate aspects of installation and procedural modification, a requirement to undertake a safety re-assessment is also in place. The nuclear installation licence currently in place for the Koeberg Nuclear Power Station (KNPS) requires that the Safety Assessment of the installation be updated on a regular basis and at a frequency acceptable to the Regulator.

As detailed in previous reports to the Convention, the first Koeberg Safety Reassessment (KSR) project started in April 1995 with the formulation of the NNR requirements. Eskom submitted its Safety Re-assessment Report (SRA) for NNR review in December 1998 and the NNR completed its review in July 1999. The NNR review and conclusions of the KSR Project are documented in the NNR KSR assessment report.

The SRA report produced by Eskom included a comprehensive listing of findings and recommendations in each of the areas assessed. The report concluded that no deficiencies had been identified that required immediate corrective action. However, some short and medium term measures were required to either justify differences with the safety referential that Koeberg was benchmarked against (the EdF French CP-1 900 MWe plants) or to resolve some of the issues identified. These measures, including modification proposals were classified according to their safety significance (medium or low categories). An implementation programme was carried out by Eskom in order to disposition the findings.

The most significant plant hardware improvements have been completed. All plant modifications will have been implemented after the refueling outages scheduled for August 2010 and early 2011.

However it became apparent that not all corrective actions stemming from the first safety re-assessment would be concluded before the start of the second safety reassessment, which commenced in 2008 and, accordingly, a revised programme for implementing outstanding actions was agreed with the NNR. Progress in implementation is monitored at the Koeberg licensing interface meetings between Eskom and the NNR.

The second safety re-assessment commenced in 2008 once the scope of the assessment was agreed between the operator (Eskom) and the NNR. The scope is based on IAEA Safety Standards Series NS-G-2.10 *Periodic Safety Review of Nuclear Power Plants*.

The review methodology is largely based on comparison with the latest EDF CP-1 safety referential with a focus on any safety changes EDF have made since the 1995 revision of the referential which was used as the benchmark for the first periodic safety re-assessment. The review is scheduled for completion during 2010.

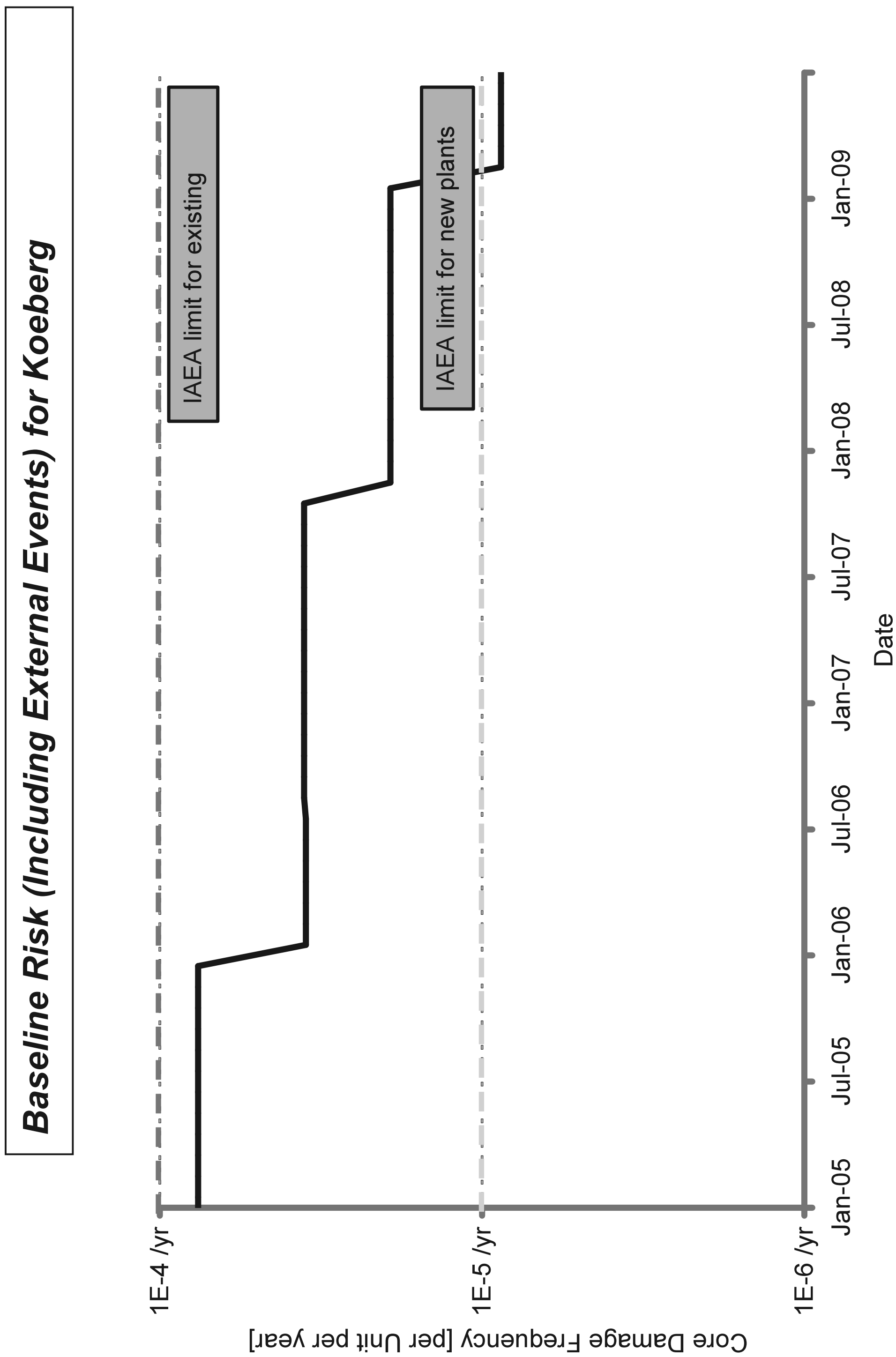
Alignment of the KNPS with the French CP-1 Referential

The first periodic safety re-assessment of Koeberg, where the 1995 revision of the EdF Family of French Nuclear Power Plants CP-1 safety referential was used as a benchmark, identified a number of plant improvements that were necessary to bring the level of safety of Koeberg to a comparable level to that of the CP-1 reference. However it was recognized that following the next 10-year safety re-assessment a further batch of modifications would require implementation in order to maintain a comparable level of safety with the CP-1 reference, which in turn was being subject to ongoing safety upgrades.

Eskom took a strategic decision to align closer to the CP-1 hardware referential. Over and above the modifications identified from the safety re-assessment, additional plant modifications (about 70) were identified for implementation. These were selected to provide strategic benefits in terms of sustaining an acceptable and demonstrable level of nuclear safety for the remainder of the operational life of Koeberg and to maximise business and safety benefits of the support contract Eskom has with EdF. The premise was that safety issues affecting Koeberg can be resolved in a similar manner to how EdF resolves the same issues for the CP-1 plants.

The so-called CP-1 modifications have been implemented in 3 batches over the past 10 years, with the final batch scheduled for implementation in 2010/2011.

The improvements in safety over this period have been quantified from on-going probabilistic risk assessments in terms of core damage frequency as shown in the following diagramme. Large Early Release Frequencies follow a similar trend.


Baseline Risk (Including External Events) for Koeberg
IAEA limit for existing
IAEA limit for new plants
1E-4 /yr
1E-5 /yr
1E-6 /yr
Core Damage Frequency [per Unit per year]
Jan-05
Jul-05
Jan-06
Jul-06
Jan-07
Jul-07
Jan-08
Jul-08
Jan-09
Date

14.4 CONTINUED HEALTH OF THE NUCLEAR INSTALLATION TO ENSURE LICENCE COMPLIANCE

The SSRP requires that operational safety-related programmes, limitations and design requirements be established on the basis of the operational safety assessment. These operational safety-related programmes include the following for the monitoring of the Plant Condition Management at the Koeberg Nuclear Power Station:

14.4.1 Routine On-Going Safety Review at the Nuclear Installation

The following major elements with respect to the maintenance of plant condition are required as part of the conditions of the Koeberg Nuclear Installation Licence.

These include:

- The maintenance of a valid and updated safety and risk assessment
- Establishment of and compliance with the plant Operating Technical Specifications (OTS), including operating surveillance requirements
- An in-service inspection programme
- An in-service testing programme
- A reactor vessel surveillance programme
- A plant maintenance programme
- A civil monitoring programme
- A physical security programme
- A fire safety programme
- A routine occurrence reporting programme
- A quality management programme

All items of the nuclear installation hardware that have a significant potential for impacting on nuclear safety, either through their lack of availability on demand or their failure during service, are subjected to systematic mandatory programmes covering maintenance, surveillance, testing and inspection. Through these processes, the licence holder is able to verify that the nuclear installation conforms to applicable criteria of reliability, availability and integrity within the original design requirements.

The formulation and control of these programmes takes cognisance of national and international codes and standards and also local safety standards and regulatory practices together with operational limits based on installation design requirements.

Fundamental to these programmes is the feedback of acquired data through a process of engineering evaluations, in order to effectively manage the ageing of the installation hardware. This process includes repairs, replacements, refurbishments, modifications and changes to operational conditions.

Compliance with the conditions set out in the nuclear licence is ensured by the implementation of various monitoring programmes by both the licence holder and the regulatory body. The major elements of these programmes are discussed below.

14.4.1.1 Plant Condition Verification Programmes

(i) In-Service inspection programme (ISIP)

A comprehensive ISIP is developed, implemented and controlled at the nuclear installation. This comprises a programme of examinations and tests conducted on nuclear safety related plant structures, systems and components to identify deviations from the design base, or deviations from the initial pre-service inspection baseline conditions.

The ISIP activities are governed by an In Service Inspection (ISI) standard, which is approved by the NNR and therefore part of the conditions of the nuclear installation licence. The ISI requirements are primarily derived from the US ASME Code, Section XI, Division 1 rules as amended for implementation by the United States Code of Federal Regulations, Title 10, Part 50, Section 55a (10CFR50.55a).

Those examinations that are required by ASME Section XI are addressed in the “Basic Scope” of the In-Service Inspection Requirements Manual (ISIPRM). Examinations identified to be performed due to criteria outside of the ASME Section XI are addressed in the “Augmented Scope” of the ISIPRM. Augmented ISI requirements may be identified and imposed by the NNR due to industry operating experience or plant specific conditions which may challenge the structural reliability of the installation.

(ii) In-Service Testing programme (ISTP)

A comprehensive ISTP is developed, implemented and controlled at the nuclear installation. This comprises a programme of examinations and tests conducted on nuclear safety related plant structures, systems and components to assess the operational readiness of certain components important to nuclear safety. These requirements apply to:

- Pumps and valves required to perform a specific function in shutting down the reactor to the safe shutdown condition, in maintaining the safe shutdown condition, or in mitigating the consequences of an accident;
- Pressure relief devices that protect systems or portions of systems that perform one or more of the three above mentioned functions;
- Dynamic restraints (snubbers) used in systems that perform one or more of these three functions or to ensure the integrity of the reactor coolant pressure boundary.

Testing and examination of the components described above was during the second interval controlled by and documented in the In-Service Inspection Programme Requirements Manual (ISIPRM). Revision of the ISIPRM for the third interval included relocating modules related to the in-service testing into the ISTPRM. Separation of the in-service inspection and in-service testing requirements into different requirements manuals for the third in-service interval followed separation of the ASME Codes – ASME Section XI for in-service inspection and ASME OM Code for in-service testing. The ISTP activities are governed by In Service Inspection standard, which is approved by the NNR and therefore part of the conditions of the nuclear installation licence. Implementation of the rules of the ASME OM Code is as per limitations and modifications identified in the United States Code of Federal Regulations, Title 10, Part 50, Section 55a (10CFR50.55a).

(iii) Reactor vessel surveillance programme (RVSP)

This programme was originally based on French experience and implemented as part of the French surveillance programme through a contractual agreement between the licence holder and EdF. Early in the life of the plant during the seventh fuel cycle of each unit a reduction in operating temperature (ORT) was introduced in order to mitigate the effects of primary water stress corrosion in the steam generator tubing.

Even though the advantages of ORT to the steam generators life management was established, it was however recognised that ORT could have a negative impact on the Reactor Pressure Vessel (RPV) embrittlement due to the reduction in the annealing effect. Accordingly the original capsule removal schedule was altered and a "spare" capsule inserted in the reactors that would see only ORT conditions.

Other changes to operational practice such as the introduction of low leakage fuel management and the use of more enriched fuels has impacted on the programme and a review of the calculation and dosimetry methods for determining pressure vessel neutron fluence will shortly be undertaken and taken into account in an updated pressurised thermal shock study.

Long term primary circuit integrity concerns such as the thermal embrittlement of the austeno-ferritic stainless steel elbows and the neutron embrittlement of the reactor pressure vessels, have been in part assuaged and subject to some small scale tests and have been re-assessed under plant life management.

(iv) Maintenance and Testing Programme

This programme covers the maintenance of mechanical, electrical, instrumentation and telecommunication hardware and the maintenance of structures on an 'ad hoc' basis in accordance with the relevant monitoring programmes. Condition-based maintenance is implemented in parallel with a fixed time-based preventative maintenance programme for items required for safety.

Maintenance functional control areas are managed through a higher tier maintenance policy document and each functional control area has at least one maintenance standard which defines the applicable rules/controls, and is supported by relevant administrative procedures, guides, lists and working procedures as appropriate.

A major emphasis of an optimisation process that is ongoing is to determine and to document the basis for maintenance for all Structures Systems and Components (SSCs) important to nuclear safety and to ensure a dynamic maintenance programme, with changes being controlled. This process, which is focusing on maintaining the safety related functional capabilities of SSC's important to nuclear safety, is based on the Reliability Centered Maintenance (RCM) philosophy and principles. As part of this approach every change in the maintenance basis (maintenance scope or frequency) is to be based on a justification utilising sound engineering practice. The entire process is to be monitored by a system/component failure and reliability monitoring programme which is to provide data for the maintenance optimisation process and for the nuclear installation's dynamic PRA reliability/availability database. Failure analyses will be conducted and corrective actions implemented, following any functional/potential functional failures.

The requirements of the Operating Technical Specifications shall not be compromised as a result of maintenance activities. During the process of planning and executing maintenance work, an assessment of the total plant equipment that is out of service is to be taken into account in order to determine the overall effect on the performance of safety functions, to ensure that the installation is operated in conformance with the defence-in-depth and ALARA principles, and within the safety criteria of the regulatory body. Maintenance effectiveness shall be assessed by reviewing the trends of functional failures that can be prevented through maintenance.

14.4.1.2 Assurance Programmes

- **Occurrence and Incident Reporting Programme**

A system of recording and reporting is required by the SSRP and a condition of the nuclear installation licence. This system encompasses amongst other things all potential occurrences from events indicating minor deviations to more serious incidents or accidents.

All the occurrences reported at the nuclear installation are recorded in a database. They are analysed in order to monitor trends, timeously indicate potential safety concerns, and update the safety and risk assessment using plant specific data obtained from the analyses. These trends are also compared with international databases. Further information is provided under Article 19.

- **Quality Assurance Inspections and Audits**

A systematic programme of inspections and audits is carried out by the licence holder and independently by the regulatory body. Areas to be inspected or audited are selected on the basis of operational feedback and safety significance in terms of compliance with the safety standards and regulatory practices and installation safety. The outcome of the inspections or audits may result in corrective action by the licence holder and also feedback into the risk assessment process. Refer to Article 13 for more details.

14.4.1.3 Risk Insights in Decision Making

As indicated in previous Articles, it is a principal radiation protection and nuclear safety requirement that the nuclear installation demonstrate compliance with the risk limits of the SSRP.

It is also a requirement of the conditions of the nuclear installation licence for the Koeberg nuclear power station that the safety assessment include a probabilistic risk analysis (PRA) for demonstration of compliance with the risk limits. In compliance with the regulatory requirements Eskom has developed and maintains a PRA for the Koeberg nuclear installation.

A comprehensive comparison of the Koeberg Probabilistic Risk Assessment methodology against internationally recognised standards was completed as part of the Koeberg Periodic Safety Reassessment reported above in 14.3. This process identified a list of improvements to be made to the Koeberg Probabilistic Risk Assessment (PRA) to align it with current international standards and practices and enhance its use as an “operational” tool. As a consequence the Koeberg PRA model has been significantly upgraded.

Eskom makes extensive use of PRA in decision making impacting on nuclear safety. The safety cases for any proposed plant change must include a probabilistic safety assessment. Operating Technical Specification changes are also reviewed from a PRA perspective. Risk insights are being used to develop new risk-informed Operating Technical Specifications.

Risk trade-off analyses are also performed, typically for optimising outage work schedules. On a routine basis, precursor analyses are performed and reviewed by Eskom safety review committees. The PRA is also used for prioritisation of safety issues, including plant safety modifications.

Given the importance and prominence of PRA in safety decision making, the PRA was recently subjected to a peer review as part of the confirmation process that the quality and scope of the PRA is appropriate for its use in risk-informed decision making.

14.5 REGULATORY ACTIVITIES

In terms of the National Nuclear Regulator Act, the NNR has the authority to restrict operation of the plant or to shut down the plant given adequate grounds. The SSRP and the conditions of the nuclear installation licence require the licence holder to report events or incidents. Depending on the level of severity the NNR may conduct inspections or investigations accordingly. The NNR also exercises regulatory control by means of approvals required in terms of the nuclear installation licence, and the compliance assurance inspections programmes outlined below.

14.5.1 NNR Approval Process

The nuclear installation licence requires that the safety case be submitted by the licence holder for approval by the NNR, that it be of sufficient scope and be established, conducted and maintained in order to demonstrate ongoing compliance with the nuclear safety standards and NNR requirements.

The nuclear installation licence also dictates that NNR approval is required for fuel unloading, fuel loading and return to criticality. Proposed modifications to the plant or changes to the licensing basis documentation referenced in the licence must be submitted to the NNR for approval prior to implementation. These changes must be supported by a safety case that includes a quantitative risk assessment.

14.5.2 Surveillance and Compliance Inspection Programme

A comprehensive surveillance and compliance inspection programme has been developed by the NNR to ensure compliance with the safety standards and the requirements of the conditions of the nuclear installation licence and to identify any potential safety concerns. The NNR compliance assurance inspection programme is independently implemented by the inspection staff of the NNR and is discussed below.

The NNR compliance assurance inspection programme for Koeberg has been largely based on consideration of a set of safety goals linked to the safety case for the plant. In the development of such a system, safety goals were established by the NNR first with a view to addressing all significant safety factors enveloping the overall safety case for the licensed facilities, including those aspects of the licence holder organisation relating to safety, in a top-down approach designed to provide assurance of safety in broad perspective in terms of the safety requirements of the NNR.

(i) Basis for the programme

As indicated above, the NNR compliance assurance inspections programme is based on safety goals developed from the principal radiation protection and nuclear safety requirements of the SSRP covering dose and risk to the workers and the public arising from normal operations and potential accidents, quality management requirements, defence-in-depth, comparison with and assessment against acceptable international benchmarks, the ALARA principle, and emergency planning requirements.

The above safety requirements imply numerous provisions, undertakings and assumptions, which underpin the safety assessment. These are to a large extent covered by the conditions of the nuclear installation licence in terms of the licence holder's safety assurance processes, the plant design, operational safety-related programmes, operating technical specifications, and the procedures themselves. In line with the objective to provide a focus on all safety assessment and assurance activities, relevant safety goals were established to address these factors, as far as practicable.

Safety indicators have also been established in correspondence with the safety goals to provide indication of the extent to which the safety goals are being achieved or could be challenged.

The use of safety indicators helps to focus attention on weak areas and to provide information in a format which can be trended and which is readily reportable and comprehensible to the licence holder management, public and different levels of the various regulatory and government organisations.

A system of ranking the level of safety concern and enunciating the status of each indicator is used.

The NNR compliance assurance inspections programme has been established to provide assurance of the state of health of the plant, processes, organisation and environment in terms of the identified safety goals.

(ii) Application of the programme

A baseline inspection, audit and surveillance programme was developed and implemented and linked to the safety indicators.

The various monitoring processes implemented by the NNR include, inter alia, the following:

1. Inspections, audits and surveillances conducted in terms of the compliance inspection programme.
2. Technical assessments conducted on submissions by the licence holder, mainly for modifications.
3. Reports submitted by the licence holder in terms of licence compliance.
4. The licence holder safety indicators (performance and safety indicators).
5. Periodic reviews or other proactive assessments conducted by the NNR (including international experience feedback).

The NNR inspector responsible for a finding arising from any of the above processes performs a provisional classification of the finding. A qualitative process is used as a first level of screening in all cases. This may be complemented by a quantitative PRA analysis if it is believed that a finding challenges the validity of assumptions or data used in the safety case.

The findings, along with their provisional classifications, are discussed at project meetings, attended by inspection and technical staff, generally held on a weekly basis, or on an ad hoc basis should the severity of the finding demand an earlier response. A final classification is then established.

Depending on the level of concern follow-up actions are initiated between Eskom and the NNR within timescales and level of seniority within the organizations (from operational to Executive management level).

(iii) NNR compliance assurance safety Indicators

As indicated above a safety indicator system is used by the NNR to record and grade findings arising from the compliance assurance programme, inspections and assessment activities. The regulatory concerns are ranked according to a colour-coded system in terms of their severity –

- red being unacceptable;
- orange being tolerably high;
- yellow being tolerably medium;
- blue being tolerably low and
- green being below regulatory concern.

The main findings (medium and above medium severity) of the NNR Compliance Assurance programme can be summarised as follow:

- Plant configuration control (classified as high and later downgraded to medium)

The licence holder has put considerable effort into a project to improve and correct configuration control issues on the plant as a result of which there has been a significant improvement. This finding was downgraded from high to medium.

- Record keeping (medium severity)

This finding relates to inconsistencies and non-conformances within the different record keeping processes applied on plant. The licence holder was requested to strengthen and update the individual processes to comply with governing standards. The implementation of these measures is being monitored through the NNR compliance assurance activities.

- Procedure compliance (medium severity)

This finding relates to minor procedure non-compliances, mostly related to procedures of low safety significance. The licence holder has taken measures to rectify this situation and the NNR is monitoring the effectiveness of the actions taken.

14.5.3 Licensing of Control Room Reactor Operators

As indicated in Article 10 the licensing of reactor and senior reactor operators is subject to NNR approval prior to commencement of duties.

14.5.4 International Experience Feedback Analysis

International experience feedback on safety issues e.g. incidents, events, etc. is an important component of the continuing safety review of the nuclear installation and is monitored by the NNR.

The relevant safety issues are analysed for their applicability and possible impact on the safety assessment of the nuclear installation. Where necessary these issues are referred to the licence holder with a view to the implementation of appropriate corrective action. Refer to Article 19 for more details.

ARTICLE 15: RADIATION PROTECTION

Each Contracting Party shall take the appropriate steps to ensure that in all operational states the radiation exposure to the workers and the public caused by a nuclear installation shall be kept as low as reasonably achievable and that no individual shall be exposed to radiation doses which exceed prescribed national dose limits.

Summary of changes:

- Section 15.2.1.2 has been updated to reflect the dose constraint and dose limit for members of the public.
- Section 15.2.1.3 has been updated with the Second Periodic Safety Reasssement (SRA-II) objective
- Section 15.2.1.4.2 has been updated to reflect a modification implemented to reduce the volumes of solid radioactive waste.
- Section 15.2.2 has been updated to include the Electronic Personal Dosimeter (EPD) Modification.
- Section 15.2.2.1 has been updated to include new developments to optimize occupational exposures.
- Section 15.2.3 has been updated to include the latest developments with regard to the Habitation Study around Koeberg.
- Section 15.3 has been updated to reflect developments in regulatory control and oversight, also specifically with respect to independent NNR inspections and new NNR Single Point Contact (SPC) meeting discussions
- Section 15.3.2 has been updated to reflect the status of the Design Basis Assesment (DBA) project.
- Section 15.4 has been updated to include recent occupational doses, public doses, activities released and direct exposure statistics as a result of the licensee's operations

15.1 SUMMARY OF LEGAL REQUIREMENTS

The Regulations R388 on Safety Standards and Regulatory Practices (SSRP) contain specific requirements for all radiological protection aspects including compliance to radiation dose limits. The regulations ensure that criteria are in place for all radiation protection oversight and authorisation activities. In Section 4.5 of the regulations, requirements and criteria are in place for all radiation protection oversight and authorisation activities

Section 4.6 of the SSRP requires that a radioactive waste management programme be established, implemented and maintained.

These requirements of the SSRP are implemented through the conditions of the Koeberg nuclear installation licence.

15.1.1 Dose Limits

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

The dose limits applicable to the Koeberg Nuclear Power Station prescribed by the NNR are applicable to both members of the public and the occupationally exposed population. These limits are referenced in Appendix 2 of the SSRP, the conditions of the Koeberg nuclear installation licence in the Koeberg Licensing Basis Manual, the NNR regulatory requirements document, the licence holder radiological standards and are summarised below:

1. **The occupational exposure of any worker** arising from normal operation shall be so controlled that the following dose limits are not exceeded:
   (i) an (average) effective dose of 20 mSv per year averaged over five consecutive years;
   (ii) a (maximum) effective dose of 50 mSv in any single year;
   (iii) an equivalent dose to the lens of the eye of 150 mSv in a year; and
   (iv) an equivalent dose to the extremities (hands and feet) or the skin of 500 mSv in a year.

(v) Furthermore the SSRP specifies dose limits for apprentices and students, women, for emergency workers and for visitors and non-occupationally exposed workers at sites.

2. Public exposure

The annual effective dose limit for members of the public from all authorised actions is 1 mSv.

For the Koeberg Nuclear Power Station the dose constraint, applicable to the average member of the critical group with the exposed population, is 0.25 mSv per year.

In achieving the radiation protection objectives, it is necessary to evaluate the facets of radiation protection design against the dose limits, and then establish complementary operational programmes which are sufficiently comprehensive to ensure compliance with those limits. These are augmented by operational verification programmes on aspects relating to radiation protection in design in order to ensure that the parameters of the safety assessment remain current and to aid in ensuring that the operational programmes are not compromised. The Koeberg licensing basis manual (discussed in Article 9) makes reference to the principles upon which these verification programmes and facets of the operational radiation protection programme are established. All of these principles are embodied in the conditions of the nuclear installation licence and the licence holder's licensing basis manual as well as corporate standards on Radiological Protection.

15.2 FULFILLMENT OF CONDITIONS FOR RADIOACTIVE MATERIALS RELEASE

15.2.1 Radiological Effluents

15.2.1.1 Establishment of Annual Authorized Discharge Quantities (AADQs)

Section 4.5.3 of the SSRP specifies that the NNR may, for the purposes of controlling radioactive discharges from a single authorised action, determine a source-specific AADQs in the nuclear authorisation, which must take into account the dose constraint which for Koeberg nuclear power station is 0.25 mSv per year applicable to the average member of the critical group with the exposed population.

The establishment and the bases of the AADQ system to control effluent discharges and as such, ensure public dose compliance, has been addressed in previous CNS Reports. The status quo in this regard is the same, and experience in this regard is well monitored by the Regulator. This relates to both design and operation.

15.2.1.2 Operational control over discharges

In the operational phase of the radiological effluent management programme, controls on the release of radioactivity in liquids and gases are such as to ensure compliance with the AADQ's for individual radionuclides and therefore, compliance with the dose limit for members of the public.

The discharge pathways from the nuclear installation can be classified as either batch or continuous. All analytical and on-line monitoring equipment is subject to an approved schedule of periodic testing in order to ensure sufficient accuracy and sensitivity. Requirements pertaining to on-line monitoring and analytical equipment are documented in the licence holder Operational Technical Specification (OTS).

15.2.1.3 Control over installation and environmental parameters of influence to the AADQ's

The AADQ's for the Koeberg plant have been updated with the current operational safety assessment assuming a defined plant configuration and suitably conservative operating parameters. In addition, certain assumptions regarding environmental parameters have been made to establish the nature of the critical group. This latter issue is addressed under the section on environmental surveillance.

In order for the AADQ's to remain valid, the nuclear installation must not operate outside of the envelope established by the operational safety assessment.

In this regard, the operational safety assessment is linked to the activity migration model, and for any change to the plant configuration, the impact on the model should be assessed.

As mentioned previously in this Report, the Second Periodic Safety Reassessment (SRA-II) Project will make provision for the validation of the Plant parameters assumptions in the AADQ Model which will be based on Plant operational experience and feedback. The AADQ Model would be updated accordingly in due course.

15.2.1.4 Radioactive Wastes

15.2.1.4.1 Establishment of annual waste produced

In terms of the SSRP radioactive wastes "*means any material, whatever its physical form, remaining from an action requiring a nuclear installation licence, nuclear vessel licence or certificate of registration and for which no further use is foreseen, and that contains or is contaminated with radioactive material and does not comply with the requirements for clearance in 2.5"* of the SSRP. The safety assessment regarding the production of radioactive wastes is complementary to that of radioactive effluents. The quantities of radioactive waste produced annually by the nuclear installation are estimated but these do not constitute limits. The nuclear installation license requirements stipulated by the NNR refer to the operational radioactive waste management programme which is discussed below. This approach is consistent with that defined in the IAEA Basic Safety Standards for "Protection against ionising Radiation and for the Safety of Radiation Sources".

15.2.1.4.2 Operational control over radioactive wastes

Operational control over radioactive wastes is exercised through the radioactive waste management programme as required by the SSRP and the conditions of the Koeberg nuclear installation licence. In line with the principle of the National Radioactive Waste Management Policy and Strategy, this programme allows for the identification of all sources of waste, the minimisation and optimization of waste production, collection, handling, treatment, conditioning, quantification, storage, and transport.

Eskom has implemented a modification to by-pass the evaporators in the liquid waste system and to increase the filtration efficiency via application of a demineraliser. This modification has resulted in reductions in the volume of solid waste produced. This practice is in line with current international trends to minimize waste volumes.

15.2.1.4.3 Quantification of radioactivity in produced wastes

The methods of quantification of the radioactive inventory associated with wastes vary according to the waste type. For process wastes comprising spent filters, and spent resins, the beta/gamma emitting radionuclide inventory is determined in the drum by measurement of dose rate and assignment of radionuclide-specific inventory by use of proportionality constants. These constants are derived from measurements of primary coolant activity for a certain period and can only be applied to wastes produced during that period. For concentrates, a sample is taken and analyzed for source term specification by gamma spectrometry. The assignment of non-beta/gamma emitting activity is performed using generic scaling factors. The licence holder has adopted the French EdF accredited scaling factors. This has been reported in previous CNS reports and the status quo still remains.

15.2.1.4 Clearance from regulatory control

Section 2.4 of the SSRP specifies that radioactive materials which fall within a Nuclear Installation Licence, Nuclear Vessel Licence or Certificate of Registration may be cleared from further compliance with the requirements of the nuclear authorisation provided that such materials meet the considerations for exemption as detailed in section 2.2 of the SSRP or that approval has been given by the NNR on a case-by-case consideration.

The licence holder generates annually small quantities of low-level volumetric contaminated waste such as contaminated oil, contaminated concrete, contaminated sewage sludge and slightly contaminated equipment. For the disposal of the slightly volumetric contaminated material, the licence holder is required to comply with not on only international standards but also with those of the SSRP indicated above.

For the licence holder, the materials not unconditionally cleared are stored on-site. A portable Multi Channel Analyser monitor/instrument has been procured for measurements/analysis to clear volumetric contaminated material from regulatory control. The sensitivity of the instrument is such that activity concentrations of contaminated material can be measured with activity concentration of less than 0.2 Bq/g which is lower than the national limit for exclusion of artificial radionuclides. The licence holder has completed further clearance assessments pertaining to volumetric contaminated equipment and materials for regulatory approval.

15.2.2 As Low As Reasonably Achievable (ALARA) Steps Taken

The SSRP requires that the magnitude of doses to individuals, the number of people exposed and the likelihood of incurring exposures must be kept as low as reasonably achievable, economic and social factors being taken into account (ALARA).

15.2.2.1 Occupational Exposure

In terms of ALARA, the NNR requires the implementation of an effective operational radiation protection programme of which the ALARA programme forms an integral part. Although all parts of the operational radiation protection programme are important, the ALARA programme is singled out for attention because it provides a systematic method for the optimisation of protection, and provides for the formalised system of feedback. The most critical features of the ALARA programme are as follows:

- The integration of the ALARA check-point into the normal system of operational radiation protection
- A tiered approach to pre-task review based on the anticipated collective dose
- The integration of dose reduction methods and practices recommended as a result of the pre-task ALARA review into the normal system of operational radiation protection
- The feedback of the effectiveness of the dose-reduction practices into a database for future use.

All tasks to be performed inside the controlled zone are subject to review by the ALARA process to ensure radiological review at the required level.

Operational practices which have been implemented at the nuclear installations to reduce occupational exposure ALARA are as follows:

(1) Operation at reduced temperature (ORT) (discussed in Article 14) where operation at high pH reduces corrosion and therefore the formation of activated corrosion product radionuclides in the primary circuit.

(2) Primary circuit oxygenation which is performed at hot shutdown conditions prior to refueling with the purpose of bringing insoluble nuclides, which are plated out on surfaces of the primary circuit internals, into solution.

(3) Reactor cavity decontamination which reduces the potential for exposure due to re-suspension by ventilation air currents causing an internal contamination hazard

(4) Reactor building contamination control during outage which involves dezoning of the reactor building prior to outage work, confining the contamination to point-of-origin using the “step-off pad principle" and an appropriate dress-out policy.

(5) Nuclear auxiliary building/fuel building contamination control which includes an aggressive decontamination policy coupled to a “valve-tracking” programme which identifies leaking valves, implements corrective action, and tracks the effectiveness of the corrective action. The floor surface contamination areas of the Nuclear Auxiliary

Building (NAB) and Reactor Building have been reduced from 13% to 1%. This is as a result of major attempts of reducing leaks in the plant.

(6) Zinc (Zn) injection where Koeberg is investigating the practice of injecting Zn into the primary circuit to alleviate/displace ^{60}Co contamination in the primary circuit materials. Although an apparent positive impact on occupational dose and ALARA could be evident in the medium or long term, the impact of Zn injection on fuel is being investigated which includes fuel clad failure possibly affecting the source term in the primary circuit.

(7) Hot spots management in the plant where a serious hot spot reduction programme has been adopted by all Koeberg Departments. This entails recognizing various methods i.e. flushing, cutting, shielding and their consequences and means of improvements.

(8) Training where a full radiation worker training simulator has been established at the training center at Koeberg which entails full practical training requirements for radiation workers encompassing step-off pads, waste handling, instruments, access control, dosimetry, etc.

(9) Dose management is integrated into the work management programme and performance management system at Koeberg. Line groups and departments have responsibilities and ownership to management dose personnel in accordance with weekly, monthly and annual dose targets. The RADPRO computer access-control system was upgraded to complement dose management.

(10) Replacement of the Whole Body Counter which was necessary due to the change of obsolete components for newer ones. This upgrade will ensure that more accurate measurements are done, based on the latest international references.

(11) The radiation protection access control software and electronic dosimeters were replaced to allow for self-access into radiological controlled zones for general duties. This modification provides better dose management capabilities, dose statistics and dose estimation tools are readily available to line groups via the intranet dose management website. The access control system is linked to turnstile gates

which allows for personnel access into radiological controlled zones after confirmation that the Electronic Personal Dosimeters (EPD's) are fully functional. The EPD system is also linked to the portal contamination monitors at the exit areas to radiological controlled zones. Personnel dose and contamination information is automatically recorded upon exit from radiological controlled zones and downloaded into the RADPRO system.

15.2.2.2 Public Exposure

As mentioned in the previous CNS Report, it was deemed appropriate to revisit both the off-site consequence modeling to establish dose conversion factors (Sv to a member of the critical group per 1 Bq discharged to air and water) for each transport pathway and for each radionuclide discharged, and to review the adequacy of the activity migration model (AADQ) from which the annual radiological effluent discharges were computed.

In terms of ALARA for public doses, the NNR required that ALARA targets for normal operation be implemented. Historical information was consulted in this regard and ALARA public dose targets were established as annually 10 μSv for one outage and 15μSv for two outages. These are formalized in the licence holder procedures. In accordance with Table 15.4-2, it is evident that the annual projected Public Doses are well below the mentioned ALARA Targets.

15.2.3 Environmental Surveillance

Section 4.7 of the SSRP requires that an appropriate environmental monitoring and surveillance programme must be established, implemented and maintained to verify that the storage, disposal or effluent discharge of radioactive waste complies with the conditions of the nuclear authorisation.

The environmental surveillance programme established at the nuclear installation is complementary to the radiological effluent management programme. The annual authorized discharge quantities which have been established within the framework of the latter provide an envelope for operational discharges such that the dose limit to members of the public is respected.

The operational environmental surveillance programme provides for the monitoring of any long-term trends in environmental radioactivity, as a result of normal reactor operation, and specific increases in radioactivity which may be caused by unplanned releases. While the former aspect addresses the possibility of discerning any undesirable trends in environmental radioactivity levels at an early stage, the latter deals with the means for observing changes caused by unplanned releases. Accordingly, a conservative philosophy was followed in the selection of samples. Sampling sites, as well as the frequency of sampling/reporting levels for all relevant radionuclides, have been set for all media which may form part of the pathways through which the population may be exposed as a result of operation of the nuclear installation.

As mentioned in the previous CNS Report, the licence holder conducted a first step habitation study in the vicinity around the plant to update current eating habits and pathways of exposure and environmental source term. This would result in an updated and more accurate public dose assessment in future. This radiological habit survey was performed by a local university in the vicinity of Koeberg Nuclear Power Station. Information and data were obtained from members of the public relating to their eating and recreational habits which may result in potential exposure. Recent radiological environmental-surveillance data and radiological monitoring data were combined with the radiological habit survey data taking the aquatic, terrestrial, direct radiation and combined pathways into account in order to review potential dose to members of the public. A radiological habit survey report was sent to the NNR for review and recommendations on its application are being implemented.

15.3 REGULATORY CONTROL ACTIVITIES

The overall regulatory requirements, safety standards and regulatory practices applicable to the operation of the Koeberg Nuclear Power Station have been extensively discussed in previous Articles.

Regulatory control related to radiation protection is achieved through the conditions of the nuclear installation licence which constrain the licence holder to operate according to defined protocols, processes and procedures. Operational feedback is obtained by the requirement on the nuclear installation to submit periodic reports in an agreed format on all aspects relating to radiation protection, as well as through problem notification follow up and the NNR compliance assurance inspections programmes including the safety indicator system (refer Article 14).

Additionally, Single Process Contact (SPC) meetings with the licence holder are scheduled on a quarterly basis and also through counterpart interfaces (frequently) at which operational problems and the effectiveness of the operational programmes are discussed.

The NNR ensures that licence holder Radiation Protection staff is involved in the planning stages of modifications and that competent persons have reviewed changes to Radiation Protection standards, modifications and procedures. All changes to Radiation Protection standards are reviewed by the regulator.

The regulatory body participates in the licence holder scheduled quality assurance audits each year. In addition, the regulatory body also implements a series of audits and inspections in accordance with an established programme. Together, these feedback mechanisms provide sufficient information for the regulatory body to focus future assurance activities on particular areas. The NNR performs independent inspections on the Koeberg Radiation protection Programme. In addition, audits, inspections and licence holder's reports for compliance serve as input to the NNR Safety Indicators to provide a measure of the extent to which the safety goals are achieved.

Issues under discussion at Single Process Contact (SPC) level, include modifications to reduce occupational doses, changes to the radiological protection computer software and hardware, operational AADQ targets for public exposure, minimisation of solid radioactive waste, results of methodology of design basis accident consequence calculations, activity assessment methodology, the review and finalisation of the revised documentation framework, habitation study, and the update of the Activity Migration Model.

15.3.1 Process based licensing for Radiation Protection

As reported in Article 9 the process based licensing process framework would require that more emphasis be placed on the licence holder to ensure that processes are in place to comply with regulatory requirements, as well as to lessen the regulatory burden in terms of minor changes and administrative changes to licence holder documents.

The radiological aspects in the licensing basis manual has undergone a number of reviews, and the NNR has ensured that significant radiological protection changes are captured and submitted to the regulator. This applies to the licence holder radiological standards, projects and modifications where the licence holder has to ensure that radiation protection staff is involved from the planning stage. Provisions have been made in the licence holder documentation to follow the correct process for interfacing with the regulatory authority and also the required review of the authorization process.

Lower level procedures are now reflecting the requirements that were deemed inappropriate for the corporate licence holder radiation protection standards. The licence holder has to ensure that qualified and competent personnel are responsible for effecting changes to lower level documentation, and that an appropriate review and approval process is in place. The NNR verifies this through audits and inspections pertaining to the technical areas.

15.3.2 Design Basis Accident consequence calculations

In terms of the evaluation of the radiological consequences of design basis accidents using an off-site consequence code to assess the maximum dose to an individual located downwind of the unit at the site boundary, a framework document was reviewed by the NNR followed by independent verification of the results of calculations performed by the licence holder.

Following the review of the results during Phase 1 of the Project (cloud-shine and inhalation only), technical meetings were held between the NNR and the Licence Holder to discuss the significant deviation between the doses in the current SAR and the modelled dose results using the PC Cosyma Computer Code deterministically. The reasons for the differences have been identified and it has been concluded that the current SAR methodology is much more conservative. The outcome from Phase 1 is that PC Cosyma may be used for further DBA Consequence analyses to cater for all other pathways including ingestion. This will be pursued during the Phases 2 & 3 of the DBA Consequence Project.

15.4. Protection of the Worker and Public Assured

15.4.1 Occupational Exposure

15.4.1.1 Control of Occupational Exposure

Effective control of occupational exposure requires compliance with the dose limits together with a system that ensures that all exposures are kept ALARA.

Table 15.4-1 provides information on the occupational doses received at the plant. Trends in recent collective doses may be attributed to the increased work scope, completion of high volume material inspection programme as part of the 10 year In-Service Inspection Programme, implementation of modifications, rework on active components due to procedure non-compliance and component replacements and additional maintenance due to plant ageing.

The reductions in the average annual dose to the occupationally exposed workers over the past three years are mainly due to integration of dose management into the work management programme and performance management system at Koeberg. Line groups and departments are successfully managing personnel dose in accordance with weekly, monthly and annual dose targets. The dose targets are derived in consultation with Line groups and departments and daily dose reviews are performed by the ALARA group at Koeberg.

Table 15.4-1
Summary of Koeberg occupational exposure data from 2002 to 2009

Year	No of Individual exceeding 20mSv	Annual Collective Dose man-mSv	Average annual Dose to the occupationally exposed worker mSv
2002	0	1585.39	0.750
2003	0	2044.3	0.998
2004	0	860.69	0.471
2005	0	2260.4	0.908
2006	0	1595.5	0.658

2007	0	1471.736	0.5906
2008	0	1498.641	0.5863
2009	0	1482.094	0.5244

15.4.1.2 Compliance with the ALARA objective

The numerical indicator selected against which the effectiveness of the ALARA programme is evaluated is the average annual dose to the occupationally exposed workers. The numerical objective is that the average annual dose to the occupationally exposed workers does not exceed 4 mSv. Table 15.4-1 provides data for the variation of this quantity from 2002 to 2009.

Experience with occupational exposure at the nuclear installation indicates that approximately 70 % of the annual collective dose is accrued during outages. It is at this time that the system of operational dose control is under the greatest pressure. The nuclear installation nevertheless performs well, in keeping collective dose for outages reasonably low.

15.4.2 Public Exposure

15.4.2.1 Control of Public Exposure

Public exposure is deduced from the product of the radionuclide-specific annual discharges in liquid and gaseous effluent and the radionuclide-specific dose conversion factor for each pathway. Such modeling is applicable to a member of the critical group, and as such, provides a suitably conservative measure of possible public exposure. The variation in the public dose by year is provided in Table 15.4-2.

Table 15.4-2

Summary of annual public projected doses due to Koeberg operational discharges from 2002 to 2009

Year	Gas (□Sv)	Liquid (□Sv)	Total (□Sv)
2002	0.190	0.34	0.53
2003	0.339	11.874	12.213
2004	1.062	7.6640	8.726
2005	0.484	5.5025	5.9869
2006	0.413	3.6006	4.013
2007	0.939	3.0443	3.983
2008	0.4687	3.8029	4.272
2009	0.2618	4.73684	4.998

It is evident that the annual projected dose arising from effluent discharges from the plant during 2003 was 4.8% of the NNR dose limit compared to less than 1% for previous years. The reason for the increase in projected dose compared to the previous year(s) can be attributed to a more accurate and realistic method of modeling doses to the public during normal operations. The revised system is based on the latest international guidelines in modeling releases from first principles.

The variation in the total activity discharged by pathway in each year from 2002 to 2009 is detailed in Table 15.4-3.

Table 15.4-3

Total activity discharged from Koeberg by year [GBq]

Year	Activity in Gaseous discharges	Activity in Liquid discharges	Total Activity discharges
2002	9.81 E+04	2.69 E+04	1.25 E+05
2003	2.63 E+04	2.08 E+04	4.71 E+04
2004	1.01 E+05	2.12 E+04	1.22 E+05
2005	2.81 E+04	1.96 E+04	4.77 E+04
2006	2.26 E+04	1.34 E+04	3.60 E+04
2007	4.79 E+04	3.28 E +04	8.08 E+04
2008	3.00 E+04	3.43 E+04	6.44 E+04
2009	1.65 E+04	2.29 E+04	3.93 E+04

Experience of discharges from operation to date indicates that the largest contribution to public dose from discharges for both liquids and gases arises from tritium.

From results obtained from the environmental surveillance programme, activity has been detected in lobster, abalone, white and black mussels. The radionuclides detected include ^{54}Mn, ^{58}Co, ^{60}Co and ^{110m}Ag. The activity concentration is dominated by ^{110m} Ag.

In terms of direct radiation, Table 15.4-4 shows representative average measurements of monthly external exposure at the site boundary by year from 2002 to 2009. The data reflects the total external dose recorded at the site boundary, primarily from natural environmental sources, e.g. the thorium and uranium decay series, environmental ^{40}K, and cosmic radiation, as well as any external contribution due to the nuclear installation. However, trend analysis has not revealed any significant changes in the dose rate at any location since the start of operation. Effluent modeling confirms a relatively insignificant external contribution from the plant.

Table 15.4-4

Average monthly TLD exposure measurements at site boundary

Year	Average Exposure(☐Sv)
2002	25.0
2003	26.9
2004	24 (33.5[a])
2005	23.8 (34[a])
2006	23.2 (33.7[a])
2007	22.8
2008	25.9
2009	25.7

Foot Note [a]: These values were incorrectly stated in the previous CNS Report. The TLDs with the highest recorded readings were previously included in Table 15.4-4 instead of averages over a year.

Sewage sludge from a sewage plant in the vicinity of the nuclear installation proved to be a very sensitive indicator of the presence of radioactivity in the environment. Owing to the physical and chemical characteristics of the sludge, radioisotopes are efficiently scavenged from the liquid phase during sewage treatment. Small amounts of ^{54}Mn, ^{60}Co and ^{110m}Ag are usually detected in the sludge. Possible mechanisms include transfer of low levels of activity through the controlled zone boundary on personnel clothing, and the fallout of activity discharged via the gaseous pathway. In spite of considerable effort, these pathways could not be identified unequivocally. Above-normal quantities of ^{131}I have been found on a number of occasions in the sludge. Although this nuclide can also originate from operations at the nuclear installation, it was concluded that the iodine was excreted by patients undergoing nuclear medical treatment, who were resident in the area served by the sewage plant.

In order to validate this conclusion, the NNR has required the licence holder to perform an investigation using data from hospitals in the vicinity to establish whether the assumed link exists. As the hospitals are authorised under the Hazardous Substances Act, the gathering of relevant data is being pursued under the cooperative agreement between the NNR and the Department of Health: Radiation Control Directorate.

ARTICLE 16: EMERGENCY PREPAREDNESS

1. Each Contracting Party shall take the appropriate steps to ensure that there are on-site and off-site emergency plans that are routinely tested for nuclear installations and cover the activities to be carried out in the event of an emergency. For any new nuclear installation, such plans shall be prepared and tested before it commences operation above a low power level agreed by the NNR.

2. Each Contracting Party shall take the appropriate steps to ensure that, insofar as they are likely to be affected by a radiological emergency, its own population and the competent authorities of the States in the vicinity of the nuclear installation are provided with appropriate information for emergency planning and response.

3. Contracting Parties which do not have a nuclear installation on their territory, insofar as they are likely to be affected in the event of a radiological emergency at a nuclear installation in the vicinity, shall take the appropriate steps for the preparation and testing of emergency plans for their territory that cover the activities to be carried out in the event of such an emergency.

Summary of changes

- An update was done throughout the document to reflect changes in name of the National Department responsible for nuclear energy, i.e. from Department of Minerals and Energy to Department of Energy.
- The information in section 16.1 was updated to reflect the development and updating of the regulations applicable to emergency preparedness and response as well as an authorization of a new Memorandum of Agreement.
- The arrangement between the NNR and off-site authorities in terms of the provision of advice in determining off-site protective actions was included in section 16.2

- Section 16.3.2 was updated in line with additional information on regulatory oversight for emergency preparedness and response.
- The second Koeberg Periodic Safety Re-Assessment (SRA-II) relating to emergency preparedness and response was included in section 16.3.3.
- The status of the late phase aspects and adoption of operational intervention levels was included in section 16.5.3.3
- Information on the update of the traffic model was included in section 16.5.3.4
- Section 16.5.4 contains the status of the licensee and off-site emergency control centres and improvements in emergency communications between the various emergency control centres.
- In section 16.7.2 the alignment of the Koeberg training programme with Systematic Approach to Training was included
- Section 16.7.2.1 reflects the regulatory emergency exercise that was conducted in 2008
- In section 16.7.2.2 information on the licensee emergency exercises was included
- The suspension of one of the emergency preparedness and response liaison forums was included in section 16.8
- Section 16.10 was added to reflect the regulatory internal arrangements for emergency preparedness and response

16.1 LEGISLATIVE PROVISION FOR ACCIDENTS – REQUIREMENTS FOR ON- AND OFF-SITE EMERGENCY PREPAREDNESS AND RESPONSE

The NNR Act and the regulations R388 on the SSRP specify the requirements on emergency planning to ensure effective preparedness and response to deal with nuclear accidents.

The NNR Act requires that, where the possibility exists that a nuclear accident affecting the public may occur, the NNR must direct the relevant holder of a nuclear installation licence to enter into an agreement with the relevant municipalities and provincial authorities to establish an emergency plan and cover the cost for the establishment, implementation and management of such emergency plan, insofar, as it relates to the relevant nuclear installation. Such emergency plan must be submitted by the holder of the nuclear installation licence for approval by the NNR.

The NNR must ensure that such emergency plan is effective for the protection of persons should a nuclear accident occur. The emergency plan includes a description of facilities, training and exercising arrangements, communication with off-site authorities, command and control as well as relevant international organizations and emergency preparedness provisions.

Furthermore, the Minister of Energy may, on recommendation of the NNR's board of directors and in consultation with the relevant municipalities, make regulations on the development surrounding any nuclear installation to ensure the effective implementation of any applicable emergency plan. When a nuclear accident occurs, the holder of a nuclear authorization in question must implement the emergency plan as approved by the NNR.

In terms of the decision-making arrangements regarding a nuclear accident, the authority to implement on-site protective actions rests with the nuclear installation emergency controller. In terms of the Disaster Management Act, the off-site authorities are required to verify and implement off-site protective actions as recommended by the authorization holder in the event of a nuclear accident according to the procedures laid down in the emergency plan.

The affected authorities at national, provincial and local level have nuclear emergency response plans in place that are exercised on a regular basis as part of the Koeberg exercises. In terms of section 38(1) of the NNR Act, the licence holder has to enter into agreement with the relevant municipalities and provincial authorities to establish an emergency plan. A new Memorandum of

Agreement between the three parties was signed in 2004 which specifies provisions for responsibilities, cooperation, inventories of resources and financial arrangements.

16.2 IMPLEMENTATION OF MEASURES INCLUDING THE ROLE OF THE REGULATORY BODY AND OTHERS

The parties involved with emergency planning are primarily the nuclear installation, the local authorities within the region, the provincial authorities, the national government and the NNR.

The role of the nuclear installation is that of accident recognition and quantification, reporting to the NNR and to any other person described in that nuclear authorization, projection of off-site consequences, assessment of off-site impact, determination of necessary protective measures and recommendation to off-site local authorities to implement such protective measures. In accordance with the relevant conditions of the Memorandum of Agreement between the three parties, the license holder has to provide the necessary facilities, equipment, response teams, training and exercising which relate to nuclear accidents.

In terms of the Disaster Management Act the local authorities are then required to mobilise their civil protection capabilities, to implement protective measures as recommended. The provincial and national governments are required to provide co-ordinated support and direction as necessary. Similarly, the relevant local and provincial authorities have established the necessary resources including emergency control centre capabilities commensurate with their required roles, compatible communication facilities, appropriate monitoring instrumentation and procedures for contamination control at isolation points and mass-care centres and training and exercising programmes. Each national organ of state indicated in the national disaster management framework must prepare a disaster management plan, co-ordinate and align the implementation of its plan with those of other organs of state and other institutional role-players and regularly review and update its plan.

When a nuclear accident is reported to the NNR, the NNR is required by the NNR Act to immediately investigate the accident and its causes, circumstances and effects; define particulars of the period during which and the area within which the risk of nuclear damage connected with the accident exceeds the safety standards as determined in the SSRP; direct the holder of the nuclear authorization in question to obtain the names, addresses and identification numbers of all persons who were within that area during that period.

Accordingly the NNR must keep a record of the names of all persons who, according to its information, were within that area during that period.

In addition, the NNR is required to exercise its regulatory responsibility of monitoring the response of parties concerned and of requiring corrective action in the event of inadequate or inappropriate response. In terms of fulfilling its regulatory responsibilities proactively, the NNR also provides a forum for liaison and communication between the parties concerned with emergency planning in order to ensure that the concerns of any party, in respect of the overall provision of emergency planning and preparedness, are addressed.

During a nuclear accident that affects the public a general emergency is declared. The facility emergency controller normally recommends the type of protective actions that are aimed at protecting members of the public. The Local Authority Disaster Operations Centre (DOC) is tasked with the implementation of recommended protective actions. The main decision makers in the DOC are comprised of representatives from the Local Authority, the Provincial Authority and National Government under the Department of Energy forming the Disaster Coordination Team. A procedure has been developed that details the communication, activation and operation of the Disaster Coordination Team (DCT).

In case technical advice or support is needed by the local authorities, the DCT could refer the recommended protective actions to the NNR for advice. The NNR would then perform technical verification and assessments using the necessary input and information as provided by the local authority or authorization holder which could inform the final decision making for off-site protective actions.

16.3 REVIEW OF KOEBERG EMERGENCY PLANNING

16.3.1 Overall national emergency preparedness

Although the aim of regulatory requirements is to ensure that the formal emergency planning arrangements of the licence holder and local authority would be able to cope with the early and intermediate phases of a major nuclear accident, it is recognised that a national disaster management organisation would be required to cope with the late phase owing to the need for multiparty/multidisciplinary co-ordination of protective and recovery measures at national level. In the case of a major nuclear accident requiring national response, the relevant Minister would declare a national state of disaster as provided for in the Disaster Management Act.

In terms of the Disaster Management Act the National Government Department of Energy (DoE) is the "National Organ of State" for coordination and management of matters related to nuclear disaster management at national level. As per Section 25 of the Disaster Management Act, each national organ of state indicated in the national disaster management framework must prepare a disaster management plan setting out the concept and principles of disaster management. The DoE plan was finalized and approved on 5 October 2005. In terms of the integrated Koeberg nuclear emergency plan, the DoE will deploy staff to the national and local disaster management centers.

16.3.2 Regulatory Control

(i) As indicated above in section 16.1, the NNR Act and the regulations R388 on the SSRP specify the requirements on emergency planning to ensure the preparedness and response to nuclear accidents.

The implementation of these requirements is carried out through a condition of the Koeberg nuclear installation licence in a regulatory Requirement Document RD-0014 "Emergency preparedness and Response at nuclear installations. The requirements in this document are based on IAEA GS-R-2 "Preparedness and Response for a nuclear or radiological emergency" and the licence holder is required to comply and demonstrate compliance to the requirements of this document. Compliance to NNR requirements is verified through reviews and audits by the NNR.

(ii) As reported in section 7.3, Regulations are in the process of being published on monitoring and control of developments in the vicinity of Koeberg Nuclear Power Station to ensure the effective implementation of the emergency plan. These regulations include the specific requirements applicable to the vicinity of Koeberg and will replace the regulations published in March 2004, which were generic and applicable to all nuclear installations.

(iii) In accordance with the NNRA, the NNR has conducted its own emergency exercise in 2008 at the utility to ensure that the emergency plan is effective. As part of the evaluation of the findings and observations, a significance determination system was implemented to classify the inadequacies that were identified during the emergency exercise. The exercise inadequacies were captured into a formal report and sent to Eskom for implementation of corrective actions. The NNR has through its compliance assurance activities ensured that all exercise inadequacies were appropriately addressed by Eskom and the Intervening Organisations.

(iv) Continuous review of the integrated Koeberg nuclear emergency plan has been performed by the NNR.

(v) The NNR has put arrangements in place to meet the requirements of the NNR Act on its role and involvement during a nuclear accident.

(vi) As reported in section 7.2, in anticipation of applications for new nuclear sites, regulations on siting of new nuclear installations were published in July 2009 for stakeholders comment.

16.3.3 Safety Assessment

As reported in previous sections, in 2008 Eskom initiated the second Periodic Safety Re-Assessment II (SRA II) of the Koeberg Nuclear Power station (KNPS). The re-assessment for Emergency Preparedness and Response was a high level evaluation of the viability of the licensee's Emergency Plan against the legislative and regulatory requirements. The conclusion was that the Koeberg Nuclear Emergency plan was deemed adequate and viable to deal with potential nuclear emergencies.

The basis for the emergency planning zones, new terminology and protective actions as derived from the technical basis are included in the Koeberg Safety Analysis Report. It is also included in the licensee procedures, as well as the integrated Koeberg nuclear emergency plan. For effective implementation of the plan, action times are specified for the different protective actions such as sheltering, evacuation, environmental monitoring etc.

16.3.4 Integrated Koeberg Nuclear Emergency Plan

In terms of the requirements in the NNR Act, and the implementation of other national legislation such as the Disaster Management Act, the NNR required the licence holder to review its emergency plan and develop an integrated emergency plan. It was decided that roles and responsibilities in the agreement between the licence holder and the relevant municipal and provincial authorities with regards to an emergency plan as well as the late phase aspects currently in place in the Koeberg emergency plan should be revisited. Amongst others, the plan aims to establish an organised emergency preparedness and response system capability for timely, coordinated action of intervening organisations in the event of a nuclear accident, and to describe the capabilities, responsibilities and authorities of intervening organisations and a concept for integrating the activities in the interest of public health and safety.

16.4 CLASSIFICATION OF EMERGENCY SITUATIONS

A system of classification of emergency situations is in place at the nuclear installation based upon the severity of the event. Depending upon the severity, the actions taken are varied and could range from activation of the licence holder’s emergency control centre, to notification of the local, provincial and national governments. Emergency situations, for which the classification system caters, are defined according to the following categories:

- Unusual Event
- Alert
- Site Emergency
- General Emergency

16.4.1 Unusual Events

An abnormal occurrence which indicates an unplanned deviation from normal operations; the actual or potential consequences of which require the partial or limited activation of the emergency plan.

Releases of radioactive material requiring off-site response or monitoring would not result unless further degradation of safety systems occurred. Only notification to the NNR would be required in such a case and there would be no automatic initiation of the emergency response organisation. Systematic handling of subsequent information would then identify the need to elevate the classification to a higher level.

16.4.2 Alert

An Alert would be declared as a result of events that involve actual or potential significant degradation in the level of safety of the installation. Minor releases of radioactive material are possible during such events. However, any release that occurs is expected to result in a very small fraction of the annual dose limit for members of the public. Events which lead to situations which necessitate the declaration of a Site Alert also have the potential to develop into those requiring declaration of a Site Emergency or a General Emergency. Therefore, specific actions and notifications are necessary for the purpose of bringing emergency personnel to a state of readiness. For example, activation of the on-site emergency control centre by the licence holder's emergency response organisation, notification of the NNR and all off-site civil protection organisations would be necessary. These notifications would ensure that;

- Emergency personnel are readily available to respond if the situation warrants it,
- Personnel are available to perform confirmatory radiation monitoring if required,
- Current information can be provided to off-site agencies.

16.4.3 Site Emergency

A Site Emergency would be declared as a result of events that involve actual or likely failure of the installation's safety functions required for the protection of the public. The potential of significant releases of radioactive material exists. However, these releases are expected to pose a serious radiological hazard only within the site boundary. At and beyond the site boundary, these releases are not expected to result in the annual dose limit to members of the public being exceeded. Severe core damage has not occurred, but extensive off-site radiation monitoring and protective actions may be required. In addition, public notification through the off-site organisations may also be required.

16.4.4 General Emergency

The highest level of classification is the General Emergency, and this would be declared as a result of events which involve actual or imminent core damage with the potential for the loss of containment integrity. The release of radioactive material can be expected to result in serious radiological consequences beyond the site boundary. Extensive off-site radiation monitoring with projections of doses to the public, and the implementation of protective actions are likely to be required. All on-site and off-site agencies are activated. The public will be notified and, if necessary, the on-site emergency response organisation will recommend the implementation of protective measures for members of the public. The on-site emergency organisation will be required to provide continuous monitoring of environmental radioactivity levels and meteorology to ensure that the appropriate protective actions are recommended.

16.5 ON-AND OFF SITE PLANS AND ARRANGEMENTS

16.5.1 Identification and Activation of emergency organization

The identification of emergency situations which pose a potential or actual threat to the installation is performed from the licence holder control room where the on-shift emergency controller, normally the supervisor in charge of the operating shift, is responsible for the initiation of emergency response. This is conducted in accordance with emergency procedures and involves the notification of other members of the emergency organization to muster at the emergency control centre of the installation and at the environmental surveillance laboratory. Owing to the potential for the rapid evolution of events from Alert condition to General Emergency, mustering and activation at the emergency control centre should happen within one hour of initial notification. In addition, the notification to off-site authorities is also given at this time and mustering of their respective emergency organizations will take place concurrently.

16.5.2 On-Site Response

Management of the emergency in the early phase is performed by the on-site emergency organization at the Emergency Control Centre (ECC). The team consists of an emergency controller, supported by staff from a range of disciplines to advise on aspects such as meteorology, radiation protection, engineering, plant operation, reactor physics, and media liaison. Survey team members, to assist in providing data from the installation and the environment, are required to muster at given locations in the installation and at the environmental surveillance laboratory. Other activities amongst others by the licence holder include classification, prognosis, public notification, communication with on-site and off-site responders and organizations, participation in press releases, etc. The licence holder Emergency Control Centre directs the off-site survey teams to provide field measurement data to be taken into consideration in determining adequate protective actions.

Upon mustering at the Emergency Control Centre, the on-site emergency team organization recommends protective actions for implementation. The verification and implementation of recommended protective actions is performed by the local authorities. In the case where there is a need for urgent protective actions in the public domain, and where the local authority is not yet in a position to order such protective actions, the on-shift emergency controller should as a priority act in the interest of the public by recommending such urgent protective actions. If time permits this should be done in consultation with the standby Disaster Manager of the City of Cape Town.

A further requirement is that an Alternate Emergency Control Centre must be available for use if the plant Emergency Control Centre becomes untenable owing to the accident consequences.

16.5.3 Off-site emergency situation

16.5.3.1 Identification and Activation

The managing of an off-site nuclear emergency affecting the public is the responsibility of the Government authorities under the Disaster Management Act. The off-site emergency organizations involved are emergency organizations from the Local and Provincial Governments and the National Government.

Initial notification of an Alert or Site/General Emergency at the Koeberg Nuclear Power Station is communicated to the City of Cape Town (CoCT) Disaster Operating Center (DOC) from the on-site Emergency Control Centre. The declaration of a General Emergency as per the Licence holder procedure KAA-811 "The Integrated Koeberg Nuclear Emergency Plan" implies a threat to the public which requires the implementation of off-site protective actions by Government authorities. From the Disaster Management Centre notification of the responders from all three spheres of Government takes place. The decision-making team (Disaster Co-ordination Team) is comprised of the Head of the Disaster Management Centre, City of Cape Town and representatives from Provincial Government of the Western Cape (Disaster Management) and the National Department of Energy.

16.5.3.2 Implementation of Protective Actions

The Koeberg Nuclear Power Station Operating Shift Manager and/or the Standby Koeberg Emergency Controller recommend protective actions in accordance with a Protective Action Form to the Disaster Co-ordination Team. The Disaster Co-ordination Team participates in joint decision making, joint co-ordination and joint management of a nuclear emergency.

The joint co-ordination team recommends a declaration of a national disaster to the National Disaster Management Committee (NDMC) following the declaration of a General Emergency at Koeberg Nuclear Power Station. The Disaster Co-ordination Team may review the recommended protective actions and the technical basis thereof, against protective actions addressed and procedures approved by the NNR, followed by the implementation of protective actions as required. In principle the Head of the Disaster Management Centre (CoCT) may implement the recommendations from the Koeberg Emergency Controller in the absence of representatives from the national and provincial governments.

16.5.3.3 Late Phase Plan

As part of the continuous improvement of emergency preparedness, the "late phase" aspects of the emergency plan have been enhanced and developed further. The late phase aspects of the emergency plan typically commence several days after the accident when work commences to reduce radiation levels in the environment to permanently acceptable levels, and cover aspects such as food bans and decontamination of the environment. The late phase aspects have now been embedded in the integrated nuclear emergency plan. This includes the requirements, processes and responsibilities applicable to late phase nuclear emergency response. The aspects have been compiled in conjunction with the relevant municipalities and provincial authorities in accordance with international standards and guidelines. The integrated nuclear emergency plan is supported by a suite of operational procedures specifically for late phase, which are sufficiently detailed to identify resources, infrastructure, and actions that may be required during the late phase response. Late phase table top and exercises are conducted on a continuing basis as part of the licensee programme of emergency exercises. Improvements in the late phase aspects in the plan are also done through the regulatory emergency exercises.

Work on selected late phase aspects, namely infrastructural decontamination, which through international experience feedback was finalised and is being benchmarked with international developments. Late phase operational intervention levels have been derived based on international guidelines and a recovery document was compiled and implemented.

16.5.3.4 Review of Traffic Model

As part of the Koeberg evacuation plan and with regard to monitoring population developments around the facility up to the boundary of the UPZ, the City of Cape Town has reviewed the traffic model and submitted it to the NNR for acceptance. The traffic model was updated in line with infrastructure and population changes, as well as in line with regulatory requirements. It was independently reviewed and is currently being implemented.

16.5.4 Upgrades of Operator and Local Authority Emergency Facilities

From 2007, Eskom and the Local Authorities had embarked on projects to upgrade and improve their respective emergency response centres. Improvements in the centres include furnishing, lay-out and improved technologies. Communication and data transfer system upgrades on and off-site were also implemented. A new computerised GIS emergency planning system was developed during 2009 to improve emergency communications between the various emergency control centres. This common system of electronic data transfer constitutes an accurate and redundant means of information transfer. Final testing of the system is in progress. Previous methods such as telephones and faxes will be retained and used as a backup.

16.6 MEASURES FOR INFORMING THE PUBLIC AND AUTHORITIES

After initial notification once the licence holder Emergency Control Center (ECC) is activated, further communication is established with the City of Cape Town Disaster Management Organization.

Prior to the activation of the Emergency Control Centre the plant Shift Manager becomes the acting Emergency Controller (EC) and will operate from the High Voltage Control Room of the power station until the stand-by Emergency Controller (EC) declares that the ECC is manned. During a nuclear emergency notification, communication from the ECC takes place by means of a telephone call, which will be followed by a fax, to the off-site Disaster Management Centre. The fax will also be copied to the Regional Nuclear Emergency Manager (part of licence holder response) situated at the Joint Alternative Emergency Control Centre (AECC). The fax message includes details of the emergency situation, the classification of the emergency, the time, and the recommended protective action(s). The off-site Disaster Management Centre staff will then disseminate information to other sub-zones at regular intervals to update them on the implementation of protective actions.

Following the declaration of a General Emergency, notification of the public within 16 kms from the installation is achieved by siren tones followed by an informative and/or instructional message. Provision of this notification is achieved by:

- 2400 Watt Siren systems installed in areas close to the installation
- 100 Watt Siren units installed on farms or in farming areas situated between 5 km and 16 km
- Vehicles equipped with sirens and public address systems to cater for informal settlements
- Broadcasting of messages via local radio stations

Within the site and up to 5 kms from the site boundary, notification is required to be effected within at least 15 minutes, throughout 360 degrees. From 5 to 10 kms, notification is required to be effected within 30 minutes, through a 67.5° downwind sector. From 10 – 16 kms, notification is required to be effected within a period of 45 minutes through a 67.5° downwind sector.

The Public Warning System Upgrade Project was initiated to include a newer digital communications and telemetry system, and a number of new sirens have been added to the south-eastern sector, where the residential areas have shown substantial growth over the last few years. Some additional sirens were also added to the Protective Action Zone (PAZ) and the residential area north east from the plant as well as installed on Robben Island to cater for visitors and residents of the island. The system now comprises 51 Farm Sirens and 42 Omni Directional Sirens, and is controlled from 1 of 4 locations, namely Koeberg High Voltage Control Room, Koeberg Emergency Control Centre, the Alternative Emergency Control Centre and the Disaster Operations Centers.

A dedicated Joint Media Center (JMC) is available where representatives of Eskom and the intervening organizations meet to finalize information that will ultimately be sent to the media for informing the public about the emergency. Representatives of the media will assemble at the JMC to receive briefings on the status of the emergency based on data provided by the Emergency Control Centre at Koeberg. Briefings will be provided by the Regional Nuclear Emergency Manager assisted by the Regional Communications Officer and technical staff from the Alternate Emergency Control Centre. Press releases will finally be sent to the South African Broadcasting Corporation (SABC) for broadcasting to the public at large.

Upon the declaration of a nuclear emergency the licence holder must notify the NNR who in turn will notify the relevant Governmental structures.

In terms of the international convention on the early notification of a nuclear accident and the convention on assistance in the case of a nuclear accident, the licence holder may also notify (depending on circumstances) the International Atomic Energy Agency (IAEA) via the South African Nuclear Energy Corporation (Necsa) who is the responsible South African institution in this regard.

16.7 TRAINING/EXERCISES

16.7.1 Training

Training in emergency planning is geared to target a specific group of professionals, with a view to enhancing efficiency in responding to an emergency situation. Hence, for the purpose of maximum benefit to the emergency personnel, training courses are grouped according to the functions that must be accomplished in an emergency situation.

Under the Emergency Planning Committee (EPC), a Training Working Group (TWG) has been established to see to the needs of all intervening organisations of the Koeberg Emergency Plan. A matrix of current estimated needs has been identified for each organisation, and has been added to Koeberg emergency preparedness and response training procedures. The Training Working Group has drawn up a strategic plan, which addresses an education process for both senior off-site responders and cascading down each organisation as further training needs are identified by each line department. Each Line Department has been actioned to appoint a Training Coordinator, who will attend the TWG meetings, and will bring the needs of his department to the attention of the TWG. Emergency preparedness and response training programmes are being aligned with the Systematic Approach to Training system which is in line with international best practices Emergency Planning (EP) training recommendations.

16.7.2 Nuclear emergency exercises

As part of emergency preparedness, emergency exercises form an important component in the rehearsal of the emergency plan. The effectiveness of the emergency plan using an exercise is determined by evaluation of the performances against defined objectives. These objectives take into account the necessity to test either distinct elements of the emergency plan, or the entire emergency plan. Because the testing of the entire plan necessarily requires the participation of off-site organisations as players, each full scale exercise involves large costs and the diversion of resources. Such exercises conducted by the NNR are therefore not frequent. They are currently being held at eighteen month to two years intervals and therefore reliance has to be placed on more frequent but less extensive licence holder exercises with the objective of testing discrete parts of the emergency plan.

The assurance that the emergency plan will function coherently and according to procedures is gained through a mixture of limited scope and full scale exercises. The NNR, however, relies on the full scale exercise in order to test overall acceptability.

16.7.2.1 2008 Koeberg Emergency Exercise Summary

The NNR conducted both unannounced and announced emergency exercises at Koeberg Nuclear Power Station on 06 May and 08 May 2008 respectively.

The findings from the previous exercises, inspections findings and occurrences, together with assessment activities were used to formulate the exercise objectives. Changed procedures or processes related to emergency preparedness and response aspects that might require testing were also considered. The overall objective of the 2008 exercise was to test the response of both the on-site and off-site organizations, as well as selected late phase aspects. The exercise was conducted in two phases, the unannounced and announced exercises tested on two separate days.

Specific objectives of the exercise included testing of certain aspects of the integrated emergency plan of the nuclear installations, namely the recognition and classification of the emergency including the following aspects:

- communication and liaison between the intervening organizations;
- decision-making of the Eskom on-site shift Emergency Controller in terms of implementation of protective actions during the early stages of the scenario;
- available resources;
- notification and activation of the off-site authorities standby personnel and facilities;
- communication to transient and special population;

- joint decision-making between off site authorities;
- initiation, communication and activation of the recovery aspects;
- operation of the radiological survey team;
- coordination of emergency workers;
- availability of and communication with the Alternate Environmental Survey Laboratory;
- decision-making around and further evacuation, relocation, return from relocation, food and water ban based on technical information.

The NNR deployed a number of umpires according to expected responses at specific locations that must be evaluated. For all the on-site and off-site locations identified prior to the exercise, the NNR umpires recorded detailed observations and associated findings.

For this exercise the NNR invited observers from local and international institutions to witness and observe the activities, responses and actions of the various organizations that were involved in the exercise. The post exercise debriefing session involving umpires and observers was held on the day after the exercise where initial impressions on the responses, lessons learned and potential areas for improvements were discussed.

The NNR validated all the findings by umpires and observers and compiled an exercise report that was discussed with the licensee and intervening organizations. The NNR concluded that the overall response of Eskom and the intervening organizations has shown that the Koeberg nuclear emergency plan is viable for the protection of persons and the environment; however specific areas were identified for improvement.

The NNR implemented a significance determination process which uses specific factors and criteria where appropriate, to assist the NNR staff to determine the safety significance of exercise findings. This process aims to provide all stakeholders with a common framework for understanding and communication of the safety significance of exercise findings, and a basis for timely assessment and enforcement actions associated with an exercise finding. Following issuance of the final report, Eskom was required to ensure that appropriate corrective actions are identified and implemented to address the findings as a matter of urgency in accordance with identified timescales. All the exercise findings and observations have been closed out to the satisfaction of the NNR.

16.7.2.2 Koeberg Internal Emergency Exercises

Every year Eskom prepares a programme of drills and emergency exercises for implementation. Eskom uses these drills and exercises as self-assessment as well as part of training of emergency responders as well as re-testing previous or recurrent deficiencies. Inadequacies which are identified are corrected in accordance with an action plan. The internal emergency exercise report is submitted to the NNR as well as an update of corrective actions taken. The NNR normally attends the licensee exercises as an observer depending on aspects to be tested.

16.8 LIAISON

The following forums have been established, with the authorities and the public in the vicinity of the Koeberg Nuclear Power Station, for liaison on emergency preparedness, planning and response.

(i) Emergency Planning Steering and Oversight Committee (EPSOC)

The Emergency Planning Steering and Oversight Committee (EPSOC) provides direction, steering and oversight relating to the development and implementation of emergency preparedness and response plans for Koeberg. The committee meets on a quarterly basis. The meeting is chaired by a representative from the organ of state (Department of Energy –DoE) responsible for nuclear activities.

(ii) Emergency Planning Committee

The Emergency Planning Committee (EPC) is a working committee instituted by Koeberg and the relevant Local and Provincial Authorities to address implementation of the Koeberg Emergency Plan and which reports to the EPSOC on progress. It is chaired by a representative of the local authority and meetings are held on a quarterly basis.

(iii) Public Safety Information Forum

As indicated above in Section 9.2, the NNR Act requires that the holder of a nuclear installation licence must establish a public safety information forum to inform persons living in the municipal area, in respect of which an emergency plan has been established, on nuclear safety and radiation safety matters.

The established Koeberg Public Safety Information Forum (PSIF) meetings take place on a quarterly basis and constitute a forum where the queries of the public are addressed. The meeting is chaired by a member of the public and is attended by all major role-players involved in the integrated nuclear emergency plan and members of the general public. The NNR participates in this forum.

16.9 INTERNATIONAL ARRANGEMENTS

South Africa has signed and ratified the following International Conventions that are pertinent to emergency preparedness.

- Convention on Early Notification of a Nuclear Accident
- Convention on Assistance in the case of a Nuclear Accident or Radiological Emergency

As the Koeberg Nuclear Power Station is very far from international borders no agreements have been signed with neighbouring countries specifically on matters relating to notification in the case of a nuclear emergency or the provision of assistance in such a case.

The licence holder is a member of Enatom and, in terms of the associated early notification agreement, would inform affected States either directly or via the IAEA.

16.10 NNR EMERGENCY RESPONSE ARRANGEMENTS

16.10.1 NNR Harmonisation Framework and Policy for Emergency Preparedness and Response

The NNR oversight in regulating emergency preparedness and response has not been implemented consistently across the range of nuclear facilities and technologies. These differences include regulatory emergency exercises, liaison with holders and other stakeholders, and review periodicity. In 2007 the NNR embarked on centralizing and harmonizing emergency planning activities. A NNR Policy was finalised in 2007 and implementation is in progress. The implementation of the EP Harmonisation Framework project will be completed in March 2011.

16.10.2 French Nuclear Safety Authority (ASN) Peer Review of NNR Emergency Response Arrangements

The NNR decided to improve its emergency preparedness and response arrangements to notifications when informed about nuclear accidents. The aim of improving the emergency response is for the NNR to actively monitor the accident events and recommended protective actions that will be implemented to protect the public. This requires the establishment of the NNR Emergency Control Centre (ECC) where NNR staff will be activated to monitor the accident with a capability to support the local authorities on technical matters.

Space to accommodate the ECC was allocated and the room equipped with the basic resources to communicate with the affected facilities and the Local Authorities. Emergency Response procedures were drafted and in 2008 the NNR, through its bi-lateral agreement, made a request to the French Nuclear Safety authority (ASN) to evaluate the newly established NNR emergency response arrangements with the view to identifying gaps which would be improved. A peer review report was drafted and contained 24 recommendations that were aimed at improving the NNR emergency response. The recommendations include the ECC procedures such as activation of the NNR response personnel, environmental sampling, accident modeling codes, operation of the ECC, training in emergency planning (EP), appointment of more EP personnel, and acquisition of an independent code to model emergency events.

The NNR is currently progressing the implementation of the ASN Peer Review short and medium term recommendations. There are however, other recommendations of long-term nature that will be completed beyond 2011 and these include provision of additional resources and the upgrade of the facilities as well as legislative changes on the role of the NNR during emergency preparedness and response.

ARTICLE 17: SITING

Each Contracting Party shall take the appropriate steps to ensure that appropriate procedures are established and implemented:

(i) For evaluating all relevant site-related factors likely to affect the safety of a nuclear installation for its projected lifetime;

(ii) For evaluating the likely safety impact of a proposed nuclear installation on individuals, society and the environment;

(iii) For evaluating all relevant external man-made and natural hazards likely to affect the safety of the nuclear installation for its projected lifetime;

(iv) For re-evaluating as necessary all relevant factors referred to in sub-paragraphs (i) and (iii) so as to ensure the continued safety acceptability of the nuclear installation;

(v) For consulting Contracting Parties in the vicinity of a proposed nuclear installation, insofar as they are likely to be affected by that installation and, upon request providing the necessary information to such Contracting Parties, in order to enable them to evaluate and make their own assessment of the likely safety impact on their own territory of the nuclear installation.

Summary of changes

1. Section 17.1 has been updated to report on the development of Regulations on siting of new nuclear installations.
2. Section 17.3.2 on development around the nuclear installation has been updated taking cognizance of the Regulations in the process of being published on monitoring and control of developments in the vicinity of the Koeberg Nuclear Power Station to ensure the effective implementation of the emergency plan.

17.1 LEGISLATION AND LICENSING PROCESS

In terms of the National Nuclear Regulator Act, nuclear authorizations are required for the siting of nuclear installations.

As reported in Section 7.2, in anticipation of applications for new nuclear sites, regulations on siting of new nuclear installations were published in July 2009 for stakeholders comment. The proposed regulations are being redrafted in the light of comments received. The purpose of these Regulations is to establish regulatory requirements pertaining to sites for new nuclear installations. In developing these regulations the NNR took cognizance on international standards and practices from sources such as the IAEA and also from relevant nuclear safety authorities of other countries. The current standards and processes applied to the current site of the nuclear installations, reported below, have to a large extent been taken into account in the proposed Regulations.

In terms of reviewing the suitability of a specific site, the applicant must submit to the NNR a site safety report which will sufficiently characterize the site such as to demonstrate that the safety standards of the NNR could be met in respect of the plant design. Typically the site safety report would address the following topics: description of site and environs, population growth and distribution, land-use, adjacent sea–usage (if applicable), nearby transportation, civil and industrial facilities, meteorology, oceanography and cooling water supply, impact of natural hazards, impact of external man made hazards, hydrology, geology and seismology, fresh water supply, site control, emergency services, radioactive effluents, ecology.

Although all these topics need to be supported by up to date validated data, one important factor in determining the suitability of the site is that the projected population growth and distribution around the site has to be such as to provide the assurance that emergency planning and preparedness arrangements for the site could be kept viable throughout the lifetime of the nuclear installation.

Should the NNR conclude that the proposed site is not viable and suitable for licensing, the applicant will need to consider other alternative sites. As part of the Koeberg Safety Re-assessment Project (addressed in Article 14) a review and update of the Koeberg Site Safety Report was carried out using up to date data.

17.2 CRITERIA FOR EVALUATING SITES

The criteria applied to the consideration of potential sites are the risk criteria used as a basis for licensing, (addressed under Article 14), which include the analysis of all the topics of the site safety report indicated above with the specific emphasis on projected population growth distribution around the site related to emergency planning, for which specific guidelines are provided by the NNR.

17.3 IMPACT OF THE NUCLEAR INSTALLATION ON THE SURROUNDING ENVIRONMENT

The NNR requires the licence holder to provide adequate source term data to demonstrate that the projected dose to the critical group of the members of the public owing to normal operating conditions comply with the dose limits as specified in the Safety Standards and Regulatory Practices. Furthermore the licence holder is required to calculate accident source terms to demonstrate compliance with the risk limits specified in the Safety Standards and Regulatory Practices. The dose and risk calculations are performed by the licence holder.

The NNR has further stipulated limits on urban developments in the vicinity of the installation and holds regular meetings with the licence holder and the local authorities in this regard. The licence holder is required to maintain an effective emergency plan. The emergency plan is regularly exercised by the licence holder and independently by the NNR (every 18 months to two years, as reported in Article 16).

17.3.1 Accident Conditions

In conformance with licensing requirements, the licence holder has developed a full-scope plant-specific probabilistic risk assessment including severe accident source terms. These are used by the NNR to determine risk to the public and compliance with the above-mentioned risk limits. The licence holder also demonstrates, through deterministic safety analyses, that the nuclear installation meets appropriate nuclear safety criteria for a suite of design basis accidents. These analyses are routinely updated using new codes and methodologies and also in the light of operational experience feedback.

17.3.2 Control of developments in the vicinity of the Koeberg Nuclear Power Station

As reported in Section 7.2, in terms of section 38 (4) of the NNR Act, Regulations are in the process of being published on monitoring and control of developments in the vicinity of the Koeberg Nuclear Power Station to ensure the effective implementation of the emergency plan. These regulations include the specific requirements applicable to the vicinity of Koeberg and will replace the regulations published in March 2004, as reported in the previous report, which were generic and applicable to all nuclear installations.

17.4 HAZARDS AGAINST WHICH SPECIAL PRECAUTIONS WERE REQUIRED FOR THE INSTALLATION

During the initial licensing of the nuclear installation all hazards (external and internal) were analysed and assessed and appropriate measures were implemented in the design and in operating procedures to manage the impact of these hazards on the nuclear installation.

As indicated in Article 14 a periodic safety re-assessment of the nuclear installation (Koeberg Nuclear Power Station) was undertaken. As part of this re-assessment major internal and external hazards were re-assessed such as the hazard from a high or medium energy pipe break, fire hazards, internal flooding, the hazard from non-seismic qualified equipment falling and damaging safety-related equipment during a seismic event and hazards from aircraft crashes.

17.5 INTERNATIONAL ARRANGEMENT REGARDING SITING

South Africa has not entered into any arrangements with neighbouring countries regarding the siting of nuclear installations.

ARTICLE 18: DESIGN AND CONSTRUCTION

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

(i) The design and construction of a nuclear installation provides for several reliable levels and methods of protection (defence-in-depth) against the release of radioactive materials, with a view to preventing the occurrence of accidents and to mitigating their radiological consequences should they occur;

(ii) The technologies incorporated in the design and construction of a nuclear installation are proven by experience or qualified by testing or analysis;

(iii) The design of a nuclear installation allows for reliable, stable and easily manageable operation, with specific consideration of human factors and the man-machine interface.

Summary changes:

1. Section 18.1 was updated related to the development of the PBMR programme
2. Section 18.2 was updated to include additional measures to strengthen the Defence In Depth at the Koeberg Nuclear Power Station.

18.1 LEGISLATION AND LICENSING PROCESS ON DESIGN AND CONSTRUCTION

The requirements of the NNR Act and the principal safety requirements formulated in the Regulations R388 on Safety Standards and Regulatory Practices form the basis for the stipulation of the regulatory requirements for design and construction of nuclear installations.

18.1.1 Operating Plant (Koeberg Nuclear Power Station)

(i) Regulatory requirements

The regulatory requirements applicable to the operation of the Koeberg Nuclear Power Station have been extensively discussed in previous Articles.

The licensing process which was applied at the time of the Koeberg plant design and construction is extensively covered in the previous South African national reports to the Convention and is not repeated here.

In summary the licensing process adopted at that time was that the design of any nuclear installation to be constructed should be based on one that was licensed in the country of origin and that utilised design codes and criteria that were broadly recognised internationally. In addition, the design was required to be subject to a quantitative safety assessment making use of probabilistic risk assessment techniques which demonstrate compliance with the quantitative risk criteria laid down by the regulatory body.

The design of the nuclear installation to be constructed was assessed to comply with all the safety requirements of the NNR and a nuclear licence was granted for the construction and subsequent operation of the nuclear installations (refer Article 6).

The operating nuclear installations are now subjected to the regulatory requirements which have been extensively discussed in previous Articles.

18.1.2 New nuclear installation licence application (PBMR)

As reported in previous Convention reports, Eskom applied in July 2000 for a construction licence for a PBMR Demonstration Power Plant (DPP). The PBMR DPP is a graphite moderated, helium cooled reactor using a direct gas cycle to convert heat, generated by nuclear fission in the reactor (pebble bed reactor core type design) and transferred to the coolant gas, into electrical energy by means of a helium turbo-generator.

(i) Regulatory requirements

The requirements of the NNR Act and the principal safety requirements formulated in the Regulations R388 on Safety Standards and Regulatory Practices form the basis for the stipulation of the Licensing Requirements for the Pebble Bed Modular Reactor (PBMR).

The NNR has not granted a Nuclear Installation Licence for the PBMR, which is still in a design phase, and the implementation of the requirements of the NNR Act and those of the SSRP is carried out through the development of specific regulatory documentation.

The scope of regulatory assessment for licensing of the PBMR is based on the licensing requirements and safety criteria defined by the NNR in appropriate requirements documents. In addition, guidance is provided on selected issues in appropriate NNR licence guides. The requirements comprise, besides the general requirements to respect good engineering practice, ALARA and defence-in-depth principle, specific radiation dose limits. These are categorised for normal operation and operational occurrences as well as for design basis events for workers and the public. The safety criteria also stipulate occupational risk limits for the workers as well as risk limits for the public for all possible events that could lead to radioactive exposure.

The dual nature of the regulatory safety standards implies that the safety analyses for demonstration of compliance of the Safety Case with the safety standards have to comprise both deterministic and probabilistic analyses. Additional requirements and recommendations are stipulated by the NNR on safety important areas like quality and safety management, supplier and component qualification, qualification of the nuclear fuel and the core structures, core design, verification and validation of computer codes and others as indicated in the table below:

NNR document #	Rev	Title
RD 0024	0	Requirements on licensees of nuclear installations regarding risk assessment and compliance with the safety criteria of the NNR
RD 0018	1	Basic Licensing Requirements for the Pebble Bed Modular Reactor
RD-0016	0	Requirements for licensing submissions involving computer software and evaluation models for safety calculations
RD 0034	0	Quality and Safety Management Requirements for Nuclear Installations.
LD 1096	0	Fuel qualification requirements for PBMR
LD 1097	0	Qualification Requirements for the Core Structure Ceramics of the Pebble Bed Modular Reactor
RD 0019	0	Requirements for the Core Design of the Pebble Bed Modular Reactor
RD 0016	0	Requirements For Authorisation Submissions Involving Computer Software And Evaluation Models For Safety Calculations
RD 0014	0	Emergency Preparedness and response requirements for nuclear installations
LG 1041	0	Licensing guide on safety assessments for nuclear power plants
LG 1045	0	Guidance for licensing submissions involving computer software and evaluation models for safety calculations
PP-0008	0	Design Authorisation Framework

(ii) Change in the PBMR Company Business Strategy

The NNR was informed in 2009 that the PBMR Company had changed its business strategy to align with the prevalent economic environment and the associated market for PBMR. This new business strategy had resulted in changing the design of the DPP to create a standardised design to serve either as an electricity generation plant or process heat plant.

Within that context the PBMR Company requested to engage the NNR on the establishment of a regulatory oversight process for the design of an indirect cycle PBMR DPP. Such a process would be of benefit in that it would allow for direct engagement with the design company, the resolution of organisational, quality, process and a wide range of nuclear safety and technical issues well in advance of an application for a licence for construction and operation of a specific design on a specific site.

In response to this request the NNR developed the position paper (PP-0008) detailing the Design Authorisation Framework. Consideration was given to current international practice, the scope of submissions, oversight process and the nature of the authorisation. While the NNR Act does not specifically make provision for a "Design Certification" process as applied for example in the USA, it does make provision for the regulatory oversight of the design of nuclear installations, which would entail the issuance of a Nuclear Authorization to Design a Nuclear Installation and a Safety Evaluation Report (SER) by the NNR on the Safety Case for the Reference Design together with conditions for the design assessment process.

The objective of the design authorization process is to:

1. Allow for engagement with the NNR on a design of the new nuclear installation application not necessarilry previously authorized

2. Identify and agree on key safety issues, and the proposed technical resolution thereof, through the application of sound system engineering principles and past experience with the aim of demonstrating through robust research, test and qualification that the design will survive all postulated transient and accident conditions or any other process disturbance, without any undue risk to the persons, property and the environment independent of the site or location where the facility will be operated.

3. Provides for regulatory decision-making process that is credible, transparent and which carries credit in subsequent licensing stages as the SER that is issued will document the NNR position and the issues that may need to be addressed fully.

Subsequently, however, in 2010 due to various factors, Eskom informed the NNR of the scale down of the PBMR licensing activities for the direct cycle PBMR DPP. Work is being undertaken to close-out the project, and to be in a position to restart the project if required in the future. The focus of the NNR licensing activities is to document the licensing status at the close out of the project, with the objective to be in a position to restart the project if required in the future.

The licensing strategy and process followed with respect to the application for the PBMR DPP was extensively covered in the previous South African national report to the Convention and is not repeated here.

18.2 DEFENCE-IN-DEPTH

18.2.1 Operating Plant (Koeberg Nuclear Power Station)

(i) Regulatory requirements

One of the principal nuclear safety requirements of section 3.9 the SSRP requires a multilayer (defence in depth) system of provisions for radiation protection and nuclear safety commensurate with the magnitude and likelihood of the potential exposures involved, and shall be applied to sources such that a failure at one layer is compensated for or corrected by subsequent layers, for the purposes of:

(a) preventing nuclear accidents;

(b) mitigating the consequences of any such accidents; and

(c) restoring sources to safe conditions after any such accident

In accordance with the safety requirements of the SSRP the principle of defence in-depth, as applied in the design, construction and subsequent operation of the nuclear installation is based on the IAEA INSAG-10 and in its broadest context is upheld by the following requirements of the NNR such that the licence holder is required to demonstrate compliance with the safety standards indicated above.

The licence holder is required to present a safety case for the proposed activity (or change to an existing activity), demonstrating compliance with the above safety standards.

(ii) Defence-in-depth in plant design and operations

a) Implementation of defence in depth in the nuclear installation design

In terms of its implementation in the initial design, the defence-in-depth principle was based on the concept first developed by the USNRC in its document WASH 1250 in which consideration is given to three levels of defence.

Subsequently the application of the defence in depth as indicated in IAEA INSAG 10 is applied at the Koeberg Nuclear Power Station in which fourth and fifth levels of defence have been implemented following the introduction of Emergency Operating Procedures and Severe Accident Management Guidelines on how to cope with beyond design base accidents, and with the existence of the Emergency Plan.

b) Implementation of Defence in depth in the Koeberg Nuclear Power Station operations

The principle of defence-in-depth is upheld in the design basis and operational safety assessment of the nuclear installation and its related operational safety-related programmes (general operating rules).

The implementation of defence-in-depth has been significantly enhanced as a result of the probabilistic risk approach required by the NNR. It has been shown to support the design basis and to identify important improvements in safety at the nuclear installation, including the following:

- Additional off-site power supplies
- Development of shutdown Operating Technical Specifications
- Moratorium on mid-loop operation with fuel in the reactor
- Fast dilution modification
- Requirements on risk management
- Protection against marine oil spills
- Addition of diesel generator power supplies and reactor pump seal supply during station blackout scenarios
- Implementation of an additional (third) cooling loop for the spent fuel pools and back-up emergency inventory supply to be completed early 2011.

The need to implement a system of risk management, (to be approved by the NNR) which includes, *inter alia*, the following requirements, is considered an essential enhancement in support of the principle of defence-in-depth:

- To ensure plant configuration control practices are taken into account in the operational safety assessment
- To ensure adequate levels of redundancy of safety trains and support systems
- To impose a risk limit on any twelve-month window including past and planned activities

Presently the licence holder complies with the above requirements through implementation of its Operating Technical Specifications (OTS) (which include the shutdown OTS) and by a process of verifying the validity of the risk assessment against the prevailing plant configuration during shutdown.

Violation of the single failure criterion for short periods of time (e.g. on-line maintenance of safety related equipment) is currently not permitted. Where a degraded condition is identified and a risk assessment and risk balance performed, on-line repairs are justified (via implementation of preventative mitigation actions) and sanctioned by safety committees.

Another important aspect of ensuring defence in depth in the operation of the nuclear installation is the comprehensive independent surveillance and compliance inspection programme implemented by the NNR to verify compliance with the nuclear installation licence requirements, and to identify any potential safety concerns, which is complementary to the licence holder's monitoring programme.

18.2.2 New nuclear installation licence application (PBMR)

In line with the principal safety requirements formulated in the SSRP, and as per RD-0018 "Basic Licensing Requirements for the Pebble Bed Modular Reactor" the principles of Defence-in-Depth (DiD) must be applied to the PBMR design 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.

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; category A grouping normal operations, category B grouping IE for design basis accidents and category C grouping all IE of categories A and B and those beyond category B (beyond design basis accidents). The frequency of events either singly or as combined events must be assessed accordingly and allocated to the appropriate category. The design provisions for category A and B events, which defines the deterministic framework of the PBMR safety case, must be part of the DiD application. Category C events define the probabilistic framework of the safety case.

Safety Functions

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 (design basis accident conditions) and to ensure that the Fundamental Safety Functions (FSF) are not violated. No credit must be taken in the analyses for category B events from early operator actions or Event Management.

The most limiting Single Failure must be applied to the functional systems of Structures Systems and Components (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.

Levels of Defence

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 (as in IAEA INSAG 10) 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 (design basis accidents).
- Provision of engineered safety features (active and passive to control and mitigate the category B events (design basis accidents).
- Prevention and mitigation of beyond category B events (beyond design basis accidents) through the consideration of events or combinations of events with an annual frequency $<10^{-6}$. Emphasis must be put on prevention of beyond category B events. Realistic assumptions and best estimate methods may be used to analyse these conditions against the Probabilistic Risk Limits of the SSRP.
- Mitigation of radiological consequences of significant releases of radioactive materials by means of off-site emergency response.

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' lifetime, both for steady states and transients occurring in any operational conditions and accident conditions.

The nuclear installation 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. Provision 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.

18.3 PREVENTION/MITIGATION OF ACCIDENTS

18.3.1 Operating Plant (Koeberg Nuclear Power Station)

The prevention of accidents and limitation of their consequences is ensured through the following levels of defence:

- Global safety design
- Quality of manufacture and construction
- Safety of operation

Structures, systems and components important for safety are designed with consideration for:

- The importance of the safety function to be performed
- Normal operating, maintenance and testing conditions
- Conditions created by postulated accidents
- Consequences of natural phenomena and human activities

Structures, systems and components important to safety are designed, fabricated, erected and tested to engineering and quality standards commensurate with the importance of the safety function to be performed. A deterministic study of accidents with potential radiological affects on the operators and general public is made on the following bases:

- The most penalising normal operating regime of the unit is considered prior to the accident for accident consequence
- The single failure criterion
- The most severe design base accident studies take place in the most severe environmental conditions (i.e. Loss Of Coolant Accident (LOCA) following safe shutdown earthquake with loss of external power supply)

The following are examples of improvements which have been implemented at the nuclear installation on the basis of the plant-specific risk assessment or on the basis of international experience feedback:

(a) Hardware modifications

The 79 modifications included in the CP1 Alignment Project resulting from the first Koeberg Safety Re-assessment (refer to Article 14) can be categorized under the following theme headings:

(i) Periodic Safety Reassessment Close Out and General Operating Rules (GORs) alignment issues

These modifications originated from the closeout report of the safety reassessment (SRA) performed in 1998 (refer to Article 14), or were identified as improvements to the plant to align the general operating rules.

(ii) Containment Safety Enhancement

This category of modification improves the containment of potential radioactive release to the public. The modifications improve system isolation potential, ventilation system, measuring of activity and improvements in system leak tightness.

(iii) Equipment Qualification

This category of modification improves the seismic and/or environmental qualification of equipment identified as essential during an incident, to ensure safe shutdown of the reactor.

(iv) Reliability Enhancement

This category of modification improves the reliability of the plant systems by, improving system start-up times, improving the control function of the systems, and by automating critical actions to avoid functional failure in an accident scenario.

(v) Plant Operating Under Accident Conditions

This category of modification improves the operating condition of the power plant under accident, and in some instances under normal operation, by installation of additional plant/operator interface equipment, installation of safety parameter display console, installation of equipment to prevent accident conditions from arising, and installation of equipment to prevent human error that may have adverse consequences.

(vi) Protection against Hazards

This category of modification includes improvements to protect against high-energy pipe breaks, against internal flooding, against earthquakes for passive equipment and against fire.

(vii) Modifications identified by the French utility EdF during their second Safety Reassessment

These modifications have the same improvement themes as the categories above, but were analysed as a separate group of differences derived from the batch of French modifications referred to as VD-2.

(b) Improvements to operational safety-related programmes (general operating rules) and operator training

- Development of shutdown Operating Technical Specifications
- Revision of accident procedures and compilation of relevant background documentation
- Implementation of a Systematic Approach to Training and subsequent Institute of Nuclear Power Operations (INPO) accreditation of operator training.

(c) Severe Accident Management Guidelines (SAMGs) were implemented in 2000 and have subsequently been updated. Additionally shutdown SAMGs have been developed and implemented.

(d) Rules for accident analysis

As reported in previous reports to the Convention, Eskom has completed a project to develop a concise set of rules for the safety case currently in force and upheld in the Koeberg nuclear installation licence. The scope of the project included the following:

- Establishment of fundamental rules for the Koeberg Safety Analysis Report (similar to the equivalent French 'RCCP' document)
- Rules for accident analysis and management
- Close-out of severe accident management issues and incorporation of severe accident procedures into the licensing framework
- Rules for component classification for maintenance purposes
- Identification of a programme of work to align Koeberg with current international practice.

18.3.2 New nuclear installation licence application (PBMR)

Prevention of Accidents

In respect of the principle of defence-in-depth and accident prevention the design must ensure that exposures to the personnel and the public exceeding the category A dose limits are unlikely to occur during the lifetime of the nuclear installation.

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.

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.

Mitigation of Accidents

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 Basic Licensing Requirements. The maximum allowable source terms from the confinement (including leakage rates and depressurisation) must be defined to satisfy the Basic Licensing Requirements for the various Initiating Events (IE), 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 Basic Licensing Requirements.

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. 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.

18.4 MEASURES REGARDING APPLICATION OF PROVEN TECHNOLOGIES

18.4.1 Operating Plant (Koeberg Nuclear Power Station)

(i) During initial design, construction and commissioning

As reported in the previous National reports to the Convention, the nuclear installation was built between 1976 – 1984 by a French consortium, with Framatome having responsibility for the nuclear island, Alsthom Atlantique for the conventional island, Spies Batignole for the civil work and Framateg for overall project co-ordination.

The plant, as designed and built, was assessed to comply with credible international norms and practices prevailing at the time. All these design requirements, as well as the specifications contained in the various codes and standards, were validated by extensive Research and Developments (R&D) experiments and testing around the world by credible companies, such as Framatome (now Areva) and Westinghouse, who held specific interests as vendors of nuclear installations.

Furthermore, an extensive testing and commissioning programme was implemented at the nuclear installation, which verified some of the assumptions made in the design of the reactor and associated systems. At each step of the commissioning programme the results of each test were compared to acceptance criteria derived from the safety analyses.

(ii) Current practices

Since the commissioning and commercial operation of the nuclear installation, the same principle pertaining to the use of proven technologies has been applied.

For example, when a modification is carried out on the plant, the design and its implementation has to comply with the requirements of the SSRP that installations, equipment or plant requiring a nuclear installation licence, a nuclear vessel licence or a certificate of registration and having an impact on radiation or nuclear safety must be designed, built and operated in accordance with good engineering practice. This implies that *inter alia* current international norms and standards including an acceptable nuclear quality assurance programme must be utilized. Where computer codes are utilised as a means of justification for the implementation of a new design, the user is required to provide extensive benchmarking evidence of the code used against experimental data; this includes a rigorous quality assurance programme.

For selected designs on more critical safety related plant systems, independent design verifications are required to be carried out. This ensures that proven technologies, codes and standards are applied during the design phase.

18.4.2 New nuclear installation licence application (PBMR)

As indicated above in terms of the requirements of the SSRP, the nuclear installation must be designed, constructed, commissioned, operated, maintained and decommissioned according to good engineering practice.

Compliance with the PBMR Basic Licensing Requirement – RD 0018 (refer 18.1.2 above) must be demonstrated by way of formalised safety analyses with reference to proven technology and in accordance with international practice (IAEA INSAG-12).

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.

Regulatory document, RD 0034 (refer Article 13 on Quality Assurance) details the Quality Management System (QMS) and Safety Management System requirements of the NNR for Nuclear Installations applicable to the PBMR. Eskom, PBMR (Pty) Ltd and the suppliers responsible for design, construction and operation of the Pebble Bed Modular Reactor are required to develop, introduce and maintain a QMS and SMS that complies with the requirements of this regulatory document.

The quality requirements related to the design include inter alia requirements on the identification and control of design interfaces, independent verification of design, test programmes, design changes, configuration management, selecting and reviewing the suitability of application of materials, parts, equipment and processes that are essential to the defined safety functions of Structures Systems and Components (SSC), and verification and validation to pre-determined requirements.

Where a test programme is used to verify the adequacy of a specific design feature in lieu of other verification or checking processes, it must include suitable qualification testing of a prototype unit under the most adverse design conditions. The test programme must be defined in writing and make provision for signoffs as the test programme conditions are met.

Furthermore, validation of the output of the design and development processes must be performed to ensure that the resulting product is capable of meeting the requirements for the specified use and all design changes affecting safety functions must be submitted to and approved by the NNR prior to introduction with respect to the safety classification of the affected SSC.

18.5 REQUIREMENTS ON RELIABLE, STABLE AND EASILY MANAGEABLE OPERATION WITH SPECIFIC CONSIDERATION OF HUMAN FACTORS AND MAN-MACHINE INTERFACE

18.5.1 Operating Plant (Koeberg Nuclear Power Station)

One of the conditions of the Koeberg nuclear installation licence requires that any design changes affecting safety related systems, components and activities are approved by the NNR prior to their implementation. Procedures, approved by the NNR, are in place to provide standard instructions for modification control compliance. Departures from established design bases must not only meet technological criteria but where man-machine interfaces are involved adequate measures to address these aspects must form part of the justification for change.

Changes to hardware must have accompanying revisions to working procedures, and the process has to incorporate the commensurate adjustments to training and qualification of staff. This includes modifications to the full scope simulator at the nuclear installation and the necessary upgrading of systems and equipment to keep abreast of internationally accepted norms and practices in NPP operation. The licence holder's organisation is structured to accommodate the development of operational improvements, the feedback of lessons learned and operating experience.

All incidents, occurrences and non-conformances are subjected to trend analysis for human factor aspects and this analysis is used as a basis for structured corrective actions to reduce human errors and/or improve the ergonomic aspects of the operations at the nuclear installation.

Many such improvements have been incorporated into the installation's design and operation since construction and the nuclear installation has benefited significantly from the French Pressurized Water Reactors (PWR) experiences over the years in this respect.

18.5.2 New nuclear installation licence application (PBMR)

The importance of prevention of accidents as the main basis of the safety is emphasised. The design must aim to provide a nuclear installation 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.

The design must not place reliance on early operator actions. No credit must be taken in the deterministic safety analysis for such action. However operator error must be considered in the accident analyses.

Adequate time scales are required for any operator actions. Simplification of systems design should facilitate elimination of adverse system interactions.

ARTICLE 19: OPERATION

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

(i) The initial authorization to operate a nuclear installation is based upon an appropriate safety analysis and a commissioning programme demonstrating that the installation, as constructed, is consistent with design and safety requirements;

(ii) Operational limits and conditions derived from the safety analysis, tests and operational experience are defined and revised as necessary for identifying safe boundaries for operation;

(iii) Operation, maintenance, inspection and testing of a nuclear installation are conducted in accordance with approved procedures;

(iv) Procedures are established for responding to anticipated operational occurrences and to accidents;

(v) Necessary engineering and technical support in all safety related fields is available throughout the lifetime of a nuclear installation;

(vi) Incidents significant to safety are reported in a timely manner by the holder of the relevant licence to the regulatory body;

(vii) Programmes to collect and analyse operating experience are established, the results obtained and the conclusions drawn are acted upon and that existing mechanisms are used to share important experience with international bodies and with other operating organizations and regulatory bodies;

(viii) The generation of radioactive waste resulting from the operation of a nuclear installation is kept to the minimum practicable for the process concerned, both in activity and in volume, and any necessary treatment and storage of spent fuel and waste directly related to the operation and on the same site as that of the nuclear installation take into consideration conditioning and disposal.

Summary of changes:

1. Sections 19.3 and 19.4 have been updated to reflect the new completion date of the revision to the Technical Specifications and the Safety Related Surveillance Manual (SRSM)
2. Section 19.5 has been updated to reflect that the upgrade of the Severe Accident Management Guidelines (SAMG's) has been completed
3. Section 19.9 has been updated to reflect the new completion date of the upgraded spent fuel pool cooling.

19.1 LEGISLATION

The legislation and associated regulations have been extensively covered under previous Articles

19.2 MANNER IN WHICH INITIAL AUTHORISATION TO OPERATE WAS ACHIEVED

The process of how initial authorisation to operate was achieved has been extensively covered in previous Articles

19.3 OPERATIONAL LIMITS/CONDITIONS BASED UPON ANALYSIS

The SSRP requires that the operational safety assessment (Safety Analysis Report – SAR for Koeberg) must establish the basis for all the operational safety-related programmes, limitations and design requirements.

In order to respect safety limits dictated by the Safety Analysis Report (SAR) the plant is operated in accordance with an Operational Technical Specifications (OTS) document. The current OTS is at Revision 6.

The Limiting Conditions for Operation (LCO) requirements were originally primarily established following a deterministic approach.

Revision 7 of the OTS is being developed and will be closely related to the latest OTS of the French EdF. The new revision is based mainly on deterministic processes and criteria, and derived requirements. This will be cross-checked and moderated using various other consistency mechanisms. Included amongst these will be an extensive use of the power station's PSA models to verify that the deterministically derived requirements are appropriate in terms of risk criteria. Completion of the project is scheduled towards the end of 2010.

To manage the issue of degraded safety equipment, the licence holder in consultation with the NNR, introduced an operability determination process in addition to the existing event reporting process and the non-conformance process. The operability determination process provides a clear mechanism by which equipment that is degraded is evaluated in terms of operability by both operating staff and engineering staff. The safety evaluation process is used to quantify the safety risk, and operational recommendations are made back to the licensed operators.

19.4 OPERATION, MAINTENANCE, INSPECTION AND TESTING OF THE NUCLEAR INSTALLATION

The SSRP requires that an appropriate maintenance and inspection programme be established. The maintenance and inspection programme must be implemented to ensure that the reliability and integrity of installations, equipment and plant having an impact on radiation and nuclear safety are commensurate with the dose limits and risk limits.

Inspection and testing is performed at Koeberg on systems, structures and components, whose failure to operate on demand, failure to function during service and/or loss of integrity, either during normal and/or during accident conditions, has a potential impact on the nuclear risk to installation operators and to the general public. Inspection and testing activities are performed in accordance with approved administrative and technical procedures. The surveillances, testing and inspections of equipment are presently distributed amongst a number of programmes.

A project was initiated to produce a Safety Related Surveillance Manual (SRSM) which will contain the functional testing and surveillance requirements, and including the associated bases. The SRSM is being developed and implemented system by system. The first systems have been completed and the project completion is scheduled for the end of 2010.

19.5 PROCEDURES FOR INCIDENTS AND ACCIDENTS

The SSRP requires that where the prior safety assessment or operational safety assessment (SAR for Koeberg) has identified the reasonable possibility of a nuclear accident, accident prevention and mitigation measures based on the principle of defence in depth and which address accident management procedures including emergency planning, emergency preparedness and emergency response must be established, implemented and maintained. The principle of defence in depth must be applied as appropriate.

Measures for emergency planning, emergency preparedness and emergency response were extensively addressed in Article 16.

Although not a member of the PWR Owners Group, the licence holder utilizes the Westinghouse generic Emergency Operating Procedure (EOP) package, including both Optimum Recovery Procedures and Function Restoration Procedures that have been adapted specifically for Koeberg. A project to update and replace the set of background documents for the EOPs has been completed in 2006.

A comprehensive set of severe accident management guidelines (SAMGs) have been written by Westinghouse for the licence holder. These were authorized by the NNR for implementation in December 2000. A further project to upgrade the SAMGs and to include guidance for severe accidents initiating during shutdown conditions has been completed.

The original suite of Koeberg incident operating procedures was reviewed and rewritten into the same format as the EOPs. This suite of procedures mainly focuses on at-power incidents. A project has been initiated to review the status of incident procedures during shutdown conditions and to make recommendations on how to improve or replace the suite of procedures. These recommendations need to take into account the intended modifications to the spent fuel pool cooling system and the collection of safety improvement modifications (refer to the French plant CP1 alignment modifications -Section 18.3).

19.6 ENGINEERING AND TECHNICAL SUPPORT AVAILABLE

To comply with the conditions of the nuclear installation licence the licence holder needs to have sufficient resources in order to address the full scope of requirements imposed by the NNR. Through its continual monitoring of activities associated with the operation of the nuclear installation, the NNR is in a strong position to determine compliance with licence conditions and ensure that the root cause of any non-compliant situation is investigated. Consequently, any deficiency in engineering or technical support would be identified by the NNR, and then be directed to the licence holder for rectification.

In order to be pro-active in this respect, the licence holder has established its own departments at the nuclear installation to handle the wide range of support activities. Where these are not fully staffed from internal resources, the licence holder engages the services of external consultants. In addition, the licence holder has entered into technical co-operation agreements with EdF and other utilities in order to be advantageously positioned through having adequate support to address the range of competencies required in any given situation.

Looking to the future, the licence holder is following closely how EdF decommissions its older nuclear plants. Eskom's decommissioning strategy including financial provision is currently based upon that of EdF, but other international practice is also being monitored.

19.7 EVENTS REPORTING

As reported in previous Articles, in terms of section 4.10.3 of the SSRP a reporting mechanism must be established, implemented and maintained for nuclear incidents, nuclear accidents or any other events that the NNR may specify in the nuclear authorization.

Monitoring the safety status of the nuclear installation requires that all deviations from the required standards and approved operating regimes are reported, graded and addressed. A condition of the nuclear installation licence is that the licence holder must establish and maintain a problem management and reporting system to the satisfaction of the NNR. This system includes any event, problem, non-conformance, quality assurance finding, quality control deficiency or occupational safety event which constitutes a threat to, or could have an impact on nuclear safety, equipment availability and/or radiation protection. In order to comply with the NNR Requirements for reporting of events the licence holder has established an approved procedure. The process is tracked using an Electronic Problem Management System (EPMS) which can be summarised as follows:

- Identification and reporting of the event by any installation staff member
- Prioritisation, classification, initiation of action and notification by the shift manager
- Review, verification of the classification and nomination of a lead group, to undertake investigation and root cause analysis according to severity level of the event. This includes the IAEA International Nuclear Events Scale (INES) rating of the event, which is performed by a committee.
- Preparation of a report on the event for nuclear installation management and the NNR
- Agreement on corrective actions and prioritisation within the nuclear installation.
- Checking outstanding corrective actions and notifying the responsible group
- Completion of actions and entering comments on EPMS
- Tracking and reviewing of the actions, updating the database and feedback of relevant information to the management of the nuclear installation and the NNR
- Printing a summary of the event and archiving for records and trending

The system in place at the nuclear installation enables any member of staff to generate a problem report that can be processed in a speedy and standard manner into the EPMS. In order to rapidly define the priority for notification and action, the NNR has laid down strict reporting criteria in accordance with the severity of the event. All events are classified, analysed and collated to provide information for indication of areas requiring further investigation and/or immediate attention to prevent recurrence.

Analysis of events has to cover the four main areas of NNR concern, namely,

a) Protection of the fuel
b) Control of reactivity
c) Containment of radioactive materials
d) Limitation of exposure

Therefore, it is considered important that measures be instituted to redress any shortfalls in the established systems, by means of appropriate corrective actions, in the case of actual events occurring or to identify precursors and trends for minor but recurrent events.

The EPMS reports are received by the NNR and the information is screened for statistical evaluation and analysis. This information is used as one of the tools to gauge compliance with the safety requirements and the conditions of the nuclear installation licence.

Additionally this information is utilised in the following areas:

- To amend the compliance inspection programme to reflect areas of weakness for further attention
- To influence the scope of audits to focus on apparent shortcomings
- To input plant-related data to the probabilistic risk assessment
- To emphasise training and competence in identified areas of operator licensing examinations
- To assist in the identification of human factors as root causes during human performance evaluation
- To highlight information for media transmittal and explanation of events including INES notification via the IAEA

Trending of events is heavily dependent upon the quality of reported data and the integrity of the staff reporting it. To monitor both these factors, the NNR conducts follow up investigations on selected events to verify the facts and to glean additional information for a more complete picture of the event. The objective is to detect problems before they arise and to minimise the consequences of events. This is often achieved by reference to events and 'lessons learned' from other nuclear power plants in the world. The International Atomic Energy Agency Incident Reporting System (IRS) data base, which is supplied to member states to highlight occurrences/incidents to the nuclear community, is supplied to South Africa and is reviewed by the NNR and the licence holder. This system has indicated situations that have needed attention at similarly designed plants and allows corrective actions to be identified before a problem manifests itself universally.

The nature of the NNR's event reporting requirements for the nuclear installation are such that events are categorised, graded and reported to the NNR in a manner related to their impact on the risk. This means that the reporting of any non-compliance is directly related to its safety significance and is dealt with by the licence holder and the NNR accordingly. At all times, the NNR ensures that non-compliant situations are identified, reported and dealt with in the shortest possible timescale. The criteria for non-compliance are clear to the licence holder and the reactive measures are well tried and effective. Any member of staff at the nuclear installation can report problems of any nature without fear of sanction or reprisal. The licence holder has fostered a healthy reporting climate and this is evidenced by the depth and scope of events reported and also by the transparency of the system. Reporting of problems, anomalies or concerns can also be effected through the licence holder's system called "notification of concerns", whereby any matter of concern can be recorded and sent to the nuclear installation management and the NNR anonymously if preferred.

Events are an important source of regulatory data and can yield extensive information for aiding further investigation by the NNR and the licence holder. The analysis, however, has to be undertaken as a component of the total regulatory system for, like all indicators, they must be treated with circumspection to obviate misinterpretations and false assumptions.

19.8 INTERNATIONAL AND NATIONAL OPERATING EXPERIENCE FEEDBACK (OEF)

Events that are significant to safety are reported by the licence holder to the NNR according to a condition of the nuclear installation licence in a regulatory document which contains commensurate reporting timescales which are relative to the safety significance of the event.

The licence holder has formed a group known as the Koeberg Event Group (KEG), which is charged with the analysis, evaluation and trending of events. Events are independently analysed and trended according to accepted methodologies (HPES, ASSET, Kepner Tregoe) by both the licence holder and the NNR. The results of these analyses are formulated into corrective actions by the licence holder, and these are continually followed up by inspections and audits of the NNR. Close-out reports of the events are produced by the licence holder and these reports are subsequently reviewed by the NNR for adequacy. These reports are also discussed with staff from the pertinent disciplines within the nuclear installation to ensure that the appropriate national feedback is given with respect to the dispositioning of the event.

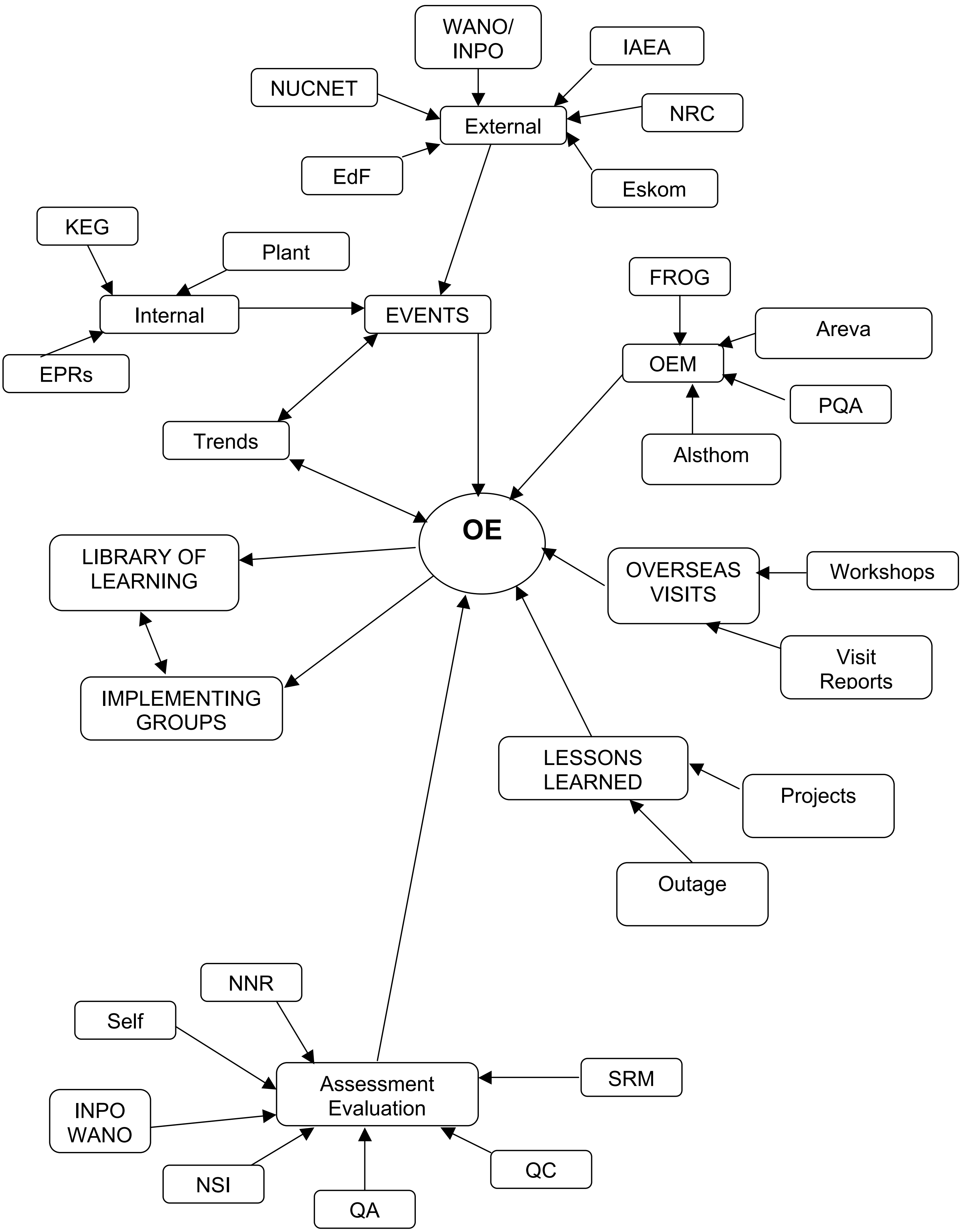
The licence holder reports nuclear safety significant events to WANO, and the NNR also reports events to the IAEA-IRS (Incident Reporting System) for international OEF. The IRS database is made available within the NNR and has proved to be an extremely useful tool. The database is also made available to the nuclear installation. An important mechanism for South Africa to receive OEF is through the attendance of the NNR at the annual joint IAEA-NEA IRS meeting. Not only are specific recent events reported and discussed in detail, but valuable personal contacts are made to broaden the sphere of international communications.

As reported in Article 8 the NNR has entered into various international bi-lateral agreements with other regulatory authorities and these forums are important in terms of OEF.

A Corporate Directive was produced by the Chief Executive Officer of the licence holder, which stated that, *inter alia,* 'The root causes of significant incidents are determined and appropriate action is taken to prevent recurrence. Experience at similar plants is monitored and utilised'. To implement and satisfy this Directive in conjunction with the requirements of the NNR, the licence holder's management at the installation produced various procedures to formalise and document its operating experience feedback mechanisms.

These procedures identify the licence holder's requirements for collecting, analysing and communicating information on significant industry operating experience. They aid in evaluating the information for applicability and tracking of the resulting corrective actions to completion. They also pro-actively guide the user to utilise and apply national and international lessons, learned to improve nuclear safety in an effective mannerthe review of industry technical information originating from external sources such as EdF, the Institute of Nuclear Power Operations, the World Association of Nuclear Operators, Framatome Owners Group, the Original Equipment Manufacturer etc. Refer to Figure 19.8-1 for sources of operating experience information.

FIGURE 19.8-1


WANO/
INPO
IAEA
NUCNET
External
NRC
EdF
Eskom
KEG
Plant
Internal
EVENTS
FROG
Areva
EPRs
OEM
PQA
Trends
Alsthom
OE
LIBRARY OF
LEARNING
OVERSEAS
VISITS
Workshops
Visit
Reports
IMPLEMENTING
GROUPS
LESSONS
LEARNED
Projects
Outage
NNR
Self
Assessment
Evaluation
SRM
INPO
WANO
NSI
QA
QC

19.9 RADIOACTIVE WASTE AND SPENT FUEL MANAGEMENT

19.9.1 Radioactive waste management

The operational radioactive waste management programme implemented at the Koeberg Nuclear Power Station has been extensively covered in Article 15.

19.9.2 Spent Fuel Management

As reported in previous reports to the Convention the spent fuel at Koeberg is stored at the power station in the following manner:
1) In spent fuel pool which have been re-racked from the initial design to ensure physical storage place for spent fuel for the 40 year operating life of both units. The increased storage of spent fuel in the spent fuel pool has necessitated upgrading of the pool cooling system. A first stage of upgrading has been completed, a second phase which included improved instrumentation was completed, and a third phase which increases the cooling capability is presently scheduled for completion early 2011.
2) In four dry storage casks in which a total of 112 spent fuel assemblies are stored.

As indicated in the National Radioactive Waste Management policy the storage on the site 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 wastes in South Africa. Included in the options for the investigations shall be the following:
Long-term above ground storage on an off-site facility licensed for this purpose
A) Reprocessing, conditioning and recycling in South Africa or in a Foreign Country
B) Deep geological disposal
C) Transmutation
But in the interim Used Nuclear Fuel is and shall continue to be stored in authorized facilities within the generator's sites.

REFERENCES

1. National Nuclear Regulator Act (Act No. 47 of 1999)

2. Regulation No. R.388 (2006). Regulations in terms of section 36, read with section 47 of the National Nuclear Regulator Act, 1999 (Act No.47 of 1999), on Safety Standards and Regulatory Practices (SSRP).

3. Nuclear Energy Act (Act No. 46 of 1999)

4. Hazardous Substances Act (Act No. 15 of 1973)

5. Disaster Management Act (Act No. 57 of 2002)

6. National Radioactive Waste Disposal Institute Act (Act No. 53 of 2008)

7. Nuclear Energy Policy and Strategy for the Republic of South Africa, August 2008

8. Requirements Document: RD 0024 'Requirements on licensees of nuclear installations regarding risk assessment and compliance with the safety criteria of the NNR"

9. Licensing Document: LD – 1077 'Requirements for medical and psychological surveillance and control.'

10. Licensing Document: LD – 1081 'Requirements for operator licence holders at Koeberg Nuclear Power Station.'

11. Licensing Document: LD – 1023 'Quality management requirements for Koeberg Nuclear Power Station.'

12. RD 0034 "Quality and Safety Management Requirements for Nuclear Installations."

13. RD 0018 "Basic Licensing Requirements for the Pebble Bed Modular Reactor"

14. RD-0016 "Requirements for licensing submissions involving computer software and evaluation models for safety calculations"

15. LD 1096 "Fuel qualification requirements for PBMR"

16. LD 1097 "Qualification Requirements for the Core Structure Ceramics of the Pebble Bed Modular Reactor"

17. RD 0019 "Requirements for the Core Design of the Pebble Bed Modular Reactor"

18. RD 0016 "Requirements For Authorisation Submissions Involving Computer Software And Evaluation Models For Safety Calculations"

19. RD 0014 "Emergency Preparedness and response requirements for nuclear installations"

20. LG 1041 "Licensing guide on safety assessments for nuclear power plants"

21. LG 1045 "Guidance for licensing submissions involving computer software and evaluation models for safety calculations"

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ABBREVIATIONS

DMR	Department of Mineral Resources
DoE	Department of Energy
EdF	Electricite de France
FNRBA	Forum of Nuclear Regulatory Bodies of Africa
GNS&A	Generation Nuclear Safety and Assurance (Eskom)
KNPS	Koeberg Nuclear Power Station
KSR	Koeberg Safety Reassessment
MDEP	Multinational Design Evaluation Process
Necsa	South African Nuclear Energy Corporation
NNR	National Nuclear Regulator (South Africa)
NNRA	National Nuclear Regulator Act (No. 47 of 1999)
NSA	Nuclear Safety Assurance (Eskom)
ORT	Operation at Reduced Temperature
OTS	Operating Technical Specifications
PBMR	Pebble Bed Modular Reactor
QMS	Quality Management System
SAMG	Severe Accident Management Guidelines
SAQA	South African Qualifications Authority
SAT	Systematic Approach to Training
SSRP	Regulation No. R.388 (2006) on Safety Standards and Regulatory Practices

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