The South African 6th National Report for the Convention on Nuclear Safety (CNS)

November 2013

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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.

ABBREVIATIONS

AADQ	Annual Authorised Discharge Quantities
AAM	KNPP Accident Analysis Manual
AFRA	African Regional Cooperative Agreement
ALARA	As Low As Reasonably Achievable
ANSI	American Nuclear Standards Institute
ANS	American Nuclear Standard
ASCOT	Assessment of Safety Culture in Organisations Team
CA	Corrective Action
CAE	Compliance Assurance and Enforcement Division
CAP	Compliance Assurance Plan
CAR	Corrective Action Review
CEO	Chief Executive Officer
CNS	Convention on Nuclear Safety
CoCT	City of Cape Town
CP	Contracting Party
CSS	IAEA Commission on Safety Standards
DBA	Design Basis Accident
BDBA	Beyond Design Basis Accident
DCT	Disaster Coordination Team
DMR	Department of Mineral Resources
DOC	Disaster Operations Centre
DoE	Department of Energy
DOH	Department of Health
EDF	Electricite de France
EERT	External Events Review Team
ENAC	Convention on Early Notification and Assistance in case on a Nuclear Accident
Enatom	Emergency Notification and Assistance Technical Operations Manual
EOP	Emergency Operating Procedure
EP	Emergency Planning
EPD	Electronic Personal Dosimeter
EPMS	Electronic Problem Management System
EPREV	Emergency Planning Review
EPSOC	Emergency Planning Steering and Oversight Committee
FNRBA	Forum of Nuclear Regulatory Bodies of Africa
FRAREG	Framatome Reactor Regulators Group
GNS&A	Generation Nuclear Safety and Assurance (Eskom)
GOR	General Operating Rules
HP	Human Performance
HRA	Human Reliability Analysis
IAEA	International Atomic Energy Agency
IMS	Integrated Management System

INES	International Nuclear Event Scale
INPO	Institute of Nuclear Plant Operations
INSAG	International Nuclear Safety Advisory Group
IRS	Incident Reporting System (IAEA)
ISIP	In-service Inspection Programme
ISIPRM	In-service Inspection Requirements Manual
JMD	JIPSA Junior Manager Development Programme
KEG	Koeberg Events Group
KLBM	Koeberg Licensing Basis Manual
KNPP	Koeberg Nuclear Power Plant
KORC	Koeberg Operating Review Committee
KOSC	Koeberg Operational Safety Committee
KSR	Koeberg Safety Reassessment
MDEP	Multinational Design Evaluation Process
MW(e)	Megawatt (Electrical)
Necsa	South African Nuclear Energy Corporation
NERS	Network of Regulators of Countries with Small Nuclear Programmes
NGO	Non-governmental Organisation
NIASA	Nuclear Industry Association of South Africa
NNR	National Nuclear Regulator (South Africa)
NNRA	National Nuclear Regulator Act (No. 47 of 1999)
NORM	Naturally Occurring Radioactive Material
NPP	Nuclear Power Plant
NRWDI	National Radioactive Waste Disposal Institute
NSA	Eskom Nuclear Safety Assurance Group
NSSS	Nuclear Steam Supply System
NTWP	Nuclear Technology and Waste Projects
NUFCOR	Nuclear Fuels Corporation
NUSSC	Nuclear Safety Standards Committee
OE	Operating Experience
OECD	Organisation for Economic Cooperation and Development
ORT	Operation at Reduced Temperature
OSART	Operational Safety Review Team
OTS	Operating Technical Specifications
PAIA	Promotion of Access to Information Act
PRA	Probabilistic Risk Analysis
PRIS	Power Reactor Information System
PSA	Probabilistic Safety Analysis
PSIF	Koeberg Public Safety Information Forum
PTR	Reactor cavity and spent fuel pit cooling system
PWR	Pressurised Water Reactor

ABBREVIATIONS

QMS	Quality Management System
RADCON	Directorate of Radiation Control
RP	Radiation Protection
RASSC	Radiation Protection Safety Standards Committee
RCM	Reliability Centered Maintenance
RPV	Reactor Pressure Vessel
RSLS	Regulatory Supervision of Legacy Sites
RVSP	Reactor Vessel Surveillance Programme
SAHRC	South African Human Rights Commission
SAMG	Severe Accident Management Guidelines
SALTO	Safety Assessment of Long-term Operations
SAQA	South African Qualifications Authority
SAR	Safety Analysis Report
SARA	Standards, Authorisation, Review and Assessment
SAT	Systematic Approach to Training
SAT	Self Assessment Tool
SOER	Significant Operating Event Report
SSC	Structures, Systems and Components
SSR	Site Safety Report
SSHAC	Senior Seismic Hazard Analysis Committee
SSRP	Safety Standards and Regulatory Practices
TEDE	Total Effective Dose Equivalent
TLD	Thermo Luminescence Dosimeter
TRANSSC	IAEA Transport Safety Standards Committee
TSO	Technical Support Organisations
WANO	World Association of Nuclear Operators
WASSC	Waste Safety Standards Committee

DEFINITIONS

i. "**assessment**" means the process, and the result, of analysing systematically the hazards associated with *sources* and *actions*, and associated protection and safety measures, aimed at quantifying performance measures for comparison with criteria.

ii. "**authorised**" means permitted in writing by the *Regulator.*

iii. "**authorised action**" means an *action authorised* in terms of the National Nuclear Regulator Act, 1999 (Act No. 47 of 1999).

iv. "**defence in depth**" means the application of more than a single protection measure for a given *radiation or nuclear safety objective*, so that the objective is achieved even if one of the protective measures fails.

v. "**discharge**" means a planned and controlled release of *radioactive nuclides* to the environment;

vi. "**disposal**" means the emplacement of *radioactive waste* in an approved, specified facility without the intention of retrieval and *"dispose of"* has the corresponding meaning;

vii. "**emergency planning**" means the process of developing and maintaining the capability to take actions that will mitigate the impact of an emergency on persons, property or the environment.

viii. "**emergency preparedness**" means the capability to promptly take action that will effectively mitigate the impact of an emergency on persons, property or the environment.

ix. "**nuclear safety**" means the achievement of safe operating conditions, prevention of nuclear accidents or mitigation of *nuclear accident* consequences, resulting in the protection of workers, public and the environment against the potential harmful effects of ionising radiation or *radioactive material*;

x. "**operational safety assessment**" means a *safety assessment* undertaken during operations.

xi. "**prior safety assessment**" means a *safety assessment* undertaken prior to commencement of operations.

xii. "**radioactive waste**" 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.*

xiii. "**safety assessment**" means an analysis to evaluate the performance of an overall system and its impact; where the performance measure is radiological impact or some other global measure of impact on safety.

xiv. "**safety culture**" means the assembly of characteristics and attitudes in organisations and individuals which establishes that, as an overriding priority, protection and safety issues receive the attention warranted by their significance.

SECTION A: INTRODUCTION

South Africa ratified the Convention on Nuclear Safety (CNS) in 1996, and its obligations under the convention commenced on 24 March 1997. The objectives of the convention as stated in Article 1 are to:

i. achieve and maintain a high level of nuclear safety worldwide through the enhancement of national measures and international cooperation including, where appropriate, safety-related technical cooperation;
ii. establish and maintain effective defences in nuclear installations against potential radiological hazards in order to protect individuals, society and the environment from the harmful effects of ionizing radiation resulting from such installations, and
iii. prevent accidents with radiological consequences, and mitigate such consequences should they occur.

As a Contracting Party to the convention, South Africa is required to fulfil its obligations by demonstrating how the objectives of the convention, especially a high level of nuclear safety, have been achieved in the country. Each Contracting Party is obligated to periodically prepare and submit a National Report to the Review Meeting of the IAEA. Consequently, all stakeholders with a legal responsibility for the safety of nuclear installations, or their regulation in the country, were invited to participate and contribute to the compilation of the 6th South African National Report, as foreseen in the convention. In addition to this, South Africa promotes international cooperation to enhance global nuclear safety, through various instruments such as bilateral and multilateral agreements.

As provided for in the *Guidelines Regarding National Reports under the Convention on Nuclear Safety, INFCIRC/572/Rev.4* [5.1], the intent of a periodic review process is to encourage the continuous improvement of safety as a whole. This not only requires reporting on changes since the last review of the national report, but it also pronounces on the extent to which relevant stakeholders have been involved in the process of compiling the national report.

Under the Guidelines, the national report must, as far as possible, be submitted by a Contracting Party in a form, length and structure that it believes will facilitate the ease of describing how it has implemented its obligations under the convention. Furthermore, the need for effective and efficient review requires that the national reports must have as far as possible a similar format, in order to assist comparison, although a flexible approach may be adopted. The aim is to make the reports as easy to read and to understand by other Contracting Parties as possible.

In terms of Section 5(e) of the National Nuclear Regulator (NNR) Act [1.1], the NNR is mandated to fulfill national obligations with respect to international instruments concerning nuclear safety, and to act as the national competent authority in connection with the International Atomic Energy Agency's Regulations for the Safe Transport of Radioactive Material. The NNR coordinates and implements South Africa's Contracting Party (CP) obligations to the IAEA Convention on Nuclear

Safety and the Joint Convention on the Safety of Spent Fuel Management and on the Safety of Radioactive Waste Management.

The national policy towards nuclear energy in South Africa is expressed in the Integrated Energy Plan for the Republic of South Africa (2003) [2.1], the White Paper on Energy Policy (2008) [2.2], and the Nuclear Energy Policy and Strategy for the Republic of South Africa (2008) [2.3], which make provision for a planned energy mix and an increase in the nuclear energy component. The intention is to promote diversification and security of energy supply; optimal utilisation of the country's uranium resources; visible contribution to economic growth; technology and infrastructure development; job creation, and skills development. In terms of the policies, nuclear energy shall be used only for peaceful purposes and in conformity with national and international legal obligations and commitments. All nuclear energy sector activities shall take place within a legal regulatory framework consistent with international best practice, giving highest priority to nuclear and radiation safety. The Integrated Resource Plan of 2010/2011 (IRP2010) [2.4] makes provision for the expansion of nuclear generation capacity of 9,6 GWe for electricity supply between 2023 and 2030.

South Africa has more than 25 years of experience in the safe operation of its two-unit 1 840 MW Koeberg NPP, and has, in addition to this, experience in research, development and use of nuclear-related technology.

This report provides an update on the South African activities in compliance with the Articles of the Convention on Nuclear Safety since the last National Report was compiled in September 2010 [3.4] and presented at the 5th Convention Review Meeting in April 2011. The main issues addressed in this report are the issues relating to Koeberg NPP, namely the periodic reviews, the post-Fukushima review, safety improvements implemented and planned, envisaged nuclear expansion in South Africa including nuclear sites, developments in the nuclear regulatory framework and the NNR regulatory self-assessment. The report has been updated to conform to INFCIRC/572 Rev 4 [5.1].

SECTION B: SUMMARY

This Report presents South Africa's continued efforts to achieve the objectives of the Convention on Nuclear Safety. The highlights of the Report are summarised below:

B.1 Important safety issues that have been identified since the previous National Report

a. The first periodic safety re-assessment of Koeberg NPP and the associated corrective actions are reported on in Article 14 (Section 14.1.3.2) of this report. The second periodic review is reported on in Article 14 (Section 14.1.3.3).

b. Improvements to operational safety-related programmes and operator training are discussed in various Articles as follows:

   i. Revision of accident procedures and compilation of relevant background documentation Article 19 (Section 19.4.3)

   ii. Implementation of a Systematic Approach to Training and subsequent Institute of Nuclear Power Operations (INPO) accreditation of operator training. Article 11 (Section 11.2.3)

   iii. Severe Accident Management Guidelines (SAMGs) were implemented in 2000 and have subsequently been updated. Additionally shutdown SAMGs have been developed and implemented. Article 18 (Sections 18.1.4, 19.4.3)

   iv. Rules for accident analysis. This was developed following the first periodic review and has been updated in preparation for future projects. The rules address both design basis and beyond design basis accidents. Article 14 (Section 14.1.3.2)

   v. Revised Operating Technical Specifications (Article 19, Section 19.2.2) and development of shutdown Operating Technical Specifications.

   vi. Safety Related Surveillance Manual: functional testing and surveillance requirements, and associated bases. Article 19 (Section 19.3.2)

   vii. Installation of second plant simulator for Koeberg NPP and construction of additional training facilities. Article 11 (Section 11.2.4).

B.2 Future safety-related activities and programmes planned for next period until the 7th Review Meeting

a. The Steam Generator Replacement and Thermal Power Uprate projects are reported in Article 14 (Section 14.2.3).

b. The replacement of the refuelling water storage (PTR) tanks is reported in Article 14 (Section 14.2.3).

c. With the country's growing energy requirements regularly under increasing scrutiny and the increasing concern for carbon emissions from the global community, nuclear power has been presented as a viable consideration as part of the energy generation mix.

d. Eskom is conducting assessments on new nuclear sites and is considering applying for site licences for these sites as part of its early engagement activities. Article 17 (Section 17.1.1.1).

e. Spent fuel dry storage for Koeberg NPS and for a nuclear fleet is reported in Article 19 (Section 19.8.2).
f. As reported below, the NNR is continuing with its preparations for the new build project, including development of regulations, position papers and guidelines.
g. Regulations on the Siting of New Nuclear Installations (R.927) [1.8] were promulgated in 2011. Article 17 (Section 17.1.1).
h. The NNR regulatory self-assessment following IAEA methodology, and follow-up actions, as well as a regional project to promote regulatory self-assessments and regulatory infrastructure development are reported in Article 8 (Section 8.1.9.2).

B.3 Special attention given to issues and topics as identified and agreed upon by the Contracting Parties at the Organizational Meeting

Among other matters discussed and agreed upon at the Organisational Meeting of the Contracting Parties, which was held in Vienna on 29 September 2009, were the following: establishment of Country Groups; invitation to inter-governmental organisations to attend the Review Meeting of Contracting Parties as observers; and further improvements in the effectiveness and efficiency of the review process. There is no follow-up activity for South Africa on this item.

B.4 Responses to the Results of the Previous Peer Review: Suggestions and / or Challenges summarised in the Rapporteur' Reports: Announcements or voluntarily accepted action at the previous Review Meeting

The various points noted in the Rapporteurs Report of Country Group 2 of 11 April 2011 are covered as follows:

a. Organisational matters including independence of regulatory bodies are taken up in Article 8 (Section 8.2.3).
b. The self-assessment of regulatory bodies in terms of the legislative and regulatory framework for nuclear and radiation safety using the IAEA Self-Assessment Methodology and its associated Self-Assessment Tool (SAT) software is reported in Article 8 (Section 8.1.9.2). Article 8 (Section 8.1.9) also addresses the development of the Quality Management System (QMS) of the NNR.
c. Article 8 (Section 8.1.4.3) addresses human resource/staffing and training in the regulatory body. Attraction of skilled human resource and retention of staff are referred to in Article 8 (Sections 8.1.5 and 8.1.8).
d. Probabilistic safety assessment is covered in terms of requirements [4.1], and applications in Article 7 (Sections; 7.2.1, 12.3.1.3, 14.1.2, 19.2.2).
e. Article 10 (Section 10.2.2) addresses safety culture enhancement.
f. Article 14 (Section 14.2) has been updated in terms of the ageing management programmes.
g. The response to the Fukushima accident and related issues regarding external events are covered in Article 14 (Sections 14.1.4.3 and 16.1.5.1), and Annexure D3.
h. The regulations on the Siting of New Nuclear Installations [1.8] are referred to in Article 7 (Section 7.2.1.1) and Article 17.

i. Article 8 (Section 8.2.5) International Cooperation refers to the FNRBA (Forum of Nuclear Regulatory Bodies in Africa), which was launched in March 2009 for harmonisation of the radiation protection, nuclear safety and security regulatory infrastructure and framework.

j. Safety upgrades implemented in Koeberg NPP as part of the French CP-1 benchmarking and alignment project are discussed in Article 18 (Section 18.1.5). Other upgrades are discussed in Article 18 (Sections 18.1.2 to 18.1.5).

B.5 Significant changes to the national nuclear energy and regulatory control programs and measures taken to comply with the convention's obligations

a. The South African national nuclear energy program is discussed under Part A. INTRODUCTION, of this Report.

b. Article 8 (Section 8.1.9.2) addresses regulatory programme development.

c. Article 8 (Section 8.2.5) addresses international cooperation, including measures taken to comply with the convention's obligations.

B.6 Respond to IAEA Generic Safety Observations Report (see Section III of the CNS Guidelines) if provided and if relevant to the particular national situation

This item is not relevant to this Report.

B.7 Results of international peer review missions including IAEA missions conducted, progress made in implementing any findings, and follow-up plans

a. International peer review missions including IAEA (SALTO, OSART) and WANO missions are reported in Article 19 (Section 19.3.6).

B.8 Operating experience, lessons learned and corrective actions taken in response to accidents, incidents and events of significance for safety of nuclear installations

a. Operational experience feedback is reported on under Article 19 (Section 19.7).

B.9 Lessons learned from emergency drills and exercises

a. Emergency exercises and corrective actions are reported in Article 16 (Section 16.1.5.2).

B.10 Actions taken to improve transparency and communication with public

a. Article 16 (Section 16.2) addresses public information on emergency planning and emergency situations.

b. Openness and transparency of regulatory activities are reported in Article 8 (Section 8.1.10).

B.11 Respond to any recommendations adopted at the plenary sessions of the previous Review Meeting of the Contracting Parties

As was agreed at the 5th Review Meeting of the Convention on Nuclear Safety which was held from 4 to 14 April 2011, the 2nd Extraordinary Meeting of the Convention was held at the IAEA Headquarters in Vienna from 27 to 31 August 2012. The objectives of the Extraordinary Meeting were to review and discuss lessons learned so far from the Fukushima Daiichi nuclear power plant accident, and to review the effectiveness of the provisions of the convention. These issues and topics are discussed under Annexure D.3, in line with the provisions of Article 14 (i) of the convention, which state that each Contracting Party shall take appropriate steps to ensure that systematic safety assessments shall be carried out on a nuclear installation, and shall be well-documented and updated, in the light of operating experience and significant new safety information. Consequently, a review of the re-assessment of Koeberg NPS to verify whether the plant would withstand a Fukushima-type accident was conducted (refer to Annexure D.3).

SECTION C: ARTICLES
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 that the convention becomes applicable 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 a safety upgrade 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

Section 6.2 has been added to cover significant safety-related issues over the last three years, and measures taken in response to these issues.

Section 6.3 has been updated with respect to planned programmes and measures for continued safety upgrading.

Section 6.4 has been added on identification of installations for which decisions on shutdown have been made.

Section 6.5 has been added with a statement on the position of the Contracting Party, concerning the continued operation of the nuclear installations.

6.1 Existing nuclear power plants

There is no change in the existing nuclear power plants. 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, when assessed, to require any significant corrective actions under Articles 10 through 19 of this convention. However, safety improvements initiatives have been, and still are being implemented at the nuclear installations indicated above, since South Africa ratified the convention in 1996 and it became enforceable on 24 March 1997. These safety improvement initiatives are reported in the various Articles 6 to 19 of this report.

6.2 Significant safety-related issues and events

Over the last three years, Koeberg NPP has undertaken two unplanned defueling short-duration outages, one to locate and replace a leaking fuel element, and the other more recently to repair a primary circuit bypass loop isolation valve.

Significant interaction has occurred with the fuel vendor to improve fuel reliability. With the initiatives that are now in place to address legacy fuel issues, the general fuel performance at Koeberg should see sustainable improvement. The failure mechanism of the primary circuit valve is understood and appropriate inspection and maintenance programmes are in place for the other susceptible valves.

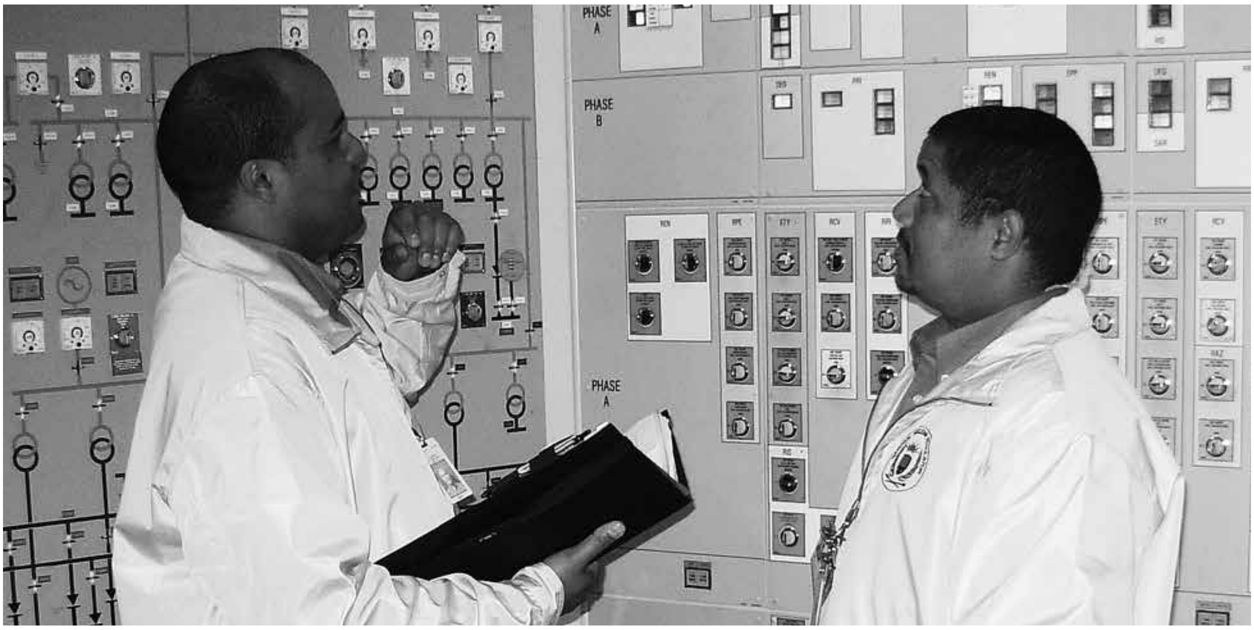
A reactor scram and a turbine trip have occurred on separate occasions following the loss of grid supplies. Grid reliability is a concern for the safe operation of Koeberg and is receiving focused attention by the utility that also operates the country's transmission system.

Inadequate vendor management has been seen as a root cause of other unplanned shutdowns. Both units had to be shut down to effect repairs to through-wall leaks in the essential service sea water cooling system, as a result of poor application of the pipes' rubber linings. Another reactor trip was caused when contractors inadvertently shorted a relay in an electrical panel when pulling cables for a plant modification to the plants radiation-monitoring system.

A number of interventions have been conducted, and systems put in place to improve vendor management, but this remains a focus area. There have been no safety related issues or events at Koeberg NPP graded level two or above on the INES scale. For INES level one, two events were reported.

6.3 Planned programmes and measures for continued safety upgrading

Modifications conducted subsequent to commissioning of the Koeberg units are discussed in Sections 18.1.2 to 18.1.4, including the completion of the modifications and other corrective actions identified in the first periodic review (reported in the previous CNS report), to align Koeberg



NPP to French CP-1 plants. The second periodic safety review of Koeberg NPP and the post-Fukushima review are discussed in Section 14.1.3.3.

6.4 Identification of installations for which decisions on shutdown have been made

The NNR has not identified any installations for which decisions on shutdown were necessary.

6.5 Position of the regulator concerning the continued operation of the nuclear installations

The NNR accepts the continued operation of Koeberg NPP based on the following:

i. The positive outcome of the assessments discussed in Sections 14 and 18, which demonstrate that Koeberg NPP complies with the safety standards (Section 7), including the design base, dose and risk criteria, and fundamental principles of nuclear safety.
ii. The compliance assurance programme (Section 7.2.3) confirms that Koeberg NPP is in compliance with the conditions of licence.
iii. The conclusions of IAEA, OSART and SALTO missions reported in Section 19, and Eskom's timeous response to the findings.

This conclusion is however conditional on the following:

iv. Effectiveness of corrective actions planned or being implemented by Eskom.
v. Effectiveness of recruitment and skills-retention programmes.
vi. Continued cooperation by the local authorities in terms of urban developments in the vicinity of Koeberg NPP.

SECTION C: ARTICLES

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 for 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.

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.

Summary of changes

Section 7.1 has been updated to provide a broader overview of the primary legislative framework for nuclear safety, including interfacing national legislation, and on the ratification of international conventions and legal instruments related to nuclear safety.

i. Section 7.2 has been updated and expanded on in terms of:
ii. National safety requirements and regulations.
iii. The process for development of regulations.
iv. Legal action and directives.

7.1 Establishing and maintaining a legislative and regulatory framework

7.1.1 Overview of the primary legislative framework for nuclear safety

[Overview of the primary legislative framework for nuclear safety, including interfacing national legislation]

The nuclear sector in South Africa is mainly governed by the Nuclear Energy Act, (Act no. 46 of 1999), the National Nuclear Regulator (NNR) Act, (Act no. 47 of 1999) [1.1] and National Radioactive Waste Disposal Institute Act, (Act no. 53 of 2008) [1.5].

Other legislation that has relevance for the nuclear industry includes the:
i. Hazardous Substances Act
ii. Non-Proliferation of Weapons of Mass Destruction Act
iii. Patent Act

iv. National Strategic Intelligence Act
v. National Key Points Act
vi. Protection of Constitutional Democracy Against Terrorist and Related Activities Act
vii. Mine Health and Safety Act
viii. Mineral and Petroleum Resources Development Act
ix. National Environmental Management Act
x. National Water Act
xi. Dumping at Sea Control Act.

The NNR operates within the following national legislative and regulatory frameworks:
i. The Constitution of the Republic of South Africa (Act no. 108 of 1996)
ii. Nuclear Energy Act (Act no. 46 of 1999).
iii. Public Finance Management Act (Act no. 1 of 1999)
iv. National Treasury Regulations
v. National Radioactive Waste Management Bill – Notice no 654 of 2008
vi. Promotion of Access to Information Act (Act no. 2 of 2000)
vii. Promotion of Administrative Justice Act (Act no. 3 of 2000)
viii. RSA Government Gazette 8755 – Safety Standards R388, 28 April 2010.

The NNR enters into co-operative governance agreements to give effect to the principles of co-operative government and intergovernmental relations as contemplated in the regulations in terms of Section 6(3) of the National Nuclear Regulator Act (Act no. 47 of 1999) [1.1] and in terms of Section 239, Chapter 3 of the Constitution of the Republic of South Africa (Act no. 108 of 1996).

The nuclear sector in South Africa is mainly governed by the Nuclear Energy Act, Act 46 of 1999 [1.2] and the National Nuclear Regulator Act (NNRA) [1.1]. Both these Acts are administrated by the Minister of Energy, through the Department of Energy (DoE). The South African regulatory body, the National Nuclear Regulator (NNR), is established by the NNRA. Its mandate is described under Article 7.2.2.1.

Additionally, the Department of Health: Radiation Control Directorate administers the Hazardous Substances Act, Act 15 of 1973 [1.3], related to Group III and Group IV hazardous substances, which include all radioactive material which is intended to be used for medical, scientific, agricultural, commercial or industrial purposes.

The National Radioactive Waste Disposal Institute (NRWDI) was established by the National Radioactive Waste Disposal Institute Act (Act No 53 of 2008) [1.5]. This act applies to all radioactive waste in the Republic of South Africa, destined to be disposed of in an authorised waste disposal facility. Transitional arrangements have been put in place to ensure that radioactive waste is properly managed, until the Institute is fully established.

The Nuclear Energy Policy and Strategy for the Republic of South Africa [2.3] was published in June 2008. As described in the introduction to this report, 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 the security of energy supply.

7.1.2 Ratification of international conventions and legal instruments related to nuclear safety

South Africa operates within the following international nuclear legislative frameworks:

South Africa has been a member state of the IAEA (International Atomic Energy Agency) since 1957 and has the following multilateral agreements in force:

i. Agreement on the Privileges and Immunities of the IAEA [5.2]
ii. Convention on the Physical Protection of Nuclear Material [5.3]
iii. Convention on Early Notification of a Nuclear Accident [5.4]
iv. Convention on Assistance in the Case of a Nuclear Accident or Radiological Emergency [5.5]
v. Convention on Nuclear Safety [5.6]
vi. Joint Convention on the Safety of Spent Fuel Management and on the Safety of Radioactive Waste Management [5.7]
vii. Revised Supplementary Agreement Concerning the Provision of Technical Assistance by the IAEA (RSA) [5.8]
viii. African Regional Co-operative Agreement for Research, Development and Training Related to Nuclear Science and Technology (AFRA) - Fourth Extension [5.9]
ix. Safeguards Agreement between the IAEA and the government of the Republic of South Africa for application of safeguards in connection with the Treaty on the Non-Proliferation of Nuclear Weapons, 1744 [5.10]
x. Protocol additional to the agreement between the government of the Republic of South Africa and the International Atomic Energy Agency for the application of safeguards in connection with the Treaty on the Non-Proliferation of Nuclear Weapons [5.11].

Legally-binding nuclear safety conventions

i. South Africa ratified the Convention on Nuclear Safety (CNS) [5.6] in 1996 and its obligations under the CNS commenced on 24 March 1997.
ii. In November 2006, South Africa acceded to the Joint Convention on the Safety of Spent Fuel Management and on the Safety of Radioactive Waste Management [5.7] and its obligations under the joint convention commenced in February 2007.

As a member state of the International Atomic Energy Agency (IAEA), South Africa is required to fulfil its respective international obligations and promote international cooperation to enhance global nuclear safety. In terms of Section 5(e) of the NNR Act [5.1], the NNR is mandated to fulfil national obligations with respect to international instruments concerning nuclear safety, and to act as the national competent authority in connection with the International Atomic Energy Agency's Regulations for the Safe Transport of Radioactive Material [5.12].

The NNR co-ordinates and implements South Africa's Contracting Party (CP) obligations to the IAEA Convention on Nuclear Safety [5.6] and the Joint Convention on the Safety of Spent Fuel Management and on the Safety of Radioactive Waste Management [5.7].

7.2.1 National safety requirements and regulations

7.2.1.1 Overview of the secondary legislation for nuclear safety

Regulations on National Safety Standards and Regulatory Practices (SSRP) [1.7] were promulgated on 28 April 2006 and these regulations are being enforced for all nuclear-authorisations holders and applicants for nuclear authorisations in the country. These regulations are based on international safety standards and regulatory practices.

Regulations on the Siting of New Nuclear Installations (R.927) [1.8] were promulgated in 2011.

The Department of Energy published draft regulations on the control of developments surrounding the Koeberg NPP for public comment in November 2010, under Government Notice No 33678. Comments from the public and local authorities have been received and reviewed. The delay in finalising the regulations is due to protracted engagements with the local authorities.

7.2.1.2 Overview of regulations and guides issued by the regulatory body

In support of these regulations the NNR presently has Regulatory Requirements documents, which are referenced in the various nuclear authorisations granted to the nuclear facilities regulated by the NNR, as well as supporting Regulatory Guidance documents.

The conditions of the nuclear licence for Koeberg NPP, and the associated regulatory requirements and regulatory guides address the following:

i. Plant description, design and configuration
ii. Control of plant design and configuration
iii. Modifications
iv. Safety assessment, including PSA
v. Scope of activities that may be undertaken
vi. Controls and limitations on operation
vii. Maintenance, in-service inspection and testing
viii. Operational radiation protection

ix. Effluent management
x. Radioactive waste management
xi. Environmental monitoring
xii. Accident management
xiii. Emergency planning and preparedness
xiv. Transport of radioactive material
xv. Nuclear security
xvi. Decommissioning
xvii. Financial security
xviii. Inspection programme
xix. Quality and safety management
xx. Licensing of reactor operators
xxi. Acceptance and approval
xxii. Reporting
xxiii. Safety culture
xxiv. On-site developments

7.2.1.3 Process of establishing and revising regulatory requirements

[Overview of the process of establishing and revising regulatory requirements, including the involvement of interested parties]

In terms of regulatory requirements issued as regulations, the process may be summarised as follows. The NNR prepares and submits draft regulations to the Minister of Energy, via the NNR board. The Department of Energy publishes the draft regulations for comment by interested and affected parties. The NNR reviews and responds to the comments in writing, and prepares a report on the outcome of the public process. This report with proposed changes is submitted to the minister via the board. The minister issues the regulation.

In terms of regulatory requirements issued, either directly in the nuclear licence, or in requirements documents referenced in the authorisation, these are developed and updated as necessary, after consultation with the relevant authorisation holders, and ratified by the NNR board.

The NNR and the Directorate of Radiation Control (RADCON) in the Department of Health (DOH) have recently conducted a self-assessment, reported in Section 8.1.9.

One of the conclusions of the self-assessment is that the nuclear and radiation regulatory framework needs to be improved, through the development of additional regulations and guidelines. For nuclear installations, the intention is to incorporate (elevate) the regulatory requirements presently referenced in the nuclear authorisations, including the Regulatory Requirements documents, (Section 7.2.1.2) into regulations, as well as to take into consideration ongoing international developments and trends regarding standards and regulatory practices. This should provide greater clarity, consistency and predictability in the nuclear regulatory process.

Arising from the Fukushima assessment (Section 14.1.4.3), the NNR has identified areas for improvement of the regulatory standards and regulatory practices which will be considered for inclusion in the new regulations, which go beyond design-basis accidents to address requirements on assessments, modifications, testing and maintenance.

7.2.2 System of licensing

7.2.2.1 Overview of the licensing system

The mandate of the NNR is given in Section 8.1.2, and authorities and responsibilities in Section 8.1.3, including those activities which require a nuclear authorisation.

Liability for nuclear damage and the provisions for financial security are dealt with in chapter 4 of the NNRA [1.1]. Safety and emergency measures, as well as the powers and duties of inspectors, are embodied in chapter 5 of the NNRA.

Section 23 of the NNRA empowers the NNR to impose such conditions as it deems necessary or desirable for the purpose of safeguarding 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, information and documentation. The provisions relating to inspectors are comprehensively set out in Section 41 of the NNRA.

Relicensing

Although relicensing per se is not conducted, periodic reviews are required, at a frequency acceptable to the NNR (ten-yearly) as described in Section 14. Based on these reviews, corrective actions are identified, and conclusions drawn on the continued operation of the plant.

7.2.2.2 Involvement of the public and interested parties

The NNRA [1.1] requires that the chief executive officer directs the applicant for a nuclear installation or vessel licence to serve a copy of the application upon every municipality affected by the application, and any other such body or person as the chief executive officer determines, and that a copy of the application is published in the Government Gazette and two newspapers circulating in every such municipality.

The act allows any person who may be directly affected by the granting of a nuclear installation or vessel licence pursuant to an application to make representations to the board, relating to health, safety and environmental issues connected with the application, within 30 days of the date of publication in the Gazette.

Further, if the board is of the opinion that further public debate is necessary, it may arrange for such hearings on health, safety and environmental issues as it determines. For this purpose the NNR prepares a public information document following initial review of the safety analysis report.

Subject to the board's approval, the chief executive officer may refuse an application for a nuclear installation or vessel licence and must provide the applicant with the reasons for the refusal in writing; or grant a nuclear installation licence or nuclear vessel licence subject to such conditions as may be determined.

7.2.2.3 Legal provisions to prevent the operation of a nuclear installation without a valid licence

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 a person on application to the NNR.

7.2.3 System of regulatory inspection and assessment

7.2.3.1 Overview of regulatory strategy

The regulatory strategy is provided in a document on the regulatory philosophy of the NNR, which refers to fundamental safety standards and principles (which include for example dose and risk limits and nuclear safety principles relating to the plant design and operation in-line with international practice). The NNR issues regulatory requirements and guidelines, which include these fundamental standards and principles.

The holder submits a safety case (which includes inter alia the SAR, OTS, operating, accident procedures) to demonstrate compliance to these regulatory requirements, in accordance with guidelines issued by the NNR.

The NNR assesses the safety case and issues a nuclear licence which enforces the safety standards and holds the applicant to their commitments and undertakings referenced in the safety case. The NNR establishes and conducts an annual inspection programme against the licence conditions, including environmental surveys and emergency exercises, and conducts enforcement as prescribed by the NNR Act.

7.2.3.2 Overview of the regulatory inspection and assessment process

The following safety assessments are required to be submitted by the applicant or holder:

i. Safety assessment for a site licence
ii. Safety assessment for authorisation to manufacture components
iii. Preliminary Safety Analysis Report for construction licence (may be combined with i.)
iv. Safety Analysis Report for operating licence
v. Safety assessments for modifications
vi. Safety assessments for nuclear authorisation changes (e.g., changes to licence binding procedures)
vii. Safety assessments for new safety issues
viii. Periodic safety assessment
ix. Safety assessment for decommissioning

The requirements for the above are provided in the respective regulations, requirements documents, nuclear licences, position papers and guidelines.

Submissions are received by the programme manager and, after screening, are assigned to a technical division comprising various groups covering design safety, operational safety, radiation protection and nuclear security. The review process is described in guidelines which address the specific requirements imposed by the nuclear regulatory framework. The outcome of the assessment is coordinated by the heads of these groups, in conjunction with the programme manager who submits the final response to the holder.

For large projects a detailed review plan is developed in conjunction with the holder, which includes timelines for preparation and review of documents by the holder and the regulator, and overall context in the safety case. Periodic reviews are required. The NNR follows up on the implementation of modifications and corrective actions. New authorisations require a directive from the NNR Board to the CEO of the NNR to approve the application. The NNR structure includes a Compliance Assurance and Enforcement Division (CAE) responsible for conducting compliance inspections against the conditions of licence, and enforcement.

7.2.3.3 Basic features of inspection programmes

The annual baseline Compliance Assurance Plans (CAPs), covering all facilities and actions regulated by the NNR involving radioactive materials, are developed and implemented by the Compliance Assurance and Enforcement Division of the NNR, in accordance with the regulatory framework.

The CAP is aligned to the four pillars: operation, design, environment and radiation protection, and emergency planning and security, and takes into consideration:

i. Trending and grading of inspection findings
ii. Operational experience feedback
iii. International experience feedback

The scope of inspections includes:

i. Compliance assurance audits and inspections to determine compliance with regulatory requirements
ii. Investigations and occurrences
iii. Regulatory emergency and nuclear security exercises
iv. Environmental surveillance
v. Follow-up on findings and/or non-compliances

The overall cumulative impact of the inspection findings is used to provide an indication of the overall state of health of the nuclear installation. A summary of the compliance and safety status of the nuclear facilities is included in the regulator's annual report.

The NNR has four inspectors and a chief inspector dedicated to Koeberg NPP, based at a site office near the plant.

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.

7.2.4 Enforcement of applicable regulations and terms of licences

7.2.4.1 Power to take legal action

The NNR Act [1.1] confers the necessary powers on the NNR to take legal action.

7.2.4.2 Overview of enforcement measures available to the regulatory body

Offences, and the appropriate sanction for the commission of such offences, are contained in the provisions of Section 52 of the NNRA [1.1]. These include fines or imprisonment.

The NNR may, in terms of the provisions of Section 27 of the NNRA, revoke a nuclear authorisation at any time. It is furthermore empowered to impose such conditions, as it deems necessary to prevent nuclear damage, upon the holder of the relevant nuclear installation licence, during their period of responsibility, as defined.

7.2.4.3 Experience with legal actions and enforcement measures

As regards the nuclear installations, there has been no need for any legal action per se.

As regards enforcement measures, the NNR has issued directives of the following types:

i. Conduct various safety reassessment (e.g. post-Fukushima)
ii. Suspension of shipment of radioactive waste (due to inspection finding on the documentation)
iii. To submit reports, data, justifications etc., to support regulatory decisions

SECTION C: Articles
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 fulfil 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 utilisation of nuclear energy.

Summary of changes

Section 8 (1), Establishment of the regulatory body, has been rewritten and expanded on under the headings provided in INFCIRC/572 Rev 4 [5.1]:

8.1 Establishment of the regulatory body
8.1.1 Legal foundations and statute of the regulatory body

The South African Regulatory Body, the National Nuclear Regulator (NNR), was established by the NNR Act (Act No 47 of 1999) [1.1], to regulate nuclear activities, for its objects and functions, for the manner in which it is to be managed, and for its staff matters; to provide for safety standards and regulatory practices for protection of persons, property and the environment against nuclear damage; and to provide for related matters.

8.1.2 Mandate, mission and tasks

The NNR is mandated by the NNRA [1.1] to provide for the protection of persons, property and the environment against nuclear damage through the establishment of safety standards and regulatory practices, the granting of nuclear authorisations, and implementation of a system of compliance inspections and enforcement.

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 NNR therefore exercises regulatory control over the safety of nuclear installations, nuclear vessels, radioactive waste, irradiated nuclear fuel, the mining and processing of radioactive ores and minerals and any actions involving radioactive material capable of causing nuclear damage. The Directorate of Radiation Control (RADCON) of the Department of Health is responsible for regulatory control of electronic generators of ionizing and non-ionizing radiation (Group III hazardous substances) as well as regulating radionuclides (Group IV hazardous substances), intended to be used for medical, scientific, agricultural, commercial or industrial purposes.

8.1.3 Authorities and responsibilities

The authorities and responsibilities of the NNR are defined in chapters 2 and 3 of the NNR Act (NNRA) [1.1].

Chapter 2 of the NNRA specifies that the Objects of the Regulator are to:

i. Provide for the protection of persons, property and the environment against nuclear damage through the establishment of safety standards and regulatory practices.
ii. Exercise regulatory control related to safety over:
   a. the siting, design, construction, operation, manufacture of component parts, and decontamination, decommissioning and closure of nuclear installations;
   b. vessels propelled by nuclear power or having radioactive material on board which is capable of causing nuclear damage
   c. through the granting of nuclear authorisations
iv. Exercise regulatory control over other actions, to which this act applies, through the granting of nuclear authorisations.
v. Provide assurance of compliance with the conditions of nuclear authorisations through the implementation of a system of compliance inspections.
vi. Fulfill national obligations in respect of international legal instruments concerning nuclear safety.
vii. Ensure that provisions for nuclear emergency planning are in place.

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.

In summary, chapter 3 of the NNRA states that no person may site, construct, operate, decontaminate or decommission a nuclear installation, except under the authority of a nuclear installation licence issued by the NNR. Similarly other actions are listed which require other types of authorisations or certificates of exemption. Requirements on applications to the NNR for authorisations are provided in chapter 3 of the NNRA.

8.1.4 Organisational structure of the regulatory body

The NNR, established as an independent juristic person by the NNRA, is comprised of a Board of Directors, a chief executive officer (CEO) and staff. Its mandate and authority are conferred through Sections 5 and 7 of the act, setting out the objectives and functions of the NNR.

The structure of the NNR is depicted in figure 1, including the reporting to the Minister of Energy.

8.1.4.1 The Board of Directors

The executive of the regulatory body reports to a board, which is appointed by the Minister of Energy. The board consists of twelve directors, including an official from the Department of Minerals and 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 to, or remaining as a director of the board if he or she, inter alia, is:

i. a holder of a nuclear authorisation or an employee of such a holder, or
ii. becomes a member of parliament, a provincial legislature, a municipal council, the cabinet or the executive council of a province.

8.1.4.2 The Chief Executive Officer (CEO)

The CEO is appointed by the Minister of Energy and is also a director of the board. The CEO is the accounting officer of the board and has the responsibility to ensure that the functions of the NNR are performed in accordance with the NNRA and the Public Finance Management Act. The CEO holds office for a period not exceeding three years, as specified in the letter of appointment, and may be reappointed upon expiry of that term of office.

8.1.4.3 The Staff of the NNR

The NNR's organisational structure is configured to perform the following core functions (Figure 8-1):

(a) Standards, Authorisation, Review and Assessment (SARA)

The SARA group renders technical assessment functions to all the divisions and consists of four functional subgroups:

i. Design Safety (twelve staff)
ii. Operational Safety (eight staff)
iii. Environmental and Radiation Protection (nine staff)
iv. Emergency Preparedness (two staff)

The functional responsibilities of the SARA group, include:

i. Review of submissions from holders or applicants as requested by the programme managers (NPP, NTWP, NORM)
ii. Conduct safety assessments

iii. Assist in enforcement/compliance assurance on request from CAE
iv. Perform independent assessments of nuclear emergency preparedness at nuclear installations

In addition a Special Projects Team coordinates the following activities:
i. Regulatory research;
ii. Development of regulatory guidance documents;
iii. Development of safety standards;
iv. Development of position papers, and
v. Review of international standards, trends and best practices.

b) Compliance Assurance and Enforcement (CAE)

The CAE group is responsible for conducting compliance inspections and enforcement on the holders of authorisations currently comprising the following ‘Programmes’:
i. Nuclear Power Plants (NPP) (four inspectors)
ii. Nuclear Technology and Waste Products (NTWP) (four inspectors)
iii. Naturally Occurring Radioactive Material (NORM) (seven inspectors)

Nuclear security (three staff) report to the senior manager (CAE).

(c) Management of Regulatory Programmes

Currently the NNR has three regulatory programme managers (NPP, NTWP, NORM) who are responsible for the planning of assessment activities and liaison with the authorisation holders.
i. The NPP Programme Manager is responsible for exercising regulatory control over nuclear power plant projects, including Koeberg NPP.
ii. The NTWP Programme Manager is responsible for exercising regulatory control over activities undertaken by Necsa at the Pelindaba Site (covering research reactors, nuclear fuel fabrication facilities, nuclear technology applications) and the disposal of low and intermediate level waste at the Vaalputs site.
iii. The NORM Programme Manager is responsible for exercising regulatory control over naturally occurring radioactive material arising primarily from the mining and mineral processing of radioactive ores.

(d) Support Services

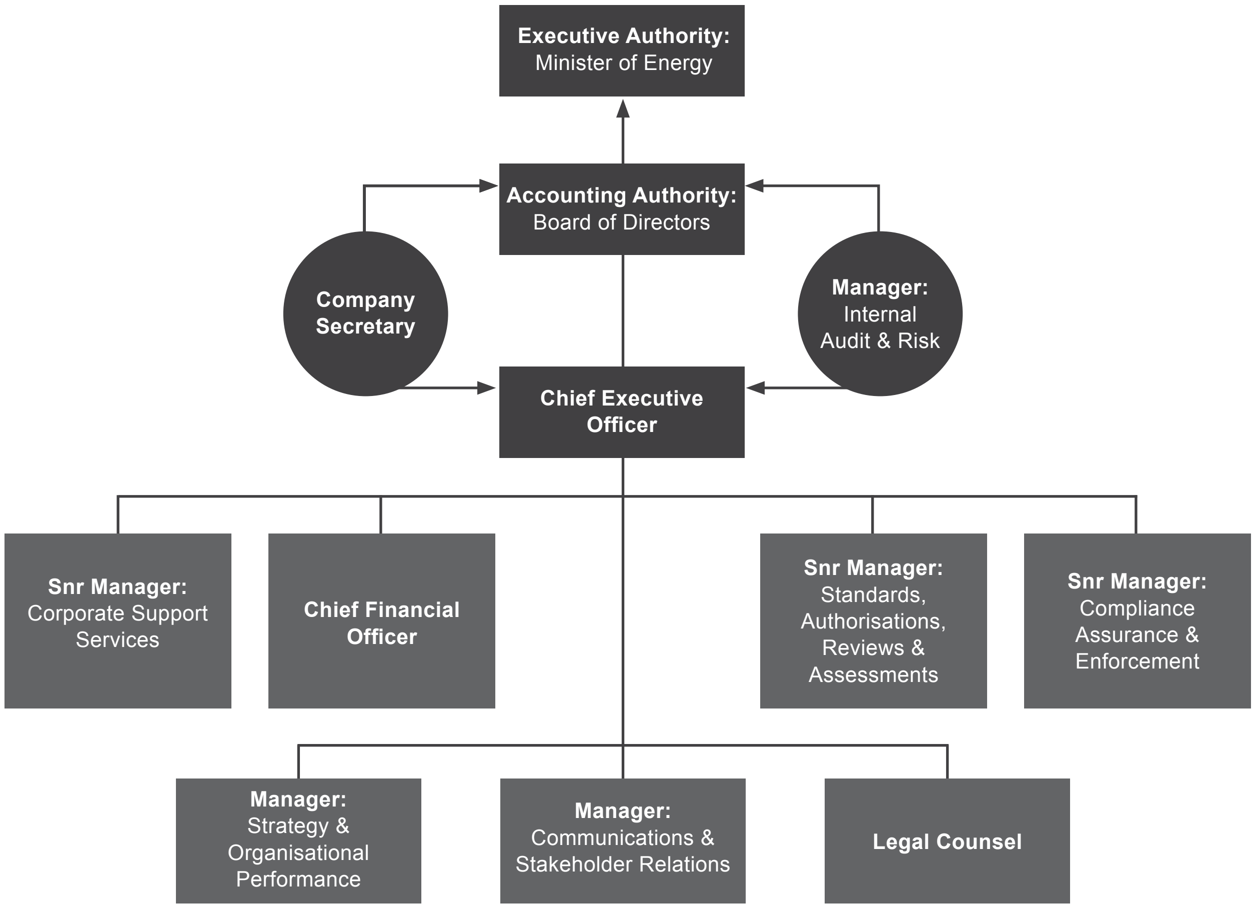
The support service divisions include: Finance, Corporate Services Strategic Planning, Communications and Stakeholder Relations and Legal Counsel.

Overall, the staff complement of the NNR comprises management (19), technical/professional staff (61) and support staff (21). The NNR plans to increase its overall complement by approximately 50 staff members for the nuclear expansion programme.

8.1.5 Development and maintenance of human resources over the past three years

Over the past three years, the NNR has been able to recruit staff in core technical areas such as science and engineering, although, due to competition for scarce skills both locally and abroad, skills retention is still a challenge.

Figure 8-1. NNR Organisational Structure and Reporting Line.



8.1.6 Measures to develop and maintain competence

In support of the capacity building strategy, the NNR runs an internship programme and offers bursaries, with the objective of addressing the inadequate supply of appropriate technical capacity to deliver on its core business.

The NNR strives to maintain high competency levels for the technical employees through continuous participation in local and international workshops and seminars, including those conducted by the IAEA.

8.1.7 Developments with respect to financial resources over the past three years

The capacity of the NNR continues to be supported through both its autonomous establishment and its funding provisions which consist of monies appropriated from parliament, fees paid to the NNR in respect of nuclear authorisations and donations or contributions received by the NNR with the approval of the minister.

8.1.8 Statement of adequacy of resources

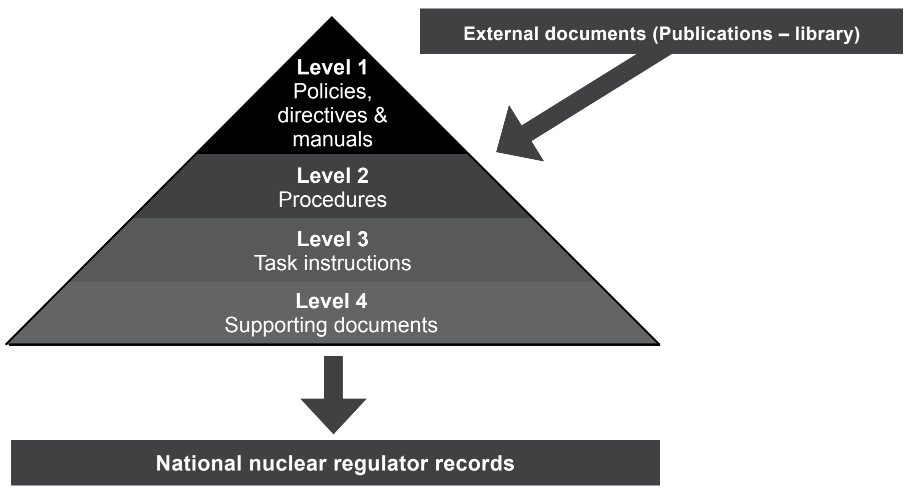
The NNR will require additional skills to cope with upcoming projects such as the steam generator replacement, thermal power uprating, spent fuel dry storage facility at Koeberg NPP, and the envisaged nuclear expansion programme. For this purpose a staff expansion programme is presently being implemented with additional funding provided from licence fees. In some technical areas, where in-house expertise is not readily available, the NNR makes use of external Technical Support Organisations (TSOs) both locally and internationally.

8.1.9 Quality management system (QMS) of the regulatory body

8.1.9.1 Overview of NNR QMS System

As indicated in Sections 1 and 8, the NNR operates within a well-defined framework of national legislation and international conventions and agreements. In order to meet these obligations, the NNR has a well-defined organisational structure, and a quality management system including a comprehensive set of policies and procedures as illustrated in figure 8-2.

Figure 8-2. NNR document structure



The NNR conducts internal audits, and is subject to review by the Audit and Risk Management Committee of the NNR Board, as well as annual audits conducted by the Auditor-General of South Africa.

8.1.9.2 NNR self-assessment and framework development

The NNR together with the Directorate Radiation Control is participating in the IAEA Regional project RAF00938 'Promoting Self-assessment and Networking of Regulatory Bodies for Safety.'

The AFRA Project on 'Self Assessment of Regulatory Infrastructure for Safety and Networking of Regulatory Bodies' was initiated by member states to strengthen national regulatory infrastructure and promote regional cooperation among regulatory bodies. The outcome of the five-year project is expected to include self-assessments compatible with the IAEA methodology.

The project involves two lifecycle reassessments.

The NNR Self-Assessment Lifecycle 1 project is nearing completion and includes:

i. Legislative and government responsibilities
ii. Responsibilities and functions of the regulatory body
iii. Organisation of the regulatory body
iv. Authorisation by the regulatory body
v. Review and assessment by the regulatory body
vi. Inspection and enforcement by the regulatory body
vii. Development of regulations and guides of the regulatory body
viii. Management system for the regulatory body
ix. Radioactive waste management and decommissioning

Progress is being made with the following:

i. Development of regulations (seven regulations drafted and reviewed so far).
ii. NNR induction and training programme developed and implemented.
iii. Requirements for control of Radioactive Sources at NIS.
iv. QMS ISO9001 processes alignment started.
v. National and regional cooperation.
vi. In terms of the Lifecycle 2 self-assessment, the NNR will use the IAEA Self-Assessment of Regulatory Infrastructure for Safety (SARIS) methodology based on GSR Part 1 as opposed to GS-R-1 used in the Lifecycle 1 assessment. The main difference is that Emergency Preparedness and Response was not included in Lifecycle 1. An EPREV mission is planned for 2013/2014 to review the emergency preparedness infrastructure in South Africa. The NNR will coordinate this national self-assessment and will use this information as a basis for Lifecycle 2.

8.1.10 Openness and transparency of regulatory activities

[Openness and transparency of regulatory activities, including actions taken to improve transparency and communication with the public]

In order for openness and transparency to be formalised in the South African context, South Africa has legislation that authorises access to information. The Promotion of Access to Information Act, 2000 (or PAIA; Act No. 2 of 2000) [1.6] is a freedom of information law in South Africa. It allows access to any information held by the State, and any information held by private bodies that is required for the exercise and protection of any rights. The act is enforced by the South African Human Rights Commission (SAHRC). The NNR as a public entity has a manual that outlines the processes and policies associated with information. There have been several requests over the past few years for information concerning incidents, inspections, and standards related to radiation and nuclear safety of nuclear installations.

As part of it efforts to improve openness and transparency, the NNR convenes quarterly information sharing meetings with civil society NGOs from different regions within South Africa.

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.

The NNR's communication with stakeholders is underpinned by its corporate value of openness and transparency. The NNR's communication thrust is aimed at developing and maintaining an awareness on matters related to nuclear radiation, transport and radioactive waste safety amongst all its stakeholders. The NNR's key focus is to ensure that the stakeholder engagement programmes provide an effective vehicle to question and interact with the NNR.

The NNR has adopted a measured approach to media relations, which seeks to inform journalists about programmes and regulatory news via briefings, interviews and news stories. The NNR's 'revamped' website, www.nnr.co.za, is the primary vehicle for communication with external stakeholders. Additionally it provides a tool for online interaction.

In accordance with the NNR Act the holder of a nuclear installation licence must establish a Public Safety Information Forum to inform the persons living in the relevant municipal area in respect of which an emergency plan has been established in terms of section 38(1) of the Act on nuclear safety and radiation safety matters related to the relevant nuclear installation. The public safety information forum must conduct all meetings open to any member of the public at a minimum frequency of one meeting per quarter. The Public Safety Information Forums are held on a quarterly basis by Eskom, regarding the Koeberg Nuclear Power Station and Necsa, pertaining to the Pelindaba and Vaalputs sites respectively. The nuclear installation licence holder invites the National Nuclear Regulator, the relevant municipality (Disaster Management Centre), the relevant Province (Disaster Management Centre) and relevant national government departments as appropriate, to all meetings to facilitate the sharing of information.

As required by Section 7(j) of the NNRA, the NNR produces 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 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.

8.1.11 External technical support

As indicated in Section 8.1.4.3, the technical safety assessment function of the NNR is carried out within the organisation. The NNR is not supported by a permanent external Technical Support Organisation (TSO). The NNR does however contract the support of consultants companies, both locally and internationally.

The NNR is sensitive to the issue of 'Conflict of Interests' and as such, in the selection process, request to be provided with the assurance and evidence that the companies are not connected with any other organisations e.g. licence holders, that 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.

In addition, the NNR has access to technical support on PWR reactor technology from other regulatory authorities with whom the NNR has entered into bi-lateral agreements (8.2.5.1).

8.1.12 Advisory committees

The Technical Committee of the NNR Board was established in 2011, comprising three non-executive directors and two external members who are experts in technical, legal or environmental matters. The role of the committee is to review the policies and practices as well as specific technical issues regarding regulatory control over nuclear installations, and to advise the board accordingly.

8.2 Status of the regulatory body

8.2.1 Place of the regulatory body in the governmental structure

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 being brought upon it.

8.2.2 Reporting obligations

[Reporting obligations to parliament, government and specific ministries]

Section 7 of the NNRA [1.1] requires that the NNR produce and submit to the Minister of Energy, an annual public report for tabling in parliament on the health and safety of workers, the public and the environment associated with all the regulated actions.

Additionally, Section 6 of the NNRA requires cooperative governance agreements between the NNR and other relevant organs of state, with functions relating to 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 nuclear hazards.

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

8.2.3 Regulatory independence

[Means by which effective separation of the regulatory body from the agencies responsible for promotion of nuclear energy is ensured]

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

The NNR operates independently from the government, when 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 to ensure that regulatory decisions are made free of other interests that may conflict with safety. The electrical utility in South Africa which operates Koeberg NPP, Eskom, reports to the Minister of Public Enterprises.

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 NNR Board. From the above-mentioned Sections it is clear that the 'de jure' independent status of the NNR is adequately provided for in the NNRA.

With regards to the 'de facto' independence of the NNR, the NNRA provides that if the minister rejects a recommendation of the board, on the contents of regulations to be published, the minister and the board must endeavour to resolve their disagreement. In the absence of resolution of such disagreement, the minister has the power to make the decision. No failure to resolve a disagreement has thus far emerged regarding recommendations from the board.

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

8.2.4 Interfaces with other national institutions

[This Section is not required by INFCIRC/572]

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

Eskom Holdings Limited (the nuclear installation licence holder) owns and operates Koeberg NPP (the nuclear installation). 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, with a mandate to essentially: develop, promote and commercially exploit nuclear and related technologies; manage radioactive waste (until this function is taken over by the NRWDI once fully established as indicated in Section 7.2 above) and implement safeguards.

NUFCOR is a commercial company engaged in the final processing and marketing of uranium concentrates. It is a private South African company which has major shareholders from 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.

Cooperative Governance Agreements

To optimise the effectiveness of the nuclear safety regime in South Africa, provisions are made in the NNR Act for the NNR to delegate certain enforcement authority to other relevant organs of state. The NNR Act establishes the principles of co-operative governance and intergovernmental relations (contemplated in Chapter 3 of the Constitution of the Republic of South Africa, 1996 (Act No. 108 of 1996). To give effect to the principles of co-operative government and intergovernmental relations all organs of state which functions in respect of the monitoring and control of radioactive material or exposure to ionizing radiation are conferred by this Act or other legislation, must co-operate with one another in order to;

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

In line with the provisions of Section 6 of the NNR Act, the National Nuclear Regulator has Co-operative Governance Agreements with the following entities;

- The Department of Health
  - Directorate Radiation Control
- The Department of Mineral Regulation
  - Directorate: Mine, Health and Safety Inspectorate
  - Directorate: Mineral Regulation
- Department of Energy
  - Electricity and Nuclear
- Department of Water and Environment
- The Department of Transport
  - Civil Aviation Authority (CAA)
  - Railways Safety Regulator (RSR)
  - Road Transport Management Authority (RTMA)
  - South African Maritime Safety Authority (SAMSA)
- The Department of Labour

Other national cooperation agreement includes: SAPS, NIA and SARS.

8.2.5 International cooperation

This Section is not required by INFCIRC/572.

Nuclear safety is a global issue and international cooperation in relation to nuclear safety, is essential to the development of a global safety regime. The organisations and persons involved in the utilisation of nuclear energy and radiation sources for peaceful purposes are interdependent in that the performance of one may have implications for all, and a serious event in one country may have a significant impact around the world.

South Africa is required as a member state of the International Atomic Energy Agency to fulfil its respective international obligations and promote international cooperation to enhance safety globally. The NNR is mandated in terms of section 5(e) of the NNR Act, to fulfil national obligations in respect of international instruments concerning nuclear safety; and to act as the national competent authority in connection with the International Atomic Energy Agency's Regulations for the Safe Transport of Radioactive Material.

Nuclear Safety Conventions

The International Atomic Energy Agency (IAEA) facilitates the establishment of international conventions on nuclear safety. These are legally binding international instruments which are required to be ratified by country legislature before they can be implemented. The Conventions place obligations on member states.

South Africa is a signatory (Contracting Party) to the Convention on Nuclear Safety; and the Joint Convention on the Safety of Spent Fuel Management and on the Safety of Radioactive Waste Management.

Convention on Nuclear Safety

South Africa ratified the Convention on Nuclear Safety (CNS) in 1996 and South Africa's obligations under the CNS entered into force on 24 March 1997. The obligations of the Contracting Parties are based on the principles contained in the IAEA Safety Fundamentals document "The Safety of Nuclear Installations''. These obligations cover aspects such as siting, design, construction, operation, the availability of adequate financial and human resources, the assessment and verification of safety, quality assurance and emergency preparedness.

The CNS is an incentive instrument and is based on the common interest of Parties to achieve higher levels of safety which will be developed and promoted through regular meetings of the Parties. The CNS obliges Parties to submit country reports on the implementation of their obligations for ''peer review'' at meetings of the Parties to be held at the IAEA. The NNR compiles and submits the country report on behalf of South Africa.

The Joint Convention on the Safety of Spent Fuel Management and on the Safety of Radioactive Waste Management.

South Africa acceded to the Joint Convention in November 2006 and South Africa's obligations under the Joint Convention entered into force in February 2007. The Joint Convention applies to spent fuel and radioactive waste resulting from civilian nuclear reactors and applications, and military or defence programmes,if and when such materials are transferred permanently to an managed exclusively within civilian programmes, or when declared as spent fuel or radioactive waste for the purpose of the Joint Convention by the Contracting Party. In addition, the Joint

Convention applies to planned and controlled releases of liquid or gaseous radioactive materials from regulated nuclear facilities into the environment.

The obligations of the Contracting Parties with respect to the safety of spent fuel and radioactive waste management are based, to a large extent, on the principles contained in the IAEA Safety Fundamentals document – "The Principles of Radioactive Waste Management" published in 1995. They include, in particular, the obligation to establish and maintain a legislative and regulatory framework to govern safety of spent fuel and radioactive waste management and the obligation to ensure that individuals, society and the environment are adequately protected against radiological and other hazards, inter alia , by appropriate siting, design and construction of facilities and by making provisions for ensuring the safety of facilities both during their operation and after their closure. Contracting Parties are also obliged to take appropriate steps to ensure that disused sealed sources are managed safely.

Forums

The NNR fulfils its regulatory mandate by inter alia, adhering to International best practices and active international collaboration to; exchange information with its foreign counterparts with a view to enhancing its regulatory approach; improve and strengthen its position in technical discussions with authorisation holders; build its internal capacity through training programmes as well as the exchange of personnel with other regulators; and play an active role in international work to harmonise nuclear safety and radiation protection principles and standards. The NNR participates actively in the IAEA safety standards committees, working groups and technical committee meetings, so as to contribute towards the maintenance and enhancement of safety standards.

The IAEA Safety Standards Committees

The IAEA Standards serve as references and benchmarks for South African nuclear safety and radiation protection. The NNR is represented in the IAEA Commission on Safety Standards (CSS) and on the following Safety Committees;

- Nuclear Safety Standards Committee (NUSSC),
- Waste Safety Standards Committee (WASSC),
- Radiation Safety Standards Committee (RASSC)
- Transport Safety Standards Committee (TRANSSC)

MULTINATIONAL DESIGN EVALUATION PROGRAMME (MDEP)

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 participates in the Multinational Design Evaluation Programme (MDEP) The NNR's participation in this forum is important in terms of South Africa's envisaged nuclear expansion programme which will require the NNR to licence the construction and operation of additional nuclear power plants in the future.

Network Of Regulators Of Countries With Small Nuclear Programmes (NERS)

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

FRAREG

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.

Bilateral Agreements

Bilateral agreements provide the NNR with a mechanism for information sharing and technical cooperation with international counterparts on various aspects of nuclear safety. The NNR has bi-lateral agreements with international nuclear safety authorities such as ASN (France), NRC (USA), CNSC (Canada), KINS (Korea) and Rostechnadzor (Russia).

Regional Cooperation

Forum For Nuclear Regulatory Bodies In Africa (FNRBA)

The Forum of Nuclear Regulatory Bodies of Africa (FNRBA) is represented by 28 member countries in Africa. South Africa plays a leadership role in the FNRBA which was given impetus by the coming into force by the Pelindaba Treaty which promotes and commits member countries to non-proliferation in the continent. Regionally, the NNR participates on the technical steering committee of the FNRBA which serves to provide for the enhancement, strengthening and harmonization of the regulatory infrastructure and frameworks amongst member states in Africa.

SECTION C: ARTICLES
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

Section 9 has been edited to be more consistent with INFCIRC/572 Rev2. Certain detail has been moved to other articles.

9.1 Holder's prime responsibility for safety – legislation

[Formulation in the legislation (quotation) assigning the prime responsibility for safety to the licence holder]

In terms of Section 3.7.1 of the Regulations on Safety Standards and Regulatory Practices (SSRP) [1.7], "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 Holder's prime responsibility for safety – implementation

[Description of the main means by which the licence holder discharges the prime responsibility for safety]

The strategy followed by Eskom was to develop a document called the "Koeberg Licensing Basis Manual" (KLBM) [4.10] to include all relevant change control processes for modifications, waivers, procedure changes, etc., and serve as a 'roadmap' of the overall safety case for Koeberg NPP including:

i. Eskom policies relating to nuclear safety.
ii. Statutory requirements.
iii. Nuclear safety criteria, codes and standards.
iv. Documented processes/procedures to meet these safety standards.
v. Monitoring of compliance with safety requirements, including reports to the 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 NPP, 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 NPP. 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.

The holder's safety policies, safety culture programmes and development, arrangements for safety management, arrangements for safety monitoring and self-assessment, independent safety assessments, and quality management system are further described in Section 10.

9.3 Holder's prime responsibility for safety – regulatory enforcement

[Description of the mechanism by which the regulatory body ensures that the licence holder discharges its prime responsibility for safety]

The NNR ensures that the licence holder discharges its prime responsibility for safety as follows: The NNR issues a nuclear installation licence which includes conditions referring to regulatory requirements (with guidelines as appropriate) (See 7.2.1).

These conditions require the holder to report on compliance as described below.

The NNR assesses the KLBM, described above, to ensure that the holder's policies and procedures adequately conform to the regulatory requirements described in Articles 7.1 and 7.2.

The NNR includes the KLBM as a condition of licence.

The NNR ensures compliance to the licence through a system of regulatory assessment and inspection, as described in Article 7.2.3.

In addition to the technical assessment reports referred to in Article 7.2.3 and Article 14, the nuclear installation licence holder is required, by the NNR Act and 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 and 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:

i. Problem notification, occurrence, quality assurance and audit reports, including close-out reports
ii. Environmental monitoring reports
iii. Reports on gaseous and liquid effluents from the plant
iv. Medical and psychometric testing reports
v. Fuel performance reports
vi. Specific Reload Safety Evaluation Reports
vii. In-service inspection reports
viii. Routine Licence Basis compliance report

9.4 Holder public communication processes

[Description of the mechanisms whereby the licence holder maintains open and transparent communication with the public]

The NNR Act places responsibilities on the licence holder to establish a public safety information forum, to inform persons living in the municipal area (for which an emergency plan has been established), on nuclear safety and radiation safety matters.

The 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.

The Promotion of Access to Information Act (PAIA) makes provision for the public to request information from the holder and the regulator.

SECTION C: ARTICLES
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

Section 10 has been updated in terms of:
- Regulatory requirements (10.1)
- Independent safety assessments (10.2.5)
- Process-oriented (quality) management system (10.2.6)
- Means used by the regulatory body to prioritise safety in its own activities (10.4)

10.1 Requirements to prioritise safety in design, construction and operation

[Overview of the Contracting Party's arrangements and regulatory requirements regarding policies and programmes to be used by the licence holder to prioritise safety in activities for design, construction and operation of nuclear installations]

The regulatory requirements are given in the requirements on safety management (Section 13), which address:
i. safety policies,
ii. safety culture programmes and development,
iii. arrangements for safety management,
iv. arrangements for safety monitoring and self-assessment,
v. independent safety assessments, and
vi. a process-oriented (quality) management system.

10.2 Measures to prioritise safety

[Measures taken by licence holders to implement arrangements for the priority of safety, such as those above and any other voluntary activities and good practices]

10.2.1 Safety policies

Within South Africa, Eskom is the major national electricity generator, owning and operating the only nuclear power station currently 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 nuclear installations and in any modifications to them, with a thorough root-cause analysis of failures or operational anomalies. Eskom, through the directive, 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 installation in-line with national regulatory and corporate requirements, and respecting IAEA standards for quality management. The policy requires that functional responsibilities will be assigned and that all employees should 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 (SSRP) [1.7], as well as the nuclear installation licence, detail the reports that must be made by the licence holder to the NNR.

10.2.2 Safety culture programmes and development

One of the principal radiation protection and nuclear safety requirements of the SSRP in Section 3.5 requires 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.

10.2.2.1 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 Organisations 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 installation 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, 2009 and 2011, involving utility personnel and contracting staff. The results and the recommendations of the surveys were shared openly with the installation staff and the NNR.

10.2.2.2 Safety culture monitoring and feedback

To aid in identifying underlying trends of a safety culture, Eskom carries out analyses of occurrences from operations, 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 on 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 shifts and providing oversight to the stations safety bodies.
xiii. A human performance corporate consultant dedicated to the Nuclear Division
xiv. WANO HP fundamental training for managers.
xv. HP training for all Koeberg NPP staff and contractors.
xvi. WANO and EDF leadership support missions.

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 an 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.

10.2.3 Arrangements for safety management

A corporate Nuclear Safety Assurance (NSA) group has been established within Eskom, providing independent safety assurance directly to the group executive (generation). Further details are given in Section 12.3.

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, with the primary goal of enhancing safety and procuring commitment from the installation's staff.

Examples of Eskom'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 Eskom to strengthen its commitment to nuclear safety are summarised below in Sections 10.4.2 to 10.4.5.

10.2.3 Arrangements for safety monitoring and self-assessment

10.2.3.1 Safety indicators

In addition to the use of World Association of Nuclear Operators (WANO) performance indicators, Eskom 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 computerised, providing a convenient database for linking the indicator levels to specific sets of findings arising from their monitoring programmes.

10.2.3.2 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:

Safety function confirmation

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

i. Trending critical plant parameters during normal operation to detect early warnings of potential safety problems.
ii. Providing an independent level of monitoring of safety system performance and make recommendations accordingly.
iii. Confirming the availability of safety-related systems.
iv. Confirming the availability of post-accident mitigation equipment.
v. Approving the plant work plan after a risk evaluation.
vi. 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 organisation concerned; the timing depending on the impact on nuclear safety.

Plant outage safety

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

Technical advice and recommendations

i. During normal operations, provide advice to the shift manager on operability determinations, suitable responses to potential unsafe conditions and similar conditions of uncertainty and ambiguity.
ii. Provide post-incident or accident monitoring of the critical safety functions and advise the operators of any unsafe conditions.
iii. Lead post trip investigations to authorise the safe restart of a unit.
iv. Investigate the causes of abnormal events that occur, assess any adverse effects and recommend changes to procedures or equipment to prevent recurrence.

v. Provide the Operations Shift and Technical Support Centre with expert assistance regarding beyond design-basis phenomena and recommend actions.
vi. Participate in the implementation of the Severe Accident Management Guidelines (SAMGs).

Safety documentation review and assessment

i. 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.
ii. Review changes to the Operating Technical Specifications (OTS) and surveillance requirements.
iii. Participate in the safety review of plant modifications and safety cases.
iv. Participate in the Koeberg Review and Safety Committees (KORC and KOSC).
v. Participate in appropriate audits and evaluations.
vi. Provide training related to nuclear accidents and incidents, prevention and mitigation.

10.2.4 Independent safety assessments

Independent safety assessments of the design and operation of Koeberg NPP are undertaken by the Nuclear Safety Assurance (NSA) Department through a programme of evaluations. Strengths and Issues Requiring Attention (IRAs) are identified and discussed with the relevant line group, and proposed corrective actions are identified. The results of the evaluations are reported to the oversight safety committees and directly to the Eskom Group Executive (Generation).

10.2.5 Process-oriented (quality) management system

The NNR has required that Eskom develop an integrated quality and safety management system that complies with Requirements Document RD-0034 [4.5]. The requirement comes from Principle 3 of the Fundamental Safety Principles of the IAEA Safety Standards, which states that, “Effective leadership and management for safety must be established and sustained in organisations concerned with, and facilities and activities that give rise to radiation risks.” The publication states further that, “Leadership for safety must be demonstrated at the highest levels in an organisation and safety has to be achieved by means of an effective management system.” These statements form the basis for the new requirements which define, over and above the requirements for a multilevel concept approach for an integrated management system, requirements for safety culture implementation.

Further details are provided in Section 13.

10.3 Regulatory oversight processes

[Regulatory processes for monitoring and oversight of arrangements used by the licence holders to prioritise safety]

The NNR has a dedicated team of site inspectors and examiners within close proximity to the nuclear installation. This enables the NNR to maintain improved communication with Eskom's staff, management and off-site bodies, and to gauge the level of commitment to safety demonstrated in all aspects of the installation operations. 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 is given to nuclear safety and enforced at the nuclear installation has been discussed in previous Articles 7 and 9, but can be summarised as follows:

The NNR ensures that the licence holder meets its commitment to nuclear 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 on demonstration by the licence holder of compliance to the conditions of licence.
iv. 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 is described further in Article 14).

10.4 Means used by the regulatory body to prioritise safety in its own activities

The NNR uses a system of annual performance plans, with quarterly and annual reports around the achievement of these plans, using indicators which reflect achievement in the various key performance areas covering the various aspects of regulatory control and internal processes. This enables the NNR to assess its performance on a quarterly basis and refocus its activities accordingly.

The regulatory approach has evolved to one which enforces processes for safety management, which include safety screening and evaluation by the holder. This tends to limit the safety submissions from the holder to those which are safety significant.

SECTION C: ARTICLES
ARTICLE 11: FINANCIAL AND HUMAN RESOURCES

Each Contracting Party shall take the appropriate steps to ensure that:
1. Adequate financial resources are available to support the safety of each nuclear installation throughout its life.
2. 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

Section 11 has been expanded to include the information required by INFCIRC/572 Rev2 in terms of the following:
- i. Contracting Party's processes to assess the financial provisions (11.1.3)
- ii. Methods used for the analysis of competence requirements and training needs for all safety-related activities in nuclear installations (11.2.2)
- iii. Arrangements for initial training and retraining of operations staff, including simulator training (11.2.3)
- iv. Capabilities of plant simulators used for training, with regard to fidelity to the plant and scope of simulation (11.2.4)
- v. Methods used to assess the sufficiency of staff at nuclear installations (11.2.7)
- vi. Policy or principles governing the use of contracted personnel to support or supplement the licensee's own staff (11.2.8)
- vii. Methods used to assess the qualification and training of contractor's personnel (11.2.9)
- viii. Description of the national supply of, and demand for experts in nuclear science and technology (11.2.10)
- ix. Regulatory review and control activities (11.2.12).

11.1 Financial resources

11.1.1 Provision of financial resources to the licence holder

[Mechanism for the provision of financial resources to the licence holder or applicant in order to ensure the safety of the nuclear installation throughout its lifetime]

11.1.1.1 Financing of safety improvements

[Principles for the financing of safety improvements to the nuclear installation over its operational lifetime]

Eskom is a very large electricity utility with a tried and tested financial planning process. All planning is based on 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.

Eskom utilises a technical planning process to allocate financial resources for improvements to the 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 Eskom's treasury department. The funding requirements of the organisation are derived from the financial plans and is determined annually and reviewed monthly.

Eskom 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 continual basis throughout the life of the installation, and nuclear safety improvements are no exception.

11.1.1.2 Financial provisions

[Principles for financial provisions during the period of commercial operation, for decommissioning and management of spent fuel and radioactive waste from nuclear installations]

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 Eskom. 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 of future estimated cash flows, in terms of decommissioning financial plans. These financial plans are reviewed regularly and adjusted annually, informed by 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.

11.1.2 Statement on the adequacy of financial provisions

In light 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 Eskom's ability to remain competitive. This in turn impacts on the NNR's responsibility to monitor for signs of safety being affected, and instituting timely measures to restore the status quo.

11.1.3 Contracting Party's processes to assess the financial provisions

The holder is required, by condition of the licence, to provide proof to the NNR that any claim for compensation, to an amount contemplated in Section 30(2) of the NNRA [1.1], can be met. They also need to demonstrate the availability of sufficient resources to enable the implementation and completion of decommissioning activities.

The regulations presently being developed (Section 7.2.1.3) will; in addition, include a requirement to demonstrate the availability of sufficient resources for long-term operation of the nuclear installation.

11.2 Human resources

11.2.1 Requirements concerning staffing, qualification, training and retraining

[Overview of the Contracting Party's arrangements and regulatory requirements concerning staffing, qualification, training and retraining of staff for nuclear installations]

The regulatory requirements are given in the requirements on safety management (Articles 7 and 13), which address the holder and suppliers' personnel selection, training and competence. The minimum training and qualification requirements, specifically for radiological protection personnel, radiation workers and reactor operators, are prescribed by the nuclear installation licence. The licensing standards of the NNR for reactor operators are fully aligned to the US NUREG 1021 [6.2]. 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 [6.3] catalog. The nuclear installation licence requires minimum shift-staffing levels and the notification of organisational changes to the NNR.

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 Eskom; however, the programme content and standard is 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.

11.2.2 Analysis of competence requirements and training needs

[Methods used for the analysis of competence requirements and training needs for all safety-related activities in nuclear installations]

Eskom implements a systematic process to: establish technical and behavioural competence requirements; employ appropriate training methods to ensure that individuals are aware of the relevance and importance of their activities in achieving the safety objectives; conduct formal assessments of competence, and evaluate training and appropriate supervision and monitoring, until full competence is achieved.

11.2.3 Initial training and retraining of operations staff

[Arrangements for initial training and retraining of operations staff, including simulator training]

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:

i. 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. pass simulator examinations in normal, abnormal and incident conditions;
iii. pass in-plant walk-through examinations; and, for SRO candidates,
iv. pass in-plant examinations in the performance of emergency controller duties.

Training and competency standards are monitored through training records, auditing, assessment of results and the analysis of occurrences for root causes.

At the end of 2012, Koeberg NPP was successful in achieving the second accreditation renewal for its entire operator training programme with the USA-based Institute of Nuclear Power Operators (INPO). Koeberg NPP was the first nuclear power station outside of the USA to achieve this accreditation in 2003. The ongoing assessment and periodic re-accreditation (2007 and 2012) provides a high level of assurance that the quality of operator training will be maintained at an international best-practice level.

This initiative resulted in and overall improvement to the operator training programme, which included the following:

i. Yearly INPO assist visits to review and recommend improvements to the programme based on INPO best practice.
ii. Improved operator performance on the plant
iii. A Systematic Approach to Training (SAT) that caters for review of plant modifications and process changes, to ensure that the training process and material is appropriate.
iv. Additional specialist training resources needed to implement an improved training programme.

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

11.2.4 Capabilities of plant simulators

[Capabilities of plant simulators used for training, with regard to fidelity to the plant and scope of simulation]

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 fit-for-purpose results indicates non-compliance with the NNR training standards, and has a direct impact on operator qualification.

The first phase of a new two-stage upgrade of the simulator modelling has been completed. The stage one upgrade has mainly improved simulation of the secondary side and provided a new instructor station interface.

The second stage upgrade will include a complete second simulator, and is planned for completion at the end of 2013.

11.2.5 Training of maintenance and technical support staff

[Arrangements for training of maintenance and technical support staff]

The training, qualification and ongoing training requirements for the production support groups (maintenance, chemistry, nuclear fuel management and nuclear engineering) are set by Eskom. Eskom follows a practice of formally authorising staff to perform tasks on safety-related plant systems, based on formal on-the-job training and examinations.

11.2.6 Improvements to training programmes

[Improvements to training programmes as a result of new insights from safety analyses, operational experience, development of training methods and practices, etc.]

Eskom has implemented a Systematic Approach to Training (SAT) which now covers all facets of training at Koeberg NPP (11.2.3).

11.2.7 Assessment of holder's staffing levels

[Methods used to assess the sufficiency of staff at nuclear installations]

Personnel at Koeberg NPP who undertake safety-related work are required to have a minimum level of qualification and experience. The minimum number of personnel per position is also determined. This includes personnel required for severe accident management. The sufficiency of staff numbers is measured and monitored through a Competency Index, which provides an indication of actual numbers, against minimum staffing levels.

11.2.8 Policy on contracted personnel

[Policy or principles governing the use of contracted personnel to support or supplement the licensee's own staff]

Long-term contracted personnel are used to supplement Eskom's own staff. They are subject to the same qualification and experience requirements and to the same work control measures.

11.2.9 Assessment of contractor's personnel

[Methods used to assess the qualification and training of contractor's personnel]

Minimum qualification and training of contractor's personnel are included in the contract and checked by Eskom's contract manager. All contractor personnel are also required to pass a fit-for-duty test, where artisan's trade skills are also assessed.

11.2.10 Status of national capacity in nuclear science and technology

[Description of the national supply of, and demand for, experts in nuclear science and technology]

There is a limited supply of experts in nuclear science and technology within South Africa. Such expertise is frequently sourced off-shore through Eskom's support agreements with company's such as Areva and with utilities such as EDF.

11.2.11 Analysis of competencies for severe accident management

[Methods used for the analysis of competence, availability and sufficiency of additional staff required for severe accident management, including contracted personnel or personnel from other nuclear installations]

Refer to 12.2.7. Any person required to perform a task, whether contractor or additional staff, needs to satisfy the qualification and competence requirements for that position.

11.2.12 Regulatory review and control activities

As reported in Article 19(5) the NNR requires the holder to conduct an annual assessment on its staffing and competency levels and to report to the NNR accordingly. This process is further covered by the regulators compliance assurance programme.

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.

Prior to 2008, Eskom experienced problems with a high turnover of staff, particularly engineers, technicians, physicists and project managers. Intervention strategies implemented during 2008 provided a significant improvement in the situation and the current turnover is manageable. 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 NPP.

SECTION C: ARTICLES
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

Section 12 has been almost entirely updated to be consistent with INFCIRC/572 Rev 4, [5.1], particularly with regard to the following:

i. Overview of the Contracting Party's arrangements and regulatory requirements to take human factors and organisational issues into account for the safety of nuclear installations (12.1)
ii. Consideration of human factors in the design of nuclear installations and subsequent modifications (see also Article 18 (3) of the Convention) (12.2)
iii. Regulatory review and control activities (12.6)

12.1 Requirements on human factors and organisational issues

[Overview of the Contracting Party's arrangements and regulatory requirements to take human factors and organisational issues into account for the safety of nuclear installations]

Human factors influence all aspects of safety, not only in operations but also in maintenance and engineering as human error could directly affect the safe operation of the plant. The requirements to take human factors and organisational issues into account for the safety of nuclear installations, are covered by the requirements on management of safety (Section 13). RD-0034 [4.5] details the requirements for a process-based integrated management system for licensees, license applicants, designers and suppliers involved in the operation, modification and/or application of a nuclear license for a nuclear installation in South Africa under the NNRA, and addresses:

i. A multilevel-concept approach for an Integrated Management System (IMS).
ii. Quality and safety management requirements to ensure that safety is appropriately taken into account in all activities and decisions by licensees, designers and suppliers, in the operation, modification or application of a nuclear installation licence.
iii. Principles for safety culture implementation in the respective organisations.

12.2 Human factors in the design and modifications

[Consideration of human factors in the design of nuclear installations and subsequent modifications (see also Article 18 (3) of the Convention)]

The requirements to take human factors and organisational issues into account for the design and modification of nuclear installations are covered by the requirements on management of safety (Section 13).

Design changes or modifications to be implemented are reviewed to ensure that the end user is taken into consideration. A design checklist ensures that the designer takes into account human-factor engineering.

12.3 Human error in operation and maintenance

[Methods and programmes of the licence holder for analysing, preventing, detecting and correcting human errors in the operation and maintenance of nuclear installations]

12.3.1 Analysis

12.3.1.1 Root-cause analysis and trending of human errors

An electronic problem management system is employed by Eskom 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 creation of a 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.

12.3.1.2 Safety culture analysis

Safety culture surveys are performed on an annual basis to assess the status of the safety culture across the station, and nuclear safety awareness seminars are conducted to promote improvements in the safety culture.

12.3.1.3 Human Reliability Analysis (HRA)

Human Reliability Analysis (HRA) methods are applied at Koeberg NPP, as part of the Probabilistic Safety Analysis (PSA) methodology, to identify human actions which can have an effect on system reliability or availability. Level 1 HRA deals with actions conducted Pre Core Damage and Level 2 HRA deals with the actions Post Core Damage. The outcomes of the PSA are benchmarked against other international PSA studies.

12.3.1.4 Man-machine interface

The discrepancies between human capabilities and the demands of the working environment are investigated and minimised through 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 [6.1] 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).

12.3.2 Prevention

Human related errors which may affect the safe operation of the plant are kept to a minimum through continuous training efforts, use of procedures, and error reduction techniques, which are used to ensure the reliability of all actions by plant personnel responsible for operating and maintaining the plant.

Operator actions in support of safety, are feasible and properly supported through procedures and continuous training. The operators are expected to use the correct HP tools, which include three-way communication, self-checking, first-checking, place keeping, peer-checking and pre-job briefing.

In the same way, knowledge of, and the use of operator fundamentals (the basics of operating), is also a management expectation and forms part of the operator training programmes. Examples are: procedure use and adherence, STAR (Stop, Think, Assess, Respond), the two metre rule, teamwork and plant status control.

‘Fundamentals’, which is a new worker behaviour initiative programme, has been implemented to improve the performance of workers and thus reduce human errors. The Fundamental Tool Kit covers various functional areas, including engineering and maintenance groups; there are also common fundamentals for other groups throughout the station.

Training of operators, engineering and maintenance personnel is used to emphasise the maintenance and improvement of personnel knowledge. Ongoing training becomes necessary when work conditions change, and operating experience and lessons learned need to be conveyed. In maintenance the work packages are governed by procedures that expect adherence to human performance error-reduction tools. Supervisors perform pre—task walk-throughs and assess potential error traps by using the TWIN analysis principle. During training, maintenance personnel have to demonstrate the use of HP Tools. In operations, the actions that are required to be performed in the control room are regularly rehearsed during training exercises. The application of the HP Tools is expected and will be adhered to.

12.3.3 Detection

Identification of human errors and potential human errors is achieved through a combination of various methods. Operational experience is continuously investigated by means of problem report analyses, for installation incidents and non-conformances. Safety culture assessments on the other hand, provide 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.

12.3.4 Correction

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

12.4 Self-assessment of managerial and organisational issues by the operator

The self-assessment programme is a way for the organisation to identify potential issues before they result in an event, and conduct investigations into their causes, so that corrective and restorative actions can be taken. It is a line-owned process which follows a structured approach to assessing the effectiveness of programmes, processes, or performance against specific criteria. It is also a management tool, and managers have ownership of the process. Self-assessment is performed for the following reasons: to identify gaps between current performance and excellence; improve safety, reliability and regulatory performance; reduce costs, and verify effectiveness of corrective actions.

The managerial structure of Eskom 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 fulfil 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 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.

The NSA department is also responsible for reporting to Eskom's nuclear safety overview committees on a regular basis. The reporting encompasses all matters relevant to safety, including aspects of human factors.

12.5 Experience feedback on human factors and organisational issues

[Arrangements for the feedback of experience in relation to human factors and organisational issues]

12.5.1 Operating Experience (OE) feedback

The OE Group within Eskom is responsible for external experience feedback and the management of the OE system which includes:

i. Endorsement by station management of all Corrective Actions (CAs) at a Corrective Action Review (CAR) Meeting
ii. Tiered approach to event investigations
iii. Reporting of world events to the organisation
iv. WANO cause categorisation
v. Off-site reporting guidelines
vi. Prioritisation 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 formalise a Koeberg NPP position. Event reports from the NEA/IAEA Incident Reporting System (IRS) are scrutinised for lessons learnt from feedback of international operational experiences.

12.5.2 Performance objectives and criteria

As an overview, performance objectives and criteria are designed to promote excellence in the operation, maintenance, safety and support of nuclear electric generating stations.

Operating experience criteria are as follows:

i. Managers are appropriately involved in promoting and reinforcing the use of operating experience through activities.
ii. A systematic approach is used to identify and implement effective corrective actions from reviews of in-house and industry operating experience.
iii. Industry operating experience information is reviewed for applicability, and applicable information is distributed to appropriate personnel in a timely manner.

iv. Rigorous investigations are performed in response to significant in-house events.
v. Operating experience that relates to human performance is effectively communicated to personnel through training, procedures, and work packages.
vi. Individuals at all levels of the organisation use operating experience to resolve current problems and anticipate potential problems.
vii. Personnel reinforce the use of operating experience, for example, through pre-job briefings, engineering design reviews, and training activities.
viii. Operating experience information is easily accessible to station personnel.
ix. An evaluation is periodically performed to determine the effectiveness of the use of operating experience information. Appropriate actions are taken to make needed improvements.
x. Timely notification via the 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.
xi. Equipment performance and engineering data is maintained up to date and in accordance with established guidance.

12.6 Regulatory review and control activities

The NNR has overall independent responsibility for the licensing of the installation's reactor operators. These are elaborated in several regulatory documents which are an integral part of the conditions of the nuclear installation licence [4.2 to 4.3].

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 utilises 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, Eskom 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 Eskom and evaluated by the NNR.

In the second Periodic Safety Re-Assessment (SRA II) of Koeberg NPP, the NNR required that the Human Factors Review incorporate human factors engineering aspects of process control and maintenance. The former required a comprehensive Human Factors Engineering Control Room Design Review, incorporating control room habitability aspects. The latter entailed an assessment of the safety and reliability aspects of human performance in maintenance activities.

The re-assessment concluded that the methods and programmes for analysing, preventing, detecting and correcting human errors in the operation and maintenance of Koeberg NPP, comply with accepted good practices, when benchmarked against international standards, and that appropriate consideration of human factors has informed the design of Koeberg NPP and subsequent modifications to the installation.

SECTION C: ARTICLES
ARTICLE 13: QUALITY ASSURANCE

> Each Contracting Party shall take the appropriate steps to ensure that quality assurance programmes are established and implemented, in order to provide confidence that specified requirements for all activities important to nuclear safety, are satisfied throughout the life of a nuclear installation

Summary of changes

Section 13 has been updated with the regulatory requirements for quality assurance and quality management (13.1).

13.1 Requirements on quality assurance programmes

[Overview of the Contracting Party's arrangements and regulatory requirements for quality assurance programmes, quality management systems, or management systems of the licence holders]

One of the principle nuclear safety requirements in Section 3.10 of the Safety Standards and Regulatory Practices [1.7] 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 Requirements Document RD-0034 [4.5], which was issued as a directive in 2012 to replace LD-1023 [4.4]. In terms of this document, the implementation of a safety management system, including a quality management programme, is required to provide adequate confidence in the validity of the operational safety assessment and safety assurance processes. A written policy stating the quality objectives to be attained during various stages of the installation's life is required and has been provided by the licence holder.

13.2 Status of implementation of holder integrated management systems

[Status with regard to the implementation of integrated management systems at nuclear installations]

Eskom's quality management and operational QA programmes presently satisfy both the international standards and codes and those of the NNR.

In preparation for a nuclear expansion programme, Eskom has established a Nuclear Division within which safety and management systems have been developed. The documentation is based on ISO 9001:2008, supplemented by ASME NQA-1 [6.4] and IAEA document GS-R-3 [5.13]. The safety and management systems are also compliant with NNR's Requirements Document RD-0034 [4.5].

13.3 Main elements of quality assurance programmes

[Main elements of a typical quality assurance, quality management or management system programme covering all aspects of safety throughout the lifetime of the nuclear installation, including delivery of safety-related work by contractors]

Eskom'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 NPP. This programme is based on the IAEA Safety Code 50-C/SG-Q, and Eskom Nuclear Division Safety and Quality Management Manual. The QA programme is being back fitted on an agreed schedule, to conform to the NNR Requirements Document RD-0034 [4.5].

Eskom follows a national system of certification of auditors, which is aligned with international certification systems. A formalised 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, while making allowance for training of unqualified auditors.

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 authorised 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 unfavourable 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 unfavourable 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.

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.

13.4 Audit programmes of the licence holders

A comprehensive audit programme of planned, periodic monitoring for the nuclear installation has been established by Eskom, to conform with the 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.

The QA monitoring programme for Koeberg NPP is developed in accordance with the regulatory requirements, in consultation with the NNR. It covers, inter alia, the following areas:

i. Radiological protection programme
ii. Maintenance programme
iii. Conformance to Operating Technical Specifications
iv. In-service inspection programme
v. Radioactive waste management and effluent discharge control programme
vi. Chemistry programme
vii. Nuclear engineering design and modification programme
viii. Emergency plan
ix. Physical security system
x. Civil works monitoring programme
xi. Environmental surveillance and meteorological programme
xii. Fuel integrity evaluation, storage, handling and transportation
xiii. Fire prevention and protection plan
xiv. Training/qualification of operating and technical staff
xv. Quality activities and functions of the management programme (including control of deficiencies and corrective actions)
xvi. Documentation and records system
xvii. Compliance with risk assessment and safety criteria of the NNR
xviii. Corporate Safety Assurance of the Nuclear Safety Assurance (GSA) oversight processes

13.5 Audits of vendors and suppliers by the licence holders

Vendors are classified according to a four-tier quality level system, based on the service/materials they provide and the safety classification of the plant which requires the vendor intervention. Quality-level one and two 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.

13.6 Regulatory review and control activities

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:

i. Corrective action close-out
ii. Incidents and problems notifications (PNs)
iii. Audit findings
iv. Non-conformance reports
v. Work orders

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

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

Audit findings and concerns are used as input to the utility's safety indicator systems. The indicators are used to prioritise future monitoring activities.

During plant refuelling outages, Eskom 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, responsible for identifying concerns, and initiating appropriate corrective actions.

In terms of the requirements of the NNR Act, the 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.

SECTION C: ARTICLES
ARTICLE 14: ASSESSMENT AND VERIFICATION OF SAFETY

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

1. 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.
2. 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

Section 14 has been expanded to include the information required by INFCIRC/572 Rev2.

Section 14.1 has been updated in terms of the following:

i. Koeberg NPP first periodic safety review
ii. Koeberg NPP second periodic safety review
iii. Reassessment of Koeberg NPP following the Fukushima accident
iv. Regulatory review and control activities

Section 14.2 has been updated in terms of the following:

i. Elements of ageing management programme(s), including Steam Generator Replacement Project
ii. Arrangements for internal review by the licence holder of safety cases to be submitted to the regulatory body

14.1 Assessment of safety

14.1.1 Requirements on safety assessment

[Overview of the Contracting Party's arrangements and regulatory requirements to perform comprehensive and systematic safety assessments]

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

The fundamental criteria and principles that must be met to ensure safety in any nuclear installation are legislated in the Regulations on Safety Standards and Regulatory Practices (SSRP) [1.7]. 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 issued requirements and guidelines [4.1-9] that are established to fulfil 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 requirements documents 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 fundamental criteria referred to above, include 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.

The SSRP requires that an operational safety assessment be done and submitted to the NNR at intervals specified in the nuclear authorisation, 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 Koeberg safety analysis report 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 requires that any plant and process changes affecting safety-related systems, components and activities are approved by the regulatory body, prior to implementation.

The licensee's modification standards, approved by the regulatory body, 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 the modification, are in place.

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 doing so, 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.

Regulations on the siting of new nuclear installations (R.927) [1.8] require that, in terms of Section 21 of the Act, the applicant for a nuclear installation licence for the siting of nuclear installation(s) must submit, in support of its application, a Site Safety Report (SSR) to the regulator.

14.1.2 Safety assessments for different licensing stages

[Safety assessments within the licensing process and safety analysis reports for different stages in the lifetime of nuclear installations (e.g. siting, design, construction, operation)]

14.1.2.1 General Requirements

For nuclear installations, the following safety assessments are required:

i. Safety assessment for site licence
ii. Safety assessment for authorisation to manufacture components
iii. Preliminary Safety Analysis Report for construction licence
iv. Safety Analysis Report for operating licence
v. Safety assessments for modifications
vi. Safety assessments for nuclear authorisation changes (e.g. changes to licence binding procedures)
vii. Safety assessments for new safety issues
viii. Periodic safety assessment
ix. Safety assessment for decommissioning

Guidelines are provided in reference [4.8].

14.1.2.2 Site licence

The applicant for a nuclear installation licence for the siting of nuclear installation(s) must submit, in support of its application, a Site Safety Report (SSR) to the Regulator in conformance with the siting regulation [1.8].

14.1.2.3 Authorisation to manufacture components

For an authorisation to manufacture components, the applicant is required to conform to quality and safety management requirements [4.5], and, as regards safety assessment aspects, to provide the following:

i. Safety assessment
ii. Detailed design of the components

iii. Justification of the design specifications, in relation to the safety assessment
iv. Justification of compatibility and interfaces of the components with the installation
v. Classification (safety, quality, seismic and environmental) process or processes

14.1.2.4 Design and construction

For an authorisation to construct a nuclear installation, as regards safety assessment aspects, the applicant is required to provide a preliminary Safety Analysis Report and Site Safety Report, accompanied by the following:

i. Topical reports
ii. Safety classification document
iii. Quality and safety management documentation
iv. Preliminary probabilistic safety assessment
v. Preliminary emergency plan
vi. Nuclear security plan
vii. Arrangements for regulatory control
viii. Commissioning plan
ix. Decommissioning strategy

14.1.2.5 Initial operation

For an authorisation to operate a nuclear installation, in terms of the safety assessment aspects, the applicant is required to provide a Safety Analysis Report, Site Safety Report, PSA [4.1], quality and safety management documentation [4.5], and a commissioning programme with results according to hold-and-witness points established in agreement with the regulator.

14.1.2.6 Operational safety assessments

The holder of a nuclear installation licence is required to document and implement a methodology to maintain the validity of the safety assessment, including the probabilistic safety assessment, on an ongoing basis, addressing any issue giving rise to changes in safety, and shall include the identification of those changes requiring submission of a safety case, including a probabilistic safety assessment [4.1], to the regulator.

The holder is required to implement a system of risk management to ensure that the nuclear installation is operated in conformance with the risk criteria given in the regulations on safety assessment [1.7].

14.1.3 Periodic safety assessments of nuclear installations

[Periodic safety assessments of nuclear installations during operation, using deterministic and probabilistic methods of analysis as appropriate, and conducted according to appropriate standards and practices]

14.1.3.1 Regulatory requirements

The holder is required to conduct systematic, periodic safety reassessments of the nuclear installation throughout its operational lifetime, at a frequency acceptable to the regulator, taking into account the operating experience and significant new safety information from relevant sources.

The holder is required to use the periodic safety reassessment to determine the extent to which the existing current licensing basis remains valid. The periodic safety reassessment must take into account the actual status of the plant, operating experience, predicted end-of-life state, current analytical methods, applicable safety standards and current state of knowledge. On the basis of the results of the periodic safety reassessment, the holder shall implement corrective actions and modifications for compliance with applicable standards and internationally recognised good practices currently available.

14.1.3.2 Koeberg NPP first periodic review

The first periodic safety re-assessment of Koeberg NPP commenced in April 1995 and was submitted to the NNR in December 1998. The NNR completed its review in July 1999. Eskom submitted the close-out report in October 2011. This was reviewed by the NNR and accepted in January 2013.The 1995 revision of the EDF Family of French Nuclear Power Plants CP-1 safety referential was used as a benchmark. The reassessment identified a number of plant improvements that were necessary to bring the level of safety of Koeberg NPP to a comparable level to that of the CP-1 reference. However, it was recognised that following the next 10-year safety re-assessment, a further batch of modifications would need to be implemented 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 (79) 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 NPP, and to maximise business and safety benefits of the support contract Eskom has with EDF. The premise was that safety issues affecting Koeberg NPP can be resolved in a similar manner to the manner in which EDF resolves the same issues for the CP-1 plants.

The so-called CP-1 modifications have been implemented in three phases over the past 10 years.

These include:

i. Improvements to the plant to align the general operating rules;

ii. Containment safety enhancement (improve system isolation potential, ventilation system, measuring of activity and improvements in system leak tightness);

iii. Equipment qualification (seismic and/or environmental qualification of equipment identified as essential during an incident, to ensure safe shutdown of the reactors);

iv. Reliability enhancement (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 (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 a 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 (protection against high-energy pipe breaks, against internal flooding, against earthquakes for passive equipment and against fire), and

vii. Modifications identified by the French utility EDF during their second Safety Reassessment (VD-2).

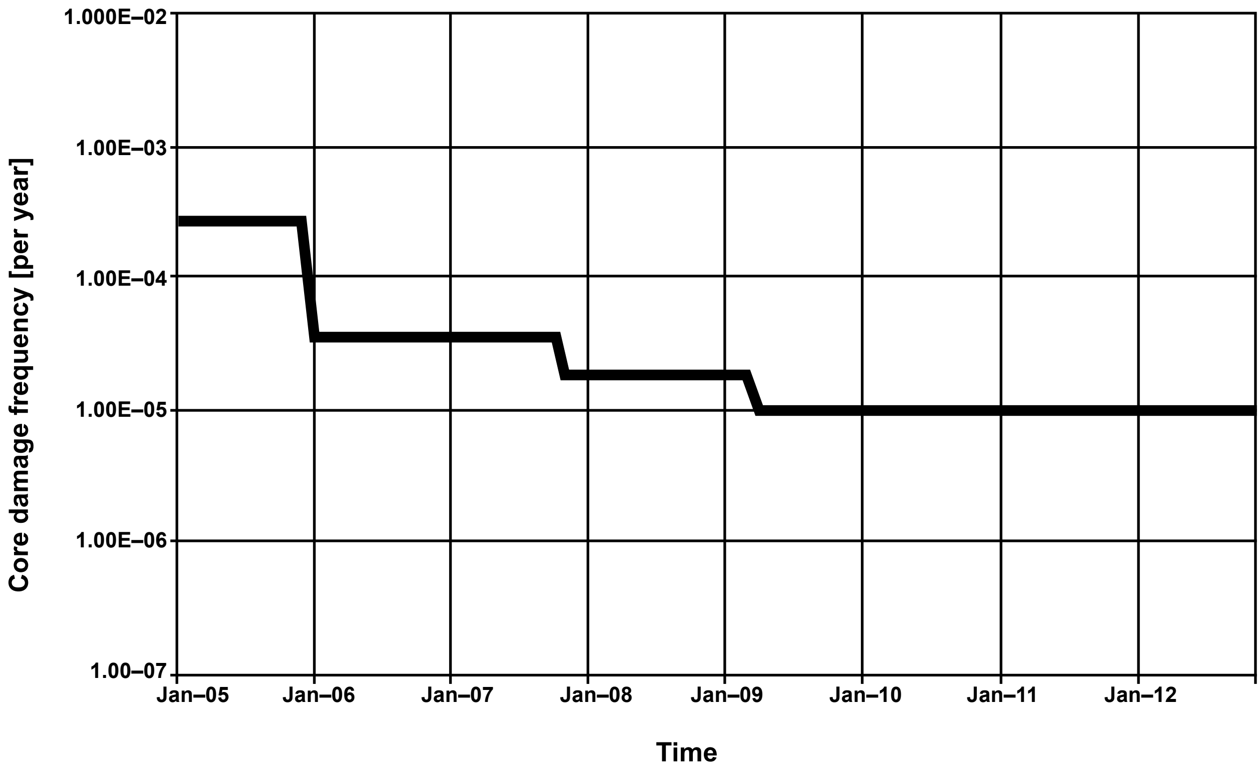
The improvements in safety over this period have been quantified from ongoing probabilistic risk assessments, in terms of core damage frequency, as shown in the diagram below. Large early release frequencies follow a similar trend.

Some 800 modifications and safety improvements implemented on EDF CP1 plants (lot 93 and so called “VD-2” scope of modifications) were reviewed for applicability to Koeberg NPP. Of these 500 differences were identified. Following screening analyses, detailed assessments were performed for 140 differences, resulting in 600 individual close-out actions being identified. Of these, nine issues were ranked of ‘medium’ safety significance, and 105 ranked ‘low’. Overall, 79 modifications were identified for implementation.

The need for rules for accident analysis was identified. The ‘Accident Analysis Manual’ (AAM) [4.11] has been developed and has been updated in preparation for future projects. The rules address both design-basis and beyond design-basis accidents.

The NNR concluded that the main objectives of the KSR Project were achieved and that continued operation of the plant was justified. This programme of improvements has since been implemented.

Baseline risk (including external events) for Koeberg



14.1.3.3 Koeberg second periodic review

The second safety re-assessment, commenced in 2008 once the scope of the assessment was agreed upon by Eskom and the NNR.

The review methodology was 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 scope was based on the IAEA guide NS-G-2.10 [5.14]. In addition, a ‘global cross-functional review’ was undertaken by EDF which included a benchmarking/comparison exercise with EDF CP1 plants in terms of the so called “VD-3” scope of modifications conducted on the French plants.

The scope of the Koeberg NPP second periodic review was as follows:

i. Plant design
ii. Actual condition of Systems, Structures and Components
iii. Equipment qualification plant
iv. Ageing (focus area)
v. Deterministic safety analysis
vi. Probabilistic safety analysis
vii. Hazard analysis
viii. Safety performance
ix. Use of Operating Experience (OE)

x. Organisation and administration
xi. Procedures
xii. Human factors
xiii. Emergency preparedness
xiv. Radiological impact

A number of plant hardware and programmatic improvements have been identified and these are being implemented in accordance with an agreed schedule. Significant hardware modifications include: the replacement of safety injection system valves to alleviate a risk of blockage, and a modification to avoid the risk of an overflowing steam generator, during a steam generator tube rupture accident.

Modifications and procedural updates are recommended to mitigate the risk of a hydrogen explosion. The accident studies should also be re-analysed and the scope of accidents increased using more up-to-date methodologies and assumptions.

The project was completed in October 2011 and is presently under review by the NNR.

14.1.4 Overview of safety assessments

[Overview of safety assessments performed, and the main results of those assessments for existing nuclear installations, including the summary of significant results for individual nuclear installations and not only according to their type and generation]

14.1.4.1 Koeberg NPP first periodic review

Refer to Section 14.1.3.2.

14.1.4.2 Koeberg NPP second periodic safety re-assessment

Refer to Section 14.1.3.3.

14.1.4.3 Reassessment of Koeberg NPP following the Fukushima accident

A summary of the post-Fukushima reassessment of Koeberg NPP is given below. Further details are given in Annexure D3.

Following the Fukushima accident on 11 March 2011, the NNR established a task team on the Fukushima accident in April 2011, and in May 2011 directed Eskom to reassess the capability of Koeberg NPP to withstand external hazards, specifically regarding the following:

i. Compliance to the current design basis for external events
ii. Stress tests (robustness against external events beyond the design basis)
iii. Adequacy of accident management and emergency planning.

Eskom had previously established an External Events Review Team (EERT) and had begun implementing guidelines issued by INPO and WANO, focussing on the above aspects, but predominantly addressing plant equipment, people, procedures and nuclear safety culture. The EERT approach was to assess the design base readiness, through a review of system health indicators, as well as a review of all non-conformance reports, operability determinations and temporary alterations.

In parallel, the Fifth International Convention on Nuclear Safety (CNS) Meeting took place in April 2011 to formulate an international response to the Fukushima accident. The NNR directive and the Eskom response covered all the requirements proposed by the CNS.

Eskom submitted their safety reassessment report in December 2011. The scope of the reassessment covered the design basis (reactor and spent fuel storage) in terms of external events and combinations of events, as well as the robustness of the facility and cliff-edge effects for a similar scope of beyond design basis events. These include prolonged total loss of electrical power and ultimate heat sink. Measures or design features to mitigate these effects were identified. The scope included on-site and off-site aspects of accident management and emergency response.

The NNR completed the review of the report in March 2012, concluding that the reassessment did not reveal any major shortcomings in the safety of Koeberg NPP in respect of external events. A number of modifications and operating procedure changes to further improve safety were however identified, as well as additional studies beyond the current design basis.

The NNR finalised the South African National Report [3.5] which was submitted to the IAEA for the Second Extraordinary Meeting of the Convention on Nuclear Safety (CNS) held in August 2012.

Eskom have submitted a second revision of the post-Fukushima Koeberg NPP reassessment covering additional external events, as well as addressing NNR comments on the first submission. Eskom have also submitted a strategy for maintenance and testing of equipment needed to respond to beyond design basis accidents. The NNR has reviewed and commented on these submissions.

In the meantime, Eskom has implemented a number of short-term corrective actions, such as portable equipment (e.g., pumps, power supplies, communication equipment etc.), and have communicated additional short-term actions to the NNR to be implemented during 2013 (including for example, portable back-up water sources, tank strengthening/extension, portable back-up water connections, a portable emergency equipment storage facility, hardened instrumentation to monitor critical plant parameters, mobile diesel generator connection points, and electrical connection points for mobile electrical supply).

In the longer term Eskom will screen, evaluate and implement the balance of the proposed corrective actions, subject to regulatory review and approval. The seismic reassessments, which began prior to Fukushima, are scheduled for completion by 2014, and the accident procedure enhancements by 2015. Overall the post-Fukushima project is expected to be completed by 2022.

The NNR position to date may be summarised as follows:

i. The assessments conducted by Eskom conform to the NNR directive and are in accordance with (and in excess of the scope of) international practice.
ii. The nuclear installations are adequately designed, maintained and operated to withstand all external events considered in the design base.
iii. There were no findings to warrant curtailing operations, or to question the design margins of these facilities.
iv. The safety reassessments identified a number of potential improvements to further reduce risk beyond the design requirements.
v. Follow-up studies need to be performed to confirm the conclusions and consolidate the formal licensing documentation.
vi. The NNR has identified areas for improvement of the Safety Standards and Regulatory Practices which will be addressed as part of the current review of the Regulatory Framework Project initiated in 2010, and due for public comment in 2013.

Improvements to the regulations under consideration relate to:

i. Inclusion of specific requirements on combinations of events, for beyond design basis events.
ii. Inclusion of specific provisions relating to elevating the level of testing and maintenance of all equipment included in the respective severe accident management measures.
iii. Inclusion of specific requirements related to the robustness of accident management measures and emergency planning arrangements, when considering beyond design basis external events.

It has been decided that a full self-assessment of all emergency planning and response infrastructures be conducted, using the IAEA Emergency Preparedness Review (EPREV) and self-assessment guidelines.

Koeberg NPP was one of the first nuclear power plants to implement Severe Accident Management Guidelines (SAMGs), and the NNR is the first regulator to include these in the regulatory process.

The NNR has consistently enforced conservative emergency planning zones around Koeberg NPP, informed by risk analysis, beyond what has been required up to now internationally.

The NNR has also consistently applied restrictions on developments in the formal emergency planning zones of Koeberg NPP, also informed by risk analysis, beyond present international requirements. To date, the City of Cape Town Disaster Management and Spatial Planning authorities have been supportive in this regard.

Eskom and the NNR will continue to engage internationally on lessons learned from the Fukushima accident.

14.1.4.4 Design-basis accident consequence calculations

Eskom is recalculating the radiological consequences of design basis accidents (DBA) using more up to date models and assumptions, including the dose contributions from ingestion pathways and from the ground shine and inhalation from the resuspension of deposited radionuclides pathways. Results to date show that the modelled dose results for all DBAs using the PC Cosyma code deterministically comply with the current Koeberg NPP SAR dose criteria.

For the Steam Generator and Thermal Power Uprate Project, Eskom will be revising the DBA dose criteria (to reflect a TEDE and be consistent with the IAEA International Basic Safety Standards [IAEA GSR Part 3 (interim)] [5.15] maximum reference level dose of 100 mSv for sources that are not under control) and updating the DBA consequence analysis methodology to align with the U.S. NRC Alternative Source Term approach as provided in Regulatory Guide 1.183 [6.5].

14.1.5 Regulatory review and control activities

The NNR reviews the scope, terms of reference and the safety analyses, to verify compliance with the regulations on safety standards and regulatory practices, as well as specific requirements in the conditions of licence, including the international benchmark (French CP-1 safety referential), and other international practice.

The NNR produces a report on the outcome of the periodic review.

The NNR uses the results of the periodic review to consider any regulatory action, such as directives to resolve issues, restrict or curtail operation.

The NNR reviews the corrective action plan, and follows up on the implementation thereof.

14.2 Verification of safety

14.2.1 Regulatory requirements for verification of safety

[Overview of the Contracting Party's arrangements and regulatory requirements for the verification of safety]

The SSRP requires that operational safety-related programmes, limitations and design requirements be established on the basis of the operational safety assessment.

The Koeberg Nuclear Installation Licence requires the following operational safety-related programmes for plant condition management at the Koeberg NPP:

i. Maintenance of valid and updated safety and risk assessment
ii. Operating surveillance requirements (incl. OTS compliance)
iii. In-service inspection
iv. In-service testing
v. Reactor vessel surveillance
vi. Plant maintenance
vii. Civil monitoring
viii. Physical security
ix. Fire safety
x. Occurrence and incident reporting
xi. Quality management

14.2.2 Programmes for continued verification of safety

[Main elements of programmes for continued verification of safety (in-service inspection, surveillance, functional testing of systems, etc.)]

14.2.2.1 Routine on-going safety review at the nuclear installation

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, Eskom 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, 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.

14.2.2.2 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 [6.6] rules as amended for implementation by the United States Code of Federal Regulations, Title 10, Part 50, Section 55a (10CFR50.55a) [6.7]. 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.

14.2.2.3 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:

i. 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;
ii. Pressure relief devices that protect systems or portions of systems that perform one or more of the three above mentioned functions, and
iii. 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 took place during the second interval and was 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 an In Service Inspection Standard, which is approved by the NNR and therefore forms 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) [6.7].

14.2.2.4 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 Eskom 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 recognised however that ORT could have a negative impact on the Reactor Pressure Vessel (RPV), causing 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 will be 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, have been reassessed under plant life management.

14.2.2.5 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 the 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 focuses on maintaining the safety-related functional capabilities of SSC's important to nuclear safety, is based on the Reliability Centred 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 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 will be assessed by reviewing the trends of functional failures that can be prevented through maintenance.

14.2.2.6 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.

14.2.2.7 Quality assurance inspections and audits

A systematic programme of inspections and audits is carried out by Eskom and independently by the NNR. 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 Eskom and will also feed back into the risk assessment process. Refer to Article 13 for more details.

14.2.2.8 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 NPP that the safety assessment must include a probabilistic risk analysis (PRA) for demonstration of compliance with the risk limits. In compliance with the regulatory requirements Eskom has developed and maintain a PRA for the Koeberg NPP.

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. In 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 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 has been 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.

14.2.3 Elements of ageing management programme(s)

Eskom has elected to follow Electricité de France’s (EDF) ageing management programme combined with Eskom’s existing suite of operational and monitoring programmes for Koeberg NPP. An equipment degradation/ageing matrix is being developed for Koeberg NPP from the EDF programme and adapted to Koeberg NPP specifics. While this formalised ageing programme is being developed, degradation of the plants structures, systems and components is managed within existing processes and procedures which include the maintenance programme, the ISI programme, plant health system reports, life of plant plans, life cycle management programmes and transient monitoring.

The following major components are being, or have been replaced as part of the plant ageing management programme.

1. Eskom is planning to replace the steam generators of both Koeberg NPP units if it is to sustain the plant lifespan, and is currently in the early stages of the commercial process. The opportunity to uprate the thermal power will also be taken. The current steam generators contain components (tubing) that are susceptible to corrosion. If this is not done by 2016, Eskom will be the only nuclear power station in the world still operating with the older type of steam generators. To date Eskom has specified the rules for undertaking the associated accident studies in line with latest international practice.
2. Reactor cavity and spent fuel pit cooling system (PTR) tank replacement. These tanks, which are susceptible to through wall cracks due to stress corrosion cracking, will be replaced. In view of premature ageing of the refuelling water storage (PTR) tanks (due to atmospheric stress corrosion cracking), the NNR issued a requirement to Eskom in February 2011 to replace the tanks by no later than outages 121 and 221 (2015). In order to meet these deadlines, Eskom have indicated their intention to initiate the PTR tank replacement project. The tanks in their present state do not pose an unacceptable risk, as Eskom to date have been able to maintain their integrity with the approval of the NNR.
3. Turbine governing and turbine safety systems. These systems have been replaced using digital technology.
4. Rod control system
5. LP turbine retrofit
6. Station transformer replacement
7. Generator stator rewind
8. Reactor pressure vessel head

14.2.4 Holder's review of safety cases

[Arrangements for internal review by the licence holder of safety cases to be submitted to the regulatory body]

All safety cases to be submitted to the NNR undergo an internal independent review by Eskom. A safety screening, justification and evaluation process is followed by qualified and authorised personnel. Prior to submission to the NNR, the safety case and the results of the safety screening, justification and evaluation are presented to the Koeberg Operational Review Committee for approval and on some occasions to the Safety Documentation Review Committee, which is a sub-committee of the Oversight Safety Committee.

14.2.5 Regulatory review and control activities

14.2.5.1 Incident reporting

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 compliance assurance inspections programmes outlined below.

14.2.5.2 NNR approval process

The nuclear installation licence requires that the safety case be submitted by the licence holder for approval to the NNR, and 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.

14.2.5.3 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, which is independently implemented by the Compliance Assurance and Enforcement Division of the NNR, is described in Section 7.2.3.3.

14.2.5.4 Licensing of control room reactor operators

As indicated in Article 11.2.3 and 12.6, the licensing of reactor and senior reactor operators is subject to NNR approval, prior to commencement of duties.

14.2.5.5 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.

SECTION C: ARTICLES
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.

Section 15 has been updated to be consistent with INFCIRC/572 Rev 4.

Table 15.4-4 “Average monthly TLD exposure measurements at site boundary” has been updated.

15.1 Requirements on radiation protection

[Overview of the Contracting Party’s arrangements and regulatory requirements concerning radiation protection at nuclear installations, including applicable laws not mentioned under Article 7]

15.1.1 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 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 must be established, implemented and maintained. These requirements of the SSRP are implemented through the conditions of the Koeberg nuclear installation licence.

15.1.2 Dose limits

In order to achieve 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 NPP 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, Eskom’s radiological standards, and are summarised below:

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.

Furthermore the SSRP [1.7] specifies dose limits for apprentices and students, women, for emergency workers and for visitors and non-occupationally exposed workers at sites.

15.1.3 Public exposure

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

For the Koeberg NPP the dose constraint, applicable to the average member of the critical group within the exposed population, is 0.25 mSv per year.

In order to achieve 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 NPP 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.

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).

Section 4.7 of the SSRP [1.7] requires that an appropriate environmental monitoring and surveillance programme must be established, implemented and maintained to verify that the storage and disposal, or effluent discharge of radioactive waste complies with the conditions of the nuclear authorisation.

15.2 Regulator expectations on holder's ALARA processes

[Regulatory expectations for the licence holder's processes to optimise radiation doses and to implement the 'as low as reasonably achievable' (ALARA) principle]

In terms of ALARA, the NNR requires the implementation of an effective operational radiation protection programme, of which the ALARA programme forms part.

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 source-specific Annual Authorized Discharge Quantities AADQs in the nuclear authorisation, which must take into account the dose constrain, which for Koeberg NPP is 0.25 mSv per year, applicable to the average member of the critical group within 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 monitored by the regulator. This relates to both design and operation.

Section 2.5 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 basis.

Koeberg NPP annually generates 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, Eskom is required to comply not only with international standards, but also with those of the SSRP indicated above.

15.3 Implementation of radiation protection programmes by the licence holders

15.3.1 Observation of dose limits, main results for doses to exposed workers

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 a 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 NPP. Line groups and departments are successfully managing personnel dose exposure, 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 NPP.

Table 15.4-1

Summary of Koeberg NPP occupational exposure data from 2002 to 2012

Year	No. of individuals exceeding 20mSv	Annual collective dose man-mSv	Average annual dose to the occupationally-exposed worker mSv
1999	1	1726.4	0.983
2000	0	848.54	0.448
2001	0	2308.38	1.020
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
2010	0	1035.935	0.3912
2011	0	1066.792	0.3886
2012	0	1533.119	0.5491

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 2012.

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.

15.3.2 Release of radioactive material to the environment

[Conditions for the release of radioactive material to the environment, operational control measures and main results]

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 Koeberg Operational Technical Specification (OTS).

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 optimisation of waste production, collection, handling, treatment, conditioning, quantification, storage, and transport.

Eskom has implemented a modification to bypass the evaporators in the liquid waste system, and to increase the filtration efficiency by use of a demineraliser. This modification has resulted in reductions in the volume of solid waste produced, as well as the dose resulting from effluent releases. This practice is in line with current international trends to minimize waste volumes. A project has been launched to improve the efficiency of the existing evaporators and have an improved waste treatment plant.

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 measuring the dose rate and assigning of radionuclide-specific inventory, using 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 analysed for source-term specification by gamma spectrometry. The assignment of non-beta/gamma emitting activity is performed using generic scaling factors. Eskom has adopted the French EDF accredited scaling factors. This has been reported in previous CNS reports and the status quo still remains.

For Eskom, 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 an activity concentration of less than 0.2 Bq/g, which is lower than the national limit for exclusion of artificial nuclides. Eskom has completed further clearance assessments pertaining to volumetric contaminated equipment and materials for regulatory approval.

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 modelling 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 NPP operational discharges from 2002 to 2012

Year	Gas (μSv)	Liquid (μSv)	Total (μSv)
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
2010	0.3918	3.1523	3.5441
2011	0.2467	2.7165	2.9632
2012	0.1816	2.1050	2.2866

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 2012. The reason for the decrease in projected dose in recent years compared to previous years can be attributed to the application of the ALARA principles in effluent treatment and the implementation of the evaporator bypass modification.

The variation in the total activity discharged by pathway in each year from 1999 to 2012 is detailed in Table 15.4-3.

Table 15.4-3

Total activity discharged from Koeberg NPP 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
2010	2.43 E + 04	3.07 E + 04	5.50 E + 04
2011	1.451 E + 04	4.147 E + 04	5.598 E + 04
2012	1.083 E + 04	2.276 E + 04	3.359 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.

15.3.3 ALARA processes

[Processes implemented and steps taken to ensure that radiation exposures are kept as low as reasonably achievable for all operational and maintenance activities]

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:

i. The integration of the ALARA check-point into the normal system of operational radiation protection.
ii. A tiered approach to pre-task review based on the anticipated collective dose.
iii. 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.
iv. 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.

In terms of ALARA for public doses, the regulatory body 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 formalised in 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 for the previous three years.

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

i. 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.
ii. Primary circuit oxygenation which is performed at hot shutdown conditions, prior to refuelling, with the purpose of bringing insoluble nuclides, which are plated out on surfaces of the primary circuit internals, into solution.
iii. Reactor cavity decontamination which reduces the potential for exposure due to re-suspension by ventilation air currents causing an internal contamination hazard
iv. 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.
v. 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 and Reactor Building have been reduced from 13% to 1%. This is as a result of major attempts at reducing leaks in the plant.
vi. Zn injection, where Koeberg NPP is investigating the practice of injecting Zn into the primary circuit to alleviate/displace 60Co contamination in the primary circuit materials.
vii. Hot spots management in the plant, where a serious hot spot reduction programme has been adopted by all Koeberg NPP departments. This entails recognising various methods i.e. flushing, cutting, shielding and their consequences and means of improvements.
viii. Training, where a full radiation worker training simulator has been established at the training center at Koeberg NPP which entails full practical training requirements for radiation workers encompassing step-off pads, waste handling, instruments, access control, dosimetry, etc.
ix. Dose management is integrated into the work management programme and performance management system at Koeberg NPP. Line groups and departments have responsibilities and ownership to manage the personnel dose in accordance with weekly, monthly and annual dose targets. The RADPRO computer access-control system was upgraded to compliment dose management.
x. Replacement of the Whole Body Counter which was necessary due to the change of

obsolete components for newer ones. This upgrade has resulted in more accurate measurements, based on the latest international references.

xi. 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 and 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 allow for personnel access into radiological controlled zones after confirmation that the 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.

Refer to Section 15.3.1 for the achievement of ALARA targets for worker doses.

15.3.4 Environmental monitoring and main results

The environmental surveillance programme established at the nuclear installation is complementary to the radiological effluent management programme. The annual authorised 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.

Eskom has performed a habitation study in the vicinity around the plant to update current eating habits and pathways of exposure and environmental source term. This has resulted in an updated and more accurate public dose assessment in future. The survey was performed by a local university in the vicinity of Koeberg NPP. Information and data were obtained from members of the public relating to their eating and recreational habits that 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.

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

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 2012. The data reflect the total external dose recorded at the site boundary, and is used to trend contributions to direct radiation by the nuclear installation. The trend analysis has not revealed any significant changes in the dose rate at any location since the start of operation. Effluent modelling confirms a relatively insignificant external contribution from the plant.

Table 15.4-4

Average monthly TLD exposure measurements at site boundary

Year	Average exposure (μSv)
2002	25.0
2003	26.9
2004	24 (33.5a)
2005	23.8 (34a)
2006	23.2 (33.7a)
2007	22.8
2008	25.9
2009	25.7
2010	25.4
2011	25.7
2012	25.4

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 54Mn, 60Co and 110mAg 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 131I 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 Eskom 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.

15.4 Regulatory review and control activities

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 thorough problem notification follow-up and the NNR compliance assurance inspections programmes, including the safety indicator system (refer Article 14). Additionally, Single Point Contact meetings with the licence holder are scheduled on a quarterly basis and regular counterpart interfaces (frequently) occur to discuss operational problems and the effectiveness of the operational programmes.

The NNR ensures that licence holder radiation protection staff are 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’s scheduled quality assurance audits. 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.

Issues under discussion with Eskom include: the Radiation Protection Functional Organisation, modifications to reduce occupational doses, changes to the radiological protection computer software and hardware, the results of the habitation study, environmental surveillance trends, 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, and the update of the Activity Migration Model.

SECTION C: ARTICLES
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 in 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 covers the activities to be carried out in the event of such an emergency.

Summary of changes

Section 16 has been updated for consistency with INFCIRC/572 Rev 4, and in terms of the following:

Development of regulations on emergency preparedness and response, and promulgation of regulations on siting of new nuclear installations (16.1.1)

Progress on late-phase aspects (16.1.3.2.3)

Regulatory review (16.1.5.1), with reference to the review of external events covered in the Koeberg Second Periodic Review, and post Fukushima

Nuclear emergency exercises (16.1.5.2) with reference to the 2010 and 2012 regulatory emergency exercises.

16.1 Emergency plans and programmes

16.1.1 Requirements for emergency preparedness

[Overview of the Contracting Party's arrangements and regulatory requirements for on-site and off-site emergency preparedness, including applicable laws not mentioned under Article 7]

In terms of the Disaster Management Act, 2002 (Act No. 57 of 2002) [1.4] the DoE is therefore also the ‘National Organ of State’ for coordination and management of matters related to nuclear disaster management at national level.

As a signatory to the International “Convention on early notification of a nuclear accident” [5.4] South Africa will also notify the International Atomic Energy Agency in case of a nuclear accident. The South African Nuclear Energy Corporation (NECSA) has been designated by the DoE as the National Competent Authority to service this convention and to be the designated contact point, using the 24-hour NECSA Emergency Control Centre.

The NNR Act and the regulations R388 (SSRP) [1.7] specify the requirements on emergency planning to ensure effective preparedness and responses 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 an emergency plan, insofar as it relates to the relevant nuclear installation. Such an emergency plan must be submitted by the holder of the nuclear installation licence for approval by the NNR.

The NNR must ensure that such an 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 organisations and emergency preparedness provisions.

Furthermore, the Minister of Energy may, on recommendation of the NNR 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 the nuclear authorisation in question must implement the emergency plan as approved by the NNR.

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

These requirements are enforced through a condition of the Koeberg nuclear installation licence in a regulatory Requirement Document RD-0014 “Emergency Preparedness and Response at Nuclear Installations.” [4.7] The requirements are based on IAEA GS-R-2 “Preparedness and

Response for a Nuclear or Radiological Emergency" [5.16] and the licence holder is required to comply and demonstrate compliance to the requirements of this document.

The NNR is in the process of developing regulations on emergency preparedness and response which will supersede RD-0014 and the regulations R388 on the Safety Standards and Regulatory Practices (SSRP) [1.7]. These regulations will be based on the draft IAEA DS457, which will replace GS-R-2 when approved.

As reported in Section 7.2.1.1, regulations are being published on monitoring and control of developments in the vicinity of Koeberg NPP to ensure the effective implementation of the emergency plan. These regulations include the specific requirements applicable to the vicinity of Koeberg NPP and will replace the regulations published in March 2004, which were generic and applicable to all nuclear installations.

One of the requirements is that the municipal authority must develop and maintain a traffic evacuation model, approved by the regulator, for use in decisions on urban planning.

Regulations on the Siting of New Nuclear Installations (R.927) were promulgated in 2011 [1.8]. These impose requirements with regard to emergency planning zones.

For Koeberg NPS 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.

16.1.2 National emergency plan, roles and responsibilities

[Overview and implementation of main elements of national plan (and regional plan, if applicable) for emergency preparedness, including the role and responsibilities of the regulatory body and other main actors, including state organisations]

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 NPP exercises. In terms of Section 38(1) of the NNR Act [1.1], 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.

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 Integrated Koeberg Nuclear Emergency Plan contains the roles and responsibilities in the agreement between the licensee and the relevant municipal and provincial authorities, as well as the late-phase aspects. Among other things, the plan aims to establish an organised emergency preparedness and response system with a 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 interests of public health and safety.

The role of the nuclear installation is that of: accident recognition and quantification; reporting to the NNR and to any other person described in the nuclear authorisation; 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 [1.4] the local authorities are required to mobilise their civil protection capabilities, to implement protective measures, as recommended. The provincial and national governments are required to provide coordinated 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, training and exercising programmes.

Each national organ of state indicated in the national disaster management framework must prepare a disaster management plan, coordinate 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.

16.1.2.1 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 manage the late-phase, owing to the need for multiparty/multidisciplinary coordination of protective and recovery measures at national level. In the case of a major nuclear accident requiring national response, the Minister of Corporative Governance and Traditional Affairs (COGTA) would declare a national state of disaster, as provided for in the Disaster Management Act (Act no 57 of 2002). In terms of the Disaster Management Act [1.4], the national organ of state, the national government Department of Energy (DoE) is obliged to prepare a disaster management plan in the nuclear area, resulting in the National Nuclear Disaster Management Plan.

The DoE is responsible for coordination and management of matters related to off-site nuclear disasters 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 concepts and principles of disaster management. The National Infrastructure on Nuclear Emergency Preparedness is currently being reviewed through the IAEA EPREV mission to identify gaps in the stakeholders emergency plans including the DoE National Nuclear Disaster Management Plan.

South Africa is a member of the Convention on Early Notification and Assistance in case of a nuclear accident (ENAC). The National Competent Authority and the National Warning Point are functions delegated to the South African Nuclear Energy Corporation (Necsa) and coordinated through the IAEA RANET programme. The early notification activities are part of the National Nuclear Emergency Plan.

The NNR established its own Emergency Control Centre (ECC) in 2006 in order to fulfil its role in case of nuclear and radiological emergencies. This centre will provide a centralised location, where key NNR staff members can receive notification from authorised holders and other stakeholders, monitor the evolution of the accident conditions, perform verification analysis, and provide advice to off-site authorities regarding decisions that are taken to protect people and the environment. The ECC will also provide the means for the NNR to communicate with the relevant stakeholders, such as affected facilities, the public through press releases, and the national Department of Energy (DoE). Even though the NNR ECC had been operational, its function needed to be enhanced in order to appropriately service the current and additional obligations.

In December 2012, the NNR received financial support from the DoE for a major upgrade of its Emergency Control Centre and the related infrastructure. A project plan was established in January 2013 for the upgrade of the centre and includes the proposed capabilities of the NNR ECC as derived from the needs analysis and benchmarking with the national and international emergency and disaster operations centres. The legislative role of the NNR regarding the nuclear and radiological emergencies is also being reviewed.

The various specifications for the refurbishment and upgrade of the ECC were established for procurement purposes. The specifications include the necessary ICT infrastructure, redesign of the ECC, electronic communications equipment, on-line radiological and technical data transmission, plume modelling tools, radiological measurement instrumentation, and development of new procedures, while updating the existing ones.

The refurbishment of the ECC is targeted for completion by the end of 2013/2014, with implementation taking place in the first quarter of 2014.

16.1.3 Implementation of emergency preparedness measures by the licence holders

16.1.3.1 Classification of emergencies

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 vary 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:

i. Unusual Event
ii. Alert
iii. Site Emergency
iv. General Emergency

16.1.3.1.1 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.

16.1.3.1.2 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:

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

16.1.3.1.3 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 for 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.

16.1.3.1.4 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.

In terms of the classification of the different type of emergencies, Eskom is currently in the process of aligning the criteria for the different categories with those specified in the Safety Standards and Regulatory Practices.

16.1.3.2 Main elements of the emergency plans and resources

[Main elements of the on-site and, where applicable, off-site emergency plans for nuclear installations, including, availability of adequate resources and authority to effectively manage and mitigate the consequences of an accident]

When a nuclear accident is reported to the NNR, the NNR is required by the NNR Act to immediately investigate such an 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 authorisation 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 an inadequate or inappropriate response. In terms of fulfilling its regulatory responsibilities pro-actively, 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 local authority to the NNR for advice. The NNR when would then perform technical verification and assessments using the necessary input and information as provided by the local authority or authorisation holder which could inform the final decision making for off-site protective actions.

16.1.3.2.1 Identification and activation of emergency organisation

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 organisation 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 organisations will take place concurrently.

16.1.3.2.2 On-site response

Management of the emergency in the early phase is performed by the on-site emergency organisation 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 by the licence holder include: classification, prognosis, public notification, communication with on-site and off-site responders and organisations, 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 organisation 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 interests 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.

16.1.3.2.3 Off-site emergency situation

Identification and activation

The management 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 organisations involved, are emergency organisations from the local, provincial and national government.

Initial notification of an Alert or Site/General Emergency at the Koeberg NPP is communicated to the City of Cape Town (CoCT) Disaster Operating Centre (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 Coordination Team) is comprised of the head of the Disaster Management Centre, City of Cape Town and representatives from the provincial government of the Western Cape (Disaster Management) and the Department of Energy.

Implementation of protective actions

The Koeberg NPP operating shift manager and/or the standby Koeberg emergency controller recommend protective actions in accordance with a Protective Action Form to the Disaster Coordination Team. The Disaster Coordination Team participates in joint decision making, joint coordination and joint management of a nuclear emergency.

The joint coordination team recommends a declaration of a national disaster to the National Disaster Management Committee, following the declaration of a General Emergency at Koeberg NPP. The Disaster Coordination Team may review the recommended protective actions and the technical basis for them, 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 NPP emergency controller in the absence of representatives from the national and provincial governments.

Late-phase plan

As part of the continuous improvement of emergency preparedness, the 'late-phase' aspects of the emergency plan have been enhanced and further developed. 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 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 conducted through the regulatory emergency exercises.

Work on selected late-phase aspects, namely infrastructural decontamination has been finalised informed by international experience feedback, 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.

Review of traffic model

As part of the Koeberg NPP evacuation plan, and to monitor 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 approval. The traffic model was updated in 2012 to account for infrastructure and population changes. Refer to Section 16.1.1 for the requirements on the traffic (evacuation) model.

16.1.3.3 Holder facilities for emergency preparedness

[Facilities provided by the licence holder for emergency preparedness (if appropriate, give reference to descriptions under Article 18 and Article 19 (4) of the convention, respectively)]

From 2007, Eskom and the local authorities 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. Previous methods such as telephones and faxes will be retained and used as a backup. This system has been used successfully for three years now and also receives periodic upgrades in order to keep up with technological advances.

16.1.4 Training, exercises, and main results

[Training and exercises, evaluation activities and main results of performed exercises including lessons learned]

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. TWG meetings are held, at which intervening organisations' training representatives can address specific training needs. Emergency preparedness (EP) and response training programmes at Koeberg NPP are aligned with the Systematic Approach to Training system which is in line with international best practice.

Koeberg NPP internal emergency exercises

Every year Eskom prepares a programme of drills and emergency exercises for implementation. Eskom uses these drills and exercises as part of the training of emergency responders, but more importantly as a self-assessment, and for 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.

16.1.5 Regulatory review and control activities

16.1.5.1 Regulatory review

The NNR reviews and approves the emergency plans submitted in terms of the requirements indicated in Section 16.1.1. The NNR reviews and approves the traffic evacuation model submitted by the municipal authorities in terms of the requirements indicated in Section 16.1.1.

The NNR is in the process of upgrading its Emergency Control Centre in order to monitor nuclear accidents and provide advice.

Eskom completed the Second Periodic Safety Re-Assessment (SRA II) of the Koeberg NPP in 2010 (Section 14.1.3.3). 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 viable and adequate to deal with potential nuclear emergencies.

As reported in Section 14.1.4.3, following the Fukushima accident in Japan in 2011, Eskom undertook an external event safety re-assessment as directed by the NNR which focused on external events, both in the design basis and beyond design basis domains. The review of the emergency plan focussed on:

i. emergency management actions and preparedness following the worst-case accident;
ii. radiological monitoring following a nuclear accident involving radiological release;
iii. public protection emergency actions, and
iv. communication and information flow in an emergency situation.

The assessment methodology, main findings, conclusions and proposals were summarised as follows.

The provision of the design basis for extreme natural phenomenon and combinations of external events has been predominantly assessed and included plant walk-downs and inspections to confirm the health of the plant. The analysis of the emergency plan has been conducted by comparing the needs with the actual capacity. A needs-analysis was performed on the proposed emergency plan actions, necessary to minimise radiological releases and for recovering the plant following such an accident. The overriding finding was that there is currently no design base for the facilities and equipment being used to implement, coordinate, and support the emergency plan.

Various proposals have been made by Eskom. The major proposal made is that a design basis be developed for the facilities and equipment being used in the emergency plan. This design basis should include consideration for external events that could potentially challenge the ability to implement the emergency plan.

Eskom had conducted the needs-analysis on the emergency plan for the following: assessment of the facilities, resilience of facilities to external events, muster control, access control, exposure monitoring, dosimetry, medical emergency, power supplies, ventilation, lighting, support functions, step-off point, scanning, contamination control, protective clothing, personal hygiene, food and water, rest, transport, voice communications, documentation, data and information, loss of AC power, seismic impact on equipment, flooding, high winds, electronic models for the release of radioactive materials, tools and spares, procedures, local staging, and mobile options.

Recommendations were made to address shortfalls on facilities and equipment in accordance with the needs-analysis conducted on the above areas.

Eskom's conclusion is that the Koeberg NPP Emergency Plan and plant recovery strategy is in line with the requirements currently in place. However, if the current capacity is challenged by the type of severe conditions similar to that at the Fukushima, the plan will become difficult to implement. A number of upgrades and improvements are required to improve the level of response to ensure effective implementation, when subjected to severe accidents, especially when accompanied by extreme external events.

The NNR had also directed Eskom to conduct a re-assessment of the Koeberg NNP Emergency Plan (EP) to determine the adequacy of emergency personnel and communication capabilities following an external event which results in the loss of off-site power, affecting both units. This plan considers resources and personnel required to fulfil the functions of the Emergency Control Centre, the technical support centre, radiation protection, engineering, maintenance, operating, and fire fighting at Koeberg in the case of a beyond design basis external event. The purpose of this assessment is to determine the minimum number and composition of the emergency response standby personnel, to implement mitigation strategies and repair actions intended to maintain or restore core cooling, containment integrity, and spent fuel pool cooling capabilities for the affected units.

The conclusion was that the emergency personnel are considered adequate for one unit failure and the emergency personnel are considered not adequate for failure of both units. There is sufficient means of communication for Koeberg NNP to the EP during an external event.

Proposed modifications have been made in order to increase the robustness of the existing installed communication means. These modifications included purchasing new satellite phones, upgrading the existing installed communication equipment, enhancing the robustness of the existing communication equipment to seismic and flooding events, and installation of gene-phones on key areas on site.

The NNR will be provided with periodic feedback on how Eskom deals with issues of the adequacy of personnel resources and communication in case of a beyond design basis external event.

16.1.5.2 Nuclear emergency exercises

As part of emergency preparedness, emergency exercises form an important component in the rehearsal of the emergency plan. Using an exercise to test the effectiveness of the emergency plan requires 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 diversion of resources.

Such exercises conducted by the NNR are therefore not frequent, currently being held at eighteen month to two-year 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 procedure 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.

The NNR conducted an announced emergency exercise at Koeberg NPP on 5 September 2012.

The findings from the previous exercises, inspections findings and occurrences, together with assessment activities were used to formulate the exercise objectives. The overall objective of the 2012 exercise was to test the response of both the on-site and off-site organisations. Specific objectives of the exercise included testing of certain aspects of the integrated emergency plan of the nuclear installations which included:

i. To test communication aspects that will include the Koeberg NPP GIS/ Electronic Communication System.
ii. Protection of emergency workers (traffic police).
iii. Physical availability of the transport for evacuees.
iv. Physical evacuation of the public (simulation).
v. Activation, availability and operation of Mass-Care Centres in detail.

vi. Arrangements to provide for the evacuees at the Mass-Care Centres.
vii. Preparation of the press release and conducting of a press briefing.

The NNR deployed a number of umpires at the on-site and off-site response locations in accordance with the simulated scenario. For all the on-site and off-site locations identified prior to the exercise, the NNR umpires recorded detailed observations and associated findings and these were captured in the exercise report.

For this exercise, the NNR invited observers to witness and observe the activities, responses and actions of the various organisations 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 had validated, in order to ensure adequate correction of all inadequacies, all the findings by umpires and observers and compiled an exercise report. The NNR concluded that the overall response of Eskom and the intervening organisations has shown that the Integrated Koeberg Nuclear Emergency Plan is viable for the protection of persons and the environment; however specific areas were identified for improvement.

Following issuance of the final report, Eskom and the intervening organisations were required to ensure that appropriate corrective actions are identified and implemented to address the findings as a matter of urgency, in accordance within identified timescales. All the exercise findings and observations have been closed out, to the satisfaction of the NNR.

16.1.5.3 Forums

The Emergency Planning Steering and Oversight Committee (EPSOC) was established with the authorities in the vicinity of the Koeberg NPP, for liaison on emergency preparedness, planning and response. This forum provides direction, steering and oversight relating to development and implementation of emergency preparedness and response plans for Koeberg NPP. The committee meets on a quarterly basis. The meeting is chaired by a representative from the Department of Energy (DoE), which is responsible for nuclear activities.

16.1.6 International arrangements

South Africa has signed and ratified the following international conventions that are pertinent to emergency preparedness.

i. Convention on Early Notification of a Nuclear Accident
ii. Convention on Assistance in the case of a Nuclear Accident or Radiological Emergency

As the Koeberg NPP 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. This matter will however be addressed in the legislative review.

Eskom is a member of Enatom and, in terms of the associated early-notification agreement, would inform affected states either directly or via the IAEA.

16.2 Information for the public and neighbouring states

16.2.1 Informing the public about emergency planning and emergency situations

[Overview of the Contracting Party's arrangements for informing the public in the vicinity of the nuclear installations about emergency planning and emergency situations]

After initial notification, once the licence holder's Emergency Control Centre (ECC) is activated, further communication is established with the affected municipality (e.g. the City of Cape Town Disaster Management Centre, in the case of Cape Town).

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

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

Within the site, and up to 5 km from the site boundary, notification is required to be effected within at least 15 minutes, throughout 360°. From 5 to 10 kilometres, notification is required to be effected within 30 minutes, through a 67.5° downwind sector. From 10 to 16 kilometres, 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 are being added to the south-eastern sector on an ongoing basis, where the residential areas have shown substantial growth over the last few years. The system now comprises 30 farm sirens and 50 omni-directional sirens. A number of off-site farm sirens were moved on-site and the affected areas are now covered by additional omni-directional sirens. All off-site sirens are controlled from one of four locations, namely Koeberg NPP Voltage Control Room, Koeberg NPP Emergency Control Centre, the Alternative Emergency Control Centre and the CoCT Disaster Operations Centres.

A dedicated Joint Media Centre (JMC) is available, where representatives of Eskom and the intervening organisations meet to finalise information that will ultimately be sent to the media to inform 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 NPP. 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 for broadcasting to the public at large. Upon the declaration of a nuclear emergency, the licence holder must notify the NNR who will in turn 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) which is the responsible South African institution in this regard.

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

i. Emergency Planning Committee

The Emergency Planning Committee (EPC) is a working committee instituted by Koeberg NPP and the relevant local and provincial authorities to address implementation of the Koeberg NNP Emergency Plan and it reports to the EPSOC on progress. It is chaired by a representative of the local authority, and meetings are held on a quarterly basis.

ii. Public Safety Information Forum

As indicated above in Section 9.4, the NNR Act requires that the holder of a nuclear installation licence 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.

16.2.2 Arrangements to inform competent authorities in neighbouring states

Not applicable as Koeberg NPP is in the south-western part of South Africa, far from neighbouring states.

Article 16 (3) Emergency preparedness for contracting parties without nuclear installations

Not applicable.

SECTION C: ARTICLES
ARTICLE 17: SITING

Each Contracting Party shall take the necessary 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, and

(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 of the nuclear installation on their own territory.

Summary of changes

Section 17 has been updated to be consistent with INFCIRC/572 Rev4 [5.1] and to address the following:

i. Regulatory requirements (17.1.1)
ii. Assessment of new sites (17.1.1.1)
iii. Regulatory review and control activities (17.1.2)
iv. Criteria for evaluating the likely safety-related impact of the nuclear installation on the surrounding population and the environment (17.2.1)
v. Re-evaluation of sites (17.3)

17.1 Evaluation of site-related factors

17.1.1 Requirements on siting and site evaluation

[Overview of the Contracting Party's arrangements and regulatory requirements, relating to the siting and evaluation of sites of nuclear installations, including applicable national laws not mentioned under Article 7 of the convention]

In terms of the National Nuclear Regulator Act [1.1], nuclear authorisations are required for the siting of nuclear installations. The regulation on siting of new nuclear installations [1.8] requires the applicant for a nuclear installation licence for the siting of nuclear installation(s) to submit, in support of its application, a Site Safety Report (SSR) to the NNR, comprising the following:

i. Motivation for the choice of the site
ii. Statement as to the proposed use of the site (maximum thermal power, general design characteristics)

iii. Source term analysis
iv. Characteristics of the site, in terms of external events
v. Probabilistic Risk Assessment (PRA) (including cumulative impact of nuclear installations)
vi. Analysis of the impact on the public, due to normal operations
vii. Analysis to demonstrate the viability of an emergency plan
viii. Identification and determination of the emergency planning zones

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

17.1.1.1 Overview of assessments and criteria

[Overview of assessments made, and criteria applied for evaluating all site-related factors affecting the safety of the nuclear installation, including multi-unit failure, loss of infrastructure, and site access following an event]

To establish a strategic reserve of nuclear sites to support any future nuclear build programme, Eskom is qualifying two potential new sites and is re-analysing the site upon which Koeberg is constructed and operated. The sites are being qualified in accordance with the newly promulgated Siting Regulations described above.

Probabilistic seismic hazard assessments of these sites are being undertaken in accordance with NRC Regulation Guide 1.208 [6.8] using the Senior Seismic Hazard Analysis Committee (SSHAC) Level 3 process.

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

17.1.1.2 Overview of design provisions against external events

[Overview of design provisions used against human made external events and natural occurring external events such as fire, explosion, aircraft crash, external flooding, severe weather conditions and earthquakes and the impact of related, sequential, natural, external events (e.g. Tsunami caused by an earthquake, mud slide caused by heavy rain)]

The Koeberg design against external hazards is discussed in the Annexure.

17.1.2 Regulatory review and control activities

For new applications, the NNR Act requires the NNR to direct the applicant to publish the application in the Government Gazette and two newspapers circulating in the vicinity of the site, and to serve copies of the application to the municipalities affected by the application, and any such body as determined by the chief executive officer.

The NNR reviews the submissions for a site licence to verify compliance with the regulations on safety standards and regulatory practices, as well as the specific requirements in the regulation on site licences (Refer to Section 17.1.1).

The NNR conducts a public participation process using a public information document prepared by the applicant.

The NNR prepares a report on the safety review and the public process which is submitted to the NNR Board who then directs the chief executive officer of the NNR to approve or reject the application.

Note: Prior to the NNR public process, the applicant is required to conduct an Environmental Impact Assessment in accordance with environmental legislation. This process culminates in a record of decision by the Minister of Environment.

17.2 Impact of the installation on individuals, society and environment

17.2.1 Criteria for public and environmental safety impact

[Criteria for evaluating the likely safety-related impact of the nuclear installation on the surrounding population and the environment]

The criteria for site evaluation are referred to in the regulation on siting of new nuclear installations (17.1.1).

The NNR has further stipulated limitations on urban developments in the vicinity of nuclear installation and holds regular meetings with Eskom and the local authorities in this regard. 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 NPP, 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. Similar regulations will be developed for other nuclear sites.

17.2.2 Implementation of these criteria in the licensing process

The applicant is required to submit a site safety report, demonstrating compliance with the criteria referred to in Section 17.2.1.

17.3 Re-evaluation of site-related factors

17.3.1 Re-evaluation of sites

[Activities for re-evaluation of the site-related factors as mentioned in Article 17 (1) of the convention to ensure the continued acceptability of the safety of the nuclear installation, conducted according to appropriate standards and practices]

The regulation on siting of new nuclear installations (17.1.1) stipulates that in the event of an application for a construction licence on the site for which a site licence has been granted, the factors affecting the site safety report would have to be re-evaluated if five years had passed since the issuance of the site licence.

Operating nuclear power plants are subject to ten-yearly periodic reviews, which include site-related factors.

17.3.2 Results of recent re-evaluation activities

Refer to Sections 14.1.3.2, 14.1.3.3 and 14.1.4.3 on the first and second periodic reviews, and post-Fukushima reassessment respectively.

As indicated in Sections 14.1.3.2, 14.1.3.3, two ten-yearly periodic safety re-assessments of the nuclear installation (Koeberg NPP) have been undertaken. As part of these re-assessments internal and external hazards were re-assessed. For the latter re-assessment the hazards listed in the IAEA Safety Guide No. NS-G-2.10 (2003) [5.14] and the internal hazards studied by Electricité de France (EDF) for their VD3 project were used. The re-assessment included a review of design provisions used against man-made external events and natural occurring external events such as fire, explosion, aircraft crash, external flooding, severe weather conditions and earthquakes and the impact of related sequential, natural external events.

As indicated in Section 14.1.4.3, following the Fukushima accident in 2011, an external event safety re-assessment was undertaken as directed by the NNR. The scope of the re-assessment included:

i. Review of the provisions taken in the design basis concerning flooding, earthquake, other extreme natural phenomena and combinations of external events applicable to the Koeberg site.
ii. A review of the robustness of the Koeberg design to maintain its safety functions beyond

the design basis hazards, including earthquakes and flooding exceeding the design bases, other extreme external conditions challenging the site and a combination of events

iii. A review of the consequential loss of safety functions following a prolonged loss of electrical power and a prolonged loss of the ultimate heat sink, which for Koeberg is sea water cooling.
iv. The identification of potential cliff-edge effects in the assessment of external events and potential measures or design features to mitigate these effects.
v. Emergency management and response.
vi. Accident management.

The re-assessment included safety considerations for operation of multi units at the same facility site. The findings of the re-assessment are summarised in Section 14.1.4.3.

17.3.3 Regulatory review and control activities

The NNR reviews the scope, terms of reference and the safety analyses, to verify compliance with the regulatory requirements, including the international benchmark (French CP-1 safety referential), and other international practices.

The NNR produces a report on the outcome of the periodic review.

The NNR uses the results of the periodic review to consider any regulatory action, such as directives to resolve issues, restrict or curtail operation.

The NNR reviews the corrective action plan, and follows up on the implementation thereof.

17.4 Consultation with other contracting parties likely to be affected by the installation

17.4.1 International arrangements

South Africa’s nuclear sites are far removed from boundaries with other countries, and therefore such consultation is not required.

17.4.2 Bilateral arrangements with neighbouring states, as applicable and necessary

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

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

Summary changes

Section 18 has been almost completely updated to conform to INFCIRC/572 Rev 4.

18.1 Implementation of defense-in-depth

18.1.1 Regulatory requirements on design and construction

[Overview of the Contracting Party's arrangements and regulatory requirements concerning the design and construction of nuclear installations]

The NNR is mandated by the NNR Act to inter alia exercise regulatory control related to safety over the siting, design, construction, operation, manufacture of components parts, and decontamination, decommissioning and closure of any nuclear installation through the granting of nuclear authorisations.

The requirements of the NNR Act and the principal safety requirements formulated in the Regulations R388 on Safety Standards and Regulatory Practices (SSRP) [2] form the basis for the stipulation of the regulatory requirements for design and construction of nuclear installations. These principal safety requirements explicitly uphold the principle of defense-in-depth.

One of the principal nuclear safety requirements of Section 3.9 of the SSRP requires a multilayer (defense-in-depth) system of provisions for radiation protection and nuclear safety, commensurate with the magnitude and likelihood of the potential exposures involved, to 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 defense-in-depth, as applied in the design, construction and subsequent operation of the nuclear installation, is based on the IAEA INSAG-10 [5.18] 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 stipulated safety standards.

For holders of current licences, design and manufacture can be conducted under the authority of the licence which requires implementation of supplier and procurement processes in accordance with requirements on management of safety. Approval by the NNR is required for modifications as described in other Articles. The NNR conducts assessments and inspections on the design and manufacturing processes.

For a new build, the NNR Act dictates that a construction licence is required. A prerequisite for this is that the applicant must be in possession of a site licence as dictated by the Regulations on the Siting of New Nuclear Installations (R.927) [1.8].

The applicant for a construction licence must provide:

i. A project plan, including licensing schedule, vendor and suppliers
ii. Safety management during construction
iii. Preliminary safety analysis report
iv. Site safety report
v. Topical reports
vi. Safety classification document
vii. Quality and safety management documentation
viii. Preliminary probabilistic safety assessment
ix. Preliminary emergency plan
x. Nuclear security plan
xi. Arrangements for regulatory control
xii. Commissioning plan
xiii. Decommissioning strategy

The applicant is further required to comply with mandatory hold and/or witness points, beyond which work may not proceed without the approval of the regulator. These hold and/or witness points, depending on the type of installation and the associated nuclear risk, include:

i. Site establishment
ii. Early site activities
iii. Component manufacturing
iv. Carrying out of civil works
v. Installation of components and equipment

vi. Performance of pre-commissioning or functional tests of individual sub-systems of components

The licensing process which was applied at the time of the Koeberg plant design and construction was that the design of the 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 installation.

18.1.1.1 Modification control process

One of the conditions of the nuclear installation licence is that a valid plant description and configuration must be maintained, and that a modification control process be in place to ensure that modifications to the installation are controlled in an acceptable manner. Furthermore, it is a condition of the nuclear installation licence that a valid and updated safety assessment, which must include a risk assessment, be maintained of the installation.

18.1.1.2 The licence holder's modification process

Modifications to the installation were implemented by Eskom, 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 e.g. 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 subjected to a comprehensive review process, must also address all the required changes to the applicable documentation, including operating documentation of the installation e.g. OTS, operating procedures, maintenance programme, radiological protection programme etc.

18.1.2 Status of application of the defense-in-depth

[Status with regard to the application for all nuclear installations of the defense-in-depth concept, providing for multiple levels of protection of the fuel, the primary pressure boundary and the

containment, with account taken of internal and external events and the impact of related sequential, natural external events (e.g. Tsunami caused by an earthquake, mud slide caused by heavy rain)]

The safety assessments referred to in Article 14, including the First Periodic Safety Reviews and the post Fukushima assessments, thus far confirm that Koeberg NPP conforms to its design basis, and that the design basis and operating practices conform to the principle of defense-in-depth, in line with current international practice.

The implementation of defense-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:

i. Additional off-site power supplies for grid strengthening
ii. Revision of Operating Technical Specifications (OTS) and development of shutdown OTS
iii. Moratorium on mid-loop operation with fuel in the reactor
iv. Fast dilution modification
v. Requirements on risk management
vi. Protection against marine oil spills
vii. Addition of diesel generator power supplies and reactor pump seal supply during station blackout scenarios
viii. Implementation of an additional (third) cooling loop for the spent fuel pools and back-up emergency inventory supply.

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 defense-in-depth:

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

Presently Eskom complies with the above requirements through implementation of its Operating Technical Specifications (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 defense-in-depth in the operation of the nuclear installation, is the comprehensive independent surveillance and compliance inspection programme (complementary to the licence holder's monitoring programme), implemented by the NNR, to verify compliance with the nuclear installation licence requirements and to identify any potential safety concerns.

18.1.3 Extent of use of design principles

[Extent of use of design principles, such as passive safety or the fail-safe function, automation, physical and functional separation, redundancy and diversity, for different types and generations of nuclear installations]

The following are examples of improvements that 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 categorised 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 systems, 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 a 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, internal flooding, 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.

18.1.4 Implementation of design measures for beyond design basis accidents

[Implementation of design measures or changes (plant modifications, back fitting) to prevent beyond design basis accidents or to mitigate their radiological consequences if they were to occur]

The application of defense-in-depth, as indicated in IAEA INSAG 10 [5.18] is applied at the Koeberg NPP 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. Koeberg has also installed passive autocatalytic recombiners.

18.1.5 Design improvements implemented

[Improvements implemented for designs for nuclear power plants as a result of deterministic and probabilistic safety assessments made since the previous national report; and an overview of the main improvements implemented since the commissioning of the nuclear installations]

The following are examples of improvements that 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 categorised 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 systems, measuring of activity and improvements in system leak tightness. Included under this category has been the installation of passive autocatalytic recombiners.

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. Included under this category has been the installation of new pressuriser relief valves.

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. Included under this category has been the replacement of rod control, turbine control and turbine safety systems with digital technology.

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 a 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. Included under this category has been the installation of station black-out diesel generators, located 14 metres above the site terrace.

vi. Protection against hazards

This category of modification includes improvements to protect against high-energy pipe breaks, internal flooding, 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.

18.1.6 Regulatory review and control activities

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 prior approval by the NNR, before being implemented. The process to be followed by the licence holder 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:

i. Any 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.
ii. 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.
iii. 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.

Periodic safety assessments are submitted to the NNR for review. The NNR prepares a review report concluding on the continued operation of the facility. The holder submits a corrective action plan for approval by the regulator. The NNR monitors implementation of the corrective action plan.

As described above, approval by the NNR is required for modifications or changes to the licence basis. The NNR conducts assessments and inspections on the design and manufacturing processes.

18.2 Incorporation of proven technologies

18.2.1 Requirements on proven technology

[Contracting Party's arrangements and regulatory requirements for the use of technologies proven by experience or qualified by testing or analysis]

The regulatory requirements (Article 7) dictate that:

All systems, structures and components (SSC) important to safety must be designed according to the latest or currently-applicable approved standards. If possible, the SSC should be of a design proven in previous equivalent applications, and must be consistent with the plant-reliability goals necessary for safety.

Where new or innovative design or features are used, the results of the investigations on applicability of the codes and standards must be provided to the NNR. It must be demonstrated that the selected codes and standards are fully applicable to the SSC. In any other case, a revised code, standard or specification must be developed and approved.

18.2.2 Measures taken by the licence holders to implement proven technologies

As reported in the previous national reports to the convention [3.4], the nuclear installation was built between 1976 and 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 coordination.

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 Development (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.

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 utilised [4.5]. 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 [4.6, 4.9].

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

18.2.3 Qualification of new technologies

[Analysis, testing and experimental methods to qualify new technologies, such as digital instrumentation and control equipment]

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. Included under this category has been the replacement of rod control, turbine control and turbine safety systems with digital technology.

18.2.4 Regulatory review and control activities

Periodic safety assessments are submitted to the NNR for review. The NNR prepares a review report concluding on the continued operation of the facility. The holder submits a corrective action plan for approval by the regulator. The NNR monitors implementation of the corrective action plan.

As described above approval by the NNR is required for modifications or changes to the licence basis.

The NNR conducts assessments and inspections on the design and manufacturing processes as considered necessary.

18.3 Design for reliable, stable and manageable operation

18.3.1 Requirements on human factors and ergonomics

[Overview of the Contracting Party's arrangements and regulatory requirements for reliable, stable and easily manageable operation, with specific consideration of human factors and the human–machine interface (see also Article 12 of the convention)]

The regulatory requirements (Article 7) dictate that the design of systems, structures and components (SSC) important to safety be consistent with the plant-reliability goals necessary for safety. Further, the PSA conducted pursuant to the requirements on risk assessment will reveal human factor issues regarding the design and operating procedures.

The Koeberg nuclear installation licence requires that any design changes affecting safety-related systems, components and activities be 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.

18.3.2 Implementation measures taken by the licence holder

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

18.3.3 Regulatory review and control activities

As described above, approval by the NNR is required for modifications or procedure changes as determined by a safety screening and evaluation processes (Sections 14.2.4, 19.3.1).

The NNR conducts assessments on proposed modifications and procedure changes to verify compliance to the requirements referred to above.

SECTION C: ARTICLES
ARTICLE 19: OPERATION

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

(i) The initial authorisation 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 organisations 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

(ix) Conditioning and disposal is taken into consideration for 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.

Summary of changes

Section 19 has been updated to be consistent with INFCIRC/572 Rev 4 [5.1] and in particular to include information on the 2011 SALTO Mission to Koeberg (19.3.6.1), and the 2011 OSART Mission to Koeberg (19.3.6.2).

19.1 Initial authorisation

As stated in Section 18, the licensing process which was applied at the time of the Koeberg plant design and construction was that the design of the 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. This approach applied to the commissioning programme as well, which demonstrated that the installation, as constructed, is consistent with design and safety requirements. On this basis a nuclear licence was granted for the operation of the nuclear installation.

As indicated in Section 7, in preparation for the envisaged nuclear expansion programme in South Africa, the NNR is presently developing new regulations and guidelines which cover design, manufacturing, construction, commissioning, operation and decommissioning of nuclear installations. These regulations are based on IAEA standards and guidelines, as well as those of other countries.

19.2 Operational limits and conditions

19.2.1 Requirements on operational limits and conditions

[Overview of the Contracting Party's arrangements and regulatory requirements for the definition of safe boundaries of operation and the setting of operational limits and conditions]

The Regulations on Safety Standards and Regulatory Practices [1.7] require that:

i. The operational safety assessment (Safety Analysis Report – SAR for Koeberg) establishes the basis for all the operational safety-related programmes, limitations and design requirements.
ii. The OTS includes: operating safety limits as imposed by the design and safety criteria, surveillance requirements to verify that equipment important to safety is operating satisfactorily, parameters are within the safety limitations, and limitations on the operation in the event that equipment important to safety becomes inoperable or in the event that safety limitations are exceeded.

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 nuclear licence dictates compliance to the OTS, and that any changes to the OTS are approved by the NNR, prior to implementation.

19.2.2 Implementation of operational limits and conditions

[Implementation of operational limits and conditions, their documentation, training in them, and their availability to plant personnel engaged in safety-related work]

The current OTS is at Revision 7, which was developed specifically for Koeberg NPP and is similar to the latest OTS of the French EDF.

The new revision, which was reviewed and approved by the NNR in 2011, is based mainly on deterministic processes and criteria, and derived requirements. This was crosschecked and moderated using various other consistency mechanisms, including extensive use of the power station's PSA models to verify that the deterministically-derived requirements are appropriate in terms of risk.

Training on the OTS is included in the training programme for the operation staff.

19.2.3 Review and revision of operational limits and conditions as necessary

Changes to the OTS are subject to review and assessment internally by Eskom before submission to the NNR for approval.

19.2.4 Regulatory review and control activities

The regulator's review of the OTS Rev 7 took place over four years, resulting in approval in September 2011. Changes to the OTS require regulatory approval, prior to implementation.

Compliance to the OTS, operator training, and configuration management of the OTS is covered by the regulator's compliance inspection programme.

19.3 Procedures for operation, maintenance, inspection and testing

19.3.1 Requirements on procedures for operation, maintenance, inspection and testing

[Overview of the Contracting Party's arrangements and regulatory requirements on procedures for operation, maintenance, inspection and testing of a nuclear installation]

The Regulations on Safety Standards and Regulatory Practices [1.7] require that:

i. Operations are conducted in accordance with formal procedures, as required by the conditions of licence.

ii. An appropriate maintenance and inspection programme be established, to ensure that the reliability and integrity of installations, equipment and plant, having an impact on radiation and nuclear safety, are commensurate with their safety significance.

As indicated in Section 9, the Koeberg Licensing Basis Manual (KLBM) [4.10] which is included in the conditions of the Koeberg nuclear installation licence, 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, including operation, maintenance, inspection and testing. The KLBM includes the necessary processes for configuration control, periodic review, modifications to plant and procedures, and regulatory approval thereof.

The nuclear licence dictates compliance to the KLBM, and, by implication, the process of safety screening and regulatory approval for changes to the operational procedures.

19.3.2 Implementation, review and approval of operational procedures

[Establishing of operational procedures, their implementation, periodic review, modification, approval and documentation]

The operational safety-related programmes 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:

i. Compliance with the dose and risk limits
ii. Optimisation of radiation protection and nuclear safety applying the 'As Low As Reasonably Achievable' (ALARA) principle
iii. Safety assessment (prior and operational)
iv. Good engineering practices
v. Safety culture
vi. Accident management and emergency planning, preparedness and response
vii. Defence-in-depth principle during the design and operational phases of the installation
viii. Quality management
ix. Controls and limitations on operation
x. Maintenance and inspection
xi. Staffing and qualification
xii. Radiation protection
xiii. Radioactive waste management
xiv. Environmental monitoring and surveillance
xv. Transport of radioactive material
xvi. Physical security arrangements
xvii. System of records and reports
xviii. Monitoring of workers
xix. Decommissioning
xx. Provisions for accidents, incidents and emergencies

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

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 has been completed to produce a Safety-Related Surveillance Manual (SRSM) that contains the functional testing and surveillance requirements, and includes the associated bases. The SRSM was developed and implemented system by system.

19.3.3 Availability of the procedures to the relevant nuclear installation staff

The KLBM dictates that all modes of plant operation shall be controlled by detailed, validated and formally-approved operating procedures.

19.3.4 Installation staff involvement in procedure development

[Involvement of relevant nuclear installation staff in the development of procedures]

The requirements on management of safety [16] essentially require that documents related to nuclear safety be prepared, reviewed and verified by technically competent personnel.

19.3.5 Safety management of operational procedures

[Incorporation of operational procedures into the management system of the nuclear installation]

Incorporation of operational procedures into the management system of the nuclear installation is covered by requirements on management of safety (Section 13.1).

19.3.6 Regulatory review and control activities

The nuclear licence dictates compliance to the KLBM, and by implication the implementation of the procedures, training, development and approval for procedures and changes to such procedures.

Compliance to the operating procedures, staff training, and configuration management of the operating procedures is covered by the regulator's compliance inspection programme.

19.3.6.1 IAEA SALTO (Safety Assessment of Long-Term Operation)

The NNR considered that an independent review of the In-Service Inspection (ISI) programme for Koeberg NPP would be desirable as part of the NNR assessment of the ISI programme. The ISI programme is intended to ensure the integrity of the systems, structures and components of the plant. Koeberg entered its third ten-yearly interval in its ISI programme, which was initiated in 2007. This was also the first period in which Eskom implemented the ASME XI code [6.6] in conjunction with a risk-informed approach to the selection of inspections.

Given the potential nuclear safety risks, the NNR requested a SALTO mission (Safety Assessment of Long-Term Operation of nuclear power plants) from the IAEA on the Koeberg ISI programme, which took place between 14 and 18 March 2011.

Summary of main findings:

i. Identification of critical systems, structures and components (SSCs) acceptable.

ii. Risk analysis methodology and process for screening out SSCs not acceptable, as it does not properly account for the benefits of performing ISI on the SSCs.

iii. Lack of in-house competence to conduct the risk analysis, and too much reliance on the consultants to perform these analyses.

Eskom has implemented the corrective actions.

19.3.6.2 IAEA OSART (Operational Safety Review Team)

At the request of the government of the Republic of South Africa, an IAEA Operational Safety Review Team (OSART) visited Koeberg NPP from 21 August to 8 September 2011. The purpose of the mission was to review operating practices in the areas of management organisation and administration; operations; maintenance; technical support; radiation protection; operating experience; chemistry and severe accident management. A review of safety culture was also undertaken at the same time.

The OSART report was submitted to the Minister of Energy and shared with the Minister of Public Enterprises, where Eskom is reporting administratively. The OSART team concluded that the Koeberg management team was committed to continuously improving the operational safety and reliability of their plant. The team found good areas of performance and also identified a number of proposals for improvements in operational safety.

The main recommendations related to the following:

i. Frequency of Eskom organisational changes

ii. Products and services from contractors

iii. Operating Technical Specifications (OTS Rev 6)

iv. Fire protection system

Special mention was made of the ageing steam generators.

Good areas of performance were identified, relating to the:

i. Corrective Action Programme

ii. External Event Review Team (EERT) and External Events Safety Re-assessment Project, as a quick response to the Fukushima accident

iii. Severe Accident Management Guidelines.

The OSART team has followed up on the corrective actions, confirming that these have been implemented, except for several minor omissions (such as trending of diesel generator fuel quality and housekeeping in the laboratory).

19.3.6.3 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 NPP in November 2011. 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 NPP.

As a basis for the review, the team used the Performance Objectives and Criteria for WANO Peer Reviews. 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 WANO team noted some improvements in selected areas since the previous review. Areas in need of improvement included radiation protection fundamentals and electrical systems reliability, particularly emergency diesel generator reliability. The utility has developed action plans to address the areas for improvement and recognise the importance of instilling high levels of worker behaviours to achieve and sustain performance achievement goals.

19.4 Procedures for responding to operational occurrences and accidents

19.4.1 Requirements on accident and incident procedures

[Overview of the Contracting Party's arrangements and regulatory requirements on procedures for responding to anticipated operational occurrences and accidents]

The SSRP [1.7] 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.

As indicated in Section 9, the Koeberg Licensing Basis Manual (KLBM) which is included in the conditions of the Koeberg nuclear installation licence, 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, including procedures for responding to anticipated operational occurrences and accidents.

19.4.2 Emergency operating procedures

[Establishment of event-based and/or symptom-based emergency operating procedures]

Although not a member of the PWR Owners Group, Eskom utilises the Westinghouse generic Emergency Operating Procedure (EOP) package, including both Optimum Recovery Procedures and Function Restoration Procedures that have been adapted specifically for Koeberg.

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).

19.4.3 Severe accidents procedures

[Establishment of procedures and guidance to prevent severe accidents or mitigate their consequences]

A comprehensive set of severe accident management guidelines (SAMGs) has been written, by Westinghouse, for the licence holder. These were authorised by the NNR for implementation in December 2000. The SAMGs have been upgraded to include guidance for severe accidents initiating during shutdown conditions.

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

19.4.4 Regulatory review and control activities

The nuclear licence dictates compliance to the Koeberg Licensing Basis Manual (KLBM) (Section 9), and by implication the implementation of the procedures, training, development and approval for procedures and changes to such procedures.

Compliance to the operating procedures, staff training, and configuration management of the operating procedures is covered by the regulator’s compliance inspection programme.

19.5 Engineering and technical support

19.5.1 Technical support for construction, operation and decommissioning

[General availability of necessary engineering and technical support in all safety-related fields for all nuclear installations, under construction, in operation or under decommissioning]

The requirements on management of safety (Section 13.1) include organisational requirements which cover availability of necessary engineering and technical support in all safety related fields. This applies to all nuclear installations, under construction, in operation or under decommissioning.

19.5.2 Availability of technical support for the holder

[General availability of necessary technical support on the site, and also at the licence holder or utility headquarters, and procedures for making central resources available for nuclear installations]

Eskom 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, Eskom engages the services of consultants. In addition, Eskom has entered into technical cooperation agreements with Electricité de France and other utilities in order to be advantageously positioned, and enjoy adequate support to address the range of competencies required in any given situation.

Looking to the future, Eskom is following closely how Electricité de France 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.

19.5.3 Dependence on consultants and technical support

Refer to 19.5.2.

19.5.4 Regulatory review and control activities

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 it would then be directed to the licence holder for rectification.

The regulations require that the NNR report on an annual basis on the adequacy of staffing of the nuclear installation. This report is provided in the regulators annual report. The NNR in turn requires the holder to conduct an annual assessment on its staffing and competency levels and to report to the NNR accordingly. This process is further covered by the regulators compliance assurance programme.

The current situation at Koeberg NPP is that all areas of technical support are well covered.

In response to a concern raised by the NNR on overall quality of work (mainly by contractors) at Koeberg NPP, Eskom has implemented a plan of corrective action. The NNR continues to monitor implementation of the corrective actions. According to the inspections there is reasonable improvement in this regard.

19.6 Reporting of incidents significant to safety

19.6.1 Requirements on incident reporting

[Overview of the Contracting Party's arrangements and regulatory requirements to report incidents significant to safety to the regulatory body]

Section 4.10.3 of the SSRP [2] requires that a reporting mechanism be established, implemented and maintained for nuclear incidents, nuclear accidents or any other events that the NNR may specify in the nuclear authorisation.

The NNR has issued specific requirements on the reporting of incidents including the manner of reporting, timescales, classification, and corrective actions.

Section 6 of the SSRP provides a definition of a nuclear accident and incident and requires that the holder immediately inform the NNR when a nuclear accident or incident occurs, in terms of the current situation and its evolution, measures taken to terminate the nuclear accident or incident and to protect workers and the public, and the exposures that have occurred and those expected to occur.

As indicated in Section 9, the Koeberg Licensing Basis Manual (KLBM) which is included in the conditions of the Koeberg nuclear installation licence, 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, including procedures for reporting incidents significant to safety to the regulator.

19.6.2 Criteria and procedures for incident reporting

[Overview of the established reporting criteria and reporting procedures for incidents significant to safety and other events such as near misses and accidents]

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, Eskom has established an approved procedure. The process is tracked using an Electronic Problem Management System (EPMS) which can be summarised as follows:

i. Identification and reporting of the event by any installation staff member.
ii. Prioritisation, classification, initiation of action and notification by the shift manager.
iii. 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.
iv. Preparation of a report on the event for nuclear installation management and the NNR.
v. Agreement on corrective actions and prioritisation within the nuclear installation.
vi. Checking outstanding corrective actions and notifying the responsible group.
vii. Completion of actions and comments entered on EPMS.
viii. Tracking and review of the actions, updating the database and feedback of relevant information to the management of the nuclear installation and the NNR.
ix. 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:

i. Protection of the fuel
ii. Control of reactivity
iii. Containment of radioactive materials
iv. 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:

i. To amend the compliance inspection programme to reflect areas of weakness for further attention.
ii. To influence the scope of audits to focus on apparent shortcomings.
iii. To input plant-related data to the probabilistic risk assessment.

iv. To emphasize training and competence in identified areas of operator licensing examinations.
v. To assist in the identification of human factors as root causes during human performance evaluation.
vi. 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) database, 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. Eskom 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', where 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.

19.6.3 Statistics of reported incidents significant to safety for the past three years

There have been no safety-related issues or events at Koeberg NPP graded level two or above on the INES scale. Refer to Section 6.2.

19.6.4 Documentation and publication of event reports

[Documentation and publication of reported events and incidents by both the licence holders and the regulatory body]

Eskom reports nuclear safety significant events to WANO, and the NNR reports events to the IAEA-IRS (Incident Reporting System).

19.6.5 Policy for use of the INES scale

The policy of Eskom and the NNR is to use the INES scale for reporting of nuclear events.

19.6.6 Regulatory review and control activities

The NNR reviews the incident reports submitted in terms of the requirements referred to in Section 19.6.1. Depending on the level of severity, the NNR will prepare and submit a report to the media and to the IRS as appropriate.

The NNR compliance inspection programme covers the licence holder's processes for event reporting, and corrective action processes.

19.7 Operational experience feedback

19.7.1 Requirements on collection, analysis and sharing of operating experience

[Overview of the Contracting Party's arrangements and regulatory requirements of the licence holders to collect and analyse and share operating experience]

The regulatory requirements dictate that the management is responsible for ensuring that systems are in place to continuously improve organisational systems and processes.

This includes implementing operating experience and lessons learned from internal and external sources, both within and outside the nuclear industry. A systematic in-depth event analysis and corrective action process, which addresses human and organisational factors alongside technical issues, must be established.

As indicated in Section 9, the Koeberg Licensing Basis Manual (KLBM) [4.10] which is included in the conditions of the Koeberg nuclear installation licence, 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, including procedures for collecting and analysing and sharing operating experience.

19.7.2 Local and international operating experience feedback

[Overview of programmes of licence holders for the feedback of information on operating experience from their own nuclear installation, from other domestic installations and from installations abroad]

Eskom has an Operating Experience (OE) Group which is responsible for external experience feedback and the total direction and management of the OE system. (Refer to Section 12.5.1).

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.

Eskom reports nuclear safety significant events to WANO.

19.7.3 Procedures to analyse domestic and international events

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 national and international lessons learned to improve nuclear safety in an effective manner and applies to the review of industry technical information originating from external sources such as Electricité de France, the Institute of Nuclear Power Operations, the World Association of Nuclear Operators,

Framatome Owners Group, the Original Equipment Manufacturer and the United States Nuclear Regulatory Commission. Refer to Figure 19-1 for sources of operating experience information.

Eskom has formed a group, known as the Koeberg Events 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 Eskom 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 Eskom, 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.

19.7.4 Feedback from operational events to modifications and training

[Procedures to draw conclusions and to implement any necessary modification to the installation and to personnel training programmes and simulators]

All internal events are entered onto the stations electronic problem notification system (EPMS) and receive an appropriate analysis, depending on the grading of the event (refer to Section 12.5.1). External events (i.e. events reported by other plants/utilities) are also analysed for relevance to the station. The Corrective Action Review (CAR) Committee reviews all the event analyses and endorses the recommended corrective actions or makes additional recommendations. These could include modifications to the plant, or to personnel training programmes and the simulators. Implementation of the recommended actions is also tracked on the EPMS.

19.7.5 Sharing experience feedback with other operating organisations

Eskom has a partnership arrangement with EDF, where there is a Koeberg Integrated Team (KIT) established at the station composed of Koeberg and EDF staff. Operating experience from EDF and from Koeberg is shared with the respective organisations through the KIT (refer to Section 12.5.1). Links to other organisations such as WANO are established through the KIT office.

19.7.6 Use of international information databases on operating experience

Covered by Section 19.7.3.

19.7.7 Regulatory review and control of holder programmes

This process is covered by the regulators compliance assurance programme (Section 7.2.3).

19.7.8 Regulatory body feedback of operational experience

[Programmes of the regulatory body for feedback of operational experience and the use of existing mechanisms to share important experience with international organisations and with other regulatory bodies]

As reported in Section 8, the NNR has entered into various international bi-lateral agreements with other nuclear regulatory authorities and these forums are important in terms of OEF.

The NNR also reports events to the IAEA-IRS (Incident Reporting System) for international OEF. The IRS database is made available to all staff within the NNR and the nuclear installation. The NNR participates in the annual joint IAEA-NEA IRS meeting.

19.8 Management of spent fuel and radioactive waste on the site

19.8.1 Requirements for the on-site handling of spent fuel and radioactive waste

[Overview of the Contracting Party's arrangements and regulatory requirements for the on-site handling of spent fuel and radioactive waste]

Regulatory requirements regarding radioactive waste management are given in the SSRP [1.7] in terms of a waste management programme, safety of long-term radioactive waste storage, clearance, discharge, and transport.

As indicated in Article 9, the Koeberg Licensing Basis Manual (KLBM) which is included in the conditions of the Koeberg nuclear installation licence, 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, including on-site handling of spent fuel and radioactive waste.

The nuclear licence restricts Eskom, in terms of the numbers of fuel elements stored in the spent fuel pools, and in terms of the number and type of spent fuel dry storage casks.

19.8.2 On-site storage of spent fuel

As reported in previous reports to the convention, the spent fuel at Koeberg is stored at the power station in the following manner:

i. In a spent fuel pool which has 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 the installation of a third train of spent fuel cooling.
ii. In four dry storage casks in which a total of 112 spent fuel assemblies are stored, with a strategy to procure additional casks.

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 indefinitely sustainable. 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:

i. Long-term above ground storage on an off-site facility licensed for this purpose
ii. Reprocessing, conditioning and recycling in South Africa or in a foreign country
iii. Deep geological disposal
iv. Transmutation

In the interim, used nuclear fuel is, and shall continue to be stored in authorised facilities within the generator's sites.

19.8.3 Implementation of on-site treatment, conditioning and storage of radioactive waste

The operational radioactive waste management programme implemented at the Koeberg NPP has been extensively covered in Section 15.

19.8.4 Waste minimisation

[Activities to keep the amount of waste generated to the minimum practicable for the process concerned, in terms of both activity and volume]

Covered in Section 15.

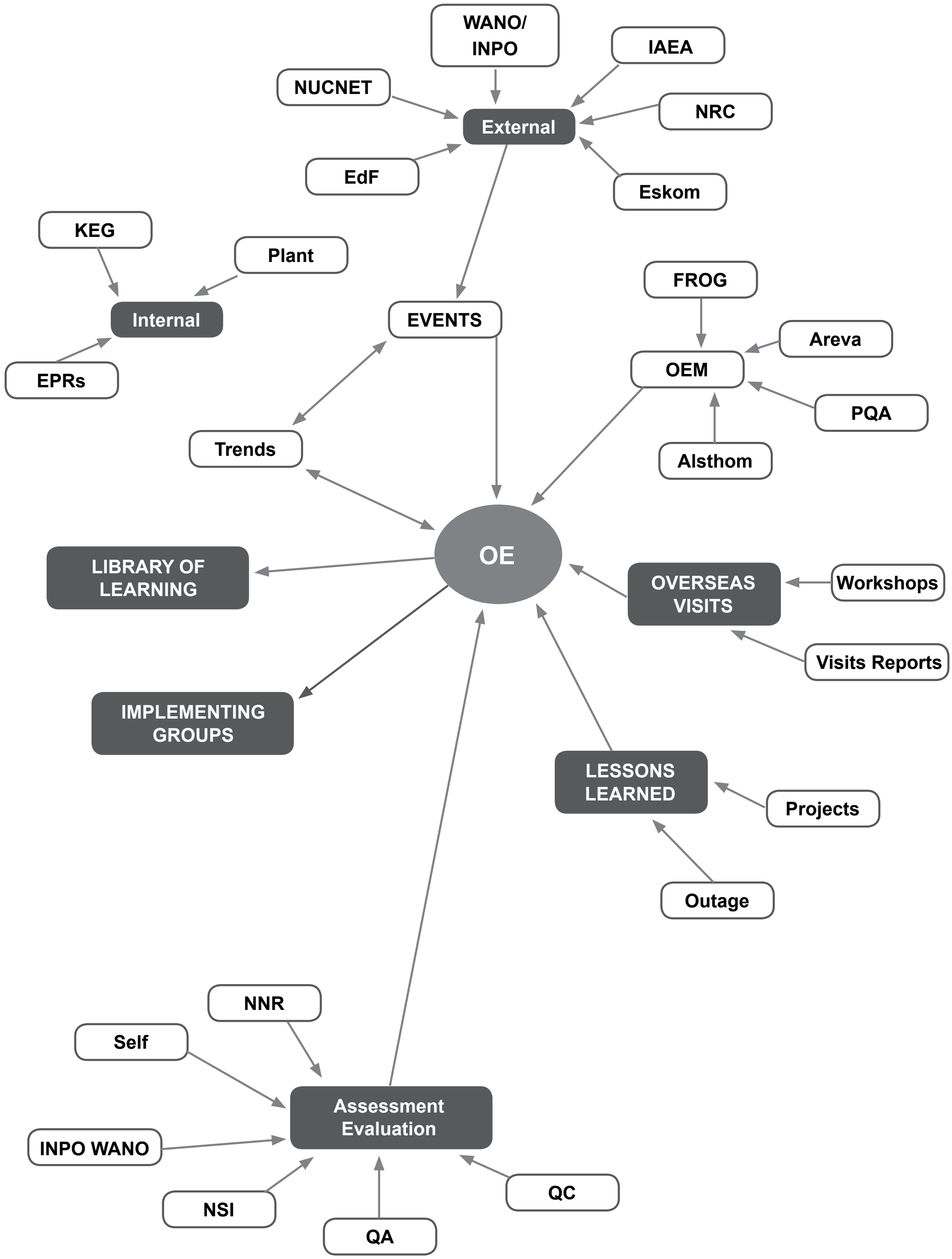
19.8.5 Established procedures for clearance of radioactive waste

Covered in Section 15.

19.8.6 Regulatory review and control activities

Covered in Section 15.

Figure 19-1. Koeberg NPP OEF system



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4.7 RD 0014 “Emergency Preparedness and response requirements for nuclear installations”
4.8 LG 1041 “Licensing guide on safety assessments for nuclear power plants”
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4.11 Koeberg Accident Analysis Manual

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5.5 Convention on Assistance in the Case of a Nuclear Accident or Radiological Emergency
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5.7 Joint Convention on the Safety of Spent Fuel Management and on the Safety of Radioactive Waste Management
5.8 Revised Supplementary Agreement Concerning the Provision of Technical Assistance by the IAEA (RSA)
5.9 African Regional Co-operative Agreement for Research, Development and Training Related to Nuclear Science and Technology (AFRA) - Fourth Extension
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D ANNEXURES

D.1 Annexure 1 Results of Koeberg External Events Safety Reassessment

In light of the lessons learned from the Fukushima-Daiichi nuclear accident in March 2011, Eskom completed a safety re-assessment of Koeberg NPP focussed on external events, both in the design basis and beyond design basis domains, as directed by the NNR. The safety re-assessment evaluated the provisions of the design basis concerning extreme natural phenomena and combinations of external events appropriate for the Koeberg site. The robustness of the facility's design to maintain its safety functions beyond the design basis hazards (which includes the prolonged losses of electrical power and the ultimate heat sink) was also evaluated. In this assessment, potential cliff-edges have been identified where the defence-in-depth will be eroded to the point where small deviations in plant behaviour could give rise to severe plant damage.

The assessment of the availability and reliability of accident management measures specifically considered events that potentially affect both Koeberg units, as well as the spent fuel storage facility. The adequacy of emergency management and response provisions was also assessed.

The re-assessment concluded that the Koeberg NPP is adequately designed, maintained and operated to withstand all the external events that were considered in the original design base. Nothing has been found to warrant curtailing operation or to question the integrated design margins inherent in the current facility.

The assessment identified hardware modifications, additional procedural guidance and training and additional manpower and equipment that can extend the robustness of the facility to cope with extreme external events. These will increase plant safety margins, provide more flexibility and diversity for accident management and in some cases remove or extend identified cliff-edges. The provision of portable equipment has been considered as an alternative where plant hardware modifications are not feasible or cost beneficial. Some portable equipment such as fire pumps, salvage pumps and diesel tankers are being, or have already been procured.

The station is currently designed to cope with a loss of off-site power for up to two days and for a station black-out for eight hours. Recognising that a severe external event may challenge the timely augmentation of off-site support and services, additional reserves of diesel fuel and associated equipment are being procured in order to extend this coping time.

Provided the potable water reservoirs remain intact, the station has adequate water supplies to supply make-up water for periods in excess of 20 days, using mobile water pumps. The complete loss of the ultimate heat sink (sea) will not result in fuel damage, but damage to the infrastructure will occur to the extent that the plant will be rendered unusable for future power generation.

The station is built on a terrace that provides adequate margin against a design basis Tsunami-induced flood. A flood higher than the design basis, which comes over the terrace, will render significant safety systems inoperable. In terms of flooding, this represents a cliff-edge. A new detailed Tsunami hazard assessment is merited due to the fact that considerable uncertainty surrounds the likelihood of some of the more obscure causes of Tsunamis that could potentially affect the Koeberg site. To increase the safety margins against flooding will require modifications to certain equipment and making some rooms, housing essential equipment, watertight.

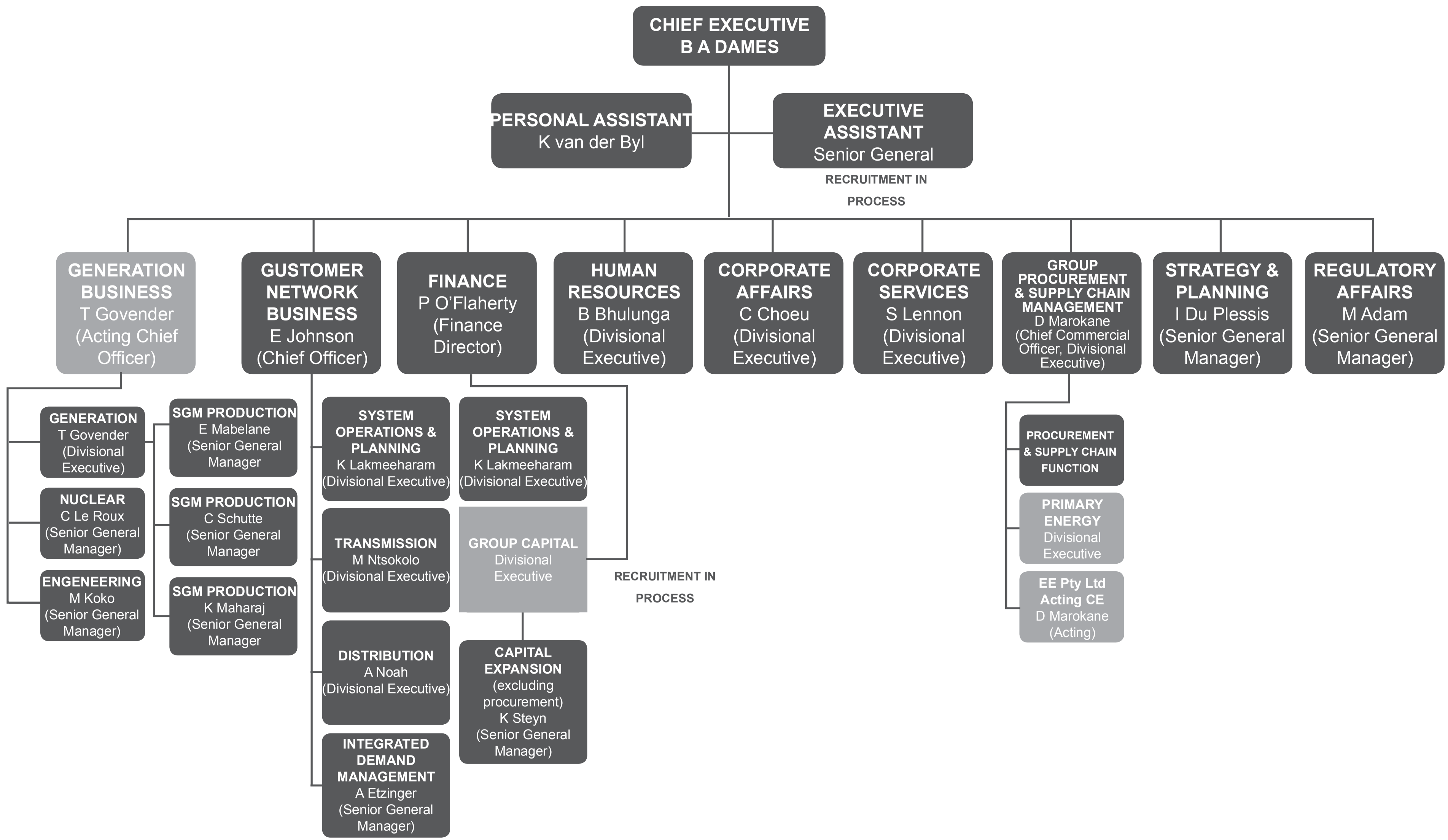
The plant's design is robust against a seismic event with significant margin on most safety-related equipment. The fire protection systems for non-safety related plant equipment are not seismically designed and no reliance can be placed on these systems; alternative measures are required. Most administration buildings and storage facilities are not seismically qualified. Collapse of these buildings following a seismic event could complicate the station's response to such an event and may impede accessibility to vital recovery equipment and spares. The emergency control centre and technical support centre are not equipped to adequately respond to a major earthquake.

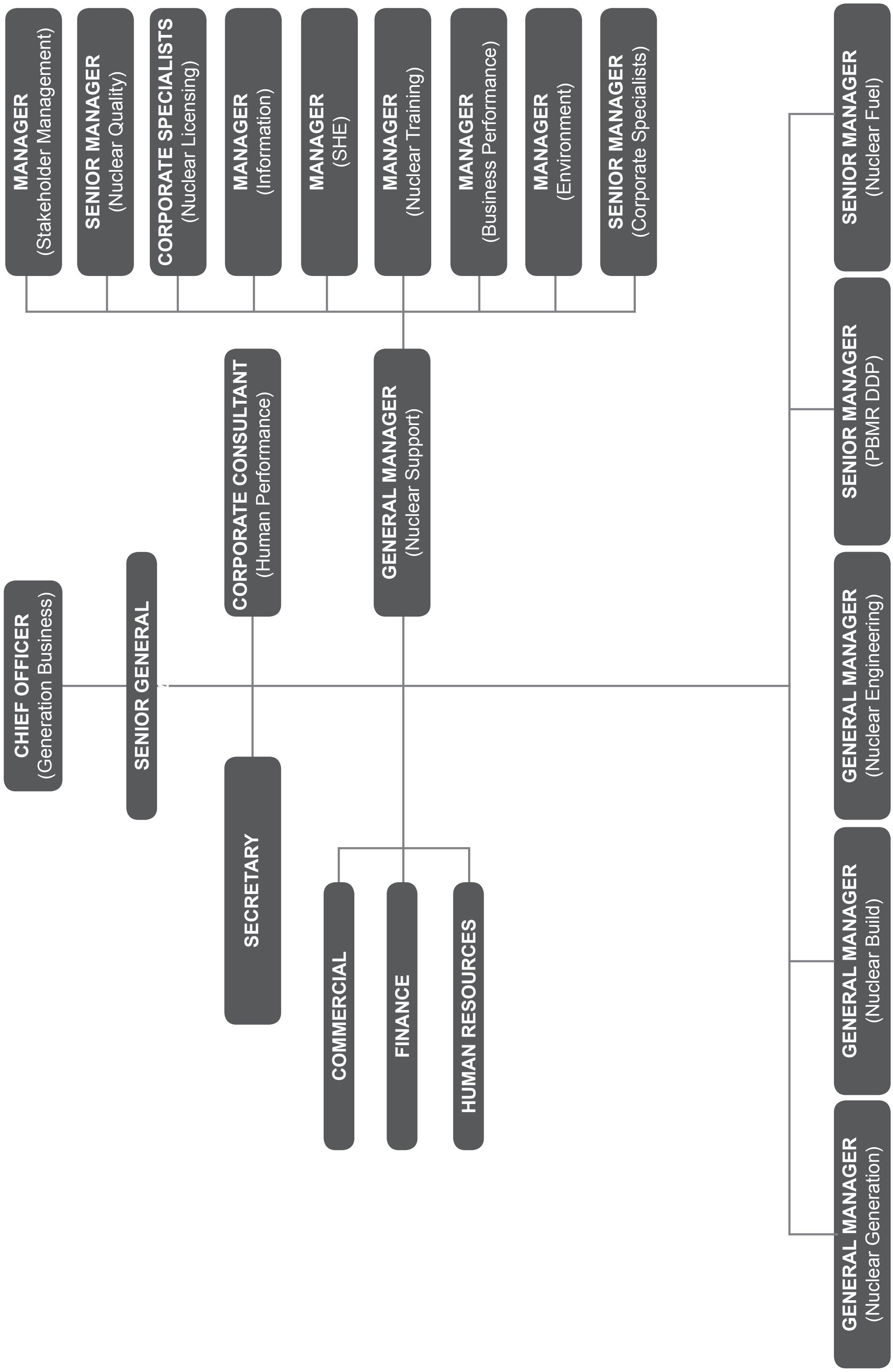
The planned installation of flanged connections in existing cooling systems is a reasonable, but effective means of utilising alternative sources of cooling water, and increases the flexibility and diversity of accident management. Similarly, the planned installation of terminal panels and junction boxes with electrical cross-connection cabling is an effective means of facilitating the supply of alternative electrical power from other areas of the plant and from off-site sources.

The current emergency plan would be challenged if faced with an accident of the severity experienced at Fukushima-Daiichi. Some equipment used in the plan does not have the suitable capability to withstand certain external hazards.

Equipment is stored and temporary buildings are erected on the Koeberg site in a manner which could complicate the station's response to a severe external event, for example by blocking access routes, generating missiles etc. General design basis weaknesses have been identified for protection against wind-borne and tornado-borne missiles and dealing with large chemical spills.

D.2 Annexure 2. Eskom Organisational Structure




CHIEF OFFICER
(Generation Business)
SENIOR GENERAL
CORPORATE CONSULTANT
(Human Performance)
SECRETARY
GENERAL MANAGER
(Nuclear Support)
COMMERCIAL
FINANCE
HUMAN RESOURCES
MANAGER
(Stakeholder Management)
SENIOR MANAGER
(Nuclear Quality)
CORPORATE SPECIALISTS
(Nuclear Licensing)
MANAGER
(Information)
MANAGER
(SHE)
MANAGER
(Nuclear Training)
MANAGER
(Business Performance)
MANAGER
(Environment)
SENIOR MANAGER
(Corporate Specialists)
GENERAL MANAGER
(Nuclear Generation)
GENERAL MANAGER
(Nuclear Build)
GENERAL MANAGER
(Nuclear Engineering)
SENIOR MANAGER
(PBMR DDP)
SENIOR MANAGER
(Nuclear Fuel)

D.3 Annexure 3 – Post-Fukushima Actions

External Events

No changes to the Koeberg Licensing Basis have been identified as a result of the safety reassessments.
Although no peer review has been conducted, benchmarking has been performed against international bodies with regards to the safety reassessments.

The safety reassessments resulted in many proposed actions to further improve plant robustness, and strategies have been developed to further enhance safety as regards to the following:

- Subcriticality
- Primary inventory
- Heat removal
- Depressurisation
- Shutdown fall-up strategy
- Ultimate heat sink
- Spent fuel pool cooling
- Containment integrity (cooling, filtered containment venting, sump level indication, hydrogen control)
- Spent fuel pool building integrity
- Emergency planning (e.g., permanent radiation monitors, onsite emergency facility hardening, plume monitoring)
- Off-site emergency facility strategy (e.g., upgrading off-site facilities and communication)
- Command and control strategy (e.g., local action management points, critical plant parameter indication, water and electrical emergency connection points)
- On-site and off-site diesel supply strategy
- On-site toxic and hazardous chemical strategy
- Procedure enhancement strategy
- Accident Mitigation Equipment Availability (e.g., beyond design basis Operating Technical Specifications and maintenance regime)
- Specific external hazards (e.g., seismic trip signal, improving seismic margin)
- High rainfall
- Safety culture enhancement
- Training courses on lessons from the Fukushima accident

Regulatory changes concerning external events under consideration, relate to:

- Inclusion of specific requirements on combinations of events for beyond design basis events.
- Inclusion of specific provisions relating to elevating the level of testing and maintenance of all equipment included in the respective severe accident management measures.
- Inclusion of specific requirements related to the robustness of accident management measures and emergency planning arrangements considering beyond design basis external events.

Design Issues

Robustness of electrical power supply is being addressed under the following headings:

- Improving robustness/reliability of off-site power under severe environment conditions
- Improving protection of on-site electrical distribution network
- Additional power source (new diesel generators, mobile power sources (5 MW), diversity)
- Improving reliability and protection of on-site power sources
- Enabling easy connections of (off-site/mobile) supplies and designing appropriate storage to ensure availability of mobile power sources
- Switchyard robustness enhancement
- Longer autonomy of AC and DC emergency power sources.

As regards robustness of essential I&C systems and essential equipment, an independently powered, hardened monitoring system is to be installed for core temperature, SG level, SG pressure (RCP pressure), SFP level, and containment pressure. Investigation is being conducted to conclude if containment hydrogen monitoring is also required.

In terms of robustness of the cooling system, a feasibility study is currently underway as regards the following:

- Protecting pumping station and on-site water sources
- Multiple and diverse means of heat removal
- Develop alternative provisions for SG feeding, core and SFP cooling in all conditions, by using fixed and mobile means for water feeding
- Increase the reliability and the availability of the fire extinguishing system for its use in all conditions
- Robust alternative cooling system for SF pool, emergency diesel generators, reactor secondary system
- Alternate heat sink to be available
- Spent fuel accident scenario and cooling issues

In terms of robustness of containment systems, currently, the Koeberg containment buildings are fitted with passive autocatalytic hydrogen recombiners on various levels throughout the buildings to scavenge hydrogen gas inside containment. Koeberg is currently in the process of procuring portable pumps and installing a hardened piping system to supply water directly to the containment spray system (EAS) to reduce the presence of steam inside containment, when conventional plant equipment is unavailable. Containment filtered venting is under consideration.

As regards ensuring reliability and availability of equipment required for maintaining containment integrity in all conditions, Eskom intends to create a technical requirements document defining the minimum amount and type of equipment required to be on site and operable to mitigate beyond design basis events.

The beyond design basis scenarios addressed in the safety assessment are:

- Seismic
- Tsunami
- Flooding
- Hail
- Lightning
- High wind
- Tornado
- Jellyfish
- Oil spill
- Fire
- Explosions (on and off-site)
- Chemical spill
- Aircraft crash
- Cyber attack
- Solar flares

Other assessments conducted include assessment of the emergency plan, steam line break in the turbine hall, assessment of loss of off-site power supply, loss of all AC power and loss of ultimate heat sink, review of the emergency operating procedures and severe accident management guidelines, assessment of credible combinations of events (including earthquake and Tsunami, with induced events; and severe storm and induced events). For all these, hazards of varying magnitudes were analysed, safety margins were evaluated and cliff-edges were identified.

As regards use of PSA as complementary to deterministic analysis, a new revision of the Koeberg Site Safety Report is currently under development. This takes into account the applicable findings made in the safety assessment. The probability of occurrence of external events will be reconsidered by Eskom, following the new revision of the Koeberg Site Safety Report. It is expected however, that the proposed plant modifications resulting from the safety assessment will affect the current core damage frequency (CDF). All work performed during the safety assessment assumed that all units on the site (two) were affected by the external hazard under consideration.

For new nuclear power plants, careful consideration is being given to the safety objectives and regulatory requirements (Section 8.1.9.2).

Severe accident management

Work is progressing under the following headings:

- Review of regulatory framework (refer to Section 8.1.9.2)
- Improvement of emergency operating procedures, severe accident management guidelines and training
- Use of PSA
- Others (including alternative water sources, recovery from SA, radiological analysis

In terms of improvement in instrumentation, systems and components to mitigate a beyond design basis event, the following are under consideration:

- Trailer-mounted pumps
- Trailer-mounted diesel generators
- Diesel storage and transportation tanks
- Rubble removal vehicles
- Floating and salvage pumps
- Portable DC power supplies
- Multimetre kits
- Portable ventilation units
- Telephonic communication units
- Diesel fuel transfer pumps
- Mobile control unit
- Mobile decontamination and Hazmat units
- Pipe and cable extensions and connections
- Personal protective equipment
- Motor-operated valve power supply
- Fire truck

Diverse and geographically separated emergency connection points are proposed on site for the connection of the portable pumps, and portable diesel generators and multimetres.

Improvements in buildings

The following are the intended building improvements:

Main control room:

- Improve fire resistance
- Seismically-strengthen the main control room and ventilation intakes

Emergency Control Centre:

- Upgrade the facility to better cope with extreme external events

Additional buildings:

- Build a hardened portable equipment storage facility

Emergency Preparedness and Response

As regards enhancements in radiation monitoring and communication capability, the relevant modifications:

- On-site communication aerials to withstand extreme winds
- Upgrading all off-site public address transmitters and the control panel to be battery backed
- Additional portable satellite phones
- Back-up power supply to the communication systems within the Emergency Control Centre.

- Improvements to the existing powerless on-site communication system
- Permanent radiation monitors
- Plume monitoring system

The adequacy of the emergency response headquarters for Koeberg NPP has been assessed. The following facilities are currently being used by Koeberg for the purposes of the emergency plan:

- Site Common Control Room
- Site Emergency Control Centre
- Bellville Emergency Control Centre (approximately 45 km away from Koeberg NPP)
- Johannesburg Emergency Control Centre
- Areva Paris Emergency Control Centre
- EDF Paris Crisis Control Centre

To further improve the resilience of the emergency response facilities, the intended changes are:

- Enhancing site decontamination capability
- Development of a mobile access control point (containing facilities for command and coordination of staff, breathing apparatus, radiation protection, decontamination, maintenance staging etc.)
- Upgrading the ECC and TSC, to cope with extreme events, particularly high wind and seismic events
- Improving the power supply to the facilities through improved back-up diesel generators.
- Upgrading the alternative ECC at Bellville to include an alternative TSC (including providing a TSC plant data link to the alternative TSC)
- Integrating the alternative ECC (at Bellville) telephone switchboards and upgrading the site's public address system to allow and alternative ECC to make announcements.

Eskom will seek to collaborate with other utilities worldwide, including but not limited to Framatome Reactor Owners Group members, on recovery aspects of emergency preparedness, and intends on entering into a partnership agreement with EDF to allow for greater information exchange and sharing of support and expertise between the two organisations.

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