CHAPTER 3: OVERVIEW OF PLANNED ACTIVITIES AT THE SITE

File name: [3] Eskom_Duynefontyn SSR Ch 3 Overview of Planned Activities_Rev 1a

Author declaration: I declare that appropriate diligence and quality assurance was applied in the compilation of this report. As such I am confident in the results here described and the conclusions drawn.

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Peer Reviewer: I declare that this report has undergone independent peer review by myself, that comments were addressed to my satisfaction, and that as such, it is considered fit for publication.

2024-03-15

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Name: Date:

NSS Manager Authorisation:

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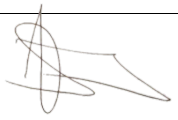
2024-03-15

Name: Date:

Eskom Acceptance:



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AMENDMENT RECORD			
Rev	**Draft**	**Date**	**Description**
0		4 June 2015	New chapter, replacing old KSSR Rev 0.
1		29 September 2021	Chapter updated to reflect the latest information on planned activities on the site, and to align with the latest template on structure and layout of Site Safety Reports.
1a		13 March 2024	Chapter updated to reflect the latest information on planned activities on the site and to address NNR comments.

EXECUTIVE SUMMARY

The Duynefontyn site ("the site") is situated circa 25 km north of Cape Town. The site is 100 per cent owned by Eskom. It covers an area of about 3 038 ha that is comprised of rocky promontories interspersed with sandy beaches and vegetated and unvegetated dunes. The site includes an existing nuclear power station, the Koeberg Nuclear Power Station (KNPS), comprised of two three-loop Pressurised Water Reactor (PWR) units; each designed for a gross fission power output of 2 785 MWth and nominal electrical capacity of 965 MWe. The steam generator replacement and the thermal power uprate projects will increase the core thermal output on each unit from 2 785 MWth (965 MWe) to 3 065 MWth (1 100 MWe).

Eskom intends to extend the operating life of KNPS from 40 to 60 years, i.e. up to 2044. All the activities associated with this life extension will occur within the KNPS site and will be authorised and licenced within the ambit of the facilities' operating licence (NIL-01) (National Nuclear Regulator, 2024a) and the applicable environmental regulatory requirements.

A nuclear installation Licence No.NIL-44 was granted to Eskom for the siting, construction, operation and decommissioning of the nuclear installation known as the TISF, and the Original Steam Generators Interim Storage Facility (OSGISF) located on the site of the TISF (National Nuclear Regulator, 2024b).

Decommissioning of KNPS is envisaged to commence in 2044 when operation ceases and an enveloping 20 years is assumed (Eskom, 2020a).

Eskom envisages the construction of a new nuclear installation(s) at the Duynefontyn site. In 2017 Eskom received environmental approval for the Nuclear-1 Project (Department of Environmental Affairs, 2017), which envisages construction of a nuclear installation(s), using Generation 3 design PWR technology, with power generation capacity of up to 4 000 MWe. The Integrated Resource Plan of 2019 (Department of Energy, 2019), however, envisages no new nuclear generating capacity before 2030, and up to 2 500 MWe new nuclear generating capacity after 2030.

This Site Safety Report (SSR) tests and demonstrates the safety of the site by enveloping for the following scenarios:

- KNPS remains the only nuclear installation to be hosted on the site, but has been modified through, among others, the steam generator replacement and the thermal power uprate projects to generate 2 200 MWe.
- A new nuclear installation(s) with a generating capacity of up to 2 500 MWe is added to the KNPS, which would increase on-site

generating capacity to 4 700 MWe.

- A nuclear installation(s) with a generating capacity of 4 000 MWe is added to the KNPS, which translates to a maximum total on-site generating capacity of 6 200 MWe.

It is assumed that a new nuclear installation(s) will become operational from 2030, will operate for 60 years, which could be extended to 80 years (i.e. up to 2110), after which a decommissioning period of 20 years will follow (i.e. up to 2130).

As no vendor has yet been appointed, detailed design of the site layout as well as the number and dimensions of plant facilities remain preliminary and conceptual. Once the new nuclear installation(s) design is selected, a detailed description of all systems and their locations at the site will be presented in an updated SSR and/or the Safety Analysis Report(s). However, Eskom has indicated (GIBB, 2017) that the nuclear new build design it is likely to be of the Generation 3 or 3+ type. These designs incorporate improved fuel technology, have superior thermal efficiency, significantly enhanced safety systems (including passive nuclear safety) and have standardised designs for reduced maintenance. All reactor types meeting the above requirements will be considered through the nuclear procurement process.

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3 OVERVIEW OF PLANNED ACTIVITIES AT THE SITE

3.1 Purpose and Scope

The purpose of this chapter is to present:

- a statement on the existing and proposed use of the site;
- the generic layout of the existing infrastructure and the footprint for the proposed new nuclear power station(s).

For the purposes of this Site Safety Report (SSR), "the site" includes the area currently occupied by Koeberg Nuclear Power Station (KNPS), which is situated on Cape Farm Duynefontyn No. 1552, as well as the adjacent farm Kleine Springfontyn 33. The whole of the Eskom property (excluding within Access Control Point (ACP) 1 – where KNPS is located) is managed as a nature reserve, all of which covers an area of circa 3 038 ha.

3.2 Regulatory Framework

The description of the existing and planned activities on the site was developed on the basis of the current national legal and regulatory framework presented in ***Chapter 2*** (Legal and Regulatory Basis) and more specifically:

- National Nuclear Regulator Act, 1999 (Act No. 47 of 1999, Section 2 (1)(a)) of the Act (Republic of South Africa, 1999) applies to the siting, design, construction, operation, decontamination, decommissioning and closure of any nuclear installation;
- R.927: The Regulations on Licensing of Sites for New Nuclear Installations (Department of Energy, 2011). Regulation 5(2) requires:

  'A statement as to the proposed use of the site in terms of the range of technologies and plant designs being considered for the nuclear installation(s) and use on the site, including where appropriate the maximum thermal power, general design characteristics such as the engineered safety features of the nuclear installation(s) included as safety measures against the hazardous consequences of postulated events, and the layout on the site.'

- R.388: Regulations in Terms of Section 36, Read with Section 47 of the Act (Department of Minerals and Energy, 2006), Sections 2.4

Licensing and 3.3 Prior Safety Assessment, which requires that:

'Measures to control the risk of nuclear damage to individuals must be determined on the basis of a prior safety assessment which is suitable and sufficient to identify all significant radiation hazards and to evaluate the nature and expected magnitude of the associated risks.'

- RG-0011: Interim Guidance for the Siting of Nuclear Facilities (National Nuclear Regulator, 2016), Section 6.3 on *Siting on Existing Site*, states in bullet 2 that "each nuclear facility, including the existing facilities, within the overall licensed site should be demarcated." While in Section 10.2 on *Site Location*, it is stated in bullet 1 that "The site location should be described with the aid of illustrations, including topographical maps. All threat environments, risks or vulnerabilities presented by the location of the proposed site should be described and applicant should also submit the diagrams to approximate scale, displaying, but not limited to the following for the review: a) Layout of all configurations of site structures being considered; i) Existing and planned culverts; j) Location of vital equipment and vital areas; m) Location of proposed intake structure; n) Location of proposed protected area boundary for power block and safety-related water structures; and o) Locations of the proposed owner-controlled area and protected area vehicle checkpoints".

3.3 Site Description

The site covers an area of circa 3 038 ha that is comprised of rocky promontories interspersed with sandy beaches and vegetated and unvegetated dunes. It currently hosts the KNPS and has been earmarked to host one or more additional nuclear installation(s).

The site is situated in the Western Cape about 25 km north of Cape Town adjacent to the R27, as presented in ***Drawing 3.1*** (further details are presented in ***Chapter 4***, Site Investigation Approach and ***Chapter 5***, Site Characteristics).

The site is 100 per cent owned by Eskom, and is surrounded by a private nature reserve, viz. Witzands Aquifer Nature Reserve (northeast), the R27 West Coast Road (east), the Duynefontein residential area (south) and the Atlantic Ocean (west). The R27 national route, known as the West Coast Road, runs in a north-south to northwest direction on the eastern boundary of the site. A tarred access road leads from the R27 to the existing KNPS and an alternative access route is via the township of

Duynefontein to the south. An existing but currently unused access road to the north of and parallel to the access road from the R27 may be upgraded to provide direct access to the northern part of the site where it is planned that the new nuclear power station(s) will be located.

Drawing 3.2 shows more detail on the site location with respect to boundaries, farms and nearby geographical features. The boundaries of the site coincide with the owner-controlled area and are shown in this drawing.

3.4 Current Site Usage

The Duynefontyn site currently hosts the KNPS, which is situated on Cape Farm Duynefontyn No. 1552 (previously consisting of Farm Duynefontyn No. 34 and Farm No. 1375 which were consolidated by the City of Cape Town in 2015), in the magisterial district of Malmesbury in the Western Cape.

The whole of the Eskom property (excluding the area within Access Control Point 1 (ACP 1) – within which KNPS is located) is currently managed as a nature reserve ("Koeberg Private Nature Reserve," which was proclaimed in 1991 in terms of Ordinance 19 of 1974). Management of the nature reserve occurs within the ambit of the Stewardship Programme of CapeNature™, which is the Provincial Conservation Authority in the Western Cape. ***Table 3.1*** lists the properties that constitute the site, and their areal extent. A

Table 3.1 List of Properties Owned by Eskom that Constitute the Duynefontyn Site

Property Description	Hectares	Title Deed
Remainder of Portion 6 of Cape Farm 33 Kleine Springfontyn (northern property)	30,426	T21287/78
Remainder of Cape Farm 33 Kleine Springfontyn (northern property)	1 399,4196	T13256/75
Portion 5 of Farm 2 Witzand	101,5741	T28036/95
Cape Farm Duynefontyn 1552	1 294,4529	T9139/2015

Construction of KNPS began in 1976, with Unit 1 synchronised to the grid on 4 April 1984, and Unit 2 following on 25 July 1985. KNPS comprises two three-loop Pressurised Water Reactor (PWR) units with their turbine generators and associated plant. Each unit is designed for a gross fission power output of 2 785 MWth and nominal electrical capacity of 965 MWe. Seawater is used as the ultimate heat sink of the two reactors. It is

collected from the KNPS Cooling Water Intake Basin, circulated by means of an isolated process through the condensers of the reactors and then released back into the ocean via the KNPS cooling water outfall canal.

Low and intermediate radioactive waste from the KNPS is transported via road in steel and concrete containers to a remote disposal site at Vaalputs located in the Northern Cape, approximately 600 km away. High level waste (used fuel assemblies) is stored on site either in spent fuel casks[1] or in spent fuel pools. The spent fuel casks are concrete assemblies approximately 6 m in height and 3 m in diameter, designated to be stored in Auxiliary Shielding Module within the Transient Interim Storage Facility (TISF). A nuclear installation Licence No.NIL-44 was granted to Eskom for the siting, construction, operation and decommissioning of the nuclear installation known as the TISF, and the Original Steam Generators Interim Storage Facility (OSGISF) located on the site of the TISF (National Nuclear Regulator, 2024b). The OSGISF comprises two concrete mausoleum buildings designed for the horizontal storage of the empty original steam generators from KNPS.

High voltage power lines run from the KNPS in an easterly direction and link up with the Eskom national power grid.

Emergency Planning Zones surround KNPS and are defined in the KNPS Emergency Plan (Eskom, 2022). The 5 km radius around KNPS is referred to as the Protective Action Zone (PAZ) and the zone between 5 - 16 km radius is referred to as the Urgent Protective Zone (UPZ) (see ***Chapter 8***). The Long Term Protective Action Zone (LPZ), within a radius of 80 km of KNPS has no specific development restrictions but preparations have been made for emergency procedures in this zone.

[1] Dry cask storage is a method of storing used fuel that has already been cooled in the spent fuel pool. Casks are typically concrete or steel cylinders which are either welded or bolted closed to provide leak-tight containment of the used fuel. The used fuel assemblies within the casks are surrounded by inert gas and each cylinder is surrounded by additional steel, concrete, or other material to provide radiation shielding to workers and members of the public. Heat generated from used fuel radioactive decay will dissipate through the external surface of the dry casks. (Department of Energy, 2010).

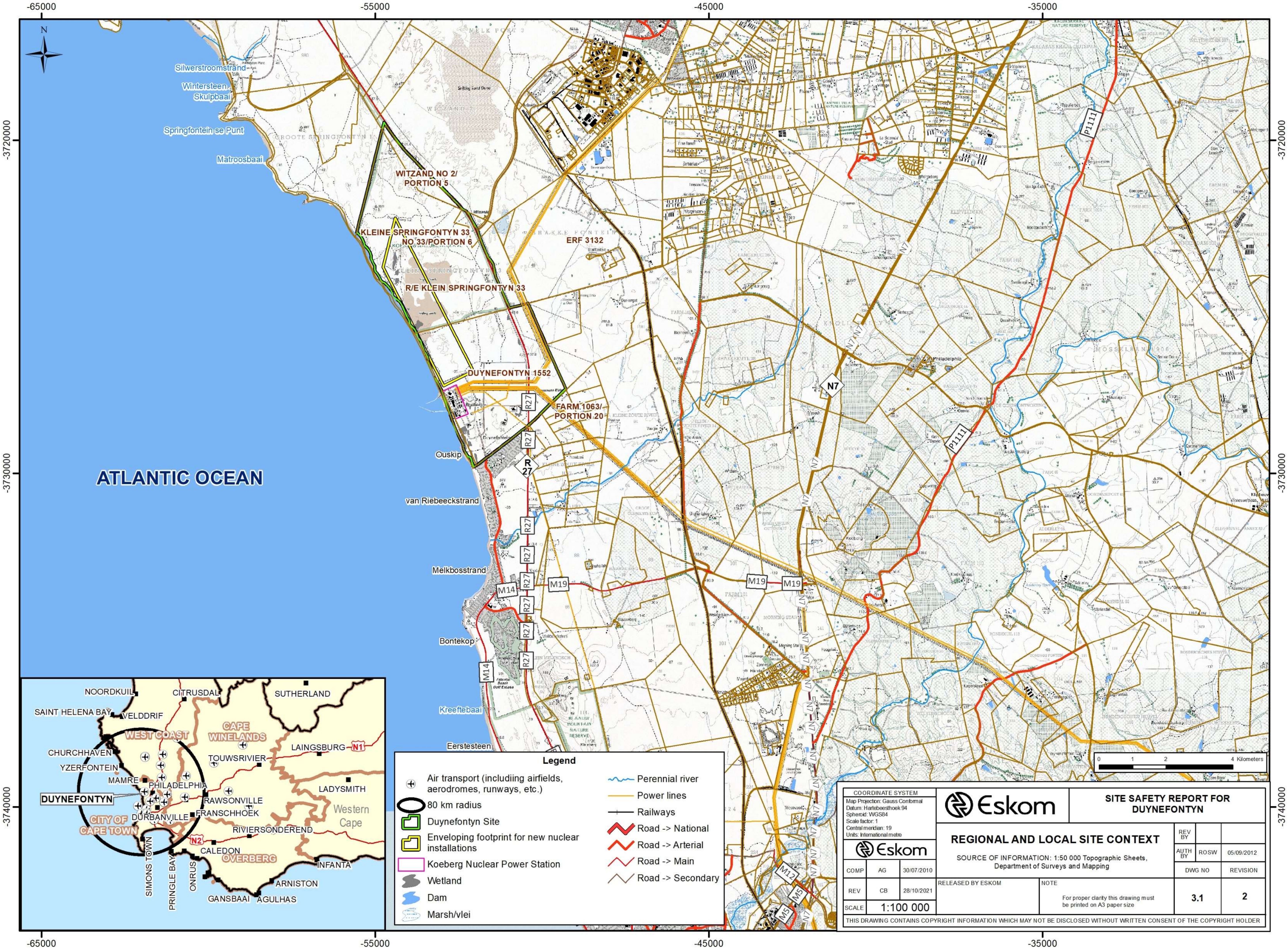
3.5 Koeberg Nuclear Power Station Response to the Fukushima-Daiichi Event

Following the Fukushima-Daiichi accident on 11 March 2011, Eskom as directed by NNR, performed a safety reassessment (SRA) of KNPS, which focused on external events both in the design basis and risk analysis domains. The SRA results were captured in External Events Safety Re-Assessment (EE-SRA) reports for each of the assessed hazards; the results of which were summarised in an Executive Summary report (Eskom, 2011a) and a Safety Reassessment Review Report (Eskom, 2011b).

The SRA concluded that KNPS has been adequately designed and is maintained and operated to withstand all the external events that were considered in the original design basis. As such KNPS has no significant safety shortcomings with respect to external events. Nonetheless, opportunities were identified to further improve safety through plant modifications, operating procedural changes, and through the conduct of additional safety studies.

An EE-SRA Status Update Report is submitted to the NNR on an annual basis (see latest report (Eskom, 2023)). In it progress in addressing the EE-SRA proposals are described.

The re-evaluation of external events that are reported on in this SSR will feed back into the external event review initiative (EERI), which will in that way ensure that the most up to date and accurate understanding of site characteristics serve as input to the assessment of plant vulnerabilities.



ATLANTIC OCEAN
Silwerstroomstrand
Wintersteen Skulpbaai
Springfontein se Punt
Matroosbaai
WITZAND NO 2/ PORTION 5
KLEINE SPRINGFONTYN 33 NO 33/PORTION 6
ERF 3132
R/E KLEIN SPRINGFONTYN 33
DUYNEFONTYN 1552
FARM 1063/ PORTION 20
Philadelphia
Ouskip
van Riebeeckstrand
Melkbosstrand
Bontekop
Kreeftebaai
Eerstesteen
N7
P1111
R27
M19
M14
M12
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CITRUSDAL
SUTHERLAND
SAINT HELENA BAY
VELDDRIF
WEST COAST
CAPE WINELANDS
CHURCHHAVEN
LAINGSBURG
N1
YZERFONTEIN
TOUWSRIVIER
MAMRE
PHILADELPHIA
LADYSMITH
DUYNEFONTYN
RAWSONVILLE
FRANSCHHOEK
Western Cape
DURBANVILLE
CITY OF CAPE TOWN
RIVIERSONDEREND
N2
CALEDON
OVERBERG
SIMONS TOWN
PRINGLE BAY
ONRUS
INFANTA
ARNISTON
GANSBAAI
AGULHAS
Legend
Air transport (includiing airfields, aerodromes, runways, etc.)
80 km radius
Duynefontyn Site
Enveloping footprint for new nuclear installations
Koeberg Nuclear Power Station
Wetland
Dam
Marsh/vlei
Perennial river
Power lines
Railways
Road -> National
Road -> Arterial
Road -> Main
Road -> Secondary
0 1 2 4 Kilometers
COORDINATE SYSTEM
Map Projection: Gauss Conformal
Datum: Hartebeesthoek 94
Spheroid: WGS84
Scale factor: 1
Central meridian: 19
Units: International metre
Eskom
SITE SAFETY REPORT FOR DUYNEFONTYN
REGIONAL AND LOCAL SITE CONTEXT
SOURCE OF INFORMATION: 1:50 000 Topographic Sheets, Department of Surveys and Mapping
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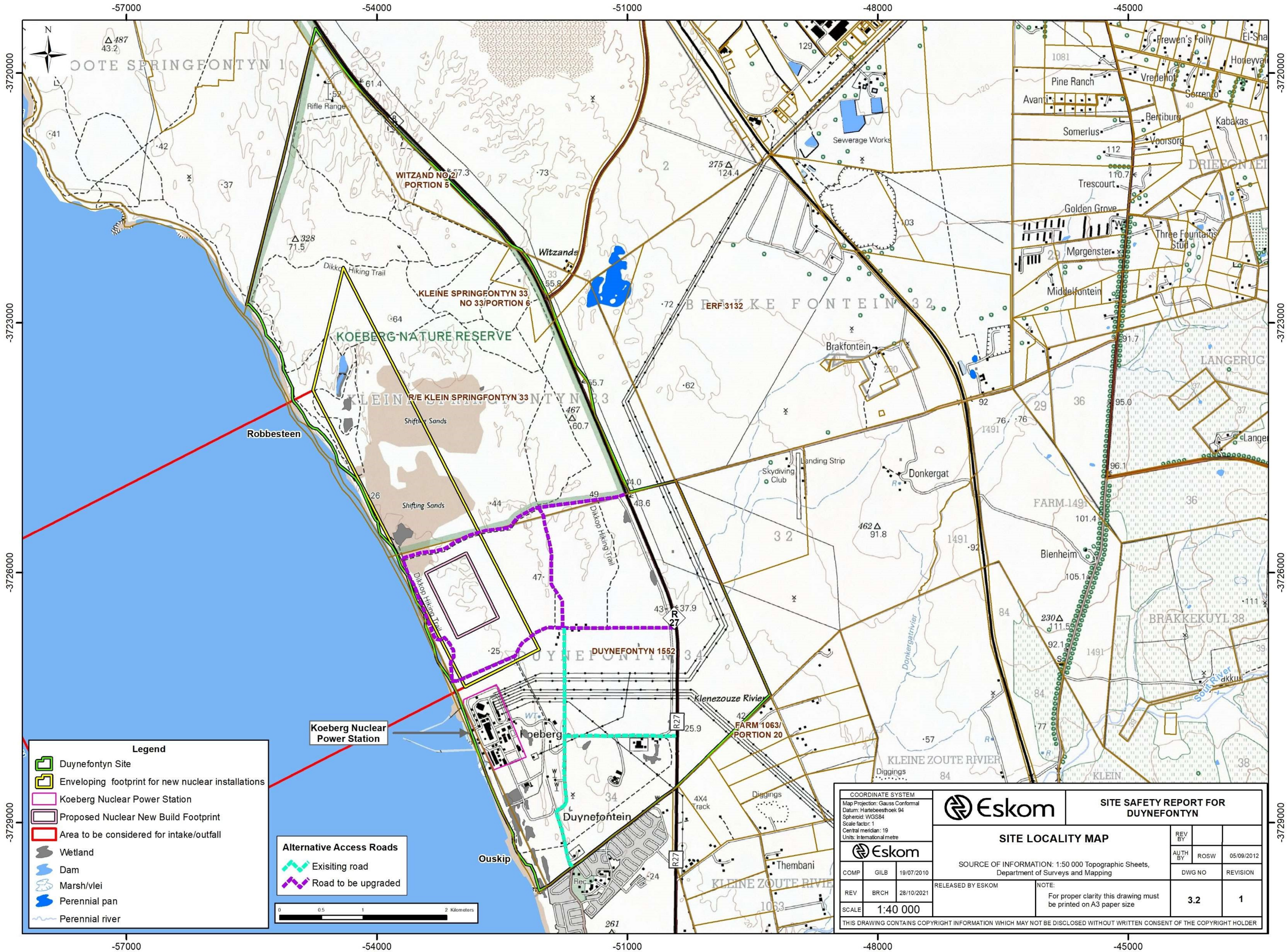

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GROOTE SPRINGFONTYN 1
Rifle Range
WITZAND NO 2/ PORTION 5
Witzands
KLEINE SPRINGFONTYN 33 NO 33/PORTION 6
KOEBERG NATURE RESERVE
R/E KLEIN SPRINGFONTYN 33
Dikkop Hiking Trail
Shifting Sands
Robbesteen
ERF 3132
BRAKKE FONTEIN 32
Brakfontein
Sewerage Works
Landing Strip
Skydiving Club
Donkergat
FARM 1491
Blenheim
BRAKKEKUYL 38
LANGERUG
DRIEFONTEIN
Frewen's Folly
Pine Ranch
Avani
Bentiburg
Somerlus
Voorsorg
Kabakas
Trescourt
Golden Grove
Three Fountains Stud
Morgenster
Middelfontein
DUYNEFONTYN 1552
DUYNEFONTYN 34
Klenezouze Rivier
FARM 1063/ PORTION 20
KLEINE ZOUTE RIVIER
Koeberg
Duynefontein
Ouskip
Thembani
Diggings
4X4 Track
R27
Koeberg Nuclear Power Station
Legend
Duynefontyn Site
Enveloping footprint for new nuclear installations
Koeberg Nuclear Power Station
Proposed Nuclear New Build Footprint
Area to be considered for intake/outfall
Wetland
Dam
Marsh/vlei
Perennial pan
Perennial river
Alternative Access Roads
Exisiting road
Road to be upgraded
0 0.5 1 2 Kilometers
COORDINATE SYSTEM
Map Projection: Gauss Conformal
Datum: Hartebeesthoek 94
Spheroid: WGS84
Scale factor: 1
Central meridian: 19
Units: International metre
Eskom
SITE SAFETY REPORT FOR DUYNEFONTYN
SITE LOCALITY MAP
SOURCE OF INFORMATION: 1:50 000 Topographic Sheets, Department of Surveys and Mapping
COMP GILB 19/07/2010
REV BRCH 28/10/2021
AUTH BY ROSW 05/09/2012
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3.6 Planned Activities

3.6.1 Koeberg Nuclear Power Station (KNPS)

Eskom intends to extend the operating life of KNPS from 40 to 60 years, i.e. up to 2044. This required the review and extension of plant ageing management programmes, together with establishing requirements for major equipment refurbishment and replacement. Many large-scale projects have been completed, are currently underway, or in the conceptual phases of development, including replacement of the KNPS steam generators and the establishment of a TISF and the OSGISF. All these activities occur within the KNPS site and will either be authorised and licenced within the ambit of the facilities operating licence (NIL-01) (National Nuclear Regulator, 2024a), or may require their own Nuclear Installation Licence, as has been required of the TISF and the OSGISF (National Nuclear Regulator, 2024a).

The steam generator replacement results in an increase of 33 MWe in the nominal electrical generator output of each unit. Eskom may also in future initiate a thermal power uprate project, which will increase energy output by a further 100 MWe per unit, which will increase the core thermal output on each unit from 2 775 MWth (965 MWe)) to 3 065 MWth (1 100 MWe).

At the end of its operational life KNPS will be decommissioned. The current strategy (Eskom, 2020a) envisages “Immediate Decontamination and Dismantling,” with “Greenfields” decommissioning as its end-point. The timelines associated with KNPS’s decommissioning remain uncertain, but for the purposes of this SSR an enveloping 20 year period starting in 2044 is assumed. The approach that will be implemented will occur through a regulator accepted decommissioning strategy and plan as required by the NNR (National Nuclear Regulator, 2008).

3.6.2 Future Nuclear Installations

Eskom envisages the construction of a new nuclear power station(s) at the Duynefontyn site. In 2017 Eskom received environmental approval for the Nuclear-1 Project (Department of Environmental Affairs, 2017), which envisages construction of a nuclear power station, using Generation III design PWR technology, with power generation capacity of up to 4 000 MWe. The Eskom application was guided by the Integrated Resource Plan (IRP) 2010 (Department of Energy, 2010), which called for up to 9,6 GWe new nuclear generating capacity to be installed. The

revised IRP 2019 (Department of Energy, 2019) envisages no new nuclear generating capacity before 2030, and up to 2 500 MWe new nuclear generating capacity after 2030.

The phases in the lifetime of Nuclear Power Plants are: siting, design, construction, commissioning, operation and decommissioning. Subsequent to decommissioning it's possible that the site may be designated for further nuclear activities. ***Figure 3.1*** illustrates approximate time intervals for various site lifecycle phases.

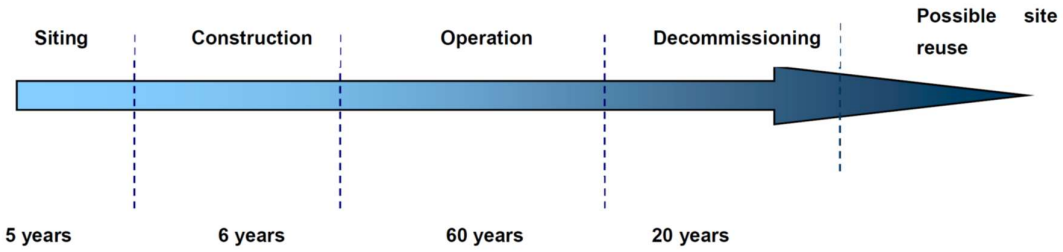

Figure 3.1: Planned Site Lifecycle Phases

This SSR tests and demonstrates the safety of the site by enveloping for the following scenarios in which:

KNPS remains the only nuclear power station to be hosted on the site, but has been modified through, among others, the steam generator replacement and the thermal power uprate projects to generate 2 200 MWe.

A new nuclear power station(s) with a generating capacity of up to 2 500 MWe is added to the KNPS (2 200 MWe), which would increase on-site generating capacity to 4 700 MWe.

A nuclear power station(s) with a generating capacity of 4 000 MWe is added to the KNPS (2 200 MWe), which translates to a maximum total on-site generating capacity of 6 200 MWe.

It is further assumed that KNPS will continue to operate until 2044, after which a 20 year decommissioning period will follow, during which spent fuel will be retained on-site. It is also assumed that a new nuclear power station will become operational from 2030 and will operate for 60 years, which could be extended to 80 years (i.e. up to 2110), after which a decommissioning period of 20 years will follow (i.e. up to 2130).

On the basis of the available information about the site characteristics

and preliminary design considerations (Eskom, 2020b), an enveloping footprint area has been selected (see ***Drawing 3.3***). This is the area within which the new reactor(s) and auxiliary buildings will be established. For modelling purposes (e.g. in ***Section 5.11***) an illustrative footprint was considered within this area. To inform modelling the dimensions of the Hinkley Point C Nuclear Island (including the two reactors, safeguard buildings, fuel building and fuel hall) was used as a surrogate (GIBB, 2017). Using this information gives rounded-up surface dimensions for the Nuclear Island of approximately 500 m x 150 m. The actual size of the footprint area will be confirmed during the detailed design phase of the project. The enveloping footprint at the site is envisaged to house the main reactor buildings and their auxiliary services, which will depend on the selected technology and supporting infrastructure. Storage of spent fuel for new nuclear installation(s) would be accommodated on site in accordance with the practice for KNPS, i.e. a spent fuel pool(s) possibly later supplemented with dry cask storage.

As part of the Nuclear-1 Environmental Impact Assessment (EIA), environmental authorisation was given based on a schematic drawing showing the zones likely to be impacted by a new nuclear power station(s) (***Drawing 3.3***). The estimated position of Nuclear-1, with its associated permanent facilities, is shown in red, while areas to be impacted during construction are shown in green and blue. As no vendor has as yet been appointed, detailed design of the site layout as well as the number and dimensions of plant facilities remain preliminary and conceptual (see (Eskom, 2020b) for Plant Parameter Envelope). All major plant and support buildings, e.g. the Nuclear Island, Conventional Island and associated administration, storage and training facilities, will be constructed within the demarcated EIA corridor. Once the new nuclear installation(s) design is selected a detailed description of all systems and their location at the site will be presented in an updated SSR and the power station specific Safety Analysis Report (SAR). In the Environmental Authorisation (Department of Environmental Affairs, 2017) it is specified that “the maximum area of disturbance of the terrestrial component of the site must not exceed 265ha”

The Department of Environmental Affairs decision to award Environmental Authorisation for the building of Nuclear-1 to the Duynefontyn site was in part informed by the opportunities for “logistical and operational synergies.” (Department of Environmental Affairs, 2017). Such synergies will likely include the portable emergency equipment, including the ten mobile diesel generators that were procured as part of the EERI. Similarly, an opportunity exists for a new nuclear installation(s) to share with KNPS its back-up electrical power supply, which is supplied

through 132 KV power lines from Eskom's Acacia and Ankerlig power stations. The primary function of this electrical supply system is to ensure continuous operation of the plant by providing electrical power to the nuclear power plant/s in the event of the loss of on-site unit generators and the preferred off-site supply (National Grid) (for context see ***Subsection 3.5.2***).

KNPS also intends to expand its High Voltage (HV) yard, which involves the construction of a new HV yard north of the ACP 2 parking area. Once refurbishment on the new HV yard is complete, the old one will be vacant and available for the new power station to utilise. Should it be found during the detailed design phase that it may not be possible to share the power evacuation transmission lines and infrastructure between KNPS and the new nuclear installation each installation will have its own means of power evacuation from its own dedicated HV yard.

In support of its emergency plan, KNPS operates and maintains over 100 sirens within the 16 km radius of KNPS. As the new nuclear installation(s) emergency zones are likely to be enveloped by the KNPS zones (see Chapter 8), there is no need anticipated to amend or expand this system in order to cater for a new nuclear installation(s).

3.6.3 Design Features of Future Nuclear Installations

Eskom has not decided on a preferred supplier for the nuclear build programme and therefore detailed descriptions of the proposed plant are not yet available, however this SSR has been completed using a plant parameter envelope (see (Eskom, 2020b)), while its associated enveloping source terms are given in ***Chapter 7***.

Salient features of the design that Eskom may seek to procure when a decision is made to build a new nuclear installation, are (GIBB, 2017):

- a standardised design for the type of plant to expedite licensing, reduce capital cost, and reduce construction time;
- a simple and robust design, making the plant easier to operate and less vulnerable to operational upsets;
- high availability and longer operating life than current operating reactors – typically in excess of 60 years;
- reduced possibility of core melt accidents;

- higher containment integrity;
- minimal effect on the environment;
- higher burn-up to optimise fuel use and reduce the amount of waste;
- burnable absorbers to extend fuel operating cycle.

These features are characteristic of current PWR technologies (also known as Generation 3 and 3+ designs). Generation 3 and 3+ reactors have utilised industry experience over the past few decades, and several improvements have been incorporated in their designs. These designs incorporate improved fuel technology, have superior thermal efficiency, have significantly enhanced safety systems (including passive nuclear safety) and have standardised designs for reduced maintenance. All reactor types meeting the above requirements will be considered through the nuclear procurement process. Generation 3 and 3+ designs currently understood to be in the market include (but are not limited to) the Westinghouse AP1000, Korean APR1400, Framatome's EPR and Rosatom's VVER1000. Key differences between these plants and the KNPS are given in ***Table 3.2*** with a brief description of each technology.

Table 3.2: Comparison of Key Characteristics of Known PWR Designs

Characteristic	**KNPS (reference)**	**AP 1000**	**APR1400**	**EPR**	**VVER1000**
Developer	Framatome	Westinghouse/ Mitsubishi	Dosam (KHNP)	Framatome	Rosatom (ASE)
Core thermal power (MW_{th})	2 775	3 400	3 983	4 250	3 200
NSS thermal power (MW_{th})	2 790	3 415	4 000	4 500	3 212
Net electrical power output (MW_e)	900	1 117	1 400	1 600 – 1 700	1 082
Plant efficiency (%)	32	35,6	35	37	34.5
Plant design life (years)	40	60	60	60	60
No of loops	3	2 hot legs/4 cold legs	4	4	4
Fuel assembly pin array	17x17	17x17 square	16x16 square	17x17 square	Hexagonal
No. of fuel assemblies per core	157	157	241	241	163
Enrichment limits (%)	4,95	4,80	3,80	5 or MOX (Mixed Oxide Fuel)	4,69
No. of steam generators per reactor	3	2 with triangular pitch	2 with a triangular pitch	4	4 corridor arrangement
Layout of steam generators	Vertical	Vertical	Vertical	Vertical	Horizontal
Reactor coolant pumps	3	4	4	4	4

3.7 Management of Uncertainties

At present the main uncertainties related to the planned activities at the site are related to the following:

- KNPS long-term-operation;
- KNPS thermal power uprate;
- decommissioning duration/end dates;
- design of the new reactors;
- size of the emergency planning zones of the new reactors;
- number of new reactors;
- new site layout and nuclear power station(s) footprint;
- lifetime of the nuclear power station(s) and the site;
- final disposal of spent fuel.

These uncertainties are addressed through evaluation of different scenarios, a range of PWR designs, consideration of an enveloping footprint, application of a conservative approach to the development of the Plant Parameter Envelope (Eskom, 2020b) and envisaged review and revision of this SSR.

3.8 Management System

The overview of the planned activities at the site was developed in line with the overall management system for this SSR (presented in detail in Chapter 10, Management System). The compliance of this chapter with the relevant regulatory requirements is summarised in

Table 3.3 (see also Subsection 3.2 above).

Table 3.3 Regulatory Compliance Matrix

Act/Regulation	Section/Regulation	Requirement/Issue	Section/Chapter
National Nuclear Regulator Act, 1999 (Republic of South Africa, 1999)	Section 2 (1) (a)	Site authorisation to construct and operate nuclear installations	The whole SSR, including Chapter 3
Regulations on the Licensing of Sites for New Nuclear Installations (Department of Energy, 2011)	Regulation 5(2)	SSR to include a statement as to the proposed use of the site in terms of the range of technologies being considered for the nuclear installation(s) and use of the site...	Section 3.5
Government Regulation R.338 (Department of Minerals and Energy, 2006)	Section 2.4	Licensing	Section 3.5
Government Regulation R.338 (Department of Minerals and Energy, 2006)	Section 3.3	Prior safety assessment	Section 3.5
RG-0011: Interim Guidance for the Siting of Nuclear Facilities, Rev.0 (National Nuclear Regulator, 2016)	Section 6.3	Discrete demarcation of nuclear facilities	Section 3.5
RG-0011: Interim Guidance for the Siting of Nuclear Facilities, Rev.0 (National	Section 10.2	Show through illustrations: a) Layout of site structures; i) Culverts; j) Vital	Section 3.5

Act/Regulation	Section/Regulation	Requirement/Issue	Section/Chapter
Nuclear Regulator, 2016)		equipment; m) Intake structure; n) Protected area boundary; and o) Owner-controlled area and protected area vehicle checkpoints".	

This chapter is the basis for all subsequent chapters/sections of this SSR and therefore has a link with all of them and some overlap, e.g. Chapter 9 (Physical Protection and Security).

3.9 References

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