

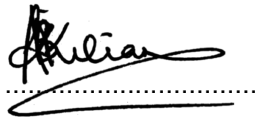
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CHAPTER 4: SITE INVESTIGATION APPROACH

File name: [4] Eskom Thyspunt SSR Chapter 4 Site Investigation Approach Rev 0b

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.

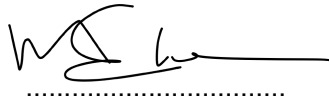


Name: Anita Kilian

Date: 2026-09-04

Peer Reviewer:

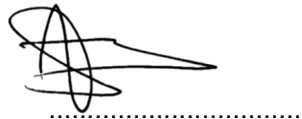
I declare that this report has undergone independent peer review by myself, that comments were addressed to my satisfaction, and that as such, it is considered fit for publication.



Name: Mervin Theron

Date: 2026-09-04

Eskom Acceptance:



Name: Israel Sekoko

Date: 2026-09-04

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AMENDMENT RECORD			
Rev	Draft	Date	Description
0		March 2016	First issue. Thyspunt Site Safety Report compiled in support of Eskom's Nuclear Installation Site Licence for the Thyspunt site.
0a		February 2026	Chapter updated to reflect the latest information, address NNR comments on TSSR Rev 0 and to align with the latest template on structure and layout of Site Safety Reports.
0b		September 2026	Document title in title block corrected.

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EXECUTIVE SUMMARY

This chapter covers the overall approach that was followed in the selection and investigation of the Thyspunt site to locate a new nuclear installation(s) for the purposes of generating electricity.

This chapter presents:

- a summary of the historical studies performed to select the site;
- the criteria used to select the site and the justification thereof;
- historical and currently available information for the site;
- motivation for the choice of the site to accommodate new nuclear installation(s); and
- Studies performed to characterise the site, develop and update the TSSR.

Eskom started the Nuclear Siting Investigation Programme (NSIP) in the early 1980s with the aim to identify and select sites suitable for the development of new nuclear installations. This work focused on investigating sites within South Africa with the main focus on the coastline (Eskom, 2012) taking into consideration economic factors, projected load growth and the large quantities of cooling water required for the safe operation of nuclear reactors.

The NSIP was implemented in four phases/steps, i.e. national survey to identify and rank regions (national desk top study); survey of regions to identify and rank candidate areas; survey of areas to identify and rank candidate sites and site specific studies of selected sites culminating in SSRs.

The national survey studies culminated in the identification of eight regions. The identified candidate regions were then ranked based on sensitivity and suitability resulting in Region VII – Cape East Coast; Region VI – Arniston; Region I(a) – West Coast (Port Nolloth) and Region I(b) – West Coast (Hondeklipbaai) as highly ranked regions. Selected regions were further assessed through field visits and surveys. They provided a rough screening of the potentially suitable areas which were investigated in more detail.

Of particular relevance to this SSR is the Cape East Coast region, where two areas were identified. These were to the east of Port Elizabeth in the Alexandria area and an area west of Port Elizabeth between Cape St. Francis and the Groot River Mouth (Eskom, 1983).

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In addition to field visits, candidate areas within the preferred regions were identified through the use of overlays, with the exclusion of areas based on the following five screening criteria, viz.: areas of high seismicity; areas near large urban populations; areas of high rural population; proximity to political boundaries; and the presence of national conservation areas.

Detailed area investigations were undertaken for the identified candidate areas. After initial field investigations, the Alexandria area was excluded on the basis of high environmental sensitivity and low suitability factors. As a result, additional studies to the west of Port Elizabeth, from Cape St. Francis in the east to the Groot River Mouth in the west, were performed. Six sites were identified for this area between Cape St. Francis and the Tsitsikamma River, namely De Hoek, Thyspunt, Tony's Bay, Klippepunt, Morgan's Bay and Brakkenduinen. Site specific suitability investigations were carried out on all six sites.

The Klippepunt, Morgan's Bay and Brakkenduinen sites were deemed unsuitable due to a major geological fault that was found to run through them (Atomic Energy Corporation of South Africa Limited, 1988). The easternmost site of De Hoek was found to be too close to the holiday resort of Cape St. Francis and was eliminated due to demographic reasons.

It was thus concluded that only two sites, Tony's Bay and Thyspunt, were viable sites (Atomic Energy Corporation of South Africa Limited, 1988). As these sites were adjacent to each other, they were consolidated into one site called Thyspunt site.

Detailed site characterisation studies were conducted from 2007 to assess the suitability of the Thyspunt site for the location of a new nuclear installation(s), the results which are contained in this SSR.

From the studies performed, it can be concluded that the siting factors and criteria taken into consideration provided the necessary assurance that radiological doses and risks to the public and the environment will be acceptably low, that natural phenomena and man-made hazards can be appropriately accounted for and that the implementation of emergency plans and security measures are feasible and that the Thyspunt site is suitable to locate a new nuclear installation(s).

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4 SITE INVESTIGATION APPROACH

4.1 Purpose

This chapter presents a historical overview of how the Thyspunt site was selected and the process that was followed to further characterise the site in support of the location of a new nuclear installation(s) for the purposes of generating electricity.

The chapter presents:

- a summary of the approach, rationale and process followed for site selection and investigation, i.e. the strategic approach from national and regional levels up to the selection of the proposed site;
- the criteria used to select the site and the justification thereof;
- the historical and currently available information for the site;
- motivation for the choice of the site to accommodate new nuclear installation(s);
- Studies performed to characterise the site, develop and update the TSSR.

This chapter covers the overall approach to the site investigation while the specific technical and detailed aspects on site characteristics (e.g. geology, seismology, demography), which substantiate the suitability of the site from a nuclear safety and security perspective, are presented in **Chapters 5 to 9**.

4.2 Regulatory Framework

The national legal and regulatory framework for the development of this SSR is presented in **Chapter 2** (Legal and Regulatory Basis). This chapter has been developed in line with the requirements as contained in the Regulations on Licensing Sites for New Nuclear Installations, R.927 (Department of Energy, 2011), viz:

“Regulation 5 (1) - A motivation for the choice of the site to ensure a low risk of public exposure from the operation of the nuclear installation(s);

“5(2) - 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 of 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

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safety measures against the hazardous consequences of postulated events, and layout on the site.”

5(3) - The characteristics of the site relevant to the design assessment, risk and dose calculations, including inter alia:

- (a) external events;
- (b) meteorological data;
- (c) land use;
- (d) population demographics;
- (e) regional development;
- (f) projections of the above data commensurate with the design life of the nuclear installation(s).”

“5(4) - A source term analysis that is representative of the overall potential hazards posed to the public and the environment owing to the new nuclear installation(s). A representative scope of internal and external events enveloping the new nuclear installation(s) must be taken into consideration.”

“5(5) - A Probabilistic Risk Assessment (PRA) using the site characteristics referred to in Regulation 5(3) and the source terms referred to in Regulation 5(4) to demonstrate compliance with the probabilistic risk limits. This analysis must include the impact of all nuclear installations and actions on the site, existing and proposed, for which authorizations have been granted by the Regulator.”

“5(6) - An analysis of the Impact on the public due to normal operations of the new nuclear installation(s) including minor occurrences that can be kept under control, to demonstrate compliance with the dose limits. This analysis must include the impact of all nuclear installations and actions on the site, existing and proposed, for which authorizations have been granted by the Regulator.”

“5(7) - The identification and determination of emergency planning zones using the characteristics of the site, source term analysis and PRA established in accordance with Regulations 5(3), 5(4) and 5(5) respectively. In determining the emergency planning zones due account must be taken of physical boundaries such as rivers, dams, mountain ranges, as well as municipal boundaries. The emergency planning zones must include the following:

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- (a) An exclusion zone which is a radius determined for the purposes of evacuating persons in the event of a nuclear accident. Within the boundaries of that zone or within any even intersecting with that zone there must be no members of the public resident, no uncontrolled recreational activities, no commercial activities, or institutions which are not directly linked to the operation of nuclear installations situated within this zone, or for which an authorisation has been granted;
- (b) An overall Emergency Planning Zone (EPZ) of such size that emergency or remedial measures must be considered where the potential exists that any members of the public may receive more than an annual effective dose of 1 mSv due to the source term;
- (c) A Long Term Protective Action Planning Zone (LPZ), where preparations for effective implementation of protective actions to reduce the risk of stochastic health effects from long term exposure to deposition and ingestion must be developed in advance consistent with international standards.”

“5(8) - An analysis to demonstrate the viability of an emergency plan taking into account relevant data established in accordance with Regulations 5(3), 5(4), and 5(5), including disaster management infrastructure. It must be shown that risks to the public, as well as the financial consequences caused by damage and radioactive contamination, are as low as reasonably achievable.”

“5(9) - An assessment on the suitability of the site, from a nuclear security perspective as determined by the National Nuclear Regulator (NNR).”

Further aspects considered in the development this SSR are contained in RG-0011, Interim Guidance on the Siting of Nuclear Installations (National Nuclear Regulator, 2016) and include:

- (a) Public and Environmental Analyses;
- (b) Proposed arrangements for control of developments around a nuclear installation(s) site;
- (c) Provision for the protection of non-human species; and
- (d) Monitoring of site conditions.

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4.3 International Guides

The following guides and other documentation were also consulted to provide useful points of reference:

- Electric Power Research Institute (EPRI):
 - Electric Power Research Institute Siting Guide on Site Selection and Evaluation Criteria for New Nuclear Energy Generation Facilities (Electric Power Research Institute, 2022).
- International Atomic Energy Agency (IAEA)
 - International Atomic Energy Agency Specific Safety Requirements SSR-1, Site Evaluation for Nuclear Installations (International Atomic Energy Agency, 2019).
 - International Atomic Energy Agency Nuclear Energy Series No. NG-T-3.7, Managing Siting Activities for Nuclear Power Plants (International Atomic Energy Agency, 2022).
 - International Atomic Energy Agency Safety Standards, Specific Safety Guide No. SSG-35, Site Survey and Site Selection for Nuclear Installations (International Atomic Energy Agency, 2015).
 - International Atomic Energy Agency Safety Standards, Site Survey and Evaluation Aspects for Nuclear Installations with Emphasis on a Graded Approach, IAEA TECDOC-2101 (International Atomic Energy Agency, 2025).
- United States Nuclear Regulatory Commission
 - United States Nuclear Regulatory Commission, General Site Suitability Criteria for Nuclear Power Stations, Regulatory Guide 4.7 (United States Nuclear Regulatory Commission, 2024).
 - United States Nuclear Regulatory Commission, Guide NUREG-1844 on Safety Evaluation Report for an Early Site Permit (ESP) at Exelon Generation Company. Example of a review of an ESP application to a nuclear regulator (United States Nuclear Regulatory Commission, 2006).

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IAEA SSG-35 (International Atomic Energy Agency, 2015), IAEA NG-T-3.7 (International Atomic Energy Agency, 2022), and IAEA TECDOC-2101 (International Atomic Energy Agency, 2025) establish requirements for the siting process. It provides recommendations and guidance on establishing a systematic process for site survey and site selection for a number of preferred candidate sites, from which one could be selected for the construction and operation of a nuclear installation.

IAEA SSR-1 (International Atomic Energy Agency, 2019) establishes requirements for site evaluation for nuclear installations, to meet the fundamental safety objective.

In accordance with SSR-1, the safety objective in site evaluation for nuclear installations shall be to characterise the natural and human induced external hazards that might affect the safety of the nuclear installation, to provide adequate input for demonstration of protection of people and the environment from harmful effects of ionising radiation.

The scope of site evaluation encompasses factors relating to the site and factors relating to the interaction between the site and the installation(s), for all operational states and accident conditions, including accidents that could warrant emergency response actions. In determining the scope of site evaluation, a graded approach is applied commensurate with the radiation risk posed to people and the environment.

4.4 Approach Adopted for the Motivation of the Site and the Demonstration of Site Suitability

The two processes relating to the safety considerations for a site of a nuclear installation(s) are the siting process and the site evaluation process.

Siting is the process of surveying and selecting a suitable site for a nuclear installation(s). The selection of a suitable site is one of the elements of the concept of defence in depth for preventing and mitigating accidents as stated in principle 8 of IAEA Safety Fundamental Principles, SF-1 (International Atomic Energy Agency, 2006) that “All practical efforts must be made to prevent and mitigate nuclear or radiation accidents.”

The siting process for a nuclear installation is divided into two stages:

- Site survey, in which candidate sites are identified after the investigation of a large region and the rejection of unsuitable sites.
- Site selection, in which the candidate sites are assessed by screening, evaluation, comparison and ranking on the basis of

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safety and other considerations to select one or more preferred candidate sites.

In South Africa, no nuclear installation licence is required for the siting process, but the process is conducted in consultation and with input from the relevant stakeholders, regulatory authorities, government departments and local authorities. The site evaluation process on the other hand, requires regulatory approval in the form of a nuclear installation site license (NISL) or a nuclear installation license (NIL).

Site evaluation is conducted through detailed investigations and studies resulting in the characterisation and derivation of site related design bases.

Site evaluation continues throughout the operating lifetime of the installation, taking into account changes in site characteristics, the availability of information, operational records, regulatory approaches, evaluation methodologies and safety standards. If the site related design parameters are changed during the operational stage, re-evaluation and/or upgrades to the installation during operation may consequently be necessary.

The site evaluation studies and investigations as well as the results are reported in the TSSR (**Chapters 5, 6, 7, 8 and 9**), which, in accordance with Regulation on Licensing of Sites (Department of Energy, 2011), are submitted to the NNR in support of a NISL.

4.5 Motivation for the Choice of the Thyspunt site – Investigated Areas

In anticipation of the expanded nuclear programme in South Africa, Eskom started the Nuclear Siting Investigation Programme (NSIP) in the early 1980s with the aim to identify and select sites suitable for the development of new nuclear installations. This work focused on investigating sites within South Africa with the main focus on the coastline (Eskom, 2012) taking into consideration economic factors, projected load growth and the large quantities of cooling water required for the safe operation of nuclear reactors. The latter ruled out inland sites at that stage.

The NSIP was implemented in the four phases/steps shown in **Table 4.1**.

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Table 4.1: NSIP Steps

Step 1	National survey to identify and rank regions (national desk top study)
Step 2	Survey of regions to identify and rank candidate areas
Step 3	Survey of areas to identify and rank candidate sites
Step 4	Site specific studies of selected sites culminating in SSRs

4.5.1 Step 1: National Surveys to Identify and Rank Regions

The NSIP involved screening based on a set of selected criteria in order to identify the most suitable regions/areas/locations and candidate sites. The criteria used were:

- water availability;
- geology and mineral deposits;
- seismology;
- urban populations;
- rural population;
- political boundaries and security zones;
- areas of national conservation importance;
- security areas; and
- national physical and development and decentralisation policies.

The first step/phase involved a national screening exercise which culminated in the identification of eight regions, as shown in **Table 4.2** (Eskom, 1983) based on the criteria presented in (Eskom, 1984).

Table 4.2: Phase 1 Overlay Results

Region	Location	Name	Area
I	S29°15' to 32°15'	Cape West Coast	Kleinsee to Lamberts Bay (3 sub-regions)
II	S32°30' to 32°45'	Cape Southwest Coast	Elandsbaai to Veldsdrif
III	E25°45' to 26°15'	Cape East Coast	Sundays River to Alexandria
IV	E23°30' to 23°45'	Cape East Coast	Plettenberg Bay to Storms River
V	E23°45' to 24°15'	Cape East Coast	Storms River to Groot River

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Region	Location	Name	Area
VI	E20°00' to 21°30'	Cape South Coast	Stilbaai to Arniston (3 sub-regions)
VII	E24°15' to 24°45'	Cape East Coast	Groot River to Cape St. Francis
VIII	E21°30' to 22°00'	Cape South Coast	Stilbaai to Gouritz River

In the case of KwaZulu-Natal and a large part of the Eastern Cape, no completely constraint-free candidate regions were identified. However, it should be noted that regions considered less favourable at that stage are not necessarily eliminated from future consideration, particularly those discarded because of a single constraint (Eskom, 1983). Subsequently, two field visits were made to the eight regions identified, together with the intervening coastal stretches, by a multi-disciplinary team comprising, *inter alia*, geologists, civil engineers, hydrologists, environmental and natural scientists.

The identified candidate regions were then ranked on a matrix using aspects of sensitivity and suitability in respect of civil engineering, geology, seismicity, demography, security, ecology, potable water availability, land use, social infrastructure and coastal geomorphology (nature of the terrace shelf).

Ranking methodologies were employed for the evaluation and scoring of criteria as well as the overall ranking of the candidate regions. Weightings were then assigned to these criteria to reflect their considered importance (Eskom, 1983).

The focus of further work was on the first-ranked candidate regions which were as follows:

Region VII – Cape East Coast;

Region VI – Arniston;

Region I(a) – West Coast (Port Nolloth); and

Region I(b) – West Coast (Hondeklipbaai).

4.5.2 Step 2: Survey of Regions to Identify and Rank Candidate Areas

Selected regions were further assessed through field visits and surveys. They provided a rough screening of the potentially suitable areas which were investigated in more detail in steps 3 and 4 (Eskom, 1983). Of particular relevance to this SSR is the Cape East Coast region, where two areas were identified. These were to the east of Port Elizabeth in the

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Alexandria area and an area west of Port Elizabeth between Cape St. Francis and the Groot River Mouth (Eskom, 1983).

In addition to field visits, candidate areas within the preferred regions were identified through the use of overlays, with the exclusion of areas based on the following five screening criteria, viz.:

- areas of high seismicity;
- areas near large urban populations;
- areas of high rural population;
- proximity to political boundaries; and
- presence of national conservation areas.

4.5.3 Step 3: Survey of Areas to Identify and Rank Candidate Sites

Detailed area investigations were undertaken for the identified candidate areas. In the East Cape two regions were investigated, viz. a region east of Port Elizabeth in the Alexandria area between the Sundays River Mouth and Cape Padrone and a region west of Port Elizabeth between Cape St. Francis and the Groot River Mouth.

After initial field investigations, the Alexandria area was excluded on the basis of high environmental sensitivity and low suitability factors. These included:

- the presence of sandy beaches with large wind-driven mobile dunes behind the shoreline, comprising the largest mobile dune field in South Africa - The engineering problems associated with the natural movement of these dunes would be considerable.
- that the nuclear installation(s) would have to be founded on at least 25 to 30 m of unconsolidated sand - Piled foundations would have to be used for which the seismic design requirements would be onerous.
- that only a small stretch of coastline approximately 1 km in length remained after applying the 50 km buffer zone demographic requirement from Port Elizabeth and the 100 km buffer zone international border requirement from the (then) Republic of Ciskei, which was considered a national border.
- that the shoreline is easily eroded and is unsuitable for the siting of a nuclear installation(s).
- proximity to the unique Alexandria Forest and abovementioned dune fields, which are highly sensitive ecological areas.

The western portion of this area, from the Tsitsikamma River Mouth to the Groot River Mouth is characterised by steep cliffs of the Table Mountain Group sandstones descending from a plateau with elevation of 100 m above sea level, straight into the sea. This portion of coastline was

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considered unsuitable for the siting of a nuclear installation(s) due to the high costs associated with excavation and terracing.

As a result, additional studies to the west of Port Elizabeth, from Cape St. Francis in the east to the Groot River Mouth in the west, were performed. These included, *inter alia*, studies on geology, geohydrology, seismology, demography, coastal engineering, water supply and access routes.

Six sites were identified for this area between Cape St. Francis and the Tsitsikamma River, namely De Hoek, Thyspunt, Tony's Bay, Klippepunt, Morgan's Bay and Brakkenduinen. Site-specific suitability investigations were carried out on all six sites.

A public communication programme was initiated in 1985, prior to the commencement of the confirmatory field investigations (Eskom, 1994).

4.5.4 Step 4: Specific Studies of Selected Sites and SSR Development

Site specific suitability investigations focussed on the assessment of site suitability and sensitivity. As such they focussed largely on the identification of potential disqualifying criteria, such as potentially active faults, the characteristics of the site and its environs that could influence the transfer of radioactive material to people and the environment, population density and population distribution and the feasibility of implementing emergency measures. Studies done included physiography, geology, geohydrology, seismology, meteorology, corrosion, demography, water supply, power transmission, coastal engineering, access routes, heavy load route investigations, transport of nuclear waste, terrain cost comparison, and sources of construction materials. Some exploratory drilling and testing were also carried out but not at a sufficient level to fully characterise these sites.

The Klippepunt, Morgan's Bay and Brakkenduinen sites were deemed unsuitable due to a major geological fault that was found to run through them (Atomic Energy Corporation of South Africa Limited, 1988). Although this fault could not be positively categorised as a capable fault, there was at that time insufficient evidence to discount this possibility. The easternmost site of De Hoek was found to be too close to the holiday resort of Cape St. Francis and was eliminated due to demographic reasons.

It was thus concluded that only two sites, Tony's Bay and Thyspunt, were viable sites (Atomic Energy Corporation of South Africa Limited, 1988). As these sites were adjacent to each other, they were consolidated into one site called, Thyspunt site.

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Detailed site characterisation studies were initiated in 2007, including regional and site-specific demography, land use, sea usage, nearby transportation and facilities, geology, seismology, hydrology, geohydrology, meteorology, oceanography, geotechnical characterisation, potential radiological impact and the feasibility of developing an emergency plan.

This SSR presents the outcomes of the in-depth site investigations and analyses carried out on the site to confirm its suitability to construct and operate a nuclear installation(s) for the purpose of generating electricity.

The investigation approach undertaken for this SSR entailed the following:

- desk top study;
- site reconnaissance;
- detailed site investigations;
- data analysis, computer-based modelling and reporting;
- peer review.

The desk top study included the collection and analysis of the existing available information and evaluation of the safety requirements and criteria for site work. Key historical information that was available and contained in the following mostly self-explanatory reports was reviewed, analysed and taken into consideration in the preparation of this SSR:

- Eskom, *“Eastern Cape Summary Report.”* Rev 1. 1994 (Eskom, 1994);
- E Raubenheimer, *“Detailed Geology of De Hoek, Thyspunt and Tony’s Bay”* (Atomic Energy Corporation of South Africa Limited, 1988);
- Council for Geoscience, *“An Assessment of the Seismic Hazard at Thyspunt/Tony’s Bay for a Potential Nuclear Power Plant Site.”* (Council for Geoscience, 2000);
- Engineering Group, *“Preliminary Report on Access Routes to Possible Nuclear Sites West of Port Elizabeth”* (Eskom, 1986);
- Fugro Surveys Africa, *“Geophysical Survey Report for Thyspunt”* (Fugro Surveys Africa, 2006).

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The detailed investigations and results presented in the TSSR, comprised:

- baseline ecological studies of the site and immediate surrounds (**Section 5.3**);
- surveys of the demography, land and water use, transport and adjacent sea use of the site and surrounding area up to an 80 km radius of the provisional site centroid (see **Sections 5.4, 5.5, 5.6** and **5.7**);
- erection of a 10 m high meteorological station for on-site measurement of rainfall, wind velocity, humidity, corrosion (also at other stations on site) and temperature (see **Section 5.8**);
- installation of oceanographic measuring instrumentation to monitor, *inter alia*, water level, waves, currents, turbidity and temperature at 10 m and 30 m water depth immediately offshore from the site and a tide gauge measuring tidal level (see **Section 5.9**);
- baseline hydrological studies of the site and surrounding quaternary catchments to assess storm water runoff, hydraulics and flood lines (see **Section 5.10**);
- drilling of boreholes for geohydrological (38 in number) and geotechnical (72 in number) testing and monitoring, mainly in the envelope footprint area but also in the surrounding site areas (see **Sections 5.11** and **5.15**);
- evaluation of local and regional water resources and desalination of sea water for freshwater supply to the nuclear installation(s) (see **Section 5.12**);
- geological mapping, seismic monitoring of the site and the surrounding area (see Sections 5.13 and 5.14) at the site region (≤ 320 km), site vicinity (≤ 40 km), site area (≤ 8 km) and site location (≤ 1 km) scale, including probabilistic seismic hazard analysis (see **Sections 5.13** and **5.14**);
- conclusions on compliance with the safety requirements and criteria for siting of a nuclear installation(s) and proposals for future monitoring programmes for the site.

This was followed by ongoing measurements/monitoring and analyses that will continue in the future for confirmatory or other purposes. These measures include monitoring of parameters related to the following (see **Section 5.2**, Monitoring):

- groundwater levels and quality;
- wetlands;
- seismology;
- oceanography;

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- meteorology;
- background radiation;
- corrosion.

On the basis of the results of the above investigations and analyses for the site performed to date, the following has been identified and presented in this SSR:

- the site characteristics (and any evolution of such over time) that support the acceptability of the site for the establishment of a nuclear installation(s) (**Chapter 5**);
- critical/important features and characteristics and identification of actions needed prior to and post construction of a nuclear installation(s), e.g. additional monitoring (**Section 5.2**), confirmatory studies and a proposed work plan;
- proposed measures to be considered in the design, construction, operation of the nuclear installation(s) in terms of external events and their importance to safety, e.g. flooding (*inter alia* storm surges, tsunamis, sea level rise) and blocking of cooling water intakes by marine organisms (**Chapter 6**, Evaluation of External Events);
- potential radiological impact on the public and the environment (**Chapter 7**);
- feasibility of emergency planning (**Chapter 8**);
- assessment of physical protection and security (**Chapter 9**);
- conclusions and areas of uncertainty that can be addressed with additional design measures (all chapters/sections and **Chapter 11**);
- Details of the approaches followed and the results for each field of study are contained in **Chapters 5 to 9**.

4.5.5 Investigated Areas and Characteristics

In accordance with IAEA SSR-1 (International Atomic Energy Agency, 2019), the suitability of a site shall be assessed at an early stage of the site evaluation and shall be confirmed for the lifetime of the planned nuclear installation. This SSR is for the update of the TSSR reflecting the current status of the site and its environs, thereby providing the National Nuclear Regulator with the latest information on the site characteristics in order to make a decision on the suitability of the Thyspunt site for a nuclear installation site licence.

The main stages followed in the update of this SSR include:

- evaluation of the safety requirements and criteria for siting of nuclear installations at national level applicable to a proposed site (see

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Sections 4.2 and **4.3** above);

- collection and analysis of existing available information for the proposed site - This included key historical information which was reviewed, analysed and taken into consideration in the preparation of this SSR, including:
 - report on preliminary site investigations (Eskom, 1966);
 - the TSSR Rev. 0 (Eskom, 2016);
- performance of complementary measurements, studies, monitoring and analysis;
- identification of uncertainties and further work required in support closing out review comments from the NNR.

The main activities carried out to update site characteristics in support of nuclear installation site licence for new nuclear installation(s), included the following:

- updated surveys of the demography, land and water use, adjacent sea use and nearby transportation, industrial and military facilities (see **Sections 5.4, 5.5, 5.6** and **5.7**);
- update of meteorological information incorporating information from the extended meteorological monitoring programme (see **Chapter 5.8**);
- update of the oceanographic information with additional oceanographic measurements and detailed numerical modelling studies and a conceptual engineering design for new nuclear installation(s) (see **Chapter 5.9**);
- update of the baseline hydrological studies of the site and surrounding quaternary catchments to assess storm water, hydraulics and flood lines (see **Chapter 5.10**);
- update of geohydrological data incorporating the additional testing and monitoring programmes (see **Chapter 5.11**);
- updated evaluation of local and regional water resources and desalination of sea water for freshwater supply to the site (see **Chapter 5.12**);
- update of the habit survey study in support of the update of **Chapter 7**;

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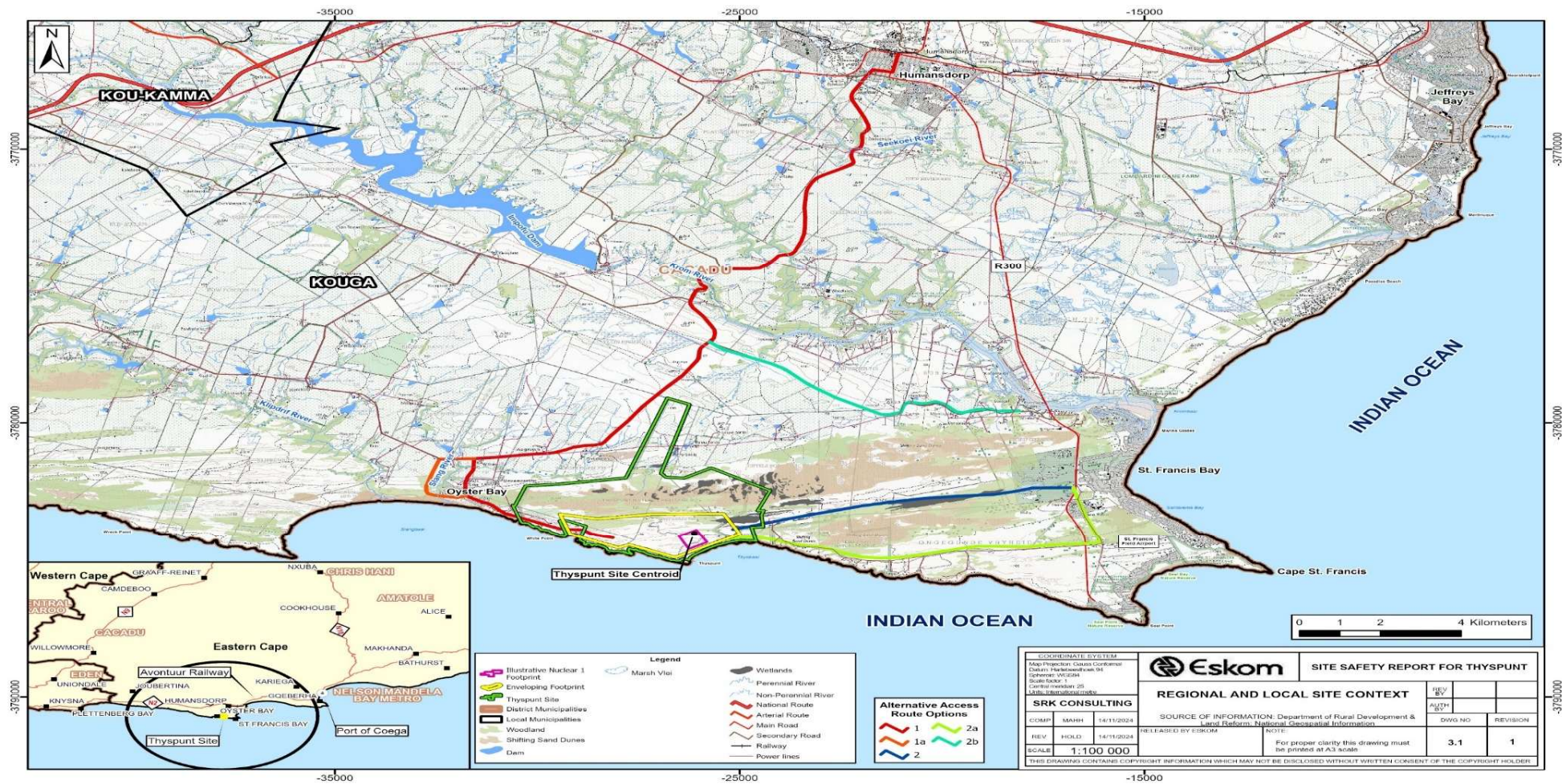
- performance of a Probabilistic Risk Assessment (**Chapter 8**);
- analysis of the above data to show that the site meets the requirements of sections 5 (3), (4), (5), (6), (7), (8) and (9) of the Regulations on Licensing of Sites (Department of Energy, 2011) including applying a graded approach to sections 6.6.3, 7, 8, 9, 10 and 11 of RG-0011 (National Nuclear Regulator, 2016);
- performance of ongoing measurements/monitoring and analyses that will continue in the future for confirmatory or other purposes. These measures include monitoring of parameters related to the following (see **Section 5.2** of this SSR):
 - groundwater;
 - oceanography;
 - meteorology, including corrosion.
- conclusions on compliance with the safety requirements and criteria for siting of nuclear installations.

On the basis of the results of the above investigations and analyses for the site performed to date, the following has been identified and presented in this SSR:

- the site characteristics (and any evolution of such over time) that support Eskom's application for a NISL for the Thyspunt site (**Chapter 5**);
- critical/important features and characteristics and identification of actions needed prior to and post-construction of a new nuclear installation(s), e.g. additional monitoring;
- a probabilistic risk assessment of external events and their importance to safety, e.g. flooding (inter alia storm surges, tsunamis, sea level rise) and seismic hazard (**Chapter 6**);
- potential radiological impact on the public and the environment (**Chapter 7**);
- feasibility of emergency planning (**Chapter 8**);
- physical protection and security (**Chapter 9**);
- areas of uncertainty that can be addressed with additional design measures (all chapters/sections and **Chapter 11**).

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Details of the approaches followed and the results for each field of study are contained in **Chapters 5** to **9** of this SSR. The regional and local site context for the Thyspunt site is shown in **Drawing 4.1**.



Drawing 4.1: Regional and Local Site Context

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4.5.6 Environmental Impact Assessment

Eskom has initiated an EIA for a new nuclear installation at the Thyspunt site.

4.6 Operating Experience

4.6.1 Operational

Koeberg Nuclear Power Station (KNPS), the only nuclear power station in South Africa and Africa, has been operating safely for more than 40 years and received authorisation from the NNR to extend the licence of Units 1 and 2 for another 20 years to 2044 and 2045 respectively. This was achieved through robust plant design, the application of rigorous safety programmes (for example, maintenance), consistent compliance with processes (quality assurance), as well as sharing experiences with international organisations such as WANO and the IAEA. The NNR also performs a crucial role in ensuring the continued safe operation of KNPS through strict and systematic regulatory oversight.

4.6.2 Learning Culture

Nuclear events trigger changes to regulatory requirements or approaches used to conduct studies. On 11 March 2011, a M_w 9.0 - 9.1 undersea earthquake occurred in the Pacific Ocean, 72 km east of the Oshika Peninsula of the Tohoku region. It was the most powerful earthquake ever recorded in Japan, and the fourth most powerful earthquake recorded since modern seismography began in 1900. The earthquake was followed by a 15 m tsunami that heavily damaged the nuclear power reactors at Japan's Fukushima Daiichi facility.

Following this accident, regulators required significant safety enhancements to nuclear power plants. These included: adding capabilities to maintain key plant safety functions following a large-scale natural disaster; new equipment to better handle potential reactor core damage events; strengthening emergency preparedness capabilities and in the case of site evaluations, updating evaluations on the potential impact from seismic and flooding events. Internationally licensees (operators) were requested to reanalyse potential flooding and seismic effects based on advances in the knowledge and understanding of seismic and flooding hazards. These re-evaluations used updated information and methodologies to inform plant operators of potential impacts to their sites. As such Eskom has changed the approach used for the seismic hazard analysis for the site, the details of which are given in **5.14** of this SSR.

Other changes to requirements included consideration of the credible

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combinations of natural and human induced external events that could affect the safety of nuclear installations on the same site or on adjacent and nearby sites, the details of which are given in **Chapter 6** of this SSR.

4.7 Management System

The site investigation approach undertaken for this SSR entailed the following:

- desk studies;
- site reconnaissance;
- detailed site investigations;
- data analysis, computer-based modelling and reporting; and
- peer reviews.

A quality assurance programme was established to control the effectiveness of the evaluation and the formulation of conclusions on the site selection. This conforms to the overall management system for this SSR, which is described in detail in **Chapter 10** (Management System), siting regulations, NNR requirements documents and international guidelines (**Sections 4.2** and **4.3**) and relevant Eskom classification procedures.

All studies carried out and reports produced for this SSR have been rigorously reviewed by selected peer reviewers who are leading experts in their fields. Further reviews have been carried out by a technical writer who has extensive nuclear licensing experience.

Electronic records of the work carried out are stored in a secure central repository with regular off-site back-up procedures. The overall quality management system complied with that set out in **Chapter 10**. All references cited are saved on the central repository.

Compliance with regulatory requirements is indicated in **Table 4.3** below. This is for the overall SSR as compliance per se is not demonstrated within this chapter.

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Table 4.3: Regulatory Compliance Matrix

Act/Regulation	Regulation	Issue	Chapter/Section in this SSR where covered
Regulations on Licensing of Sites (Department of Energy, 2011)	5 (1)	A motivation for the choice of the site	3, 4, 5, 6, 7
		Proposed use of site in terms of technologies and plant designs	1, 3, 5, 7
	5 (3)	Characteristics of the site relevant to design assessment, risk and dose calculations	3, 5, 6, 7, 8 and 9
	5 (4)	Source term analysis	3, 7 and 8
	5 (5)	Probabilistic risk assessment	3, 5, 6 and 8
	5 (6)	Impact on the public	3, 5 and 7
	5 (7)	Emergency planning zones	3, 5, 6 and 8
	5 (8)	Viability of emergency plan	5 and 8
	5 (9)	Site security	1, 3, 5 and 9
Regulatory Guide RG-0011, Interim Guidance on the Siting of Nuclear Facilities (National Nuclear Regulator, 2016)	Attachment B: Typical Content and Structure of a Site Safety Report	4. Site Investigation Approach	4
		4. Site Investigation Approach • monitoring programme	5.2 and relevant chapters of the SSR

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4.8 Conclusions

In conclusion, it can be stated that the site selection and investigation approach for this SSR has been carried out in accordance with the requirements of the Regulations on Siting of New Nuclear Installations (Department of Energy, 2011) and the Interim Guide on Siting of Nuclear Installations (National Nuclear Regulator, 2016). It has been carried out to the required level of detail and quality by suitably qualified experts and has been thoroughly peer reviewed, both internally and externally. The approach adopted indicates compliance with the regulatory requirements and international best practice.

Key site characteristics are covered in **Chapter 5**, external events in **Chapter 6**, potential radiological impact on the public and environment in **Chapter 7**, emergency planning including a bounding PRA in **Chapter 8**, physical protection and security in **Chapter 9**, with conclusions and management of uncertainties and any open items in **Chapter 11**.

The siting factors and criteria that were taken into consideration thus provide the necessary assurance that the radiological doses and risks to the public and the environment will be acceptably low, that natural phenomena and man-made hazards can be appropriately accounted for and that implementation of an emergency plan and security plan is feasible in accordance with the Regulations on Licensing of Sites (Department of Energy, 2011).

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4.9

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