DEPARTMENT OF ELECTRICITY AND ENERGY

NO. 8225 **26 November 2026**

GOVERNMENT NOTICE

DEPARTMENT OF ELECTRICITY AND ENERGY

NOTICE OF INTENTION TO MAKE A DETERMINATION UNDER SECTION 34 OF THE ELECTRICITY REGULATION ACT, 2006 (ACT NO. 4 OF 2006)

I, Dr Kgosientsho Ramokgopa, the Minister of Electricity and Energy, hereby give notice of my intention to make a determination under section 34(1) of the Electricity Regulation Act, 2006 (Act No. 4 of 2006), after consultation with the Minister of Finance and the National Energy Regulator of South Africa ("NERSA"), as follows:

1. That 5200MW of new generation capacity of electricity is required to be established or produced in line with the Integrated Resource Plan 2025 (published under Government Notice No. 6767 of 28 October 2025 in Government Gazette No. 53596) ("IRP 2025") to ensure the security of energy supply in the national interest.
2. The 5200MW of new nuclear generation capacity of electricity will be produced or generated from nuclear power.
3. The generator of the new nuclear generation capacity shall be Eskom Holdings SOC Ltd.
4. The procurer of the new generation capacity shall be Eskom Holdings SOC Ltd through a public procurement process which is fair, equitable, transparent, competitive and cost effective.
5. The National Transmission Company of South Africa (SOC) Limited shall be the designated buyer of the electricity.

Attached to this Notice is a feasibility study submitted by Eskom Holdings SOC Ltd, which sets out present considerations regarding technical feasibility and technology assessment, indicative costing within the stated ranges, funding options, project and

DETERMINATION UNDER SECTION 34 OF THE ELECTRICITY REGULATION ACT, 2006 (ACT NO. 4 OF 2006), AS AMENDED

The Minister hereby invites written comments from interested parties, including Environmental interest groups; women, the youth and children, to the extent that they may be affected thereby. Comments must be submitted within 60 days from the date of publication of this notice, by—

(a) post to: Private Bag X 96, Pretoria, 0001; or

(b) hand delivery to: Matimba House, 192 Visagie Street, Cnr Paul Kruger Pretoria; or

(c) email to: zizamele.mbambo@dee.gov.za

Comments must be addressed to the Director-General, Department of Electricity and Energy, and marked for the attention of Mr Zizamele Mbambo: Deputy Director General: Nuclear Energy Regulation and Management.

Kindly provide the name, address, contact telephone number, fax number and email address of the person or organisation submitting comments.

Comments received after the closing date will not be considered.

Comments received and responses thereto will be collated into a report and be made available to the public, the National Energy Regulator of South Africa and the Minister of Finance, as part of the consultation process.

DR KGOSIENTSHO RAMOKGOPA, MP
MINISTER OF ELECTRICITY AND ENERGY
DATE: 13/11/26

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Feasibility Report in Support of a Proposed Determination under Section 34 of the Electricity Regulation Act 4 of 2006 as amended: Nuclear New Build Programme of 5 200 MW



Eskom

Document Control

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Definitions

The following definitions apply to the key financial, technical, regulatory, governance and programme concepts used in this report.

Term	Definition
Affordability	Assessment of whether programme costs and tariff effects can be borne sustainably, considering plant-level cost, whole-system cost, consumers, taxpayers and vulnerable groups.
Bankability	The ability of the programme to support financing on acceptable terms through adequate revenue certainty, risk allocation, credit support and risk-adjusted returns.
Base Case	The central set of assumptions used as the reference point for financial, economic or sensitivity analysis.
Capacity Factor	Actual electricity generated as a percentage of the energy that would be produced if the plant operated continuously at rated capacity over its operating life.
Class 4 Estimate	A preliminary cost estimate applicable at the current level of project definition, with significant uncertainty remaining in scope, technology, schedule, financing and site requirements.
Commercial Operation Date	The date on which a generating unit is declared ready for sustained commercial operation.
Cost-Reflective Tariff	A tariff intended to recover prudent and efficient operating, capital and financing costs over the relevant period.
Creditworthy Off-taker	A purchaser with sufficient financial capacity and reliability to meet its long-term payment obligations under an off-take arrangement.
Decarbonisation	The progressive reduction of carbon emissions associated with electricity generation and the wider energy system.
Definition Phase	The PLCM phase in which scope, cost, schedule, risks, commercial arrangements and the business case are developed to support an investment decision.
Dispatchable Generation	Generation that can be scheduled or controlled to provide electricity when required by the power system.
Energy Availability Factor	The proportion of a defined period during which generating plant is available to produce electricity, considering planned and unplanned unavailability.
Energy Justice	The application of distributive, procedural, recognition and intergenerational justice to the production, distribution and consumption of energy.
Environmental Authorisation	A statutory environmental approval granted after the applicable environmental assessment process.
Fatal Flaw	A fundamental constraint, condition or deficiency that makes a proposed project, site or option technically impracticable, legally impermissible, environmentally unacceptable, financially unviable or otherwise incapable of proceeding, and that cannot reasonably be avoided, mitigated or remedied.
Final Investment Decision	The formal decision to commit to project investment after the required technical, commercial, financial, regulatory and governance conditions have been satisfied.
Firm Capacity	Generating capacity that can be relied upon to be available to meet system demand, subject to defined planning assumptions.
First of a Kind	The first implementation of a new or materially changed technology, design or project configuration, generally carrying higher delivery uncertainty.
Front-End Engineering Design	Pre-construction engineering development used to refine scope, design requirements, cost, schedule and execution planning before major commitment.
Grid Integration	The technical connection and network reinforcement required to transfer electricity from a generating facility into the transmission system.
Intelligent Owner	An owner organisation that retains sufficient internal capability and authority to specify requirements, oversee delivery, manage interfaces and make informed decisions.
Levelised Cost of Electricity	The average cost per unit of electricity required to recover capital, operating, fuel, financing and lifecycle costs over the assumed plant life and output.
Localisation	Development and use of South African goods, services, skills, suppliers and industrial capability within the programme, subject to safety, quality and commercial requirements.
Market Engagement	Structured interaction with potential vendors, financiers and delivery partners to test technology, cost, schedule, funding, commercial and risk assumptions.

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Term	Definition
Nuclear Installation Licence	A licence required for the siting, construction, operation, decommissioning or other regulated activities of a nuclear installation, as applicable.
Nuclear Installation Site Licence	A licence addressing the suitability and characteristics of a proposed nuclear installation site before a specific plant is constructed or operated.
Off-take Arrangement	A contractual or regulated mechanism under which electricity output and associated revenue are purchased or secured.
Overnight Cost	The estimated construction cost excluding financing costs and escalation incurred over the construction period.
Plant Parameter Envelope	A set of bounding plant and technology parameters used to assess whether potential designs can be accommodated by a site and its licensing basis.
Project Life Cycle Model	Eskom's phased governance framework for defining, developing, approving, executing and closing projects through controlled decision gates.
Revenue Certainty	Sufficient predictability and durability of project income to support operating cost recovery, debt service and required investment returns.
Risk Allocation	The assignment of project risks to the parties best placed to manage, control or absorb them.
Section 34 Determination	The enabling statutory decision for new generation capacity that may identify the capacity, energy source, procurer and buyer, but does not itself authorise construction or replace other required approvals.
Sensitivity Analysis	Testing how changes in key assumptions, such as capital cost, discount rate or foreign exchange, affect the financial or economic results.
Social Licence to Operate	The continuing level of public and stakeholder acceptance required to support the programme's legitimacy and implementation.
Technology Neutrality	Assessment of eligible technologies against common requirements without prematurely committing to a specific design or vendor.
Eskom Weighted Average Cost of Capital (WACC)	The average cost that Eskom incurs to finance an investment through a combination of debt and equity, weighted according to their proportion in the capital structure. It is used as the discount rate when evaluating the economic viability of major capital projects and when calculating the Levelised Cost of Electricity (LCOE).
Variable Renewable Energy	Renewable energy sources – primarily wind and solar power – whose electricity production fluctuates due to atmospheric and weather conditions.
Whole-System Cost	The total cost of meeting electricity-system requirements, including generation, network, integration, reliability, flexibility and other system impacts.

List of Abbreviations

Abbreviations	Meaning
IAEA	International Atomic Energy Agency
Board IFC	Board Investment and Finance Committee
BOO	Build, Own and Operate
BOOT	Build, Own, Operate and Transfer
BOT	Build, Operate and Transfer
CapEX	Capital Expenditure
CCGT	Combined-Cycle Gas Turbine
CCUS	Carbon Capture, Utilisation and Storage
CfD	Contract for Difference
COD	Commercial Operation Date
CSP	Concentrated Solar Power

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Abbreviations	Meaning
DEE	Department of Electricity and Energy
DFFE	Department of Forestry, Fisheries and the Environment
DFI	Development Finance Institution
DMRE	Department of Mineral Resources and Energy
DRA	Definition Release Approval
EA	Environmental Authorisation
EAF	Energy Availability Factor
ECA	Export Credit Agency
EAP	Environmental Assessment Practitioner
EIA	Environmental Impact Assessment
EMPr	Environmental Management Programme
EPC	Engineering, Procurement and Construction
EPCM	Engineering, Procurement and Construction Management
ETI	Energy Technologies Institute
EUP	Enriched Uranium Product
EUR	European Utility Requirements
ERAA	Electricity Regulation Amendment Act
ERS	Employer's Requirements Specification
FEED	Front-End Engineering Design
FOAK	First of a Kind
FX	Foreign Exchange
GCCE	Grid Connection Cost Estimate
GCO	Generation Continued Operations
GJ	Giga Joule
HTGR	High-Temperature Gas-Cooled Reactor
ICE	Indicative Cost Estimate
ICT	Information and Communication Technology
IDZ	Industrial Development Zone
IDC	Interest During Construction
IPP	Independent Power Producer
IRP	Integrated Resource Plan
IRR	Internal Rate of Return
JET	Just Energy Transition
kW	Kilowatt
kWh	Kilowatt-hour
LCOE	Levelised Cost of Electricity
LDD	Long Duration Dispatchable

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Abbreviations	Meaning
LILO	Loop In Loop Out
LSTK	Lump-Sum Turnkey
LNPP	Large Nuclear Power Plant
LWR	Light Water Reactor
MW	Megawatt
MWe	Megawatt Electric
MWh	Megawatt-hour
NEA	Nuclear Energy Agency
NEMA	National Environmental Management Act
NEP	Nuclear Energy Policy
NERSA	National Energy Regulator of South Africa
NIL	Nuclear Installation Licence
NISL	Nuclear Installation Site Licence
NNBP	Nuclear New Build Programme
NNR	National Nuclear Regulator
NPP	Nuclear Power Plant
NIPP	National Industrialisation Participation Programme
NPV	Net Present Value
NT	National Treasury
NTCSA	National Transmission Company South Africa
OCGT	Open-Cycle Gas Turbine
OPEX	Operating Expenditure
O&M	Operations and Maintenance
OECD	Organisation for Economic Co-operation and Development
OEM	Original Equipment Manufacturer
PBMR	Pebble Bed Modular Reactor
PESTEL	Political, Economic, Social, Technological, Environmental and Legal
PFMA	Public Finance Management Act
PID	Public Information Document
PLCM	Project Life Cycle Model
PPA	Power Purchase Agreement
PSP	Private Sector Participation
PV	Photovoltaic
PWR	Pressurised Water Reactor
RAB	Regulated Asset Base
RFI	Request for Information

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Abbreviations	Meaning
RFP	Request for Proposal
SEA	Strategic Environmental Assessment
SMR	Small Modular Reactor
SOC	State-Owned Company
SPV	Special Purpose Vehicle
SWOT	Strengths, Weaknesses, Opportunities and Threats
TDP	Transmission Development Plan
URS	User Requirements Specification
USD/US$	United States Dollar
VRE	Variable Renewable Energy
WACC	Weighted Average Cost of Capital

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1 Statement of Purpose and Status

This report is furnished by Eskom Holdings SOC Ltd to the Minister of Electricity and Energy in support of the Minister's consideration of a proposed determination under Section 34 of the Electricity Regulation Act 4 of 2006 [3] for new generation capacity of 5 200 MW derived from nuclear power technology, within the allocation made for that technology in the Integrated Resource Plan (IRP) 2025 [2].
It sets out the need for the capacity, the alternatives considered, the sites, technologies and licensing pathway under consideration, the indicative cost of the programme and the accuracy of that estimate, the funding structures under evaluation, the effect of the programme upon consumers, taxpayers and affected communities, the principal risks, and the work which remains to be done.

It does not establish, and does not claim to establish, that the programme has secured financing on acceptable terms, that any funding structure, guarantee or off-take arrangement has been approved, that any design has been selected, or that construction may commence. Those matters depend upon the market process, upon the regulatory, environmental, nuclear, public-finance and corporate approvals identified in this report, and upon the further decisions which this report identifies as outstanding.

A determination under section 34 of the Electricity Regulation Act 4 of 2006, as amended, would establish the need for the new generation capacity, the energy source from which it is to be generated, the person or entity responsible for procuring the capacity, the purchaser of the electricity and, where applicable under the statutory framework, the requirements and responsible entities for the associated transmission infrastructure necessary to connect and evacuate the new generation capacity. The determination would not itself authorise construction or operation, nor replace the environmental, nuclear, generation, transmission, tariff, public-finance, procurement and corporate approvals required for implementation.

This report accordingly identifies some of the key approvals required, the authority which grants it, and the activity which it permits. Eskom submits this report so that the Minister may consider, upon the evidence it contains and such other evidence as the Minister may obtain, whether the statutory requirements for a determination are met. The policy of Government, recorded in the Nuclear Energy Policy of 2008 and in the decision of Cabinet of 2 November 2016, designates Eskom as the procurer, owner and operator of nuclear generation facilities. Whether that designation is to be given effect in the determination, and in what terms, is a matter for the Minister.

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This report is not intended to, and does not, pre-empt or fetter the Minister's discretion in determining whether, and in what terms, any person is to be designated as the procurer of the proposed facilities and the purchaser of the energy and ancillary services. Any such designation remains a matter for the Minister to determine in accordance with the applicable statutory framework, the evidence before the Minister and the requirements of legality, rationality and procedural fairness.

2 Executive Summary

This Feasibility Report supports the consideration by the Minister of Electricity and Energy of a determination under Section 34 of the Electricity Regulation Act 4 of 2006, as amended, for 5 200 MW of new nuclear generation capacity. The proposed capacity is aligned with the IRP 2025 and is intended to contribute dependable, long-duration and low-carbon electricity as South Africa's ageing generation fleet is progressively retired. The report assesses whether the Nuclear New Build Programme (NNBP) presents a sufficiently credible and strategically justified basis to proceed to the next stage of market engagement, regulatory development and investment-grade business-case preparation.

The report does not constitute a final investment decision, procurement approval, construction authorisation or confirmation that the programme is affordable or bankable. It does not select a reactor design, vendor, site, procurer, buyer, funding model or contracting structure. These matters remain subject to the section 34 determination, market testing, public participation where required, environmental and nuclear licensing, procurement processes, regulatory and public-finance approvals, Eskom governance and the development of an investment-grade business case. A Section 34 determination would establish the enabling statutory basis for the proposed capacity but would not replace any of these required approvals.

Strategic need and national value

South Africa's recent improvement in electricity availability has reduced load-shedding but has not resolved the underlying structural challenge. The electricity system remains dependent on ageing and carbon-intensive coal-fired capacity, while future requirements will be influenced by coal retirements, economic growth, industrial development, electrification and decarbonisation. The identified requirement is therefore not only for additional megawatts, but for dependable, long-duration and low-carbon capacity capable of supporting system adequacy and economic activity over several decades.

Nuclear power is assessed as part of a diversified future generation mix that also includes renewable energy, storage, gas, hydro, demand-side measures and other clean-energy technologies. It is not

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presented as a replacement for these technologies. Its potential strategic value lies in providing firm, high-availability and low-carbon generation; supporting system stability; complementing Variable Renewable Energy (VRE); reducing exposure to fossil-fuel price volatility; and contributing to industrialisation, localisation, specialised employment and skills development. These potential benefits must be assessed against the programme's capital requirements, implementation period, financing exposure, environmental obligations, regulatory complexity and distributional consequences for consumers and taxpayers.

Programme and technology basis

The determination sought is for 5 200 MW net electrical output of new generation capacity derived from nuclear power technology. That capacity is expected to comprise conventional large, Pressurised Water Reactor (PWR) units and Small Modular Reactors (SMRs) at coastal sites, together with SMRs at suitable decommissioned coal-fired power station sites identified through the Strategic Environmental Assessment (SEA) currently under way. The precise unit sizes, technology mix and deployment sequence will be determined through subsequent assessment and market engagement. The minimum viable programme comprises two large PWR units at one site. Implementing less than the full programme capacity could weaken fleet standardisation, construction continuity, localisation and learning benefits, and could increase the unit cost of the capacity delivered.

The assessment of energy alternatives confirms that coal, gas, renewable energy, storage, hydropower and other technologies each have a role within the electricity system. Nuclear is preferred for the specific requirement under consideration because it can provide firm, large-scale and low-carbon generation over an extended operating life. The benchmark nuclear Levelised Cost of Electricity (LCOE) range compares favourably with coal incorporating Carbon Capture, Utilisation and Storage (CCUS) under the lower capital-cost case. Direct comparisons with non-dispatchable renewable technologies can be misleading, as their, non-dispatchable, variable and intermittent operating characteristics differ fundamentally from dispatchable generation sources that also provide inertia and other essential ancillary services.

Cost, funding and affordability

The financial assessment is preliminary and is intended to establish the scale of the programme, identify the principal cost and financing drivers and determine whether the concept can progress to market testing and an investment-grade business case. The cost estimates are based on the controlled Eskom financial model, international benchmarks and IRP assumptions. They remain Class 4 estimates with an expected accuracy range of approximately minus 30% to plus 50% and do not constitute vendor prices, approved budgets, tariffs or evidence of secured financing.

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The analysis indicates a large PWR overnight capital-cost range of approximately R390 billion to R1 402 billion and a nominal capital-cost range of approximately R471 billion to R1 667 billion. The indicative PWR LCOE ranges from R2 423/MWh to R5 065/MWh. With capital expenditure accounting for approximately 60% of the modelled PWR LCOE, affordability is particularly sensitive to construction performance, financing costs, foreign exchange exposure, design maturity, fleet standardisation and schedule discipline.

Potential instruments include sovereign support, concessional and export-credit-backed debt, local-currency debt, vendor finance, commercial loans, bonds, regulated recovery mechanisms and appropriately structured equity or private-sector participation. No guarantee, fiscal contribution, regulated revenue mechanism, off-take arrangement or financing structure has been approved. Each option must be evaluated against its all-in cost, duration, currency exposure, risk allocation, fiscal implications, affordability, legal authority and required approvals.

Affordability must be assessed at plant, programme and electricity-system levels. Construction delay represents a significant downside risk. A full affordability assessment, tariff-path model, funding structure, debt-service assessment and distributional analysis will be required once market-based cost, schedule and financing information is available.

Procurement, ownership and delivery

The programme requires an integrated legal, institutional, commercial and regulatory structure. The current preferred delivery approach for the initial large-reactor units is a modified Engineering, Procurement and Construction (EPC) or Lump-Sum TurnKey (LSTK) arrangement, subject to market testing. This approach seeks to retain vendor accountability for nuclear design integration, safety, schedule and performance while allowing selected non-nuclear packages to support localisation and the progressive development of Eskom's intelligent-customer and architect-engineer capability. A fixed-price or turnkey contract would not remove owner exposure to licensing, site access, grid readiness, financing, regulatory changes or owner-driven scope changes.

The final ownership, procurement, contracting and private-sector participation arrangements remain open. Any procurement process must comply with Section 217 of the Constitution and the public-procurement framework in force when the process is initiated. The Request for Information (RFI) and subsequent Request for Proposals (RFPs) will be used to test technology maturity, vendor capability, reference-plant performance, price, schedule, financing, localisation, risk allocation and completion guarantees.

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Sites, licensing and infrastructure

Initial development assessments are focused on Duynefontyn and Thyspunt, with Bantamsklip retained as an alternative and potential SMR locations to be identified through the SEA and subsequent site-specific processes. The proposed determination remains site-neutral. No site will proceed unless it obtains all required environmental, nuclear, water-use, coastal, land-use, transmission and other statutory approvals.

Duynefontyn has an Environmental Authorisation that is under judicial review. The Thyspunt and Bantamsklip (as alternative site) environmental processes remain under way, and the Nuclear Installation Site Licence applications for Duynefontyn and Thyspunt are progressing. Transmission studies indicate that the electrical output from both sites can be integrated into the national grid, subject to the delivery of identified network reinforcements, reactive-power support, transmission infrastructure and associated capital investment. These requirements must be incorporated into the programme cost estimate, schedule and Transmission Development Plan.

The programme must also make lifecycle provision for radioactive waste, spent fuel, decommissioning and long-term environmental stewardship. Existing arrangements for low- and intermediate-level waste provide a foundation, but national interim and final spent-fuel solutions require continued development. Programme-specific financial provision will be required to prevent unresolved liabilities from being transferred to future consumers or generations.

Organisational capability, stakeholders and energy justice

The programme is supported by a dedicated and ring-fenced delivery organisation, with capabilities in nuclear safety, engineering, licensing, commercial management, quality assurance, project management and controls, construction oversight, and commissioning progressively strengthened and expanded in line with Project Life Cycle Model (PLCM) phases.

Each two-reactor site is expected to require an owner’s team. Skills development, operating-crew training and supplier capability will need to commence sufficiently early to support construction, commissioning and long-term operation.

Stakeholder engagement and energy justice are integral to programme feasibility. Engagement must include Government, regulators, National Treasury, host and transition communities, municipalities, consumers, organised labour, civil society, industry, suppliers and financiers. The programme should transparently address safety, affordability, environmental impacts, radioactive waste, local development, employment, procurement opportunities and the distribution of costs, benefits and risks.

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Programme status, risks and outstanding work

The NNBP is in the Definition Phase of Eskom's PLCM. Material preparatory work has been completed in technical specification development, site characterisation, environmental assessment, nuclear licensing, transmission integration, programme planning and preliminary financial analysis. However, further work is required to finalise technical evaluation criteria, complete environmental and licensing processes, confirm transmission and supporting-infrastructure requirements, validate technology and cost assumptions through the market, establish funding and revenue arrangements, complete affordability and tariff-path modelling, obtain public-finance and corporate approvals and conclude an appropriate off-take arrangement with the buyer designated in the determination.

The principal risks include affordability and financing exposure, foreign exchange movements, cost and schedule escalation, regulatory delay, litigation, public opposition, owner-capability constraints, supply-chain limitations, waste and decommissioning obligations and geopolitical dependencies affecting technology, financing, fuel and supplier participation. These risks require disciplined front-end planning, strong programme governance, independent assurance, integrated scheduling, early regulatory engagement, transparent stakeholder participation, mature technical definition and clear allocation of risk before material commitments are made.

Overall conclusion and recommendation

The available evidence supports the continued and structured development of the 5 200 MW NNBP. The programme has a policy and planning basis in the Nuclear Energy Policy of 2008 and the IRP 2025, and it may contribute materially to South Africa's long-term security of supply, decarbonisation, system resilience, industrial capability and socio-economic development. The feasibility assessment provides a sound foundation for progressing the programme, with affordability, financeability and construction readiness to be further optimized and confirmed through subsequent development phases and investment decisions.

It is therefore recommended that the Minister consider making an appropriately framed Section 34 determination that enables the programme to proceed to structured market engagement, regulatory development and preparation of an investment-grade business case, without prejudging the final site, technology, vendor, procurer, buyer, funding structure or investment decision. Final investment approval should be considered only after market returnables, affordability, financing and off-take arrangements, regulatory approvals, localisation commitments, execution strategy, owner capability and risk allocation have been sufficiently developed, independently assured and approved through the applicable governance processes.

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3 Introduction

South Africa is at a critical juncture in the evolution of its energy sector and, by extension, in the future of its economy, industrial base and developmental trajectory. The decision now under consideration by the Minister of Electricity and Energy is whether new generation capacity of 5 200 MW derived from nuclear power technology is required to ensure security of energy supply in the national interest, and whether a determination to that effect should be made under Section 34 of the Electricity Regulation Act 4 of 2006 so that the programme may proceed to the statutory, regulatory, funding and procurement steps necessary to enable its responsible implementation. It is a generational infrastructure decision involving substantial capital commitment, long-term policy consequences, complex regulatory sequencing and far-reaching implications for security of supply, economic resilience, climate responsibility, industrial capability and public confidence in the electricity system.

The scale of the NNBP requires that a feasibility inquiry be approached with both ambition and discipline. A project of this magnitude must be supported by a rational, evidence-based and transparent assessment of need, affordability, system value, implementation risk and long-term national benefit. Equally, the programme cannot be assessed by reference to its capital cost alone. Its cost must be measured over the life of the asset against the benefits which the programme is expected to deliver and against the reasonable alternatives to it.

The financial figures associated with the programme must be considered through the broader lenses of enduring energy security, low-carbon or carbon-free electricity production, environmental benefit, system resilience, industrial development, localisation, skills development, socio-economic advancement and intergenerational equity. The proper inquiry is therefore whether nuclear new build can deliver sustained public value over several decades, and whether those cumulative national benefits justify the financial, institutional and regulatory commitments required to implement the programme responsibly.

Within this context, energy justice is treated as a disciplined set of questions which bear upon the rationality of the decision and upon the sufficiency of the evidence placed before the Minister, and not as a freestanding statutory test. This report therefore considers whether the NNBP can contribute to a more secure, reliable, affordable and low-carbon electricity future in a manner that is fair, rational, transparent, inclusive and equitable. This requires attention not only to megawatts, capital cost and construction timelines, but also to who benefits, who pays, who carries risk, who is heard, who may be affected, and how the interests of future consumers and future generations are protected.

This report is therefore framed to confront the central issue directly: nuclear new build is a major strategic infrastructure undertaking with long-term planning and implementation requirements, but it

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may also be one of the few generation options capable of providing long-duration strategic value through firm capacity, system stability, low-carbon electricity, job creation, skills development, localisation, industrial participation and increased energy sovereignty.

The feasibility assessment must consequently determine whether those benefits, when assessed over the life of the asset and within a properly governed implementation framework, outweigh the costs and risks in a manner that is defensible, transparent and aligned with the public interest.

The NNBP is accordingly assessed as a strategic national infrastructure investment which value must be determined over the full operating life of the asset and by reference to its contribution to the economy, broader public interest, including the needs of present and future generations.

3.1 Purpose

The immediate purpose of this report is to place before the Minister the evidence relevant to whether new generation capacity of 5 200 MW derived from nuclear power technology is needed to ensure security of energy supply in the national interest, and to each of the matters which a determination under Section 34 may address. Its broader purpose is to assess whether the NNBP presents a credible, rational and strategically justified pathway for South Africa to secure long-term, reliable, low-carbon electricity generation while advancing national development objectives and energy justice. The report is not confined to a narrow assessment of capital cost or immediate financial impact. It evaluates whether the programme, when considered over the full lifecycle of the asset, can deliver public value that is proportionate to the scale of investment, complexity of implementation and institutional commitments required.

In particular, the report assesses the strategic need for nuclear new build; its contribution to security of supply, system stability, decarbonisation and energy sovereignty; its potential to support industrialisation, localisation, skills development and long-term socio-economic advancement; and the extent to which its benefits and costs can be fairly understood across current and future generations. It also considers the principal legal, regulatory, environmental, financial, procurement, implementation and public-interest risks associated with the programme, together with the measures required to manage those risks in a responsible and transparent manner.

The report is therefore intended to support informed decision-making by the Minister on whether the NNBP should be advanced to the next stage of statutory, regulatory, funding and procurement enablement. It is framed to assist decision-makers and stakeholders to understand the programme's long-term value proposition, its limitations at this stage of development, the assumptions on which

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the assessment is based, and the conditions that must be satisfied before implementation can be responsibly pursued.

No regulation prescribes the content of this report, because regulation 2 of the Electricity Regulations on New Generation Capacity of 2011 excludes nuclear power from its application. Eskom has nevertheless prepared the report so as to address each of the matters which regulation 5 requires of a feasibility study for other technologies, and it has had regard to the guidance of the International Atomic Energy Agency (IAEA) on the development of a national infrastructure for nuclear power (NG-G-3.1, Revision 2, 2024), on the preparation of a feasibility study for new nuclear power projects (NG-T-3.3), on stakeholder engagement in nuclear programmes (NG-G-5.1) and on the management of financial risk in the financing of new nuclear power plant projects (NG-T-4.6).

3.2 Assumptions

This report is prepared on the basis of assumptions that are reasonable and appropriate for the current stage of the NNBP. These assumptions provide a preliminary foundation for assessing the programme's strategic, technical, financial, legal and energy justice basis, but do not replace market testing, procurement processes, regulatory approvals or project-specific due diligence.

This feasibility study has been prepared before the gazetting of a Section 34 determination confirming the required nuclear capacity, the designated procurer, the designated buyer or off-taker and the treatment of the associated transmission infrastructure. Government's policy position concerning the ownership and operation of nuclear generation facilities is recorded separately in the applicable nuclear policy framework. Pending the determination and completion of the required approvals, Eskom cannot undertake binding market engagement or conclude procurement, financing, technology, delivery, localisation or risk-allocation commitments.

The report therefore relies on available benchmarks, prior nuclear-sector experience, internal expertise, public information, applicable legal and regulatory requirements and reasonable planning assumptions, all of which must be tested and refined once open, fair and transparent market engagement is enabled.

For the preliminary assessment of Private Sector Participation (PSP), financing and delivery models, the report further assumes that:

- the analysis is conceptual and screening-level only, and does not select or recommend a final commercial, financing, procurement, ownership or implementation structure;

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- possible PSP models, including strategic equity participation, joint ventures, vendor-supported financing, infrastructure investment structures, government-enabled models, regulated recovery models, project financing and hybrid arrangements, remain subject to legal permissibility, affordability, public-finance requirements and market validation;
- each model must be assessed against affordability, bankability, risk allocation, procurement compliance, nuclear safety, public accountability, long-term system value, localisation, skills development and energy justice; and
- any preliminary conclusion must remain conditional until tested through open, fair and transparent market engagement, procurement, regulatory approvals and governance decision-making.

The report proceeds on the footing that the determination sought is not confined to any site. The capacity is to be established at one or more of the sites described in this report which obtain every required approval. Nothing in this report treats the selection of Duynefontyn, Thyspunt, Bantamsklip or any other site as settled, and the programme does not depend upon the outcome of the review proceedings pending in respect of the environmental authorisation.

4 Background

4.1 South Africa's Energy Demand, Availability and Deficit

South Africa’s electricity system remains in a period of structural transition. Although recent operational improvements have materially reduced load-shedding, the underlying generation challenge has not been permanently resolved. The system continues to rely heavily on an ageing coal fleet, while electricity demand has been suppressed by years of constrained supply, high tariffs, energy-efficiency responses and the growth of private embedded generation. The apparent narrowing of the supply deficit must therefore be assessed with caution: it reflects improved plant performance and moderated demand, but not yet the establishment of a durable, diversified and future-fit supply base capable of supporting sustained economic growth, industrial expansion and decarbonisation.

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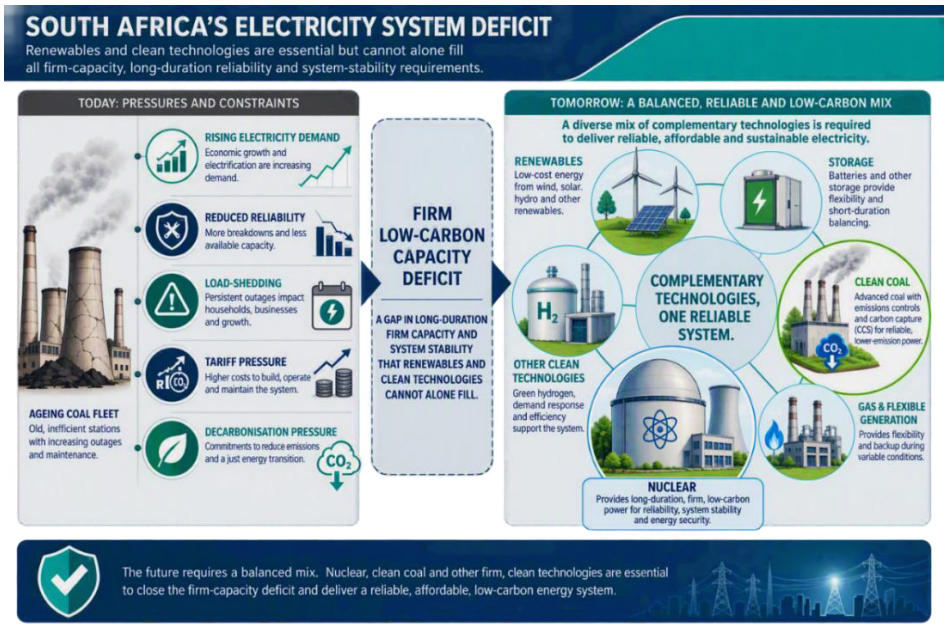

Figure 1: Illustration of South Africa's structural firm low-carbon capacity deficit and the need for a diversified future electricity mix. [1]

Eskom's Generation Recovery Plan has improved generation performance and restored greater stability to the power system, as shown in Figure 2. These improvements are significant and should be recognised. However, they do not eliminate the need for new long-term capacity. Existing coal stations remain exposed to age-related reliability risks, planned retirements and environmental compliance requirements, while future electricity demand will be shaped by economic recovery, electrification, industrial development and the need to maintain a balanced and resilient generation portfolio, capable of meeting South Africa's long-term energy needs.

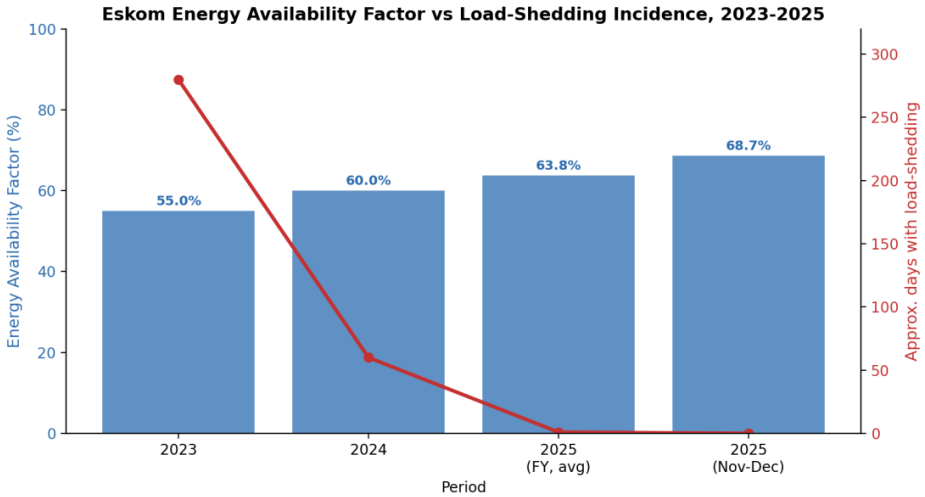

Figure 2: Eskom generation performance and load-shedding incidence, 2023–2025 [2]

[1] **Source:** Own illustration based on the feasibility study's assessment of electricity-system reliability, decarbonisation, affordability and energy justice considerations.

[2] **Source:** Compiled from Eskom system updates and publicly available power-system analyses.

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The improvement in short-term electricity availability should not be confused with structural security of supply. While coal will continue to play a central role in South Africa's electricity system for the foreseeable future, portions of the existing fleet are approaching the end of their operating lives and will require replacement, refurbishment or supplementation over time. South Africa must therefore invest in additional generating capacity to support credible demand growth, maintain adequate reserve margins and strengthen long-term system resilience. The central challenge is not merely a numerical shortage of megawatts, but ensuring the availability of dependable, dispatchable and long-duration capacity that can support a modern industrial economy while advancing national energy security, affordability and environmental objectives.

Renewable energy, battery storage, demand-side measures and other complementary technologies are important components of South Africa's future electricity system and should continue to be accelerated. However, they do not, on their own, fully address the need for large-scale firm capacity, system inertia, long-duration reliability and dependable electricity supply during extended periods of high demand or reduced renewable-resource availability. On this basis, the background to the NNBP is a structural firm-capacity and energy-security gap that requires a diversified response. Nuclear new build is considered in this report because it addresses a portion of that gap by providing reliable, long-duration generation that complements, rather than displaces, renewable energy and other generation technologies within a balanced electricity system.

4.2 The Energy Trilemma in the South African Context

This report must also be understood through the energy trilemma: the need to secure reliable supply, maintain affordability and equity, and reduce environmental impact. In the South African context, these dimensions are inseparable. A system that is low carbon but unable to supply electricity reliably will not be just. Equally, a system that is reliable but unaffordable or environmentally unsustainable will not meet the requirements of a fair and durable energy transition.

South Africa’s recent power-system experience illustrates the difficulty of balancing these objectives. Load-shedding undermined energy security and economic confidence; rising tariffs placed pressure on affordability and energy equity; and continued reliance on coal remains inconsistent with long-term decarbonisation and environmental sustainability objectives. The trilemma therefore provides a useful bridge between the background problem and the rationale for nuclear new build: the future generation mix must be capable of delivering reliability, affordability and lower-carbon electricity at the same time, rather than advancing one objective at the expense of the others.

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4.3 South Africa's Twenty-Year Energy Plan: IRP 2025

The IRP 2025 was promulgated on 28 October 2025 in Government Gazette 53596. Section 34(6) of the Electricity Regulation Act 4 of 2006, as amended requires the Minister, in making a determination, to have regard to the IRP and to the transmission development plan, and a departure from the plan requires the justification, and the prior public comment, which sections 34(6) to (8) prescribe. This report identifies, under the heading “Capacity Sought and its Apportionment”, how the programme corresponds to that phasing.

The IRP 2025 recognises that South Africa must expand and diversify its electricity supply base to support energy security, economic recovery, decarbonisation and system resilience. Within that context, nuclear is not considered as a substitute for renewable energy or other clean technologies, but as part of a balanced portfolio required to address the firm-capacity requirement.

The planning framework contemplates substantial investment in new generation capacity across multiple technologies, including renewables, storage, gas and nuclear. The inclusion of nuclear capacity in the planning framework reflects the recognition that South Africa requires a generation mix capable of sustaining reliability, reducing emissions, supporting economic growth and strengthening industrial capability over the long term. The relevant issue for this feasibility report is therefore whether nuclear new build can provide a justified and energy-justice-aligned response to the identified firm-capacity, decarbonisation and socio-economic deficit.

Table 1: Headline commitments of the IRP 2025. [3]

Element	Target / Figure
Total new generation capacity by 2039	> 105 000 MW
Total investment	R2 230 billion (~USD 128 billion)
New nuclear capacity by 2039	5 200 MW (potential expansion to 10 000 MW)
Gas-to-power by 2030 / by 2039	6 000 MW / up to 16 000-17 000 MW
Targeted Gross Domestic Product (GDP) growth by 2030	3%
Koeberg long-term operation	Both units approved; operate to 2044/2045

[3] **Source: IRP** 2025.

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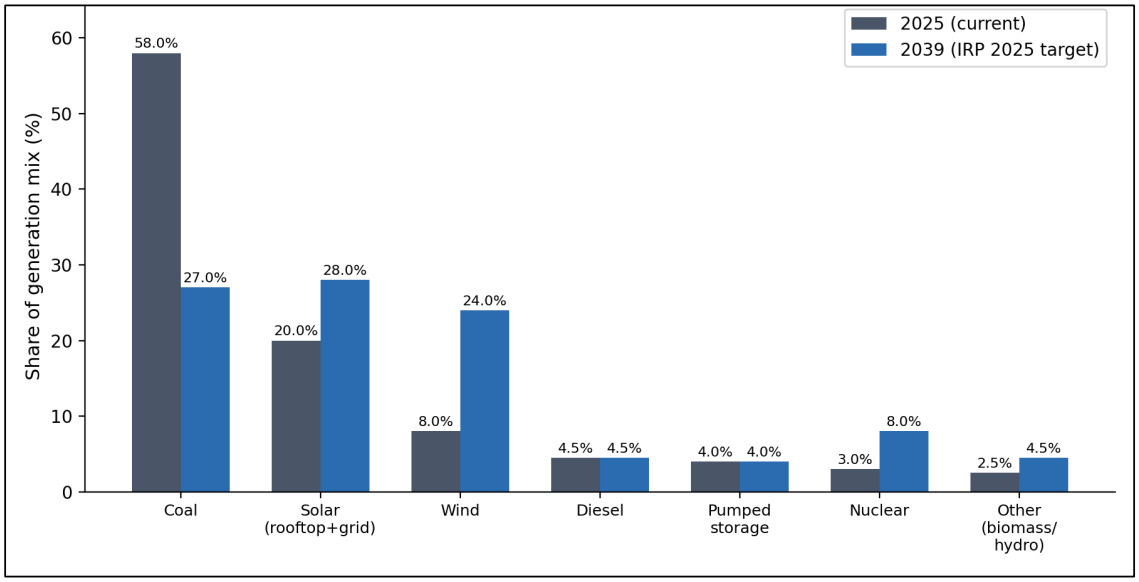

Figure 3: South Africa's 2025 generation mix compared with an illustrative 2039 pathway consistent with IRP 2025 capacity additions [4]

The 2039 figures are indicative estimates, not official percentages, since IRP 2025 publishes capacity additions in MW rather than a final percentage mix.

The background set out above establishes the problem to which the NNBP must respond. South Africa does not merely require additional installed capacity; it requires dependable, low-carbon capacity that can operate at scale, support system stability, complement VRE, and contribute to economic and social development over decades. The section which follows, headed *"5 Strategic Context and Rationale for Nuclear New Build",* therefore turns from the electricity-system deficit to the strategic rationale for nuclear new build, assessing whether the programme provides a credible response to that deficit through firm capacity, environmental benefit, industrial development, energy justice and long-term public value.

5 Strategic Context and Rationale for Nuclear New Build

The strategic rationale for the NNBP arises from the intersection of South Africa's long-term electricity-security requirements, the progressive retirement of ageing generation capacity, the need to maintain system adequacy, and the national imperative to transition to a lower-carbon economy without undermining industrial development, affordability or energy access. The programme must therefore be considered within the broader transformation of the electricity system, where reliability,

[4] **Source:** Derived from World Nuclear News, 2025b; Green Building Africa, 2025; Pinsent Masons, 2025.

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decarbonisation, cost recovery, public accountability and energy justice are no longer separate considerations, but mutually reinforcing requirements for a credible energy future.

5.1 Strategic Need for Firm, Low-Carbon Capacity

South Africa's electricity system requires a reliable supply of firm capacity capable of supporting economic activity, industrial production, public services and household welfare over the long term. VRE, storage, gas, coal transition measures and demand-side interventions all have important roles to play, but the long-term adequacy of the system requires a diversified portfolio that includes technologies capable of providing dependable, large-scale and low-carbon electricity. Nuclear new build is relevant to this strategic need because it can provide firm generation capacity with a high availability profile, long operating life and materially lower operational greenhouse-gas emissions than fossil-fuel generation.

5.2 Long-Term National Value Beyond Capital Cost

The cost of nuclear new build must be assessed with full transparency, but it should not be evaluated through a short-term capital-cost lens alone. A nuclear power plant is a long-life infrastructure asset whose value is realised over decades through reliable energy production, avoided emissions, system stability, reduced exposure to fuel-price volatility, industrial participation, job creation, skills development and sustained economic activity. The question for decision is whether the benefits delivered over the life of the asset are sufficiently material, fairly distributed and responsibly governed to justify the investment and the associated risk, and whether the same need could be met at lower cost, or with less risk, by the reasonable alternatives considered under the heading *"6.6 Alternative Energy Technology"*.

5.3 Environmental and Decarbonisation Rationale

Nuclear power generation offers a material decarbonisation benefit because it produces electricity with no direct operational carbon emissions and can operate as a stable complement to renewable energy in a lower-carbon electricity system. Its environmental rationale must nevertheless be assessed honestly and over the full lifecycle, including siting, water use, construction impacts, radioactive waste management, spent fuel, decommissioning and emergency preparedness. This balanced approach is essential for energy justice: environmental benefit cannot be asserted only at national level while site-specific, lifecycle and community impacts are ignored. The lifecycle greenhouse gas emissions of the programme and of the alternative portfolios, the cooling and desalination arrangements, the marine discharge, the cumulative effects at Duynefontyn with the

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existing Koeberg plant and the emergency planning zone for each site are addressed under *"5.4 Environmental Implications"* below.

5.4 Environmental Implications

The environmental feasibility of the NNBP must be assessed on a full lifecycle basis, encompassing site development, construction, operation, waste management, decommissioning and long-term stewardship. While nuclear generation has the potential to contribute low-carbon, reliable electricity and support South Africa's broader energy objectives, its environmental acceptability ultimately depends on compliance with applicable environmental, nuclear, water-use, coastal and other statutory requirements.

From a feasibility perspective, no strategic environmental fatal flaw has been identified at programme level. South Africa has well established environmental and nuclear regulatory frameworks, experience in operating nuclear facilities, and defined processes for assessing and managing environmental impacts. However, implementation remains contingent on the successful completion of site-specific authorisation, licensing and regulatory approval processes.

For the large coastal nuclear power plant options, environmental considerations include terrestrial and marine biodiversity, land use, seawater abstraction and discharge, coastal ecology, transmission infrastructure and cumulative impacts associated with construction and operation. Duynefontein benefits from its proximity to existing nuclear infrastructure and an established nuclear operating environment, while Thyspunt and Bantamsklip remain subject to ongoing planning and environmental assessment processes. Accordingly, environmental suitability can only be confirmed through the completion of the relevant Environmental Impact Assessments (EIAs), water-use authorisations, coastal permits and associated statutory approvals.

Water availability and cooling technology represent important feasibility considerations. Coastal large-reactor options are expected to rely primarily on seawater cooling, reducing dependence on municipal and inland freshwater resources. For potential inland SMR deployment at existing or retired coal-fired power station sites, further assessment is required to confirm long-term water availability and identify appropriate cooling technologies. These considerations should be addressed through the SEA and subsequent site-specific studies. Based on current information, no insurmountable water-related constraint has been identified, although site-specific investigations remain necessary.

Environmental impacts on biodiversity, ecosystems and land use are expected to be manageable through established mitigation measures and regulatory controls. Environmental Management

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Programmes, construction controls, monitoring requirements and licence conditions provide recognised mechanisms for avoiding, minimising and managing environmental impacts. The effectiveness of these measures must, however, be demonstrated through the applicable environmental assessment processes.

Radioactive waste management, spent fuel storage and eventual decommissioning represent long-term environmental and intergenerational obligations that must be incorporated into the programme from inception. South Africa already maintains regulatory and institutional arrangements for the management of radioactive waste associated with existing nuclear activities. While future spent fuel storage and disposal strategies will require further development and investment, no fundamental technical, institutional or regulatory barrier has been identified that would prevent implementation of the programme, provided that adequate funding and long-term stewardship arrangements are established.

Emergency preparedness and response requirements will form an integral part of the licensing process. These requirements are governed through South Africa's established nuclear regulatory framework and will be determined on a site- and technology-specific basis for approval by the National Nuclear Regulator (NNR). Emergency planning considerations are therefore considered manageable within the existing regulatory environment, subject to compliance with regulatory requirements and municipal readiness obligations.

Overall, the environmental assessment indicates that the NNBP can progress through South Africa's environmental and nuclear regulatory framework. Again, no strategic environmental fatal flaw has been identified at programme level. Nevertheless, environmental acceptability remains conditional upon successful completion of all statutory authorisation processes, implementation of effective mitigation measures, ongoing regulatory oversight, and the responsible management of waste, decommissioning and emergency preparedness obligations throughout the project lifecycle.

5.5 Socio-Economic and Industrial Rationale

The NNBP has the potential to support long-term socio-economic advancement through specialised employment, engineering capability, manufacturing opportunities, construction activity, localisation, supplier development, job creation, skills formation and participation across the nuclear value chain. These benefits are not automatic and should be deliberately designed, measured and governed. The programme’s developmental value will depend on whether opportunities are accessible, measurable and capable of benefiting current communities, transition-affected areas and future generations.

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Based on the 2017 socio-economic impact study, Koeberg Nuclear Power Station makes a substantial contribution to South Africa's economy, supporting employment, household income and economic growth. The study found that Koeberg contributed over R53 billion to GDP it additionally supports approximately 1,600 direct jobs, 14,000 indirect jobs through its supply chain and contracted services, and 20,000 induced jobs generated by broader economic activity arising from employee and supplier spending. The expansion of nuclear power through the NNBP is expected to significantly increase these benefits through localisation, industrialisation, skills development and increased opportunities for local businesses and communities.

5.6 Energy Justice as a Strategic Rationale

Energy justice provides an important framework for assessing the feasibility and public acceptability of the NNBP. It requires consideration of affordability, the distribution of costs and benefits, stakeholder participation, impacts on host and transition communities, and the management of long-term obligations such as waste, decommissioning, financing liabilities and the protection of future generations from unfunded liabilities.

The programme's contribution to energy justice will significantly depend on key implementation decisions, particularly with respect to affordability, funding arrangements, localisation outcomes, stakeholder engagements and the equitable distribution of socio-economic benefits.

Subject to appropriate governance, transparent decision-making and responsible management of long-term liabilities, the programme has the potential to contribute to energy security, economic development and environmental objectives in a manner that is consistent with energy justice principles. Energy justice should therefore remain a key consideration throughout programme planning, procurement, implementation and operation.

5.7 SWOT and PESTEL Analysis

Strengths, Weaknesses, Opportunities and Threats (SWOT) and Political, Economic, Social, Technological, Environmental and Legal (PESTEL) analyses were undertaken to support a comprehensive assessment of the NNBP's feasibility. The SWOT analysis assisted in identifying the programme's inherent SWOT, thereby providing insight into the strategic advantages, potential constraints, risks and opportunities associated with nuclear deployment.

Complementing this assessment, the PESTEL analysis evaluated the external political, economic, social, technological, legal and environmental factors that may influence the programme's

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implementation and long-term success. Together, these analytical frameworks enabled a structured evaluation of the opportunities, constraints and uncertainties relevant to the programme, informed risk identification and mitigation strategies, and strengthened the robustness, transparency and defensibility of the feasibility assessment. These analyses further assisted in evaluating the extent to which the programme aligns with national energy security objectives, energy justice principles, economic development priorities, environmental commitments and the prevailing legislative and regulatory framework, thereby supporting informed and evidence-based decision-making. (See Appendix A for detailed analysis)

5.8 Preliminary Strategic Conclusion

On a preliminary and assumptions-based assessment, nuclear new build presents a strategic rationale that warrants further development, provided that it is pursued through an open, fair, transparent, affordable and energy-justice-centred process. Its potential value lies not only in the electricity it may generate, but in its contribution to long-term system resilience, decarbonisation, industrial capability, localisation, job creation, skills development and socio-economic advancement. The rationale for progressing the programme is therefore strongest where the next stage enables Eskom and the competent authorities to test assumptions, engage the market in an open, fair and transparent way, refine financing and delivery models, assess affordability and risk allocation, and build a defensible record for future decision-making.

6 Capacity, Technology and Design Basis

6.1 Capacity Sought and its Apportionment

The determination sought is for 5 200 MW net of new generation capacity derived from nuclear power technology. That capacity is expected to comprise conventional large, PWR units and SMRs at coastal sites, together with SMRs at suitable decommissioned coal-fired power station sites identified through the SEA currently under way. The exact size of the units will be confirmed after market engagement. The plan is to deploy at least two units at each site. Implementing less than the full programme capacity would weaken fleet standardisation, construction continuity, localisation and learning benefits, and could increase the unit cost of the capacity delivered.

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6.2 Technical Assumptions: Energy Availability Factor, Capacity Factor and Plant Life

Energy Availability Factor (EAF) and capacity factor measure different aspects of plant performance. EAF reflects the proportion of time a generating unit is available to produce electricity, taking account of planned and unplanned outages and deratings, whereas capacity factor measures actual electricity generated as a percentage of the energy that would be produced if the plant operated continuously at rated capacity over the same period. Given the expected baseload operating regime and limited curtailment risk, the capacity factor is assumed to align closely with the EAF.

For the purposes of this feasibility assessment, a design base-case EAF of 90% to 92% has been assumed for large PWR units and 90% - 95% for SMR units, reflecting current technology maturity and international benchmarking. The assumed EAF of 90-92% is aligned with the European Utility Requirements (EUR) performance for Generation III nuclear power plants and is consistent with international operating experience and current industry practice. The EUR specifies a Design Availability Factor exceeding 90% over a representative 20-year operating period, including planned and unplanned outages. Generation III/III+ projects assessments commonly apply availability assumptions of approximately 92%, reflecting improvements in plant reliability, outage management, and operational performance. The 90-92% EAF performance expected from the new-build programme using modern reactor designs and current international operating practices is considered an achievable long-term and an appropriate assumption for economic modelling, consistent with international best practice. Koeberg, being a Generation II design, has historically not met this EAF objective. The achievable Koeberg EAF has been influenced by ageing-related refurbishment, operating practices and life extension activities.

Both technologies are assumed to have an economic and design life of 60 years. The financial analysis in Section *"7 Finance, Economics and Funding"* applies a 92% capacity factor for large PWR units, consistent with expected baseload operation, and tests lower capacity factors of 85% and 80% in the sensitivity analysis to assess project resilience under reduced operating performance.

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Table 2: Design Basis

#	Aspect	Large PWR	SMR
1.	Location	Initial large-reactor development assessments are focused on Duynefontyn (Western Cape, adjacent to Koeberg); and Thyspunt (Eastern Cape), with Bantamsklip retained as an alternative. The national nuclear siting programme remains ongoing and will continue to identify, assess, acquire and preserve additional suitable sites to support the present programme and potential future nuclear capacity. SMR sites will be identified through the SEA and subsequent site-specific environmental and nuclear licensing processes.	Suitable decommissioned coal power station site, to be confirmed following the SEA and site-specific EIA
2.	Gross power output	Up to 5 200 MW net in total	
3.	Design EAF	90-92%	90-95%
4.	Operation	Continuous	Dispatchable or continuous
5.	Technology	Large conventional PWR units, of a design licensed and in commercial operation in its country of origin	SMR of PWR or high-temperature gas-cooled reactor (HTGR) type; to be stated whether licensed by a recognised regulator and whether a reference plant is in operation.
6.	Net efficiency	~37%	32% (PWR) – 42% (HTGR)
7.	Station configuration	2 x standard PWRs per site	To be determined based on technology maturity.
8.	Capital cost	Capital cost to be determined	
9.	Plant life	60 years	60 years
10.	Cooling	Seawater direct cooling	Seawater at coastal sites; The intention is to utilize the existing cooling infrastructure at existing coal fired stations. The decision on dry, wet or hybrid cooling for inland site will be finalised based upon the selected technology requirements
11.	Site size	250 ha per 2-unit plant, with a minimum 500 ha buffer zone	40–60 ha with a 300 ha buffer zone

6.3 Technology Selection and Policy Compliance

The Nuclear Energy Policy of 2008 permits PWRs and a Pebble Bed Modular Reactor (PBMR) (High-Temperature Gas-cooled Reactor technology (HTGR)) [7]. This report confines its assessed technology envelope to PWR units of a design licensed and in commercial operation in their country of origin, and to SMRs of pressurised water type or of the PBMR type.

Any SMR technology that may be considered as part of the NNBP will be subjected to a comprehensive technology assessment and due diligence process before any decision is taken

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regarding its potential deployment. Such assessment will, among other things, consider the maturity of the technology, its safety performance, operational reliability, commercial readiness, compatibility with South Africa's regulatory framework and electricity system requirements, and the extent to which the design has been licensed, certified or otherwise approved by a recognised and competent nuclear regulatory authority in an appropriate jurisdiction.

The assessment will further consider whether the technology has been demonstrated through a reference plant that is either operational or under construction, thereby providing evidence of its technical and commercial viability. In the absence of such evaluation and verification, no assumption can be made regarding the suitability or eventual selection of any SMR technology.

Accordingly, at this stage of the feasibility study, the SMR component is presented as a potential technology option for further assessment and consideration, rather than as a confirmed or integral component of the NNBP. Any future decision regarding the inclusion of SMR technology will be informed by the outcome of the relevant technical, regulatory, commercial and strategic evaluations undertaken in accordance with applicable legal, policy and governance requirements.

6.4 Pressurised Water Reactor

In the PWR, the water which passes over the reactor core as coolant does not flow directly to the turbine but is contained in a pressurised primary loop. In the primary loop water cools the reactor core and passes through the steam generator which produces steam in the secondary loop. The steam drives the turbine (see Figure 4: below). The advantage of this arrangement is that the water in contact with the reactor core would not pass any radioactive contaminants to the turbine and condenser. Another advantage is that the PWR operates at higher pressure and temperature of about 16MPa and 315°C respectively, which increase efficiency.

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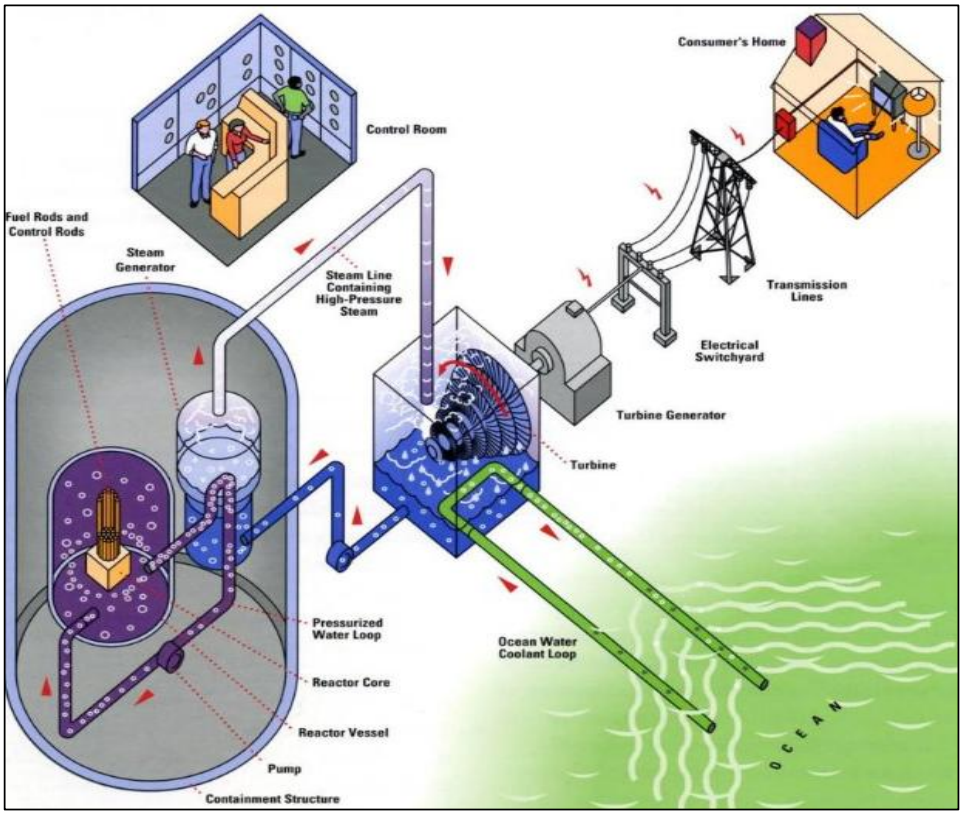

Figure 4: Diagram illustrating the operation of a PWR. [5]

6.5 Small Modular Reactors

SMRs are an emerging class of advanced nuclear reactors, typically producing up to 300 MW per unit. Unlike conventional large-scale nuclear power plants, SMRs are designed for modular construction, with major systems and components manufactured in controlled factory environments and assembled on site. This approach has the potential to improve quality assurance, reduce construction risk, shorten implementation schedules, and enable phased deployment aligned to system demand and investment requirements. Few SMR designs have been licensed by a recognised regulator and fewer still are in commercial operation. The advantages claimed for modular construction, shorter schedules and lower cost remain to be demonstrated at scale, and this report treats them as prospective rather than proven.

A potential advantage of SMRs is their capacity to provide reliable, low-carbon firm power while offering greater deployment flexibility than traditional large reactors. Their smaller footprint allows installation at a broader range of locations, including smaller sites, remote regions, industrial hubs, and areas with constrained grid infrastructure. Many SMR designs also incorporate advanced

[5] **Source:** boilersinfo.com

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passive and inherent safety features that rely on natural physical processes, reducing dependence on active systems, external power supplies, and operator intervention during abnormal operating conditions.

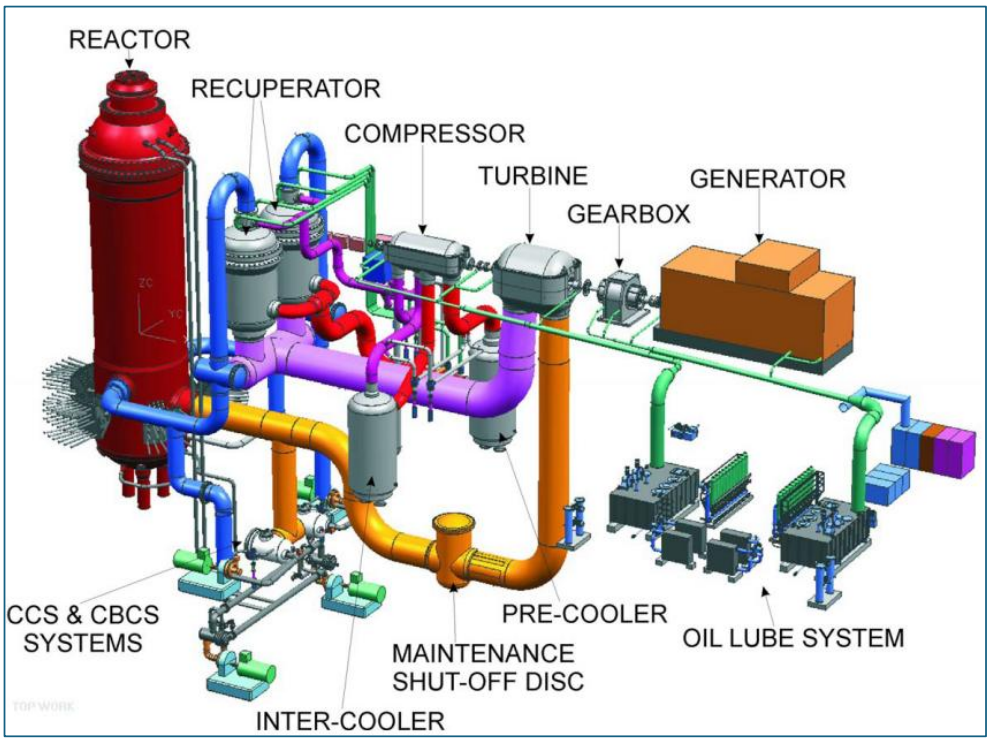

Figure 5: Diagram illustrating the operation of the PBMR. [6]

SMRs encompass a diverse range of technologies, including PWRs, HTGRs, fast reactors, and molten salt reactors, each offering different operational characteristics and potential applications. More than one hundred SMR designs are currently being developed worldwide, with technologies at various stages of licensing, demonstration, construction, and commercial deployment. South Africa has long recognised the strategic potential of SMRs. The Nuclear Energy Policy (2008) articulated the country's intention to pursue the development and eventual deployment of PBMR technology, a HTGR utilising pebble-type fuel. In parallel, Eskom intends to evaluate proven and near-term deployable PWR-based SMR technologies, while assessing their technical, commercial, regulatory, localisation, and deployment suitability within the South African context.

Given their potential to provide firm, low-carbon generation with enhanced deployment flexibility, SMRs will be assessed as a complementary technology option within South Africa's long-term NNBP, alongside conventional large-scale nuclear units, to determine the optimal mix for achieving energy security, affordability, system resilience, and economic development objectives.

[6] **Source:** PBMR (Pty) Ltd. Power Conversion Unit (PCU) 3D Layout, Direct Brayton Cycle Configuration. Reproduced from PBMR design documentation and NRC PBMR technical presentations.

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6.6 Alternative Energy Technology

The alternatives assessment does not seek to identify, endorse or pre-determine generation technology. It is undertaken against the energy system need for energy security, dependable, long-duration, low-carbon capacity capable of supporting system adequacy, reliability, affordability, flexibility, system services and decarbonisation as South Africa retires ageing coal-fired generation and integrates increasing levels of VRE. The comparison therefore considers at a high level not only installed capacity or plant-level LCOE, but also each option's ability to provide energy security, firm capacity, dispatchability, grid support, operational flexibility, emissions reduction, infrastructure requirements, implementation risks, timing, affordability and whole-system value

Coal: Coal provides baseload generation and has historically underpinned South Africa's electricity supply because it uses an abundant domestic resource, established skills and mature supply chains. However, its long-term suitability is increasingly constrained by high CO_2 and greenhouse-gas emissions, air-quality and health impacts, high water use, waste streams, long construction periods, carbon-pricing exposure and concentrated coal-field locations. While coal supports energy security in the near term, decarbonisation, financing and environmental-compliance pressures limit its future role in the South African energy mix and requires clean coal technology applications.

Gas (Open-Cycle Gas Turbine (OCGT) or Combined-Cycle Gas Turbine (CCGT)): Gas-fired generation provide mid-merit, peaking and flexible dispatch capacity. It offers lower CO_2 emissions than coal, shorter build times and high operational flexibility, but remains exposed to emissions, methane leakage, fuel-import dependency, price volatility and uncertain gas infrastructure development. Its suitability in South Africa is strongest as a flexible support technology, provided fuel supply, affordability and carbon-risk concerns are managed.

Nuclear (PWR/SMR): Nuclear power offers firm baseload capacity and essential ancillary services with low operational greenhouse-gas emissions, high energy density, small land requirements and a long economic life. It strengthens system adequacy by providing reliable generation on a continuous basis, grid frequency and voltage regulation and contributing to spinning reserve, while supporting skilled jobs and localisation opportunities. Its deployment is dependent on affordability, financing, licensing, waste management, public acceptance and strong delivery-risk controls.

Solar Photovoltaic (PV) / Concentrated Solar Power (CSP): Solar PV and CSP are well aligned with South Africa's excellent solar resource. These technologies are low-emission, modular and scalable. Their limitations include intermittency, vast land requirements, storage and backup needs, battery-duration limits, cost pressures and, for CSP, water and site constraints.

Wind: Wind power is a low-carbon renewable option that is well suited to South Africa, particularly in strong-resource areas such as the Eastern and Western Cape. It can generate during both day and night. Its variable nature, however, requires transmission capacity, storage, flexible generation

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and system-balancing support, while large land footprint and battery-cost constraints are limiting factors of its deployment.

Biomass: Biomass can provide distributed or small baseload generation where sustainable feedstock is available. It supports waste-stream utilisation, local economic activity and lower NOx/SOx emissions compared with some conventional technologies. Its role is limited by smaller generation scale, feedstock collection and transport costs, land-use competition, lower efficiency and emissions-management requirements, making it best suited to localised applications rather than large-scale national supply.

Hydropower: Hydropower in South Africa, is constrained by limited domestic hydro resources, drought exposure, hydrological variability, environmental and social impacts, geographic limitations and a shorter economic life relative to some alternatives. Its strongest contribution is likely to be system flexibility rather than large-scale new baseload capacity.

The following figures illustrate the role of dispatchable generation capacity in maintaining security of supply under different generation planning scenarios. The analysis compares the IRP 2025 pathway, which includes 5 200 MW of new nuclear capacity, against scenarios where nuclear capacity is not developed or is significantly delayed.

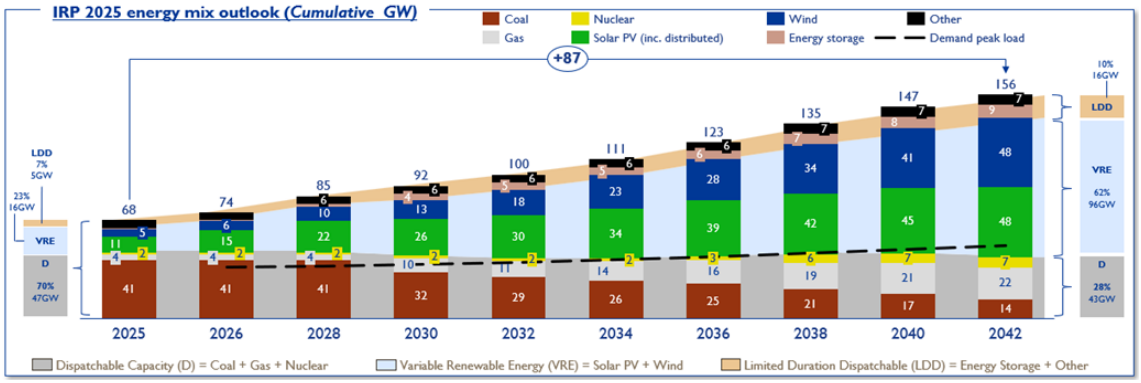

Figure 6: Ideal scenario - Achieve IRP 2025 with addition of the 5 200 MW nuclear growth

Figure 6 reflects the current IRP 2025 pathway, including the addition of 5 200 MW of new baseload nuclear capacity. Although total installed capacity increases significantly over the planning horizon, dispatchable capacity remains relatively unchanged while electricity demand continues to grow. The analysis indicates that, provided all planned nuclear, gas and renewable energy projects are delivered on schedule, sufficient dispatchable capacity should be available to meet projected demand up to approximately 2040. Baseload nuclear generation contributes to maintaining the dispatchable capacity required to support system reliability as the generation mix becomes increasingly dominated by VRE sources.

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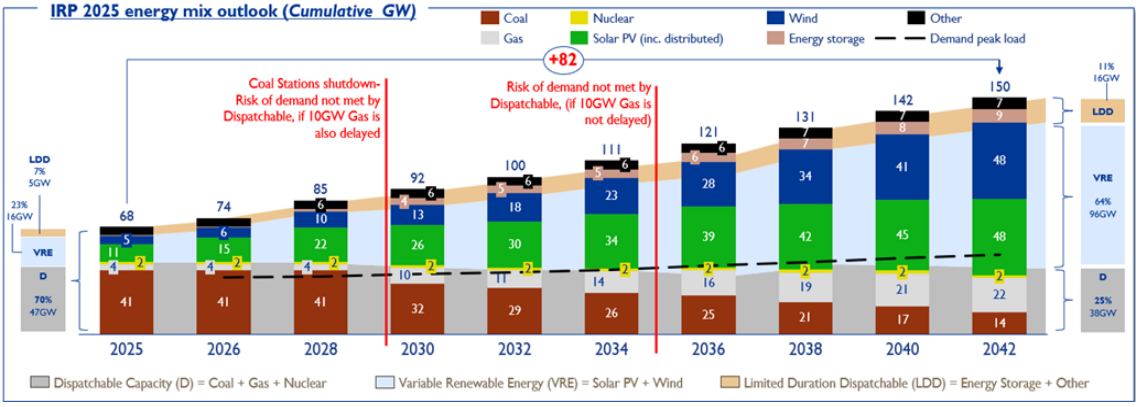

Figure 7: Do nothing - No nuclear and coal plants shut down as per IRP 2025

Figure 7 assumes that existing coal plants are retired in line with the IRP 2025, but no new nuclear capacity is delivered. As dispatchable coal capacity declines, the gap between electricity demand and available dispatchable generation begins to widen from approximately 2035 onwards. The system therefore lacks sufficient dispatchable capacity due to reliance on VRE and limited storage technologies to meet demand. While these technologies play an important role in the future energy mix, any delays in their deployment would increase the risk of supply shortfalls and unserved energy. The absence of baseload nuclear capacity reduces the overall level of firm dispatchable generation available to support the system.

Therefore, choosing not to construct the additional required baseload capacity is the most expensive available option for Eskom and the country. This decision potentially shifts costs from the utility's financial statements to the wider economy through increased load shedding or unserved energy. After acknowledging that the additional generation capacity is required and cheaper than a situation of insufficient capacity, the next step would be to select from all the feasible options the cheapest generation solution which also meets the other criteria such as environmental considerations.

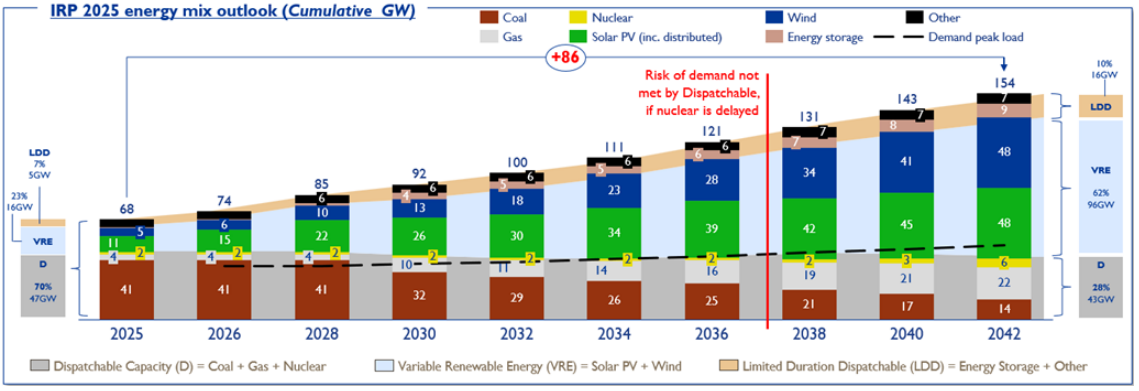

Figure 8: Nuclear comes in after 5 years-time

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Figure 8 indicates that a five-year delay in the nuclear expansion programme would reduce the availability of dispatchable capacity at a time when electricity demand continues to grow and coal-fired generation is being progressively retired. Under this scenario, the risk of demand exceeding available dispatchable generation emerges from approximately 2036 onwards, even if all planned gas, renewable energy and storage projects are delivered as envisaged. Meeting demand would increasingly depend on VRE and Long Duration Dispatchable (LDD) technologies, exposing the system to greater variability and reducing the margin of supply security.

In addition, delayed nuclear deployment increases reliance on gas-fired generation, with its associated high fuel cost implications over the long term. The analysis therefore demonstrates the importance of timely nuclear deployment to maintain sufficient dispatchable capacity and ensure a secure, reliable and cost-effective electricity supply.

6.6.1 Discussion on the Preferred Energy Alternative

The assessment indicates that no single technology is sufficient to meet South Africa's long-term electricity requirements. Renewable energy, storage, gas, demand-side measures and other technologies all have important roles in a diversified generation mix. However, for the specific requirement of firm dispatchable baseload, large-scale, low-carbon and long-duration generation capacity, nuclear power is assessed as a credible and strategic relevant option. This does not displace the role of other technologies within the energy mix but positions nuclear as a key component of a balanced future electricity system, subject to affordability, financing, licensing, procurement, implementation and public-interest requirements being satisfied.

The benchmark nuclear LCOE range of R2 423/MWh to R5 065/MWh compares favourably with coal incorporating carbon capture, utilisation and storage under the lower capital-cost case. Baseload capacity strengthens system adequacy by providing reliable, dispatchable power and ancillary services such as grid frequency and voltage regulation and contributing to spinning reserve, which are not taken into account in the LCOE. The comparison with renewables, solar photovoltaic, wind and storage should, therefore, be interpreted with caution because the technologies have significantly lower availability, operating profiles and do not provide ancillary services. Pumped-storage hydropower reflects the highest benchmark LCOE range and operates at a lower capacity factor than nuclear. Assumptions for the costing of the different technologies are summarised in Table 5.

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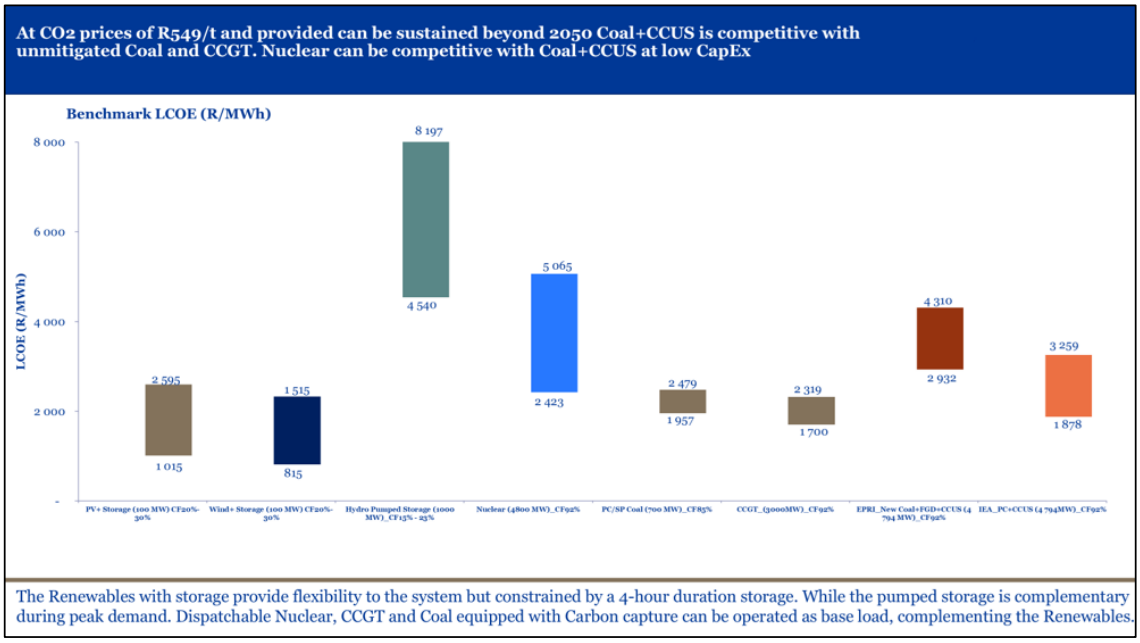

Figure 9: Eskom LCOE comparison to different technologies at different capacity rates

On this basis, nuclear power emerges as the preferred and most suitable alternative when evaluated against security of supply, decarbonisation, system adequacy, IRP alignment, and site suitability criteria.

7 Finance, Economics and Funding

7.1 Purpose and scope of the financial assessment

The purpose of the financial assessment is to determine whether the current programme concept is capable of being progressed to market testing and development of an investment-grade business case. At this stage, the assessment establishes an indicative range, identifies the principal cost and financing drivers, evaluates potential funding instruments and sets out the conditions that must be satisfied before affordability, bankability and tariff conclusions can be made.

The assessment is performed at two related levels. The first is plant-level economics, which considers capital expenditure, Operations and Maintenance (O&M), fuel, spent fuel, decommissioning, Eskom financial parameters, nuclear programme's plant life and expected output. The second is programme and system-level finance, which considers the full 5 200 MW configuration, owner and supporting infrastructure costs, grid integration, funding capacity, sovereign exposure, revenue certainty and the cost of meeting equivalent system requirements.

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7.2 LCOE methodology and limitations

The LCOE represents the average present-value revenue per megawatt-hour required to recover the cost of constructing, operating and retiring a generating plant over its assumed life and duty cycle at the required cost of capital. In financial terms, it is the unit revenue at which the project Net Present Value (NPV) is zero under the assumptions applied. The measure supports comparison of generation technologies where scope and assumptions are consistent.

It also averages costs over a 60-year operating life, whereas debt repayment may occur over a materially shorter period. A project may therefore exhibit a viable whole-life LCOE while requiring a substantially higher revenue profile during construction and the debt-service years.

The levelised costs presented in this report are indicative estimates of the cost of generation at the plant, derived from published international benchmarks and from the IRP, and normalised to Financial Year 2027 (FY2027) South African values. They exclude the cost of transmission and distribution. They are Class 4 estimates, with an expected accuracy of approximately minus 30% to plus 50%, and they are not approved tariffs, vendor prices, or evidence that financing has been secured. In ordinary language, a levelised cost is the constant price per megawatt hour, over the life of the plant, which would recover all its costs at the assumed cost of capital. It is not a tariff, a bid price, or the cost of the electricity system.

The financial results below are taken from the controlled Eskom financial model, version 8, dated 19 September 2026. The results remain indicative and appropriate for strategic feasibility assessment rather than final investment approval.

Table 3: Summary of overnight and LCOE ranges for PWR and SMRs

Measure	Value	Interpretation
PWR overnight benchmark range	US$3 131/kW to US$15 442/kW	Full desktop benchmark range
PWR LCOE range	R2 423/MWh to R5 065/MWh	IRP-average to Lazard-high cases
SMR overnight benchmark and LCOE	US$7 414/kW and R2 931/MWh	Desktop result

The cost and levelised cost figures in this report are appropriate to a desktop feasibility assessment and remain subject to material uncertainty. They rest upon defined benchmark, scope, schedule, financing, exchange rate, localisation, regulatory and operating assumptions. They are not vendor bids, an approved project budget, a tariff determination or evidence that financing has been secured. Firm pricing can emerge only once the programme has been sufficiently defined, and the market has

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returned compliant offers through an open, fair and transparent competitive procurement process conducted pursuant to the determination and the applicable approvals.

Even then, tendered prices must be normalised for scope, risk allocation, escalation, foreign exchange, financing, owner's costs, transmission and supporting infrastructure, lifecycle obligations and schedule before they may be compared with the feasibility baseline or with an alternative portfolio. Before any recommendation of a preferred bid, investment decision or material commitment, Eskom must update the controlled cost and revenue model and issue a variance report against the feasibility baseline. If the market result materially changes affordability, value for money, tariff consequences, fiscal exposure, bankability, the ranking of the reasonable alternatives or a matter addressed in the determination, the programme may not proceed upon the original record. The affected decision makers must be furnished with the revised evidence, and Eskom must then determine whether a revised business case, a further approval, an amended or replacement determination, a new procurement process or renewed public participation is required.

7.3 Project design basis and assumptions

The programme design basis provides for up to 5 200 MW of nuclear capacity, comprising conventional large PWR and SMR capacity. The Operating life for large PWRs and SMRs is 60 years, and the base capacity factor for large PWRs and SMRs is 92% and 95% respectively.

Table 4: Technical, capital, O&M, fuel and lifecycle assumptions used in the PWR analysis

	Description	Unit	Median		IRP_PWR	IEA_ PWR	Lazard
			IEA_US	IEA-EPRI_Lazard Median	Average	High	High
Technical parameters	Gross capacity	MW	5 053	5 053	5 053	5 053	5 053
	Auxillary Power	%	5%	5%	5%	5%	5%
	Capacity Factor	%	92%	92%	92%	92%	92%
	Economic Life	Years	60	60	60	60	60
	Construction period	Years	8	8	8	8	8
Capex	EPC	US$/k'W	6 000	7 784	4 294	10 044	15 442
	Non-Plant Capex	% of EPC	3	3	3	3	3
	ODC	% of EPC	5	5	5	5	5
O&M	Fixed O&M	R/k'W/year	3 539	3 539	3 539	3 539	3 539
	Variable O&M	R/MWh	122	122	122	122	122
Fuel & Other	Fuel	R/MWh	117	117	117	117	117
	Spent Fuel	R/MWh	49	49	49	49	49
	Heat Rate	KJ/kWh	10 000	11 250	11 250	11 250	11 250
	End of life costs	% of EPC	15	15	15	15	15

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Table 5: Benchmark LCOE assumptions

	Description	Unit	Coal+CCUS	CCGT	Pumped Storage	Wind + Storage	Solar PV + Storage
Technical parameters	Gross capacity	MW	4 794	3000	1000	100	100
	Auxillary Power	%	18%	3.75%	-		
	Capacity Factor	%	92%	92%	23%	20%-30%	20%-30%
	Economic Life	Years	30	25	30	30	30

7.4 Desktop benchmark analysis

The desktop analysis draws on the IRP 2025 and on benchmarks published by the International Energy Agency (2020), the Electric Power Research Institute (2024) and Lazard (2025). The large-PWR overnight-cost range is US$3 131/kW to US$15 442/kW. The wide range reflects different countries, project types, delivery environments and First of a Kind (FOAK) or repeat-build conditions.

The benchmark estimates and figures presented in this report are provided solely for indicative and comparative purposes to inform strategic evaluation and option analysis in support of the feasibility assessment. These values have been derived from industry reference data and are included to illustrate potential order and scale of ranges observed in comparable projects and market conditions and must not be interpreted as target costs, approved project estimates, budgets, approved procurement values, or funding.

To achieve a cost outcome within the lower ranges of these estimates, the programme would need to establish the underlying conditions reflected in lower and medium-cost programmes, including design maturity, standardisation, build continuity, qualified supply chains, disciplined scope and change control, capable owner governance, competitive procurement, construction productivity and suitable financing.

7.5 Indicative capital cost and LCOE

The full-range analysis reports an overnight capital-cost range of approximately R390 billion to R1 402 billion and a nominal capital-cost range of approximately R471 billion to R1 667 billion.

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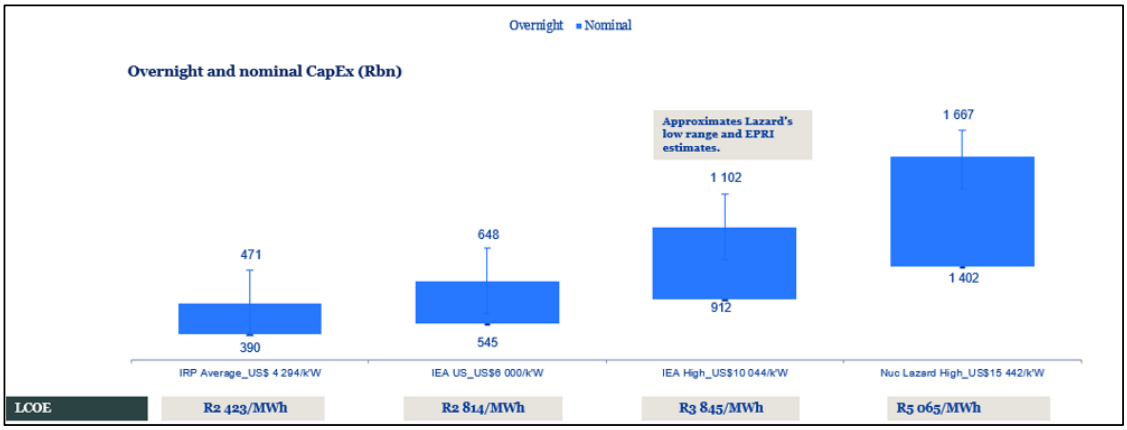

Figure 10: Overnight and nominal PWR capital-cost outcomes across benchmark cases

7.6 Cost composition and value drivers

The analysis attributes approximately 60% of PWR LCOE to capital expenditure, approximately 17% to fixed O&M, approximately 5% to variable O&M and approximately 5% to fuel. The remaining cost relates to spent fuel and other programme components reflected in the model. The predominance of capital cost explains why procurement, financing, schedule and foreign exchange have a greater effect on LCOE, than equivalent changes in fuel or variable O&M.

The cost of spent fuel management is carried in this report at R49 per MWh, and the cost of decommissioning at 15% of EPC cost, consistent with the OECD Nuclear Energy Agency and World Nuclear Association range of 10% to 20%, which varies with reactor technology, site-specific conditions, the waste disposal route and the decommissioning strategy selected, and is intended as a prudent representation of the full lifecycle cost of nuclear generation.

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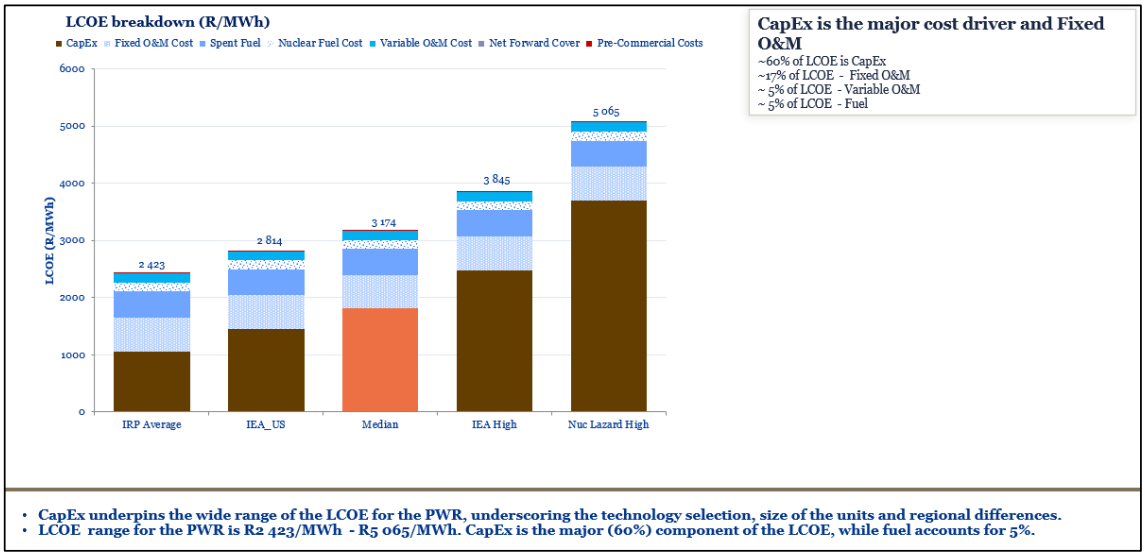

Figure 11: PWR LCOE composition and contribution of major cost components

7.7 Strategic target position and cost-control requirements

The strategic objective is to obtain a repeatable, standardised programme outcome rather than a FOAK cost outcome. The feasibility evidence identifies build continuity, domestic supply-chain development, qualified personnel and consistent regulatory and procurement frameworks as important to this objective. The RFP should therefore test not only price but also schedule certainty, reference-plant evidence, financing terms, localisation deliverability, completion obligations, performance guarantees and contractual risk transfer.

The international evidence shows a wide delivered-cost spectrum. It distinguishes mature, standardised and repeat-build programmes from Western FOAK or complex projects. An assessment by the Energy Technologies Institute of 34 completed nuclear projects [28] and reported that FOAK projects in countries that had not built occupied the upper cost range, while a material proportion of projects were delivered at lower cost levels. The cost drivers are summarised in Table 6 below:

Table 6: Cost drivers, effect on financial outcome and required control to minimise cost.[7]

Cost driver	Effect on financial outcome	Required control
Design maturity	Design change causes rework and delay	Mature the selected design and baseline requirements before construction

[7] Energy Technologies Institute

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Cost driver	Effect on financial outcome	Required control
Standardisation	Variants reduce learning and predictability	Retain common configuration across units where practicable
Programme sequence	Interrupted cadence erodes supply-chain learning	Plan the units as a fleet with controlled decision gates
Construction productivity	Poor execution increases cost and schedule	Measure productivity, rework and constraint removal
Supply chain	Limited qualified capacity increases delivery risk	Develop qualification, quality and localisation capability
Financing duration	Delay increases financing exposure	Integrate schedule assurance with financing strategy
Owner capability	Slow or weak decisions increase interface risk	Maintain an intelligent-owner organisation with clear authority

7.8 Estimate maturity and tariff impact

No final tariff increases or trajectory is established in this report. The tariff path will be produced through integrated financial and system-level modelling after the programme configuration, market cost, financing structure, construction schedule, off-take arrangement and regulatory treatment have been sufficiently defined.

The next level of confidence must be obtained through market returnables and a controlled cost model. The future model will reconcile the large-PWR and SMR components, owner's development and construction costs, grid and supporting infrastructure, escalation, IDC (Interest During Construction), contingency, foreign exchange, lifecycle obligations, funding terms and annual revenue requirements. The whole system tariff impact and pathway will be concluded in the final business case.

7.9 Feasible Funding Options

7.9.1 Preliminary funding architecture

The funding structures described in this report are options under evaluation. No sovereign guarantee, fiscal contribution, regulated revenue mechanism or off-take commitment has been approved, and none is assumed to have been approved because it appears in a scenario. Each instrument will be assessed for its legal authority, its affordability, its allocation of risk and the

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approvals it requires, including those required under Section 54 of the Public Finance Management Act 1 of 1999 and preserved by Section 34(9) of the Electricity Regulation Act.

7.9.2 Funding instruments

Table 7: Funding instruments

Instrument	Potential role	Advantage	Material limitation
Sovereign or government-led funding	Core credit-support pillar	Can lower Weighted Average Cost of Capital (WACC) and improve lender confidence	Creates fiscal pressure and contingent liabilities
Vendor and Export Credit Agency (ECA) finance	Imported technology and equipment funding	May offer long tenor and credit support	Often accompanied by export-content, technology sourcing that could limit localisation and industrial development opportunities within the NNBP. May also increase exposure to foreign exchange volatility, supplier concentration risk and geopolitical dependencies, thereby requiring careful consideration alongside the programme's affordability, localisation, energy security and long-term sustainability objectives.
DFI or concessional debt	Lower-cost development or construction finance	Can reduce cost of capital	Availability, eligibility and conditions require confirmation
Commercial loans and bonds	Supplementary debt capacity	Broadens lender base	Pricing, tenor, covenants and refinancing risk
Local rand debt	Funding for domestic expenditure	Reduces currency mismatch	Domestic capacity may be insufficient for programme scale
Regulated Asset Base (RAB) model	Construction-period cost recovery	Can reduce IDC	Transfers cost and delay exposure to current customers
Contract for Difference (CfD) or similar support	Revenue-price stabilisation	Can improve revenue predictability	Not sufficient if reference pricing does not recover full cost
Equity or PSP	Broadens capital base and may reduce leverage	Can introduce strategic capital	Required returns may increase revenue need
Industry off-taker model	Targeted customer participation	Aligns supply and cost certainty	Not identified as the principal programme solution

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7.10 Affordability

7.10.1 Whole-system affordability

The IRP 2025 modelled the total cost of the electricity system to 2050 under a scenario which includes 5 200 MW of nuclear capacity at R2 273 billion, against R2 233 billion under the least-cost reference case. The difference of R40 billion is a comparison of modelled system-cost totals over the planning horizon in 2024 terms which indicates that an energy mix including nuclear is approximately 1.8% higher in overall system cost than the reference case without nuclear, based on the IRP 2025's technology cost and other assumptions. This premium is offset by strategic benefits associated with nuclear power and ancillary services, including technology and fuel diversification, localisation potential, lower carbon emissions and enhanced long-term system resilience.

The Reference Case and the other scenarios (including the nuclear scenario) are all very close in cost and each of them reflect (for that particular scenario) the optimized least cost which achieves security of supply (in terms of the objectives of the IRP). By definition any 'lower cost alternative' will not achieve security of supply, which implies a far higher cost to the economy, Thus the 'most affordable' solution would be the least cost that achieves security of supply. However, the cost of all the scenarios is very close (even the highest cost scenario i.e. the 'delayed shutdown' reflects only a 9% cost premium vs. the reference case, which premium might be offset to some degree once socio-economic impacts are factored in). The relatively small cost differences in an analysis such as the IRP might be statistically immaterial given the many assumptions that have to be made for this type of analysis; Hence the most affordable solution would be any of these scenarios which all achieve security of supply.

7.10.2 Schedule and downside affordability

Construction delay increases nominal cost through escalation, foreign exchange, internal cost and IDC, while delaying the commencement of revenue as experienced in Vogtle, Hinkley Point, Flamanville and Olkiluoto. These projects have reached overnight cost above $10 000/kW which is driving the LCOE range to higher levels as demonstrated in the desktop studies.

8 Legal and Commercial Architecture

The programme's commercial and implementation framework under development takes into consideration the applicable commercial, legal and regulatory requirements.

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Table 8: Procurement architecture, legal source and authority

Architecture element	Legal source	Responsible authority
Section 34 determination	Section 34 of the Electricity Regulation Act 4 of 2006, as amended, read with the applicable planning, public-finance, procurement, licensing and regulatory framework	Minister of Electricity and Energy
Procurer	The Section 34 determination, Government nuclear policy, Eskom governance requirements and applicable procurement law	The Minister in relation to designation in the determination; the designated procurer for execution once lawfully appointed and authorised
Buyer / off-taker	The Section 34 determination, the Electricity Regulation Act, generation licensing and tariff-related approvals, and any approved power purchase or equivalent off-take arrangement	The Minister in relation to identification in the determination; NERSA for licensing and tariff approvals; the National Transmission Company or another creditworthy buyer if lawfully designated and approved
Procurement law	Section 217 of the Constitution, Section 54 of the PFMA, applicable Treasury Regulations, the Preferential Procurement Policy Framework Act and its regulations	
Contracting model	Applicable procurement law, construction-law principles, Eskom governance requirements and project-specific contractual approvals	The designated procurer, supported by technical, commercial, financial and legal advisers

8.1 Procurement Strategy by Technology

The purpose of a procurement strategy at feasibility phase, and related to the NNBP, is to ascertain, at a strategic and high level, the potential implementation pathways, procurement approaches and delivery models that may be available for the NNBP should a future decision be taken to proceed with its implementation.

The strategy is intended to determine whether viable, lawful and commercially practicable options exist for procuring, financing and delivering new nuclear generation capacity within the applicable constitutional, legislative, regulatory and governance framework.

For the large conventional PWR units, the current high-level procurement strategy is to contract on a traditional EPC basis under an Eskom/Government funding model, still to be finally determined, informed by the market intelligence gathered through the RFI process. An open, fair, transparent, competitive and cost-effective bidding process, including possibly technical pre-qualification, will follow for the main conventional nuclear island, to identify vendors with the technical capability, capacity and track record required to deliver a new nuclear build project; the RFPs may include vendor financing options. Credible vendors who have recently completed or are presently active in nuclear new-build programmes in Britain, Canada, China, Russia, India, South Korea, France, Egypt, Turkey, Pakistan, Bangladesh, Belarus and the United States. The owner's scope will be divided into

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multiple work packages, each procured in accordance with Section 217 of the Constitution and the procurement framework in force at the time, through competitive bidding save where a deviation is justified and recorded under that framework, with a strong focus on participation by South African industry. Should an equity-based private-sector participation model instead be selected, a competitive process will identify a suitable strategic partner, requiring specialised transaction, legal, financial, technical and commercial expertise to ensure a technically sound, commercially viable, legally robust and bankable outcome.

For SMRs, a two-stage process is also envisaged: a RFI to assess market readiness and technology maturity, followed by an open RFPs for technology-partner selection. As with the large units, the owner's scope will be packaged and procured with a strong emphasis on local industry participation, and a private-sector participation model, if adopted, will be informed by the same market intelligence and will require the same specialist advisory support.

8.2 Funding Model

The ownership structure of the programme remains under evaluation pending the outcome of market engagement. Two broad implementation models are presently under consideration: a traditional EPC contract under the procurer's own, debt-based funding model, or a private-sector participation framework under a combined funding model incorporating equity from public, private, vendor or development-finance-institution sources, or other funding options.

8.3 Contracting Strategy and Operating Architecture

Three contracting models have been considered. A full EPC/turnkey approach offers the lowest delivery risk but limits owner control, localisation and capability development, at the highest cost premium. Split-package contracting offers greater owner control but introduces integration, schedule and performance risks that exceed Eskom's current capability for a FOAK programme. A multiple-package (EPCM) approach offers the greatest owner control and localisation opportunity, but carries execution, licensing and capability risks that are presently unacceptable for a FOAK nuclear programme.

On balance, the envisaged strategy is a modified EPC, LSTK approach, which provides the best balance between risk allocation, cost efficiency, design integrity, localisation and capability development. It retains a single experienced nuclear technology vendor or consortium responsible for the nuclear island and overall plant performance guarantees, securing nuclear safety, design integration, schedule certainty and accountability, while the owner retains responsibility for selected

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packages outside the main plant boundary, allowing greater local supplier participation and the progressive development of South African engineering, project-management and architect-engineer capability.

A LSTK contract allocates to the vendor the risk of completing the contracted scope for the contracted price and within the contracted time. It does not remove the owner's exposure to late access to the site, to the timing of licences and authorisations, to the readiness of the grid connection, to changes required by the owner or by the regulator, or to the availability of financing, and a fixed price does not remove that exposure. The contracting strategy, which is being developed in parallel with this report, will provide expressly for those residual risks.

Table 9: Key elements of the contracting strategy

Element	Description
Reactor vendor contract	Appointment of an experienced reactor vendor under a modified EPC/LSTK contract for the power block — the nuclear island, turbine island, balance-of-plant works, safety-critical systems and on-site infrastructure
Non-nuclear packaging	Packaging of non-nuclear works into approximately 17 discrete contracts that the owner can manage without disturbing the main vendor interfaces
Localisation requirements	Localisation and supplier-development requirements built into the procurement framework, to support the growth of a South African nuclear industry
EPCM support	Potential engagement of an EPCM support contractor to strengthen project management, construction management and engineering-integration capability
Vendor accountability	Retention of full technical and performance accountability by the reactor vendor, while enabling the owner to develop future architect-engineer capability

8.4 Long-Term Fleet Strategy

For units beyond the present 5 200 MW allocation, the contracting model is intended to evolve progressively from the initial modified-EPC approach toward a split-package or EPCM delivery model, as local capability matures in architect-engineer and design capability, nuclear project and construction management skills, nuclear quality assurance and safety culture, local supplier capacity, regulatory certainty for multi-package delivery, and integration and interface management.

A phased approach with early units delivered by experienced vendors to manage integration risk, later units drawing increasingly on local content, owner capability and supply-chain participation, is intended to reduce cost and maximise national economic benefit over time, with the objective of a self-sufficient South African nuclear industry that maintains nuclear safety, quality and performance standards throughout.

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8.5 Localisation and Industrialisation

The scale, duration and technical complexity of the programme provide a platform for developing local manufacturing capability, industrialisation, engineering services, construction capacity, specialised nuclear supply chains and high-value technical skills. Subject to technology selection, market engagement and commercial negotiation, Eskom intends to pursue a structured localisation strategy that maximises sustainable local content, supplier development and skills transfer while maintaining nuclear safety, quality and delivery requirements. A Section 34 determination will enable Eskom to undertake the market engagement, technology assessment and localisation planning necessary to establish realistic commitments and to develop a comprehensive Nuclear Industrialisation Plan as part of the investment-grade business case that follows. Localisation requirements will be imposed through evaluation criteria and contractual undertakings only to the extent permitted by Section 217 of the Constitution and by the preferential procurement legislation in force when the RFPs are issued.

9 Human Capacitation

The NNBP is established as a ring-fenced portfolio, separate from Koeberg. A central portfolio office will control common governance, technology, commercial, licensing and assurance arrangements. Each site follows the same new reactor delivery model and will have an accountable owner's site team for its reactors and a separately mobilised operating and maintenance organisation. The human capital delivery timeline identifies readiness and training streams for the operating crew, engineering and scientific resources, maintenance personnel, radiation protection and chemistry personnel, artisans and technicians, semi-skilled and unskilled labour, and instructors. The table below transcribes the indicative sequence. Dates remain illustrative and must be re-baselined for each site.

Table 10: Training scheduling requirements

Resource / training stream	Illustrative timing	Training or mobilisation activity
Skilled resource pool	2028-2032	Develop engineering, scientific and project-management capacity ahead of construction and commissioning.
Semi-skilled and unskilled labour pool	2030-2031	Build the entry-level site labour pool before major construction.
Artisan and technician pool	2032-2034	Develop and mobilise artisans and technicians for construction support, maintenance preparation and plant familiarisation.
1st operations crew	2033	First operations cohort enters the plant-specific pathway.
1st crew vendor simulator training	2034-2035	Technology-vendor simulator training.

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Resource / training stream	Illustrative timing	Training or mobilisation activity
1st crew on-site training	2036-2037	Plant-specific, on-site training and commissioning exposure.
2nd operations crew	2034	Second operations cohort enters the pathway.
2nd crew vendor simulator training	2035-2036	Technology-vendor simulator training.
2nd crew on-site training	2037-2038	Plant-specific, on-site training and commissioning exposure.
Maintenance crew plant-systems training	2034-2036	Maintenance personnel complete plant-systems training before turnover and commissioning.
RP and chemistry training	2034-2035	Radiation protection and chemistry personnel complete role-specific training.
Instructor training	2036-2037	Develop instructors for initial, NPO, simulator and requalification training. Instructors must hold active licences.
Operating crew readiness	Before commissioning and operation	Complete licensing, roster formation and readiness assurance before operating responsibility is transferred.
Operating and Maintenance Organisation	From operating readiness onward	Transition trained resources into the permanent site O&M organisation.

10 Stakeholder Management

Eskom recognises that the successful implementation of the NNBP depends on maintaining transparent, constructive and trust-based relationships with stakeholders throughout the programme lifecycle.

A comprehensive stakeholder engagement strategy will be established to ensure early identification of stakeholder requirements, proactive communication, effective management of concerns, and incorporation of stakeholder input into programme planning and decision-making.

Stakeholder engagement will extend across all phases of the programme and will include national, provincial and local government structures, regulators, with particular focus on affected communities around identified sites for both LNPP and SMRs, organised labour, industry associations, environmental organisations, investors, suppliers, academic institutions, the media and other interested and affected parties.

Eskom has a long history of stakeholder engagement associated with major infrastructure development and nuclear operations. This experience, together with lessons learned from previous nuclear and mega-project programmes, is being applied to ensure the NNBP is implemented in a transparent, legally defensible and socially responsible manner.

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Initial engagements have already been undertaken with key stakeholders, including the City of Cape Town, Kouga Local Municipality and various national departments, to introduce the programme, discuss potential socioeconomic opportunities and identify stakeholder expectations. Public participation processes have also been undertaken through the EIA and Nuclear Installation Site Licence (NISL) processes, providing a platform for engagement with communities, government institutions, industry and non-governmental organisations. That participation was conducted under the National Environmental Management Act 107 of 1998 and the National Nuclear Regulator Act 47 of 1999 for the purposes of those statutes.

Stakeholder engagement will continue to be aligned with the principles of transparency, accountability, inclusiveness and responsiveness, with particular emphasis on building public confidence and trust, promoting informed participation, and maintaining the programme's social licence to operate.

Table 11: Stakeholder Engagement Matrix

Stakeholder	Interest / concern	Engagement objective
Minister and DEE	Section 34 determination, national energy policy, public interest and lawful designation of responsible entities	Support evidence-based consideration without pre-empting or fettering statutory discretion.
NERSA	Regulatory concurrence, licensing implications, tariff treatment and consumer protection.	Enable a rational and properly informed regulatory assessment.
National Treasury	Fiscal exposure, guarantees, contingent liabilities, debt capacity and affordability.	Support assessment of the programme’s public-finance implications.
NNR	Nuclear safety, licensing readiness, site suitability and lifecycle regulatory obligations.	Ensure nuclear safety and licensing requirements are integrated from project definition through implementation.
DFFE and environmental authorities	Environmental authorisation, public participation, biodiversity, water, waste and climate-related impacts.	Ensure environmental risks and mitigation measures are identified, assessed and disclosed.
Host communities and interested and affected parties	Safety, local impacts, employment, procurement opportunities, land-use effects and transparency.	Build trust and enable informed, meaningful participation.
Consumers and civil society	Tariffs, affordability, transparency, safety, alternatives and long-term liabilities.	Demonstrate that the cost-benefit case is transparent, balanced and capable of scrutiny.
Vendors, financiers and private sector participants	Bankability, procurement rules, technology requirements, revenue certainty and risk allocation.	Test capability, appetite and commercial terms once lawful market engagement is enabled.

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11 Project Management

11.1 Status of Project Development

The programme is presently in the Definition Phase of Eskom's PLCM, progressing the technical, regulatory, environmental, transmission, commercial, financial and site-readiness activities required to support future investment and implementation decisions. Substantial development work has been completed over several years, including site selection and characterisation, environmental authorisation processes, nuclear licensing activities, grid-integration planning, technical specification development and preliminary economic assessment. Progression to market engagement and procurement remains contingent on the necessary Government policy and regulatory approvals, including a Section 34 determination, together with confirmation of the preferred implementation approach; the proposed RFPs process is intended to reduce uncertainty, test market appetite, validate cost and financing assumptions, and establish the information needed for a robust, bankable business case.

11.2 Technical Scope

The Employer's Requirements Specification documents Eskom's minimum technical, performance, regulatory, operational, functional and process requirements for new standardised PWR plants.

The scope encompasses the power production plant (reactor buildings and turbine halls) and all directly connected and integrated structures, systems and components; the support systems, services and site infrastructure required; and the processes necessary for sustainable commercial operation, including operation and maintenance support, training, the initial fuel supply and the first three fuel reloads. The scope also includes the intake and outfall structures into the ocean, a seawater desalination plant, water storage reservoirs, gas storage and supply pipelines, meteorological mast, high voltage yard and transmission and distribution lines 132 kV, 400 kV or 765 kV, internal and access roads and other auxiliary service infrastructure, including offices, canteens and workshops. For the construction period temporary coffer dams in the ocean, laydown areas and other areas to be cleared are identified. Separate user requirements specifications cover the off-site facilities and infrastructure upgrades forming part of Eskom's owner scope.

The Employer's Requirements Specification and associated Owner's Scope User Requirements Specifications for the large plants have been substantially completed. Eskom is accordingly well positioned to issue a robust, reviewed technical specification for the planned procurement process.

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Maturity and technical-readiness assessments for SMRs are still to be carried out, given that this technology continues to develop globally.

11.3 Transmission Grid Integration

Electricity from the proposed nuclear power station must be integrated into the national transmission grid before delivery to end-users. Grid integration depends on technical factors including transmission capacity, proximity to load centres, infrastructure readiness, and connection costs. NTCSA has assessed integration requirements for Duynefontyn and Thyspunt and provided indicative cost estimates which have been taken into account in *"Section 7. Finance, Economics and Funding"* for scope of works to assess the feasibility to integrate nuclear power stations within the Greater Cape region of South Africa in phases.

The initial phase proposes commissioning the reactors that will be integrated at Duynefontyn and Thyspunt sites in the Western Cape and the Eastern Cape, respectively.

The Duynefontyn and Thyspunt Nuclear Power Station Integration Indicative Cost Estimate (ICE) (Grid Planning Report), GP_25/294, October 2025 [34] confirms that both Duynefontyn and Thyspunt are technically feasible sites for integrating new nuclear generation into the South African transmission network, subject to implementation of the identified network reinforcements. The study demonstrates that the proposed developments can meet Grid Code requirements for system security, thermal loading, voltage stability, fault levels, contingency performance and power transfer capability.

The required transmission infrastructure, transformer capacity, reactive power support and corridor strengthening measures should be incorporated into the project capital cost estimate, implementation schedule and overall financial evaluation. The transmission infrastructure upgrades are to be incorporated into the 2026 revision of the Transmission Development Plan.

Both sites are technically viable, compliance with the Grid Code is achievable once the recommended upgrades are implemented, and the required upgrades, transmission lines, transformer capacity, substation works and reactive power support, are necessary to ensure reliable power evacuation. Steady-state load flow, thermal loading, voltage stability, contingency and fault-level assessments indicate that the transmission system can remain secure and stable once those reinforcements are implemented, although synchronous condensers or other voltage-support measures may be required to maintain performance under all operating conditions. The analysis further demonstrates that strengthened transmission corridors can support the transfer of nuclear-

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generated power to major load centres, with transfer limits and reinforcement requirements identified to ensure secure operation under normal and contingency conditions.

The network strengthening identified in the study is a material component of the overall capital investment and will be incorporated into the project capital cost estimate and delivery schedule, forming the basis of a Grid Connection Cost Estimate has been integrated into the overall financial model, and into the 2026 revision of the Transmission Development Plan. The study concludes that there are no material transmission-related fatal flaws at either site, providing a robust technical basis for project development and supporting the transmission-related requirements of the Section 34 determination process, provided the identified reinforcements are delivered. The application, and the associated application fees, will be formally lodged with the grid access units once the Section 34 determination is obtained.

11.4 Site Supporting Infrastructure

Beyond grid integration, significant on-site and local infrastructure must be assessed, including roads, water, sewerage, stormwater, electrical networks, lighting and security. Duynefontyn is expected to require lower-cost, shorter-lead-time upgrades, given its existing nuclear infrastructure and proximity to Cape Town, while Thyspunt will require more extensive infrastructure development, including transport, accommodation and municipal services, but could in turn provide significant economic stimulus to the Eastern Cape. The first-site decision should accordingly weigh infrastructure readiness, development cost, timing and alignment with local, provincial and national development priorities; development of both sites is intended to proceed concurrently to support successful deployment of the fleet as a whole. The regulations governing development within the Koeberg emergency planning zone have not been promulgated, the Department and the City of Cape Town are consulting on a draft, and the City's draft amendment by-law is out for comment, so that the land-use restrictions which will apply within the zone, and their effect on surrounding land use and on the programme's own supporting infrastructure, remain to be settled. The emergency planning zone which will apply at each site, and the restrictions within it, are stated under section *"5.4 Environmental Implications"*

The supporting infrastructure requirements specifications require revision to reflect local changes in population demographics and municipal spatial development plans, and the technical evaluation criteria for this scope remain to be developed; local municipal agreements need to be concluded before execution release approval. Thyspunt in particular requires early municipal alignment, since population influx and bulk-service constraints are likely to affect water, sanitation, electricity, roads and waste capacity, making early engagement with local government important to expedite the development of schools, hospitals, clinics, transport, housing and municipal services around the site.

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Duynefontyn benefits from the established Cape Town and Koeberg infrastructure, including road, port, airport and information-and-communications-technology assets, but water, sanitation, electricity and waste assumptions still need to be confirmed through project-specific studies and municipal engagement, and the City of Cape Town's existing capacity constraints including the Traffic Evacuation Model that need to be assessed against the specific requirements of a new nuclear build requirements.

11.5 Nuclear Siting, Environmental Approvals, Permits and Licensing

A nuclear power station requires two principal authorisations from two regulatory authorities: an Environmental Authorisation under the National Environmental Management Act 107 of 1998 [25], from the Department of Forestry, Fisheries and the Environment, and a Nuclear Installation Licence under the National Nuclear Regulator Act 47 of 1999 [5], from the NNR, together with several further authorisations before construction may commence. Depending on the licensing strategy adopted, an applicant may apply for a Nuclear Installation Site Licence, demonstrating that the relevant siting factors, including external hazards, have been characterised and the site parameter envelope quantified so that the site is acceptable for the future siting, construction and operation of nuclear facilities conforming to a range of technologies; a separate application to construct and operate is then required once a specific technology is selected, demonstrating that the chosen design is enveloped by, or complies with, the site licence. Section 24 of the NEMA [25] separately requires that activities with the potential to affect the environment, the socio-economic environment or cultural heritage materially be investigated, assessed and authorised before implementation.

Eskom initiated studies to identify, select, qualify and licence coastal sites in the 1980s, in order to secure them before other development could preclude their use for nuclear generation. Thyspunt and Duynefontyn have since been characterised in detail for the Nuclear 1 project, supporting the decisions required of the environmental authorities and the NNR, and are Eskom's preferred sites for the first units, given their proximity to load centres.

Brazil and Schulpfontein were excluded during scoping, on DFFE's recommendation, for limited local demand and the absence of transmission corridors. An Environmental Authorisation for Duynefontyn was granted in October 2017. Appeals against it were dismissed on 29 July 2025. The authorisation is presently the subject of judicial review. A new EIA process for Thyspunt, with Bantamsklip as the alternative site, is under way, with the Environmental Authorisation for Thyspunt expected by July 2027. Bantamsklip’s characterisation is approximately 60% complete, covering land use, population and hydrology, with seismic and tsunami hazard studies still required, and is retained as an alternative to Thyspunt. Both SMRs and large reactors may in principle be deployed at Thyspunt and Duynefontyn, although space constraints limit SMR deployment where large PWRs are also

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constructed; the Thyspunt/Bantamsklip EIA includes SMRs as a potential technology at that site, while an additional EIA may be required for SMR deployment at Duynefontyn.

An SEA has also been initiated to identify suitable coal-station sites for SMR deployment, with further analysis needed to confirm deployment timelines, and additional greenfield sites may need to be identified should the allocation later increase to 10 000 MW under the Nuclear Industrialisation Plan.

The nuclear installation site licence application envisages that either technology should be enveloped by the plant parameter envelope used, so that the sites remain technology neutral. The nuclear installation site licence applications for both Thyspunt and Duynefontyn are progressing, with potential approval by mid-to-late 2027; rezoning of the Thyspunt site will follow receipt of the Environmental Authorisation. Significant site characterisation work still need to be performed on Bantamsklip site. Further environmental permits and licences, beyond those identified here, will be initiated as the programme evolves.

11.6 Strategic Infrastructure Project (SIP) Registration

Thyspunt was registered as a Strategic Infrastructure Project under the Infrastructure Development Act 23 of 2014 [11] on 26 May 2026. The registration bears upon the timeframes within which the approvals for that site will be processed, through the steering committee, the concurrent processing of applications and the time periods prescribed in Schedule 2 to that Act. The registration is recorded as a fact concerning the approvals for that site, and not as a selection of the site.

11.7 Water Supply

For the large plants, Eskom's plan is not to draw on municipal water supply at the coastal sites, but to build a desalination plant for site water needs; the requirements specification for that plant has been compiled. For inland coal-to-nuclear or SMR sites, engagement with the relevant municipality on water supply will be required.

11.8 Land Ownership and Use

At Duynefontyn, the land required for the plant has been secured, with the remaining parcels still to be acquired; rezoning is in progress. At Thyspunt, the land has similarly been secured, with final parcels still to be acquired; rezoning will follow the Environmental Authorisation. At Bantamsklip, land acquisition is partially complete, with the remaining parcels outstanding. Rezoning studies for submission to the relevant municipalities are to be initiated once the applicable environmental

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authorisations are in hand, and a mandate is awaited to conclude the necessary municipal agreements at each site.

11.9 Fuel Supply

South Africa has uranium resources and historical fuel-cycle capability, but localising conversion, enrichment and fuel fabrication is not economically viable at the scale of this programme. Fuel for the new units will accordingly be procured, as it is for Koeberg, from international suppliers of conversion, enrichment and fabrication services, under long-term contracts with a panel of suppliers, with opportunities for local participation in uranium supply and in selected component manufacture. The security of supply depends on the breadth of the panel and on Eskom's ability to pay for material delivered.

11.10 Radioactive Waste Management

Low- and intermediate-level waste from Koeberg is treated, stored and transported for disposal at the Vaalputs national repository under established licensed arrangements, which will be extended to the new units. Spent fuel is presently stored at Koeberg in the spent fuel pools and in dry storage casks. A similar strategy will be followed for new build program and requirements has been set for spent fuel storage capacity of 10 years.

The Central Interim Storage Facility that the National Radioactive Waste Disposal Institute is to establish at Vaalputs is targeted for completion by 2030. The intention is to ship the spent fuel to the Central Interim Storage Facility after 10-years of on-site cooling.

South Africa has not yet sited a deep geological repository for the final disposal of spent fuel, which is the responsibility of the Institute under the National Radioactive Waste Disposal Institute Act 53 of 2008 [12].

11.11 Decommissioning

Section 26A of the National Nuclear Regulator Act requires the holder of a nuclear licence to ensure that adequate financial resources are available for decommissioning and waste, commensurate with a facility-specific estimate that is periodically reviewed. Financial provision for disposal of spent fuel of the new units will be established after commissioning in accordance with the Waste Fund Bill which is expected to be enacted by 2029.

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Decommissioning is a critical lifecycle obligation, ensuring that the station and its associated facilities are placed in a safe end state, with no unacceptable radiological risk to the public, workers or the environment; contaminated systems, structures, components and areas must be decontaminated to levels acceptable for reuse, restricted use, transport or disposal at a licensed radioactive waste facility. Successful decommissioning requires early, integrated planning across technical, financial, human-resource, regulatory and stakeholder dimensions. A clear decommissioning strategy will define the intended end state, guide implementation, support adequate financial provision, and address factors beyond the operator's direct control, including national, provincial and local government requirements.

11.12 Remaining Work to Complete Project Development

A ministerial Section 34 determination will enable Eskom to undertake further development activities required to mature the feasibility and bankability assessment into a final market-tested, investment-grade business case. These activities will allow Eskom to commit to and support key internal and external workstreams before any construction decision is made, including:

a) Procurement and contracting strategy for a proposed EPC turnkey approach.
b) Issue Requests for Information (RFIs) for both large PWR and SMR technologies to gather information on technology and funding options and to firm up costs from the market. This will be followed by the issue of Requests for Proposals (RFPs) to the market.
c) National Treasury, PFMA and NERSA application activities.
d) Identification of options for funding.
e) Submission of the final Execution release approval business case to Eskom committees after conclusion of the RFI process.
f) Challenge the legal review application of the Duynefontyn site EA.
g) Obtain EA for the second site.
h) Localisation strategy development.

11.13 Schedule

11.13.1 Schedule Strategy and Overall Assessment

The NNBP schedule has been developed as an integrated programme schedule linking policy enablement, regulatory approvals, financing, procurement, supply-chain mobilisation, site development, construction, commissioning and commercial operation.

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The schedule is based on international nuclear programme experience, Eskom's PLCM requirements, IRP 2025 deployment assumptions, and lessons learnt from major infrastructure and nuclear projects both in South Africa and internationally.

The schedule has been structured around the following principles:

- Complete front-end development before major investment commitments.
- Alignment of regulatory, commercial and technical workstreams.
- Progressive reduction of uncertainty through stage-gate approvals.
- Fleet deployment at 12-to-18 month intervals to maximise learning effects and supply-chain continuity.
- Integration of transmission, funding and licensing schedules with nuclear construction schedules.
- Preservation of adequate schedule contingency at each phase.
- Continuous schedule-risk assessment and independent schedule assurance.

Based on the current assessment, no schedule-related fatal flaw has been identified. However, schedule performance remains highly dependent on regulatory approvals, financing arrangements, procurement execution, transmission infrastructure delivery, supply-chain readiness, disciplined programme governance, contractor performance during execution and the project team’s ability to deliver on its commitments.

Table 12: Integrated Programme Dependencies and Critical Path Milestones

Milestone	Key Dependency	Schedule Significance
Section 34 Determination	Ministerial approval process	Enables procurement
Environmental Authorisations	EIA completion, appeal resolution	Site development
Nuclear Installation Site Licences	NNR licensing reviews	Site readiness activities
RFI	Board Approval of strategy	Market intelligence and procurement basis
Procurement Strategy Approval	Governance approvals	Enables RFP issue
RFP	Section 34 determination	Vendor selection process
Preferred Vendor Selection	RFP evaluation	Technology, schedule and cost validation
Nuclear Construction Licence	Detailed licensing submissions	Enables first nuclear concrete
Long-Lead Equipment Procurement	Vendor award	Reactor and turbine manufacture
Transmission Reinforcement Projects	NTCSA implementation schedule	Power evacuation capability
First Nuclear Concrete	Licensing and financing approvals	Construction commencement
Mechanical Completion	Equipment manufacture and installation	Testing readiness

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Milestone	Key Dependency	Schedule Significance
Hot Functional Testing	Construction completion	Fuel-loading readiness
Fuel Loading	NNR approval	Commissioning progression
Commercial Operation Unit 1	Commissioning completion	First generation delivery
Commercial Operation Units 2 to 4	Fleet continuity and resource availability	Full programme delivery

Delays occurring in any of these activities are likely to propagate through the remainder of the programme and directly affect commercial operation dates.

11.13.2 International Nuclear Schedule Lessons Learned

A review of major nuclear programmes in Europe, North America, Asia and the Middle East shows that successful programmes demonstrate remarkably similar characteristics. Table 13 provides a summary of schedule related lessons from Nuclear projects worldwide.

Table 13: International Nuclear Schedule Lessons Learned

Project	Country	Schedule Outcome	Key Lesson
Barakah	UAE	Successful	Mature APR1400 design and strong governance
APR1400 Fleet	South Korea	Strong performance	Standardisation and fleet construction
Hualong One Fleet	China	Strong performance	Build repetition and supply-chain continuity
Olkiluoto 3	Finland	Major delay	Design immaturity and FOAK execution
Flamanville 3	France	Major delay	Quality and manufacturing challenges, new design
Vogtle 3 & 4	USA	Significant delay	Supply-chain and contractor capability weaknesses, new design
Hinkley Point C	UK	Extended schedule	Complexity and labour productivity constraints

11.13.3 South African Schedule Lessons Learned

Koeberg Steam Generator Replacement Project

The Koeberg Long-Term Operation programme and Steam Generator Replacement Project provide important local lessons relevant to NNBP. Table 14 provides a summary of schedule related lessons from the Koeberg Steam Generator Replacement projects.

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Table 14: Koeberg Schedule Lessons Learned

Lessons Observed (Key themes)	Context and Schedule Implication	Application to the NNBP
Early regulatory and stakeholder alignment	Early and continuous engagement with the regulator and key stakeholders improves clarity, supports timely decisions and reduces the risk of approval delays, regulatory rework and unresolved interfaces.	Engage the NNR and other relevant stakeholders early, maintain clear governance forums and integrate regulatory requirements into the programme schedule.
Integrated planning and programme controls	Detailed planning, realistic sequencing, critical-path management and integrated cost, schedule and risk controls are essential for identifying emerging constraints and protecting key milestones.	Maintain an integrated programme schedule covering licensing, engineering, procurement, construction and commissioning, supported by schedule-risk analysis, contingency planning and independent assurance.
Supply-chain and resource readiness	Long-lead equipment, constrained specialist resources and complex logistics require early procurement, continuous supplier oversight and advance workforce planning.	Secure manufacturing slots and critical resources early, monitor supplier performance and implement skills-development and localisation initiatives ahead of peak demand.
Interface and configuration management	Complex nuclear work depends on effective coordination across engineering, operations, contractors, suppliers, safety functions and regulators. Weak interface or design-change control can cause rework and delay.	Establish clear interface accountabilities, disciplined configuration management and formal change-control processes before major procurement and construction commitments.
Nuclear quality and execution readiness	Nuclear-quality documentation, inspection, testing and regulatory hold points directly influence activity duration. Failure to plan for these requirements can delay installation and commissioning.	Incorporate nuclear-quality requirements, inspection points, testing, documentation and regulatory witness activities into schedules and readiness reviews from the outset.

Medupi and Kusile Lessons

The Medupi and Kusile experience demonstrate that megaproject schedule performance depends on completing engineering before construction, controlling scope growth, maintaining clear design ownership and integrating schedule, cost and risk management. It also highlights the importance of contractor accountability, configuration control and independent assurance to prevent delay, rework and cost escalation. Table 15 provides a summary of schedule related lessons from the Medupi and Kusile projects.

Table 15: Medupi and Kusile Schedule Lessons Learned and Application to NNBP

Theme	Key Lesson Learned	Application to the NNBP
Front-End Engineering and Design Maturity	Significant schedule overruns occurred where engineering and design continued after construction commenced, resulting in rework and disruption to execution.	Complete FEED, technology assessment and design maturation before major procurement and construction commitments.

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Theme	Key Lesson Learned	Application to the NNBP
Scope, Configuration and Change Control	Changes to approved designs and expanding scope resulted in delays, cost growth and reduced schedule predictability.	Maintain disciplined scope definition, design-freeze milestones and rigorous configuration and change-control processes throughout the programme lifecycle.
Owner Capability and Governance	Effective delivery depended on a capable owner organisation with clear accountability, timely decision-making and strong project oversight.	Establish a dedicated, ring-fenced NNBP organisation with strengthened capability in engineering, licensing, commercial management, project controls and quality assurance.
Supply Chain, Contractors and Quality Management	Contractor performance issues, supply-chain constraints and quality defects were major contributors to delays and rework.	Implement robust supplier qualification, contractor management, nuclear-grade quality assurance and early long-lead procurement strategies.
Programme Integration and Risk Management	Delays often originated from weak interface management, insufficient programme controls and inadequate management of emerging risks.	Apply integrated programme controls, formal interface management, quantitative schedule risk analysis and independent assurance across all programme phases.

The lessons learnt from international nuclear projects, Koeberg's Long-Term Operation and Steam Generator Replacement programmes, and the Medupi and Kusile megaprojects confirm that schedule certainty for the NNBP will depend on disciplined front-end planning, early regulatory and stakeholder alignment, mature engineering definition, realistic procurement sequencing, effective interface management and strong owner oversight. The programme schedule should therefore remain indicative at feasibility stage and only be converted into a committed baseline once key approvals, market returnables, funding arrangements, execution strategy, owner capability and risk mitigations have been sufficiently matured and independently assured.

Successful nuclear programmes are typically distinguished by mature designs, standardised fleet deployment, strong owner capability, stable regulation, early procurement and disciplined change control. Conversely, delayed programmes are often affected by weak front-end planning, late design changes, poor interface management, regulatory rework, supply-chain constraints and quality or productivity challenges. The key lesson is that schedule performance is largely determined before construction starts, through the quality of planning, governance, design maturity and execution readiness.

Integrated Schedule Risk Register

The Integrated Schedule Risk Register in Table 16 below consolidates the principal schedule-related risks that may affect the timely delivery of the NNBP. It provides a structured basis for tracking risk causes, potential impacts, mitigation actions, ownership and monitoring requirements across the programme's critical path, approval sequence, procurement process, licensing activities and construction-readiness milestones.

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Table 16: Critical Schedule Risk Register

Risk	Potential Schedule Impact	Mitigation Strategy
Legal Challenges, Litigation and Regulatory Appeals	Judicial review or appeals against the Section 34 determination, environmental approvals, licensing decisions or procurement outcomes could delay critical programme milestones by several years.	Develop and maintain a robust administrative record, ensure procedural fairness, undertake transparent stakeholder engagement, proactively address objections, maintain legal readiness, and obtain independent reviews of key submissions before decisions are taken.
Licensing and Regulatory Delays	Delays in environmental authorisations, Nuclear Installation Site Licences, Nuclear Installation Licences and related regulatory approvals may postpone site readiness and construction commencement.	Maintain early and continuous engagement with regulators, submit mature licensing packages, align programme schedules with regulatory requirements, and undertake readiness reviews prior to key submissions.
Funding and Financial Close Uncertainty	Delays in securing funding, sovereign support, buyer arrangements or financial close could defer procurement, construction and commercial operation.	Progress funding and commercial strategies in parallel with project development, use market engagement to validate assumptions, mature funding models early and maintain continuous engagement with relevant financing stakeholders.
Technology, Supply Chain and Contractor Performance	Design immaturity, long-lead equipment delays, supply-chain constraints, contractor underperformance or quality failures can result in major schedule overruns during execution.	Prioritise proven technologies, complete front-end engineering before major commitments, secure long-lead manufacturing capacity early, implement rigorous vendor qualification, and maintain strong quality assurance and contractor oversight.
Owner Capability, Programme Integration and Infrastructure Readiness	Weak programme integration, delayed decision-making, inadequate owner capability or misalignment with transmission and supporting infrastructure delivery may create cumulative delays across multiple workstreams.	Maintain a dedicated and adequately resourced programme organisation, implement integrated programme controls, establish clear governance and interface-management structures, and align transmission and supporting infrastructure schedules with the nuclear programme.

The schedule assessment indicates that programme success will depend primarily on effective management of five critical risk areas: legal and regulatory challenges, licensing approvals, funding certainty, technology and supply-chain readiness, and programme integration. Experience from international nuclear projects and South African megaprojects demonstrates that these risks are the principal drivers of schedule performance. If proactively managed through robust governance, early stakeholder and regulatory engagement, disciplined front-end development, effective risk allocation and integrated programme controls, no schedule-related fundamental impediment has been identified.

Schedule Contingency and Confidence

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The current programme schedule is appropriate for a feasibility-stage assessment and should be regarded as indicative rather than a committed delivery baseline. Schedule confidence is expected to increase progressively as key uncertainties and programme risks are resolved, including legal challenges and litigation risk, environmental and nuclear licensing outcomes, the Section 34 determination process, technology selection, market returnables, funding and commercial arrangements, procurement outcomes, long-lead equipment availability, transmission infrastructure readiness, and finalisation of construction and delivery contracts. Particular attention will be required to legal and regulatory risks, as international and local megaproject experience demonstrates that litigation, appeals and regulatory review processes can have material impacts on project schedules. Prior to Execution Release Approval and Financial Close, a formal Quantitative Schedule Risk Assessment (QSRA) will be undertaken to determine appropriate schedule contingency, schedule confidence levels and critical-path sensitivities in accordance with international nuclear project delivery practices.

11.13.4 Schedule Feasibility Conclusion

The schedule assessment concludes that the NNBP is achievable, provided that international best practices for nuclear project delivery are consistently applied. Experience from successful global nuclear programmes demonstrates that schedule performance is primarily driven by mature front-end planning, standardised designs, strong governance, capable owner organisations and proactive risk management.

The key factors that will determine schedule success include the timely resolution of legal and regulatory challenges, achievement of required approvals and licences, disciplined project development, technology maturity and stability, early funding certainty, alignment of transmission and supporting infrastructure delivery, effective management of long-lead equipment and supply-chain constraints, robust programme controls, strong owner and contractor capability, rigorous quality assurance, and the preservation of fleet continuity to capture learning, productivity and standardisation benefits. Experience from major nuclear and infrastructure projects demonstrates that legal challenges, regulatory appeals, design changes, supply-chain disruptions and weak governance are among the most significant causes of schedule delay and must therefore be proactively managed throughout the programme lifecycle.

Based on the current assessment, no schedule-related disqualifying issue has been identified. Subject to effective management of these critical success factors, the programme schedule is considered feasible and capable of supporting the commissioning timelines envisaged in IRP 2025. Figure 12 and Figure 13 below provide a High-Level Schedule for the NNBP.

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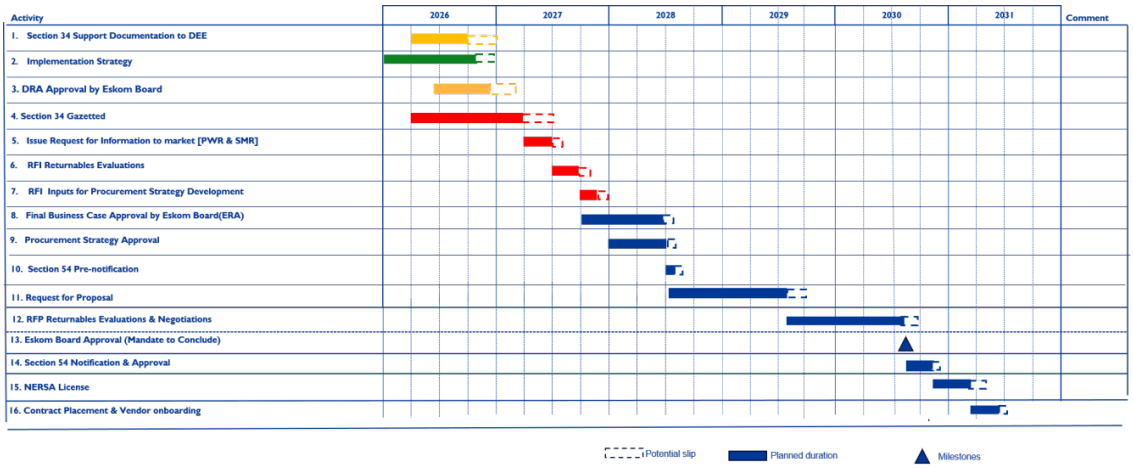

Figure 12: High-Level Plan for NNBP

Some of the project mitigations include early regulatory engagement, proactive stakeholder management, advance procurement strategies, proven technology selection, strong governance, and appropriate schedule and risk contingencies.

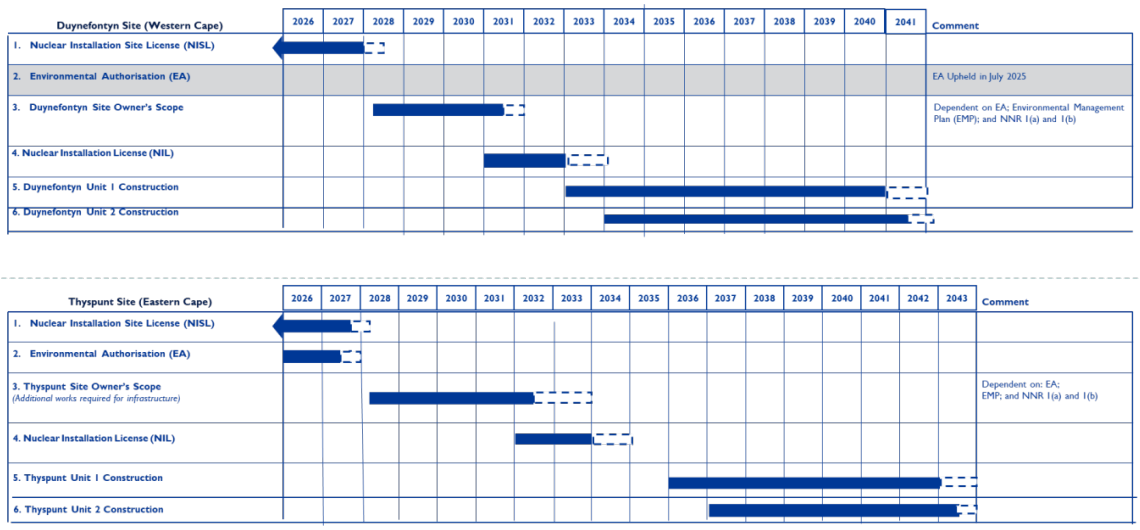

Figure 13: Specific site milestones for Duynefontyn and Thyspunt

12 Conclusions and Recommendations

The material assembled in this report supports the continued and structured development of the NNBP. Eskom's Board resolved on 29 April 2026 to authorise the initiation of the process under Section 34 and on 28 August to authorise the implementation strategy for the NNBP. Eskom accordingly submits this report to the Minister for consideration of a determination for new generation

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capacity of 5 200 MW derived from nuclear power technology, to be established at one or more sites which obtain every required approval.

This report does not represent that the programme is affordable at any particular tariff, that it is bankable, or that it is ready for construction. Those conclusions will depend upon the market process, upon the tariff, financing and off-take arrangements, and upon the approvals identified in this report, and the final investment decision will be taken only when they have been established. The matters which this report defers to those later stages, and the conditions which must be satisfied before further commitments are made, are set out.

As set out in IRP 2025, the NNBP is aligned to South Africa's long-term energy security, decarbonisation and energy mix diversification objectives. The programme has a clear policy basis under NEP2008 and an IRP 2025 capacity allocation of 5 200 MW. Preparatory work has progressed materially, particularly with respect to environmental authorisations, licensing submissions, technical readiness and site strategy. The Front-End Engineering Design (FEED) will continue and remains a key risk mitigation measure, applying lessons learned from previous Eskom mega projects to improve project maturity, reduce execution risk, and enhance cost and schedule certainty before construction.

The programme has reached a phase where every feasible funding, financing, ownership or procurement model is being identified and assessed, however, the programme is not yet at a stage where a final funding, financing, ownership or procurement model should be selected.

Eskom should proceed with a phased approach to market engagement, scenario evaluation, and bankable business-case development. This approach mitigates historical legal and megaproject risks by strengthening front-end planning, public participation, regulatory readiness, owner capability, market-tested costing and governance discipline.

A Section 34 determination would enable Eskom to complete the remaining development work necessary for a robust, market-tested and bankable NNBP business case. Final investment approval should only be sought once market returnables, affordability implications, financing structures, regulatory approvals, localisation commitments, execution strategy and risk mitigation measures have been fully assessed.

The report therefore distinguishes between the current feasibility assessment required to support a Section 34 determination and the final investment-grade business case that will be developed after market returnables, affordability implications, financing structures, regulatory approvals, localisation commitments, execution strategy and risk mitigation measures have been assessed.

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13 Development Team



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15 Document Acknowledgement

By signing this document, the people listed record their agreement to the contents of this document.

Legal and Regulatory:



Project Development:



Finance:



Environment:



Project Management:



Project Director:



Chief Nuclear Officer



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APPENDIX A: SWOT and PESTEL Analysis

Table 17: SWOT Analysis

SWOT category	Key factor	Summary assessment	Strategic consideration for strengths and opportunities and mitigations for weaknesses and threats
Strengths	Long-term dispatchable baseload generation	Nuclear generation can provide continuous, firm and dispatchable electricity over extended operating periods, independent of prevailing weather conditions or the availability of solar and wind resources. This enables nuclear capacity to support system adequacy during periods of reduced VRE output. For the NNBP, its principal strategic value is its potential to replace a portion of the dispatchable baseload capacity that will be progressively lost as ageing coal-fired power stations are retired.	Supports long-term security of electricity supply by providing firm, dispatchable baseload generation that can operate continuously and reduce exposure to supply gaps as ageing fleet is progressively retired. This strength is particularly important in a system with increasing VRE penetration, because nuclear generation can provide predictable output when wind and solar resources are unavailable or constrained. From an energy justice perspective, the strategic value is that reliable supply protects households, public services, essential industries and vulnerable communities from the disproportionate economic and social impacts of load shedding and unserved energy. Eskom should therefore ensure that this strength is reflected in system-planning, affordability, grid-integration and just-transition assessments, while confirming that the timing, cost and implementation pathway remain aligned with the IRP, Section 34 determination process and subsequent regulatory approvals.
Strengths	Grid stability and system reliability	As the adoption of wind and solar generation increases, the power system will require adequate controllable generation, operating reserves and network capability to maintain the real-time balance between supply and demand. Nuclear generation provides predictable, firm and dispatchable output that can support grid stability, strengthen system reliability and complement VRE within a diversified generation portfolio.	Strengthen system adequacy and resilience by recognising nuclear generation as a firm, controllable and dispatchable resource capable of supporting the real-time balance between electricity supply and demand. This contribution is particularly important as VRE penetration increases, because the system will require dependable capacity, operating reserves, voltage and frequency support, and sufficient network capability to manage periods of low wind or solar output. Eskom should therefore assess the NNBP not only on a plant-level cost basis, but also on its system value in maintaining reliability, reducing the risk of unserved energy, supporting grid stability and enabling an orderly transition to a more diversified low-carbon generation mix.

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SWOT category	Key factor	Summary assessment	Strategic consideration for strengths and opportunities and mitigations for weaknesses and threats
Strengths	Koeberg experience and capability	South Africa has nuclear operating experience through Koeberg and established nuclear institutions, professional capability and regulatory experience. This gives the NNBP a stronger starting point than a country introducing nuclear power for the first time. Existing capability must still be assessed against the larger demands of a new-build programme. Eskom has operated the two units since 1984 and 1985 under the licence and oversight of the NNR, which has granted long-term operation licences for both.	Provides a base for owner capability, licensing, operations readiness and knowledge transfer, while highlighting the need to retain and rebuild scarce skills.
Strengths	Existing programme development base	Eskom has developed a substantial programme development foundation through prior work on nuclear siting, environmental assessments, licensing processes, technical specifications and programme planning. This body of work provides institutional knowledge and a practical basis for progressing the NNBP, subject to confirmation that the relevant studies, authorisations and technical inputs remain legally valid, technically current and applicable to the present programme scope.	The existing programme development base provides a substantive foundation for the NNBP through prior studies, authorisations, technical specifications and programme-planning work. Its value lies in preserving institutional knowledge, reducing duplication of earlier development effort and providing a practical starting point for further programme maturation, subject to confirmation that the relevant inputs remain current, legally valid and applicable to the present programme scope. The site-neutral nature of the proposed determination is consistent with this position, as prior site-related work informs programme readiness without constituting final site selection.

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SWOT category	Key factor	Summary assessment	Strategic consideration for strengths and opportunities and mitigations for weaknesses and threats
Weaknesses	Affordability and financing exposure	The NNBP entails substantial upfront capital expenditure, a prolonged pre-revenue development and construction period, exposure to foreign currency movements and sensitivity to financing costs and schedule delays. These factors may affect Eskom's balance sheet, customer tariff outcomes and potential fiscal support requirements, particularly in circumstances where conventional funding routes are constrained by Eskom's financial position.	The affordability and financing exposure will be mitigated through a disciplined, risk-adjusted and market-tested financial model that is progressively refined as the programme matures. The model should define the proposed funding structure, revenue framework, off-take arrangements and risk allocation principles, and will be stress-tested against foreign exchange movements, interest-rate volatility, construction delays and disruptions, cost escalation and interest during construction (IDC). It should also assess the potential tariff, fiscal and distributive impacts so that affordability is evaluated on a whole-system basis and not only by reference to plant-level cost.
Weaknesses	Long and complex development path	The programme requires careful sequencing and coordination across policy, public participation, site development, environmental authorisation, nuclear licensing, procurement, financing, transmission integration and construction readiness. Inadequate sequencing, immature submissions or weak interface management may result in delays, rework and increased implementation risk.	The long and complex development pathway will be mitigated through an integrated programme schedule that identifies the critical path across policy approvals, environmental authorisation, nuclear licensing, public participation, procurement readiness, financing, transmission integration and construction preparation. The programme will be managed through clear stage-gate controls, defined decision points, disciplined interface management and early engagement with the NNR and other competent authorities, so that approvals, submissions and commitments are properly sequenced before material procurement or investment obligations are incurred.
Weaknesses	New-build owner capability	South Africa has established nuclear operating experience but limited recent experience in delivering a new nuclear build programme of this scale and complexity. Specialist project delivery, design authority, licensing, nuclear quality, commercial, project controls and owner-engineer capabilities may be limited, dispersed or require reinforcement for effective programme execution.	The new-build owner capability risk will be mitigated through the establishment of a dedicated, properly resourced and independently assured programme organisation with clear authority, accountability and governance arrangements. Eskom should retain and strengthen intelligent-owner capability in nuclear safety, design authority, licensing, engineering, procurement, project controls, commercial management and construction oversight, while using specialist external support and structured knowledge-transfer arrangements to build sustainable internal capability over the life of the programme.

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SWOT category	Key factor	Summary assessment	Strategic consideration for strengths and opportunities and mitigations for weaknesses and threats
Opportunities	Alignment with IRP 2025	The NNBP is linked to the national electricity planning framework rather than being an isolated corporate initiative. This provides a policy basis for programme development. Eskom recognises, however, that the IRP allocation does not constitute final investment approval, procurement authority, environmental authorisation or a nuclear installation licence.	The NNBP is aligned with the IRP 2025 planning framework, which identifies new nuclear capacity as part of South Africa's diversified long-term generation mix. This alignment provides a national policy and system-planning basis for the programme by linking the proposed capacity to the IRP allocation, projected system requirements, transmission planning considerations and the subsequent statutory approvals required under the Section 34 process, environmental legislation, nuclear licensing framework and applicable governance requirements. The IRP allocation supports the strategic rationale for the programme, while recognising that procurement, investment and construction decisions remain subject to the prescribed approval processes.
Opportunities	Aging fleet retirement	The NNBP provides an opportunity to replace a portion of the firm dispatchable capacity that will be lost as coal-fired power stations are progressively retired. It also supports a more diversified long-term generation portfolio by contributing reliable, low-carbon capacity that can strengthen security of supply and system resilience. SMR deployment at decommissioned coal stations may be able to reuse existing grid infrastructure, which may reduce the exposure of that component of the programme to grid-development constraints, subject to confirmation by the National Transmission Company.	The coal replacement and energy security opportunity is supported by the need to replace retiring coal-fired dispatchable capacity with reliable, low-carbon generation that contributes to long-term system adequacy. Updated demand projections, coal-retirement assumptions, transmission requirements and portfolio modelling provide the factual basis for assessing the timing, scale and system value of the NNBP relative to no-build, delayed-build and alternative generation portfolio outcomes.

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SWOT category	Key factor	Summary assessment	Strategic consideration for strengths and opportunities and mitigations for weaknesses and threats
Opportunities	Coal plant just energy transition and local development	Appropriately located SMR deployment at coal stations can support just energy transition and repowering and repurposing strategies by creating alternative employment, supplier development, industrial and skills opportunities in communities affected by coal retirement. The extent of these benefits will depend on site suitability, technology selection, localisation commitments and the ability to translate programme opportunities into measurable local development outcomes.	The just energy transition and local development opportunity arises from the programme's potential to create alternative employment, supplier development, industrial participation and skills-development benefits in communities affected by coal retirement. Its value depends on independently assessed site suitability, clearly identified affected groups, place-based development opportunities, measurable socio-economic outcomes and meaningful community participation in decisions that may affect local livelihoods and development pathways.
Opportunities	Industrialisation and skills potential	A sustained nuclear programme has the potential to strengthen South Africa's industrial base by supporting specialised engineering, nuclear-grade manufacturing, construction capability, quality assurance, professional services and long-term operational skills. These capabilities may create broader economic value beyond the nuclear sector through supplier development, technology transfer and the development of high-value technical expertise.	The industrialisation and skills value of the NNBP is linked to the programme's ability to develop nuclear-grade supplier capability, specialised engineering capacity, construction expertise, quality assurance competence and long-term operational skills. This strength is realised through capability-based localisation, structured supplier qualification, technology transfer and measurable employment, skills-development and supplier-development outcomes, supported by evidence-based commitments rather than unsupported localisation percentages or unverified benefit claims.

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SWOT category	Key factor	Summary assessment	Strategic consideration for strengths and opportunities and mitigations for weaknesses and threats
Threats	Litigation and legal challenge	Legal challenge may delay, constrain or invalidate an enabling decision where the administrative record is incomplete, stakeholder participation is fragmented, material considerations are not adequately addressed, or the determination is perceived to prejudge site selection, technology choice or procurement outcomes.	The litigation and legal challenge risk will be mitigated through a complete, current and defensible administrative record that demonstrates lawful decision-making, proper consideration of material factors and alignment with the applicable statutory framework. Public participation should be coordinated, transparent and meaningfully documented, with all substantive comments, objections and responses recorded in a traceable evidence register. The proposed determination should remain site-neutral and technology-neutral to avoid any perception that it prejudges site selection, technology choice or procurement outcomes before the required environmental, nuclear, procurement and governance approvals are obtained.
Threats	Delays	Project delays may arise where design, site or safety information is insufficiently mature, statutory processes are poorly sequenced, institutional interfaces are not effectively managed, or engagement with the relevant regulators occurs too late in the programme development cycle.	The project delay risk will be mitigated through an integrated risk management strategy that sequences all statutory submissions, approvals and dependencies across the Section 34 process, environmental authorisations, nuclear licensing, water-use approvals, transmission integration and related governance requirements. Early and structured engagement with the NNR, DFFE, NERSA, National Treasury, NTCSA and other competent authorities should be maintained to clarify information requirements, reduce rework and ensure that submissions are sufficiently mature before formal lodgement. The programme should also maintain a consolidated regulatory schedule, supported by accountable workstream owners, decision milestones and escalation mechanisms for resolving inter-agency dependencies.

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SWOT category	Key factor	Summary assessment	Strategic consideration for strengths and opportunities and mitigations for weaknesses and threats
Threats	Public opposition and reputational risk	Public opposition may arise from concerns regarding affordability, governance, nuclear safety, radioactive waste management, site-specific biodiversity impacts, socio-economic impacts, alternatives assessment and the fair distribution of costs and benefits. Addressing such concerns on their merits is essential to maintaining public confidence, procedural fairness and the programme's social licence to operate.	The public opposition and reputational risk will be mitigated through a thorough a credible stakeholder engagement and communication strategy that is transparent, inclusive, evidence-based and responsive to community concerns. Eskom should maintain a formal comment-and-response process that records each substantive objection, identifies the evidence considered, explains how the concern has been addressed and records any resulting programme adjustment. Communication should address affordability, governance, safety, radioactive waste, environmental and social, site impacts, alternatives and energy justice considerations in clear and accessible language, while ensuring that unresolved residual issues are accurately disclosed and managed through the appropriate statutory processes.
Threats	Cost and schedule escalation	Cost and schedule escalation may result from insufficient front-end definition, design changes, interface failures, financing delays, supply-chain constraints, regulatory slippage or delays in supporting infrastructure. Such escalation may increase the overall programme cost, defer the realisation of system benefits and adversely affect affordability and public confidence.	The cost and schedule escalation risk will be mitigated through disciplined front-end planning, stage-gate governance and integrated project controls that establish clear requirements for scope definition, design maturity, cost estimating, schedule baselining, contingency and change control before major commitments are made. Independent assurance should be applied to cost, schedule, constructability, procurement readiness and risk allocation, with specific accountability for owner, vendor, contractor and interface obligations. The contracting strategy should allocate design, delivery, performance and delay risks to the parties best able to manage them, while maintaining transparent reporting of cost movements, schedule variance and emerging delivery risks.

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SWOT category	Key factor	Summary assessment	Strategic consideration for strengths and opportunities and mitigations for weaknesses and threats
Threats	Waste and intergenerational liability	Inadequate planning, funding or institutional provision for spent fuel, radioactive waste management, decommissioning, remediation and long-term environmental stewardship may transfer residual financial, technical and regulatory obligations to future generations.	The waste and intergenerational liability risk will be mitigated through a lifecycle management strategy that addresses spent fuel, radioactive waste, decommissioning, site remediation and long-term environmental stewardship from the earliest stages of programme development. The business case should identify the responsible institutions, technical pathways, regulatory obligations and financial provisioning arrangements required to ensure that lifecycle liabilities are funded, monitored and governed over the full operating and post-operating life of the facilities. Any residual uncertainty or unfunded exposure should be expressly disclosed, tracked through programme stage gates and updated as technology selection, licensing conditions and waste-management arrangements are progressively defined.

Table 18: PESTEL Analysis

Dimension	Summary assessment	Adopted response or mitigation
Political	IRP 2025 provides the national planning context for the NNBP and links the programme to South Africa's energy-security, economic-development and industrialisation objectives. The political dimension is therefore characterised by the need for continued alignment between Government, Eskom and competent authorities, while recognising that geopolitical relationships may influence technology access, supplier participation, export controls, financing arrangements and nuclear fuel services.	The political response is to maintain clear institutional alignment between Government, Eskom and the competent authorities through defined roles, an updated approvals map and technology-neutral decision criteria. Geopolitical, supplier, export-control, financing and fuel-service dependencies will be assessed before any binding commitment is made, while preserving lawful competition, constitutional principles associated with procurement alternative supplier options and consistency with the IRP 2025 planning framework.
Economic	The economic dimension reflects the programme's potential to support long-term electricity security, industrial development, employment creation and localisation, while also requiring substantial upfront capital investment. The affordability and bankability of the NNBP will depend on the financing structure, cost of capital, exchange-rate exposure, construction duration, revenue arrangements and the extent of Eskom or State financial support. Any assessment of economic benefit must also consider the distribution of costs and benefits across consumers, taxpayers, affected communities and future users of the electricity system.	The economic mitigation is to apply a market-tested, risk-adjusted affordability and bankability assessment that considers plant-level costs, whole-system costs, tariff impacts, fiscal exposure, foreign-exchange risk, financing tenor, construction duration and lifecycle obligations. Funding, revenue and off-take arrangements will be developed only through the applicable approval processes, supported by sensitivity analysis and a distributional assessment of impacts on consumers, taxpayers, affected communities and future users of the electricity system.

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Dimension	Summary assessment	Adopted response or mitigation
Social and Energy Justice	The social and energy-justice dimension reflects the programme's potential to create employment, develop specialist skills, support localisation and contribute to transition opportunities in areas affected by coal retirement. It also recognises that communities and consumers may raise concerns regarding nuclear safety, affordability, governance, radioactive waste, site-specific impacts and the equitable distribution of programme costs and benefits. Host communities, transition communities and vulnerable consumers may experience different impacts and therefore require distinct consideration in the feasibility assessment.	The social and energy-justice response is to undertake meaningful, accessible and properly documented stakeholder participation, supported by a clear stakeholder and vulnerability map. The programme should assess the distribution of costs, benefits and risks across host communities, coal-transition communities, vulnerable consumers, workers and future generations. Local benefit, skills-development and supplier-development commitments should be measurable, evidence-based and capable of being monitored, while all substantive objections should be addressed on their merits through a transparent comment-and-response process.
Technological and Operational	The technological and operational dimension is informed by Eskom's experience in operating Koeberg's two PWR units under NNR oversight, together with the regulatory, engineering, operating and training capability developed through that experience. This existing capability provides a relevant foundation for the NNBP, but it must be assessed against the distinct demands of a new nuclear build programme, including technology maturity, design standardisation, licensing readiness, supply-chain capability and the need to maintain operational performance at Koeberg.	The technological and operational mitigation is to separate the NNBP delivery organisation from Koeberg's operating requirements, while retaining the benefit of Eskom's existing nuclear operating experience. The programme should be supported by dedicated resources, independent assurance, strengthened intelligent-owner capability, and clear criteria for technology maturity, design standardisation, licensing readiness, supply-chain capability, constructability and operational maintainability. This approach enables the programme to build on Koeberg-related experience without compromising ongoing operational performance.
Environmental	The environmental dimension reflects nuclear generation's potential contribution to firm, low-carbon electricity supply, while recognising that the programme must address lifecycle environmental impacts. These include land use, water and cooling requirements, biodiversity, construction effects, radioactive waste, spent fuel management, decommissioning and long-term environmental stewardship. Site-specific impacts must be assessed through the applicable environmental, water-use, coastal, waste-management and nuclear licensing processes and cannot be resolved through general claims regarding the low-carbon nature of nuclear technology.	The environmental mitigation is to manage the programme through an integrated environmental, water-use, coastal, waste-management and nuclear licensing roadmap. Baseline studies, cumulative-impact assessments, climate-resilience considerations, biodiversity impacts, water and cooling requirements, construction effects, spent fuel, radioactive waste and decommissioning obligations should be addressed through the applicable statutory processes. Environmental commitments should be translated into design, procurement, construction and operational controls, with adequate financial provision for long-term stewardship.

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Dimension	Summary assessment	Adopted response or mitigation
Legal and Regulatory	The legal and regulatory dimension reflects that the NNBP is subject to the Electricity Regulation Act and the Section 34 determination process, the NNR Act framework, environmental and water legislation, public-finance requirements, procurement law and multiple statutory authorisations. Legal and regulatory risk may arise where the administrative record is incomplete, consultation is fragmented, reasons are inadequate, material objections are not properly addressed, or submissions are made before the relevant technical, site, safety and regulatory information is sufficiently mature.	The legal and regulatory mitigation is to maintain a complete, current and defensible administrative record that demonstrates compliance with the Electricity Regulation Act, the Section 34 process, the NNR framework, environmental and water legislation, public-finance requirements, procurement law and all applicable statutory approvals. The programme should use a consolidated approvals schedule, evidence register, clear decision rights and coordinated public participation process to reduce litigation and regulatory-delay risk. Any determination should remain appropriately framed so that it does not prejudge final site selection, technology choice, procurement outcome or investment approval before the competent authorities have completed the required processes.

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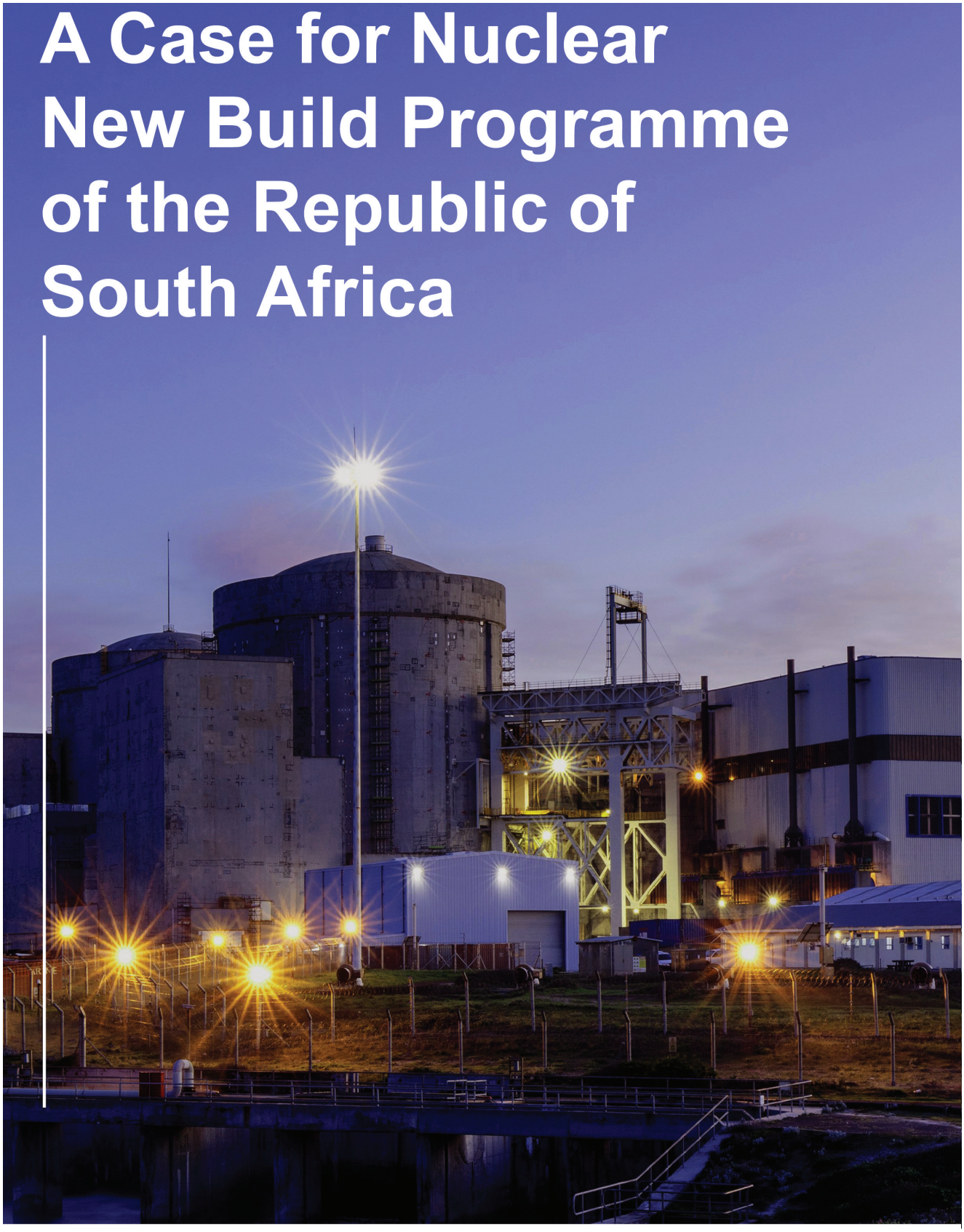
A Case for Nuclear New Build Programme of the Republic of South Africa



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A Case for Nuclear New Build Programme of the Republic of South Africa

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1 EXECUTIVE SUMMARY

Purpose. This report sets out the Government position and rationale for the Nuclear New Build Programme (NNBP), a programme that positions South Africa to secure dependable, low-carbon power for the long term. It supports the Ministerial section 34 determination for 5 200 MW of new nuclear capacity under the gazetted Integrated Resource Plan 2025 (IRP 2025), Government Notice 6767, 28 October 2025. The IRP provides for this capacity by 2039, as part of more than 105 000 MW of new generation. The Nuclear Energy Policy of 2008 is the policy foundation. It names Eskom as the main owner and operator of nuclear power plants in South Africa, with Eskom keeping the controlling shareholding in any PPP.

Case for nuclear. Nuclear is firm, low-carbon generation that strengthens security of supply and grid stability as ageing coal capacity retires. South Africa is well placed to deliver it, with Koeberg operating experience, uranium resources, an established legislative and regulatory framework, and strong non-proliferation credentials.

Technology. The programme comprises 4 800 MW of pressurised water reactors (PWRs) and 400 MW of small modular reactors (SMRs). PWRs are the preferred choice for large units, offering a proven and widely supplied technology. SMRs follow a parallel pathway for modular deployment and coal-station repurposing, subject to technology maturity, licensing and affordability.

Sites and grid. Duynefontyn and Thyspunt are the primary sites, with Bantamsklip as the alternative to Thyspunt. Environmental and site-licence decisions are expected in 2027, and the Duynefontyn authorisation remains under legal review. Earlier grid studies are no longer valid, so grid readiness is a critical-path item.

Fuel cycle, waste and safeguards. A 5 200 MW programme does not, on its own, justify conversion, enrichment, or fuel-fabrication plants. These will be reassessed under the Nuclear Fuel Cycle Strategy and Nuclear Industrialisation Plan. The National Back End Strategy adopts direct disposal of used fuel and calls for a Radioactive Waste Management Fund. NPT, IAEA safeguards and security obligations will be embedded from pre-procurement through decommissioning.

Industrialisation and skills. About 30% localisation is achievable for a two-PWR programme. The indicative workforce peaks at 15 000–25 000 construction workers and 2 500–3 500 permanent operational staff, subject to validation. Artisan and craft skills are scarce.

Affordability and conditions. State support is neither automatic nor unlimited, and no amounts or affordability conclusion are established. A section 34 determination is not evidence of affordability and does not displace PFMA controls. The report supports preparatory work and non-binding market engagement, not unconditional procurement readiness. The recommendation is to allow allow Eskom to test the market for real market values in the build-up towards procurement. The full

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5 200 MW envelope and the first phase require separate scope, affordability and readiness decisions. It is important to support the proposed Ministerial section 34 determination to enable Eskom to test the market and obtain the information required to procure the nuclear new build programme.

Way forward. Convert Eskom's feasibility study into an IRP 2025 roadmap with decision gates for:

- policy and section 34 determinations;
- site and grid readiness;
- licensing;
- procurement;
- financing;
- localisation.

Implement a coordinated PWR and SMR procurement pathway, maintain a living risk register, and uphold the Owner and Operator principle in line with Government Policy. Ensure proper coordination through the NEPIO structure as a single point of contact.

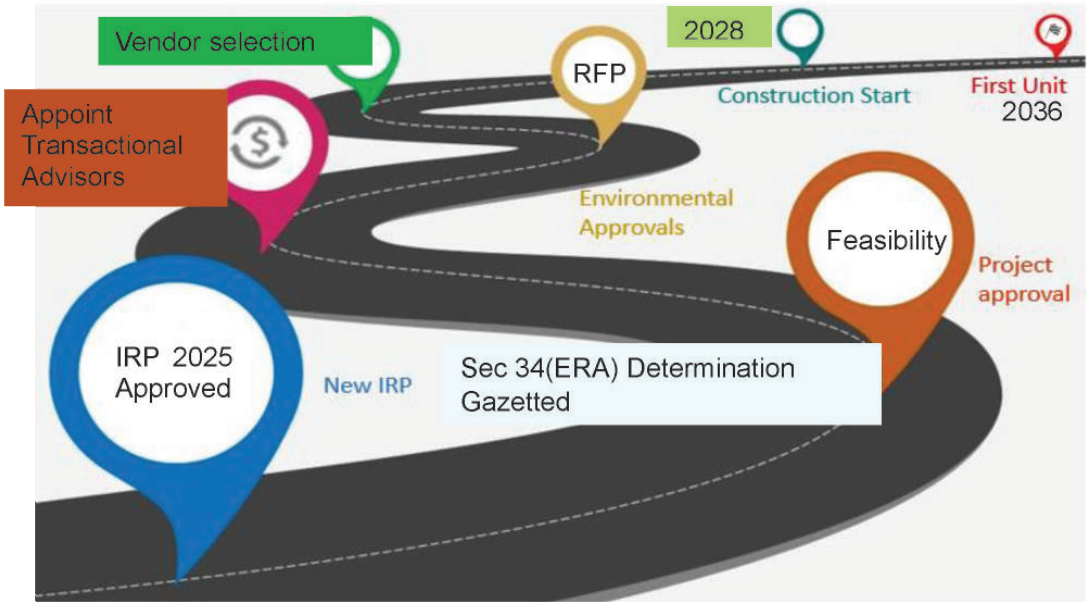

Figure 1: Diagram illustrating the envisaged Nuclear New Build Roadmap for 5200MW implementation (Refer to Eskom's Feasibility Report for a detailed roadmap)

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2 INTRODUCTION AND SCOPE

2.1 Scope of the Report

This report serves as a motivation and case for implementing 5 200MW of NNBP, including Decision 4 of the IRP2025, in support of the Nuclear Energy Policy of 2008. The report outlines how the NNBP will be implemented through a structured, phased approach, in line with the IAEA milestone approach and within the applicable legal framework in the Republic.

2.2 Background and Purpose

South Africa is one of the most experienced nuclear energy countries in the world. It has benefited from nuclear energy since the dawn of the nuclear era. In 1948, the Atomic Energy Board was established for uranium mining and trade. The country's strength in nuclear energy is underpinned by key infrastructure, expertise, education and training and nuclear-related research. In 1965, the first nuclear research reactor was commissioned at Pelindaba, west of Pretoria, known as SAFARI-1, or South African Fundamental Atomic Research Installation; this reactor is currently one of the top three producers (out of over 200 research reactors) of medical radioisotopes. These isotopes are used in over 30 million medical procedures worldwide.

South Africa proudly holds the distinction of being the first and only country to voluntarily disarm its nuclear weapons program. Demonstrating its commitment to peaceful use of nuclear energy, South Africa's research facilities at Necsa achieved a significant milestone in 2009 by becoming the first to successfully implement large-scale production of radioisotopes using exclusively Low Enriched Uranium (LEU), a grade of uranium that cannot be used in nuclear weapons.

Koeberg Nuclear Power Station (KNPS), located near Cape Town, houses the 2 nuclear power reactors in Africa. Each unit (Unit 1 and 2) has a net electrical capacity of approximately 940 MW (Megawatts). Together, they supply about 4.2% of South Africa's total electricity needs, significantly contributing to electricity stability in the Western Cape. With no viable coal power stations for base-load electricity in the region, and despite potential from other sources such as gas, these reactors have been pivotal in providing stable, affordable electricity for the region for approximately four (4) decades. The safety record of these nuclear reactors is on par with the best in the world. The plant adheres to a robust Nuclear Safety Culture and implements the ALARA (As Low As Reasonably Achievable) principle, ensuring continuous improvement in safety and radiation dose minimisation.

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3 LEGISLATION – ACTS AND REGULATIONS

3.1 NUCLEAR ENERGY POLICY, 2008

Sets out the government's 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.

3.2 RADIOACTIVE WASTE MANAGEMENT POLICY AND STRATEGY OF 2005

Originally published in 2005 by the Department of Minerals and Energy, the National Radioactive Waste Management Policy and Strategy for the Republic of South Africa laid the foundation of South Africa's radioactive waste management programme. It is now overseen by the Department of Electricity and Energy (DEE). This framework establishes the core principles that South Africa implements through state-owned institutions to ensure public and environmental safety.

The policy governs all forms of radioactive waste, except operational liquid and gaseous effluents (waste discharges). These routine operational releases are excluded from this specific scope because they are regulated and authorised directly by the National Nuclear Regulator (NNR) and the South African Health Products Regulatory Authority (SAHPRA).

Ultimately, this policy and strategy allow South Africa to advance its nuclear programme while strictly upholding the "Polluter Pays Principle" across all waste management operations, protecting future generations from the burden of long-term radioactive waste management.

3.3 NATIONAL BACK-END STRATEGY

The recently approved National Backend Strategy (2026) serves as the official implementation roadmap for managing used/spent nuclear fuel (UNF/SNF) and high-level waste (HLW).

3.4 NUCLEAR ENERGY ACT 46 OF 1999

Establishes the South African Nuclear Energy Corporation to undertake and promote research and development in nuclear energy and radiation sciences and technology. It also provides for responsibilities for implementing and applying the Safeguards Agreement and any additional protocols entered into by the Republic and the International Atomic Energy Agency in support of the Nuclear Non-Proliferation Treaty acceded to by the Republic.

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3.5 NATIONAL NUCLEAR REGULATOR ACT 47 OF 1999, AS AMENDED

The National Nuclear Regulator Act (NNRA), No. 47 of 1999, provides for the establishment of a National Nuclear Regulator to regulate nuclear activities. It also defines the objects and functions of the NNR and the way it is to be managed and governed. Most importantly, it provides a framework for safety standards and regulatory practices for the protection of persons, property, and the environment against nuclear damage, and for matters connected therewith. More specifically, some important elements of the NNRA are defined in the various subsections below:

Section 5: The responsibility of the National Nuclear Regulator is to provide for the protection of persons, property and the environment against nuclear damage through the establishment of safety standards and regulatory practices and to exercise regulatory control related to safety over the siting, design, construction, operation, manufacture of component parts and decontamination, decommissioning and closure of nuclear installations and other actions to which this Act applies. These include radioactive waste management facilities associated with nuclear power stations, nuclear fuel cycle facilities, and facilities that mine and process radioactive ores and minerals.

Section 6: The Regulator must conclude co-operative governance agreements with every relevant organ of state, as defined in section 239 of the Constitution, on which functions in respect of the monitoring and control of radioactive material or exposure to ionising radiation are conferred.

Section 7(1)(h): The National Nuclear Regulator acts as the national competent authority for the International Atomic Energy Agency's Regulations for the Safe Transport of Radioactive Material.

3.6 ELECTRICITY REGULATION ACT 4 OF 2006

Establishes a national regulatory framework for the electricity supply industry and makes the National Energy Regulator of South Africa (NERSA) the custodian and enforcer of the national electricity regulatory framework. It also provides for the regulation of generation, transmission, distribution, reticulation, trading and the import and export of electricity through licences and registration and regulates the reticulation of electricity by municipalities.

3.7 NATIONAL ENERGY ACT 34 OF 2008

Provides for energy planning and security of supply to ensure uninterrupted supply of energy to the Republic and ensure that diverse energy resources are available, in sustainable quantities and at affordable prices, to the South African economy in support of economic growth and poverty

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alleviation, taking into account environmental management requirements and interactions amongst economic sectors.

3.8 NATIONAL RADIOACTIVE WASTE DISPOSAL INSTITUTE ACT 53 OF 2008

The National Radioactive Waste Disposal Institute Act (NRWDI Act), No. 53 of 2008, provides for the establishment of a National Radioactive Waste Disposal Institute to manage radioactive waste disposal on a national basis. The NRWDI Act defines the functions and how the NRWDI is to be managed, regulates its staff matters, and provides for matters connected therewith. More specifically, some important elements of the NRWDI Act are defined in the various subsections below:

Chapter 2: This chapter establishes the Institute as a wholly owned State entity and outlines the functions of the Institute, Ancillary powers, Management of the affairs of the Institute, financial management, funding, Board of Directors and General Management. This chapter also deals with assets, rights, liabilities, obligations, licences and authorisations regarding the Vaalputs National Radioactive Waste Disposal Facility, which is currently operated by the South African Nuclear Energy Corporation.

Chapter 3: This chapter deals with applications for a radioactive waste disposal certificate, the conditions relating to such a certificate, and the responsibilities of generators of radioactive waste. The Institute is responsible for developing the waste acceptance and disposal criteria (WAC) in compliance with the applicable regulatory safety requirements and any other technical and operational requirements. The generators of radioactive waste are responsible for financial, technical and administrative management of wastes at their premises and when such wastes are transported to an authorised disposal facility. The generators of waste have the responsibility of complying with the waste acceptance criteria as developed by the Institute
Provides for the establishment of the National Radioactive Waste Disposal Institute to manage radioactive waste disposal on a national basis.

3.9 NATIONAL ENVIRONMENTAL MANAGEMENT ACT 107 OF 1998 (NEMA)

NEMA makes provision for co-operative environmental governance. This Act deals with Environmental Impact Assessments and related records of decision which are required for any designated facilities. Operators of nuclear facilities apply for relevant permits from the Department of Forestry, Fisheries and the Environment before construction of facilities.

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3.10 INTEGRATED RESOURCE PLAN, 2025

The Integrated Resource Plan 2025 is South Africa's updated electricity infrastructure development plan. It provides the planning basis for balancing security of supply, affordability, environmental commitments and system flexibility. The plan confirms the need for a diversified energy mix and identifies more than 105 000 MW of new generation capacity by 2039. Within this framework, IRP 2025 includes 5 200 MW of new nuclear generation capacity by 2039 (Decision 4), with scope for further nuclear capacity to be assessed through the nuclear industrialisation plan.

3.11 ELECTRICITY REGULATIONS ON NEW GENERATION CAPACITY, 2020

The Electricity Regulations on New Generation Capacity, 2020, were amended to allow municipalities in South Africa to develop their own power generation projects, provided they meet certain requirements. These amendments aim to facilitate the planning and procurement of new generation capacity in line with the Integrated Resource Plan (IRP) and municipal Integrated Development Plans (IDPs). Municipalities must be in good financial standing and submit feasibility studies and proof of compliance with relevant financial and public-private partnership regulations. This move is intended to promote a more decentralised and efficient approach to power generation.

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4 NUCLEAR AS A CLEAN BASELOAD ELECTRICITY SOURCE

Nuclear power can provide a sustained supply of low-carbon electricity to the South African grid. Nuclear reactors generate heat without burning fossil fuels. Greenhouse gas emissions arise across the life cycle, including from construction, fuel production and decommissioning, but life-cycle emissions are low. In this section, “clean” refers to that emissions profile. Nuclear safety, spent fuel and radioactive waste management, and decommissioning remain integral to the programme. [65]
Koeberg Nuclear Power Station provides South Africa with operating experience in nuclear baseload generation. The strategic case for the proposed 5,200 MW Nuclear New Build Programme is that dependable nuclear generation could help replace retiring coal capacity and complement wind, solar, storage and other flexible resources. The value of that contribution will depend on when units enter service, their availability during periods of system stress, and the grid’s ability to accommodate them. Eskom’s separate feasibility assessment will examine technology and site options, financing models and affordability.

4.1 ENERGY AVAILABILITY FACTOR CONTRIBUTION BY NUCLEAR

The Energy Availability Factor (EAF) measures the proportion of a plant’s maximum potential generating capability that is available over a specified period, after allowing for planned outages, unplanned outages and other losses of capability. Capacity factor measures actual electricity generated against the maximum possible output over the same period. An available unit can therefore retain a high EAF even when the system operator schedules it to produce less than its full output. For the Eskom fleet, a nuclear unit contributes to fleet EAF in proportion to its capacity and availability. Its effect on security of supply also depends on whether it is available when the system needs it. [66]

4.2 HIGH RELIABILITY

Nuclear units can sustain long periods of operation when supported by effective maintenance, equipment monitoring and outage planning. Eskom reported that Koeberg Unit 2 completed 365 consecutive days of operation through 9 March 2026, with an average EAF of 99.4% following major upgrades. This is an example of one unit’s performance over a defined operating period. Planning assumptions for new units should account for refuelling, major maintenance, unplanned outages and partial losses of capability across multiple operating cycles. [67]

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4.3 LONG OPERATING PERIODS BETWEEN REFUELLING

Many light-water reactors can operate for well over a year between scheduled refuelling outages, depending on the reactor design and fuel cycle. Refuelling outages also provide an opportunity to perform inspections and maintenance. In a multi-unit programme, staggering outages where practicable can reduce the risk of several units being unavailable simultaneously and help manage seasonal capacity requirements. [68]

4.4 STABLE FUEL SUPPLY

Nuclear units can operate for extended periods on the fuel already loaded in the reactor. This allows replacement fuel to be procured well ahead of scheduled refuelling and limits exposure to short-term fuel delivery disruptions. Fuel security over the life of the plant depends on timely contracting for uranium, conversion, enrichment where required, fabrication and transport of qualified fuel. Fuel supply arrangements should reflect the reactor design and the availability of qualified suppliers. [65, 68]

4.5 GRID BALANCING

A nuclear unit operating steadily at baseload provides a predictable contribution to scheduled generation. Balancing still requires the system operator to match supply and demand as electricity use and wind and solar output change. Storage, pumped storage, demand response and other flexible resources can manage shorter-term changes. A suitably designed nuclear unit can also contribute through scheduled changes in output within its authorised operating limits. [5]

4.6 GRID STABILITY

When connected to the grid, synchronous turbine-generators can contribute rotational inertia, which helps slow the initial change in frequency after a disturbance. Their excitation systems can also support voltage through reactive power control within equipment limits. The sudden loss of a large nuclear unit is itself a contingency that the system must be able to withstand. Transmission and system studies should therefore assess credible unit trips, reserve requirements, voltage performance and the strength of the grid connection at candidate sites. [69]

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5 REPURPOSING COAL POWER STATION SITES FOR NUCLEAR

Retiring coal stations offer an opportunity to assess whether a new nuclear plant could be developed on or near an existing power station site. Where compatible with the selected design and the condition and capacity of existing assets, a project may be able to reuse switchyards, transmission connections, roads and support facilities. The extent of reuse will vary by site. The reactor and its safety systems require a purpose-built nuclear installation. Any proposed reuse of cooling systems, turbines or other generating equipment would require a design-specific engineering assessment and demonstration that the equipment meets the applicable requirements. [69, 70]

A coal station's location and grid connection are starting points for screening. A nuclear siting assessment must address matters such as seismic and flooding hazards, geotechnical conditions, population distribution, emergency preparedness and a reliable cooling water supply. Coal ash and other legacy contamination must also be considered. The National Nuclear Regulator's siting requirements apply, alongside applicable environmental and other approvals. The assessment should test whether the existing grid can accommodate the new unit sizes and whether coal closure and nuclear commissioning schedules leave a gap in generation or local employment. [69, 70]

A site that meets these requirements could retain value from existing infrastructure and provide opportunities for local workers and suppliers. Nuclear-specific training, qualification and licensing requirements would shape workforce transition. Coal-site repurposing can therefore be assessed alongside development at dedicated nuclear sites, including consideration of suitable small modular reactor designs as they become commercially available. [69]

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6 BASELOAD AND LOAD FOLLOWING

Baseload operation means running a plant at a steady output to serve the portion of demand that persists over time. Nuclear plants are generally suited to this operating mode because high utilisation spreads fixed costs over more units of electricity, and fuel is a relatively small part of the incremental cost of generation. In periods of low net demand, a suitably designed unit can reduce output and then increase it as net demand rises. Net demand is the electricity demand remaining after accounting for wind and solar generation in this context. [68]

Load-following capability varies by design, fuel-cycle conditions and approved operating limits. Technology assessment should consider minimum stable output, ramp rates, the permitted frequency of power changes and any implications for maintenance and annual generation. The value of using nuclear flexibility should be assessed across the power system, taking account of storage, demand response and other resources that can provide flexibility. [68]

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7 DISPATCHABLE SOURCE OF ELECTRICITY

Dispatchable generation can be scheduled or directed by the system operator, subject to the plant's availability and operating constraints. Nuclear generation can be committed ahead of time and scheduled to supply electricity during periods such as evening peaks or extended periods of low wind and solar output. Where the plant is authorised and configured for flexible operation, its output can be adjusted within the approved range. Upward response requires headroom below the available maximum, and restart after shutdown can take time. [68]

The 5,200 MW programme's contribution to security of supply will depend on the capacity that can be relied upon during stressed periods, after allowing for outages, unit sizes, reserve requirements and transmission constraints. Eskom's feasibility work and associated system studies should test these factors against South Africa's demand profile and generation mix. [68]

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8 NUCLEAR POWER TECHNOLOGY CHOICE

8.1 PRESSURISED WATER REACTOR (PWR)

In a pressurised water reactor (PWR), the water that passes over the reactor core as coolant does not flow directly to the turbine; it is contained in a pressurised primary loop. The primary loop water produces steam (via a steam generator) in the secondary loop, which drives the turbine (see Figure 2 below). The advantage is that a fuel leak in the core would not pass radioactive contaminants to the turbine and condenser. A typical PWR the size of Koeberg can operate at higher pressure and temperature, about 16MPa and about 315°C.

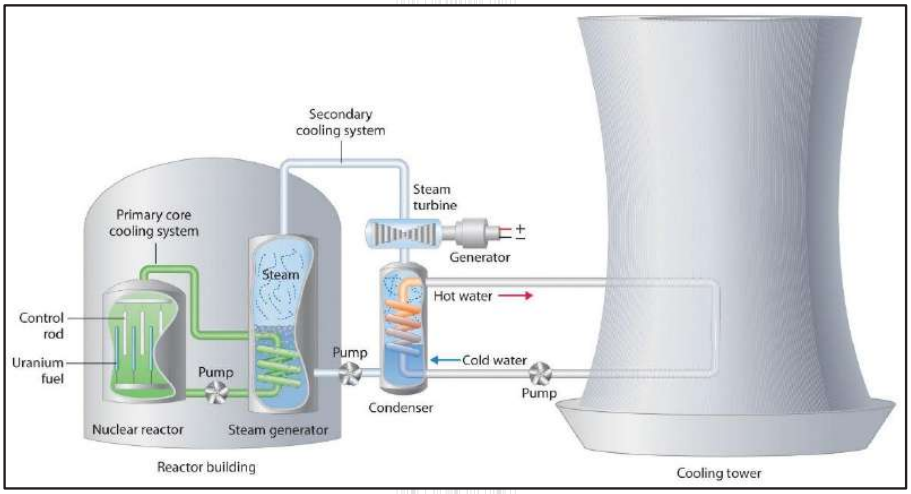

Figure 1: Diagram illustrating the operation of a Pressurised Water Reactor

The typical size of a PWR is 1200 MW, and the main suppliers of these reactors are:

- Areva (previously Framatome-ANP), supplying the European Pressurised Water Reactor, or EPR, of 1200/1600MW.
- Westinghouse, supplying the Advanced Passive, AP1000 of 1200MW and the AP600 of 600MW.
- KEPCO, Korea Electric Power Company, supplying the Advanced Power Reactor 1400, or APR1400 of 1000/1400MW.
- ROSATOM, supplying the Water-Water Energy Reactor, VVER 1200, of 1200MW/1300MW.
- Mitsubishi, supplying the Advanced Pressurised Water Reactor, APWR, of 1700MW

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- Mitsubishi-Areva joint venture, supplying the Atmea Reactor, of 1100MW
- SNPTC (State Nuclear Power Technology Company, supplying the Chinese Advanced Passive, CAP1400, of 1400/1500MW and CAP1000 OF 1000/1250MW and the Hualong One 1000 of 1000/1200MW.

8.2 DRIVERS FOR POLICY ON TECHNOLOGY CHOICE

The Nuclear Energy Policy (NEP) of 2008 states that South Africa intends to pursue the PWR technology for its nuclear programme. Some of the drivers behind this policy decision are that the technology should:

- Provide an opportunity for South Africa to become a global player in the nuclear industry.
- Ensure self-sufficiency in all aspects of the nuclear fuel cycle, especially to minimise the risk to security of supply, i.e., fuel and components for maintenance should not depend on single or sole suppliers.
- Build on the current nuclear operations knowledge of Eskom, namely, the Pressurised Water Reactor of the two Koeberg Nuclear Power Station units.

From the previous subsections of this report, it is clear that PWR technology dominates the nuclear landscape, and most suppliers of nuclear technologies worldwide can provide PWRs. Consequently, the diversity of suppliers for fuel and components is the highest for the PWR technology.

During the development of the NEP, PWRs were the largest proportion of currently operating reactors. Today, the situation is unchanged, as illustrated in Figure 3 below, where the pressurised water reactor remains the dominant nuclear reactor. In addition, PWRs made up more than 80% (54 of 67) of reactors under construction in 2018, and over 86% (87 of 102) of reactors being planned. PWRs will remain the dominant large reactor type.

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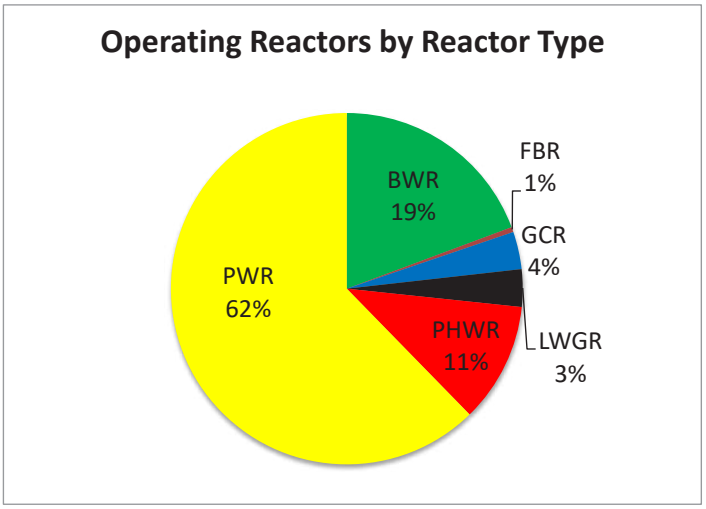

Figure 2: Proportion of operating reactors by reactor type. Power Reactor Information System. IAEA (2013)

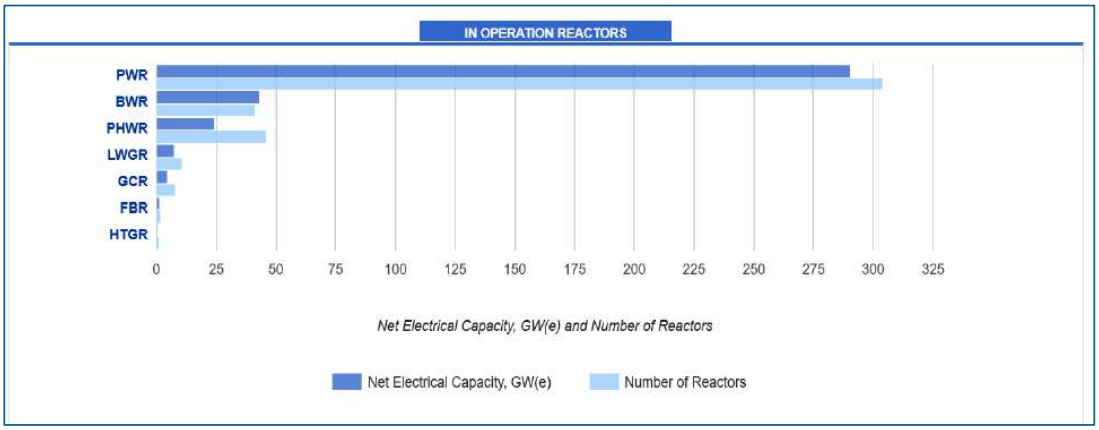

Figure 3: Generation capacity per reactor type for reactors in operation (IAEA PRIS Database)

Figure 4 compares the number of operating nuclear reactors and their combined net electrical capacity by reactor type. Using data from the IAEA's Power Reactor Information System (PRIS). Pressurised Water Reactors (PWR) account for about 300 operating units and approximately 290 GWe of net electric capacity in the data shown. The boiling water reactors rank second in total capacity, even though Pressurised Heavy Water Reactors (PHWR) are slightly more numerous. This indicates that the operating BWRs. If a higher average electric capacity per unit. The remaining reactor types contribute comparatively little to total capacity. Figure 5 below shows that PWRs dominate nuclear construction, with approximately 49 units and 53 GW of net electrical capacity.

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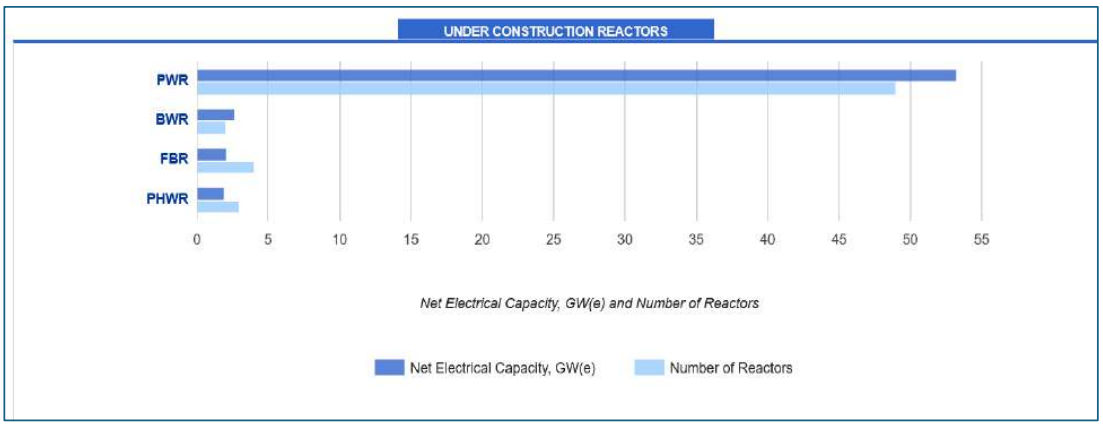

Figure 4: Generation capacity per reactor type for reactors under construction (IAEA PRIS Database)

It is therefore clear that the drivers behind pursuing a PWR technology-based nuclear programme remain unchanged where large nuclear generating plants are feasible to construct. Only the Pressurised Water Reactor technology would be considered for sites where a large conventional nuclear unit is feasible.

8.3 SMALL MODULAR REACTOR (SMR)

IRP 2025 reinforces the need for a diversified and flexible electricity system that combines firm, low-carbon generation with renewable energy, storage, gas, and grid expansion. In this context, SMRs should be assessed as a complementary pathway to large PWR units, particularly for modular deployment, decommissioned coal-station repowering and repurposing, process heat, industrial clusters, remote loads and future high-temperature applications. The SMR pathway should remain subject to technology maturity, licensing readiness, local industrial participation, safeguards, security, fuel-cycle implications and whole-system affordability. For the purpose of this document, Small Modular Reactors are classified as having a maximum capacity of 300MW(e). Figure 6 below shows the classification according to the IAEA, which states different types of SMRs as follows:

- Land-based water-cooled;
- Marine-based water-cooled;
- High-temperature gas-cooled;
- Fast Neutron Spectrum;

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- Molten Salt; and
- Micro-sized designed to generate electrical power typically up to 10 MW(e)

Under an IRP 2025-aligned approach, procurement planning should allow for separate but coordinated procurement pathways for large proven PWR units and SMRs. Large PWR procurement should prioritise proven technology, bankability, grid readiness, construction risk management and localisation. The SMR pathway should be more flexible and should assess technology maturity, demonstration status, licensing approach, fuel supply, local intellectual property, manufacturing partnerships, modular construction capability and potential non-grid applications. These units are seen as the leading technology for replacing some of the existing Eskom coal power stations that will retire post-2030. The lead time to licence an old coal power station site as a nuclear site will take significant time. The two pathways should be managed under one national nuclear programme governance framework.

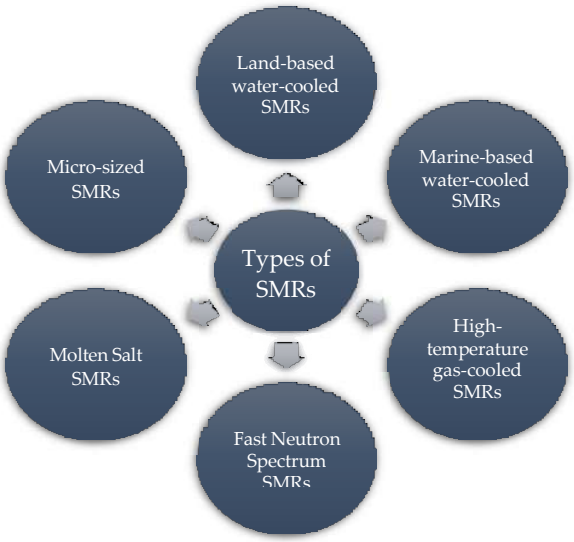

Figure 6: SMR classification scheme from the IAEA. (SMR: 10 MW to 300 MW, Micro-Reactors: 10MW and below Large Reactors above 300MW)

Figure 6 shows six types of small modular reactors. Two use water for cooling, one is designed for use on land, and the other for use at sea. The other four are high-temperature gas-cooled reactors. Fast neutron reactors. Molten salt reactors and micro-reactors, which are the smallest group.

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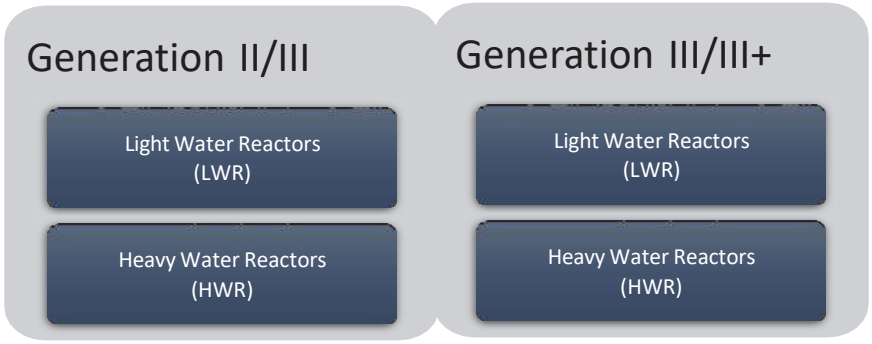

Figure 5: Generation classifications IAEA

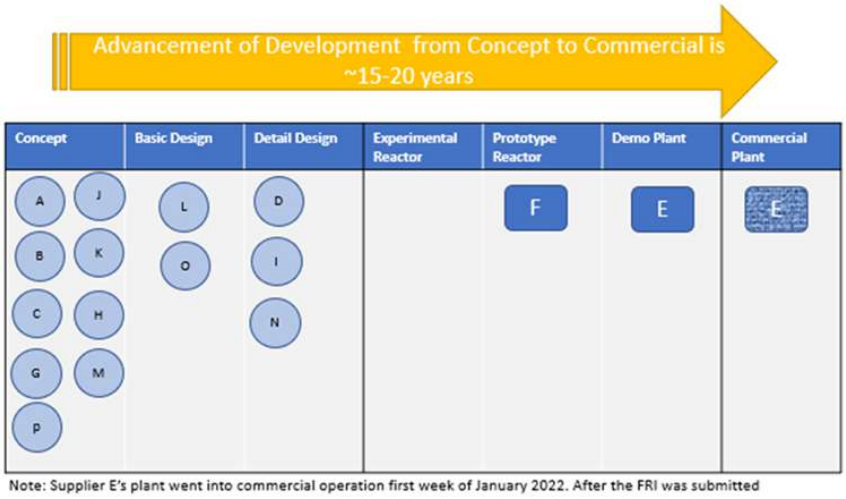

Figure 6: RFI Outcomes – Technology Development Status of SMRs

The former Department of Mineral Resources and Energy (DMRE), now DEE, issued a Request for Information (RFI) in June 2020 to gather valuable market information necessary for decision-making. The RFI results indicated that most suppliers are still in the development phase for SMR technologies. There are exceptions, namely the Russian 75 MWe floating reactor (Akademik Lomonosov, which uses two KLT-40S reactors) and China's HTR-PM, which generates 210 MWe,

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both of which are in commercial operation. These two entered commercial operation in May 2020 and December 2023, respectively.

South Africa has declared its intention to pursue a nationally developed Pebble Bed Modular Reactor Programme, High Temperature Gas Reactors (HTGR), and other SMRs using TRISO-coated particle fuel and the latest proven Generation IV technologies. Consideration could be given to important factors that can support South Africa's intention to establish a modern nuclear technology industry and do modular construction. The process of transferring PBMR from Eskom to Necsa is at an advanced stage following Cabinet's approval in November 2025, with Section 54 of the PFMA recently completed and approved by the Minister of Electricity and Energy, and noted by the Minister of Finance in September 2026.

8.3.1 MATURITY OF SMR TECHNOLOGY

This section captures observations on the state and nature of the SMR industry. The global view is important to South Africa's policy position on SMR deployment, to be informed by worldwide progress in SMR technologies (Figure 7). It is also important for assessing possible collaboration with countries or entities advancing SMRs that South Africa is interested in. Various sources have been identified and analysed in order to sketch a relevant picture of this dynamic sector. In particular, the following sources have been consulted and are relevant to the development of SMR deployment approach:

1) The UxC Special Report on Small, Advanced and Micro Reactor Assessments, 2023
2) The IAEA Advances in Small Modular Reactor Developments, 2022
3) NEA/OECD SMR Dashboard, 2023
4) IEA Nuclear Power and Secure Energy Transitions, 2022
5) International Energy Forum SMR Key Considerations for Deployment, 2024

8.3.2 SMR PROGRESS BASED ON TECHNOLOGY READINESS

Government, through the PBMR Company, is focused on the electricity and process heat applications of Pebble Bed technology (Nuclear Energy Policy, 2008). South Africa has a declared intention to pursue a nationally developed Pebble Bed Modular Reactor Programme. High-temperature gas reactors and other SMRs using TRISO-coated particle fuel and utilising the latest proven Generation IV technologies will be considered. Consideration could be given to a supplier that can support South Africa's intention to establish a modern nuclear technology industry and do

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modular construction. Table 1 below shows the IAEA Advances in SMR Technology Developments 2020 document stipulated SMR development phases, i.e., in the 4th column, against the USA DOE's technology readiness levels and relative level of technology development. For instance, an SMR stated as being in operation by the IAEA will be TRL 9.

Table 1: Measures of technology readiness

Relative Level of Technology Development	TRL Level	TRL Definition	IAEA Scheme
System Operations	TRL9	Actual system operated over the full range of expected mission conditions	In operation/Operable
System Commissioning	TRL 8	Actual system completed and qualified through test and demonstration	Finalizing Construction
	TRL7	Full-scale, similar (prototypical) system demonstrated in relevant environment	
Technology Demonstration	TRL6	Engineering/pilot-scale, similar (prototypical) system validation in relevant environment	Basic and Detailed Design
Technology Development	TRL5	Laboratory scale, similar system validation in relevant environment	
	TRL4	Component and/or system validation in laboratory environment	
Research to Prove Feasibility	TRL3	Analytical and experimental critical function and/or characteristic proof of concept	Conceptual Design
	TRL2	Technology concept and/or application formulated	
	TRL1	Basic principles observed and reported	

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Relative Level of Technology Development	TRL Level	TRL Definition	IAEA Scheme
Basic Technology Research			

8.4 TECHNOLOGY READINESS LEVELS OF SMR AS OF 2024

8.4.1 THE SMR KEY CONSIDERATIONS FOR DEPLOYMENT

The 2024 Nuclear Energy Forum report presents nineteen key findings for nations considering SMR deployment, covering technical considerations, regulation and governance, cost, and financing. It also includes a decision-making framework that can serve as a tool for interested policymakers and stakeholders. The key findings are as follows:

i. SMR deployment requires a coordinated and sustained effort across governments, industry, and international institutions.
ii. Countries with substantial vested interests in SMRs are willing to embrace the First-of-a-Kind (FOAK) risk associated with this new technology.
iii. SMRs offer enhanced flexibility for low-carbon power generation. A key promise of many SMR designs is modularity, meaning that they can be factory-fabricated, transported to the site, assembled, and stacked to reach the desired total energy output. This feature enables more flexibility in deployment locations, allows for better load following in grid systems with higher penetrations of variable renewable resources, and permits incremental growth in output capacity.
iv. Nations must consider fuel types when selecting a reactor design, since their availability will impact reactor operations, regulatory requirements, international partnerships, and waste management.
v. SMR designs integrate inherent safety features that reduce the risk of accidents and could contribute to greater public acceptance of these reactors as safe and sustainable power generation options.
vi. The choice of technology partner holds long-term implications for energy security, supply chains, and international partnerships.

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vii. SMRs pose distinct challenges for existing nuclear waste management processes. SMRs produce more complex waste streams in both composition and volume. This complexity is driven by increased neutron leakage from their smaller reactor cores, which occurs when neutrons escape and interact with surrounding materials, leading to more radioactive material.

viii. SMR deployment necessitates adherence to the same international conventions governing nuclear safety, security, safeguards, and liability as large NPPs.

ix. An independent regulator is an essential prerequisite to SMR deployment.

x. The smaller size of SMRs does not equate to a simplified regulatory process under existing regulatory frameworks.

xi. While SMRs may introduce complexities into the licensing process, regulatory reforms hold the promise of accelerating SMR deployment at scale.

xii. When estimating the life-cycle cost of SMRs, four cost drivers should be considered: capital costs, operations and maintenance (O&M) costs, fuel costs, and decommissioning costs.

xiii. Unique characteristics of SMRs, such as modularisation, learning effects, shorter construction times, and co-siting economies, can potentially reduce costs for SMRs.

xiv. The commonly used cost metric, levelized cost of electricity (LCOE), does not account for grid integration costs and grid flexibility. It is important to look beyond the LCOE to fully evaluate the economic potential of SMRs.

xv. The lack of definitive data for SMR costs necessitates a thorough and cautious evaluation from investors and policymakers.

xvi. Governments can provide critical financial support to FOAK SMR projects.

xvii. Demonstration projects play an essential role in understanding cost estimates for specific SMR designs and demonstrating commercial viability. Most SMRs in operation today are demonstration projects; this is an important step for both SMR designs deployed domestically and designs destined for export. Demonstration projects are an important indicator to investors and can help establish an order book for future projects.

xviii. There are many potential financing structures and business models for SMR projects. SMR projects can be sponsored directly or indirectly by national governments or by private sponsors, including utilities, industrial companies, data centres, or other power off-takers. Projects will likely utilise a blended financing approach, relying on a mix of grants, debt, and equity, regardless of source.

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xix. SMR projects will rely on financing from numerous stakeholders and dedicated financial institutions. If SMRs are exported to other host countries, a wider range of stakeholders could be involved in financing the project. For example, export credit agencies are uniquely positioned to help finance these projects by providing direct loans or loan guarantees to foreign commercial entities.

8.5 NUCLEAR REACTOR CAPACITY

The primary determining factors for the capacity of the nuclear power reactor is the cost per unit power and the grid infrastructure and electricity demand to support the size of the plant. Because nuclear power reactors are suited to baseload and are not designed to follow load demands, it is generally recommended that the reactor size be no less than 10% of the total electricity demand on the national grid. There are exceptions such as Lithuania, where the nuclear reactor supplies over 40% of the national demand; however, in this case the connection to the European Grid provides the necessary offtake of excess electricity.

South Africa has over 40 GW of installed electricity capacity at present and is projected to have over 60GW by 2030. This demand is suitable for even the largest nuclear reactors. In addition, the national grid covers almost the entire country and all energy-intensive users that need nuclear baseload electricity. Establishing grid interconnections from the proposed sites to the national grid would not be a significant cost factor. Instead, these costs would easily be offset by the reduced transmission losses incurred on transporting electricity to the coastal demand areas.

Contrary to expectations, the cost of nuclear power per unit installed is not directly related to plant size. For reactors below 1000 MWe, there is a strong dependency on size; however, above that, the cost depends on a myriad of factors, ranging from labour costs in the country of origin to the quantities and availability of materials, and the transport and manufacture of very large components. It has also been seen that the largest reactors are suffering from delays and cost overruns, so the argument for economies of scale related to plant size may be overridden by economies of scale in the number of units produced.

Another factor to consider is space limitations due to the limited number of nuclear sites available. The footprint of a 500MW nuclear plant vs a 1500MW plant is not much different, as most of the space is taken up by auxiliary systems and conventional island equipment. Therefore, building a

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small reactor would require more nuclear sites. Eskom's Roadmap points to the initial implementation of 4 800 MW of conventional large Pressurised Water Reactors and 400 MW of Small Modular Reactors.

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9. NUCLEAR PLANT LOCATION

9.1 POLICY AND PLANNING CONTEXT

South Africa's Nuclear Energy Policy establishes a coordinated framework for developing the national nuclear energy sector. Under Section 15.8, the Government, through Eskom, must identify, acquire and license suitable nuclear sites in accordance with the NNR Act, thereby maintaining a strategic reserve for future nuclear development.

9.2 SITING AND SITE EVALUATION PROCESS

The siting and site evaluation processes relate to the safety considerations of a site for a nuclear installation. These two processes are divided into three phases extending from site survey to site confirmation (see Figure 9).

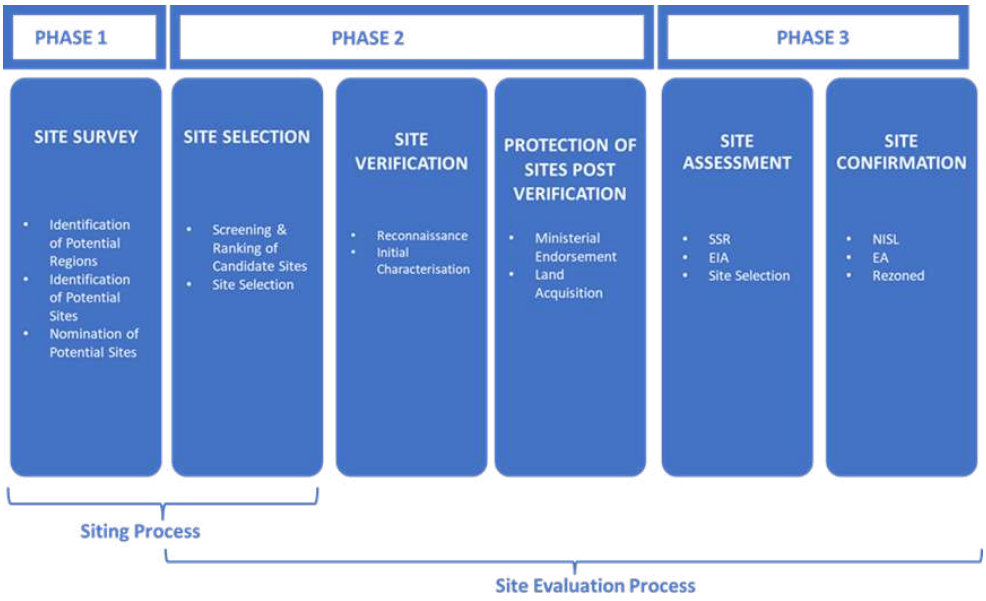

Figure 7: High-level description of nuclear siting process [19]

9.2.1 SITING PROCESS

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 areas;

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- Site selection, in which unsuitable sites are rejected, and the remaining candidate sites are assessed by screening, evaluation, comparison and ranking based on safety and other considerations to select one or more preferred candidate sites.

The siting process is based on an incremental screening process from National level to regions of interest, candidate areas, and then potential sites. The process is executed by considering both safety- and non-safety-related criteria through the application of a Strategic Environmental Assessment (SEA). The SEA approach is guided towards selecting environmentally and socially sustainable sites for nuclear installations, aiming to ensure a high level of confidence in the selected sites.

Third parties or businesses could also nominate sites. The potential sites together with the nominated sites are then screened to select candidate sites. This is performed using suitability criteria based on published data and reconnaissance-level information. The principal objective is to exclude unfavourable sites based on both safety-related and non-safety-related considerations. Safety-related criteria considered in the siting process should be consistent with the site evaluation requirements established by the NNR. Non-safety-related criteria are not directly related to nuclear safety (e.g., availability of cooling water, topography, access to the electrical grid, non-radiological environmental impacts, etc.).

Candidate sites are screened to arrive at preferred candidate sites. The preferred candidate sites are subjected to a ranking/screening process to select the final sites. A criterion for ranking candidate sites may be the likelihood that the specific site parameters fall within the standard plant design or a Plant Parameter Envelope (PPE) of potential vendors for nuclear installations (when the plant design is not known). PPE information should be used either to screen out candidate sites or decide where design changes may be necessary to bring the design parameters within the site bounding envelope. PPE information or generic design information should already be available during the site selection stage.

In South Africa, the siting process (i.e., site survey and site selection) is not regulated, and no nuclear installation licence is required. Although the process is not regulated, it is guided by a clearly

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established set of criteria consistent with the relevant regulatory requirements. The information collected throughout these stages is used to inform site selection during the site assessment and confirmation stages under the National Environmental Management Act and the National Nuclear Regulator (NNR) Act.

9.2.2 SITE EVALUATION PROCESS

The site evaluation process extends from the last stage of the siting process (i.e. the stage of evaluation of candidate sites to arrive at the preferred candidate site(s)). It involves detailed investigations and characterisation studies (i.e. site verification and assessment) that result in the characterisation and derivation of site-specific design bases for external events for the nuclear installation(s). The results of these investigations and characterisations are reported in a site safety report and/or a safety case which is submitted to the NNR in support of a Nuclear Installation Site Licence (NISL) or Nuclear Installation Licence (NIL) application.

An EIA process can also be conducted during the site assessment stage. The last stage of site evaluation is the site confirmation stage with the conclusion of the regulatory authorisations, i.e. NISL / NIL to site and/or EA. The site evaluation process continues throughout the operating lifetime of a nuclear installation with the performance of a monitoring programme and the re-evaluation of site characteristics in line with an operating station's periodic safety reviews and safety reassessments.

9.2.3 STATUS OF SITING AND SITE EVALUATION

Nuclear Siting Studies (NSS) activities in support of the Eskom Nuclear New Build Programme (NNBP). NSS is responsible for identifying, selecting, assessing/evaluating, and licensing sites suitable for the location of new nuclear facilities, and for creating a strategic reserve of those sites for future use. In the early 1980s, Eskom conducted a Nuclear Siting Investigation Programme for nuclear power plants, which resulted in five sites being selected as potentially suitable for the siting of nuclear power plants, namely: Duynefontyn (on which the Koeberg Nuclear Power Station is located), Thyspunt, Bantamsklip, Brazil and Schulpfontein (see **Error! Reference source not found.**). These sites, except Duynefontyn, are all greenfield sites at different levels of qualification (readiness) to support a nuclear build programme.

The siting strategy is based on the need to license historical sites that were identified as part of the nuclear siting programme in the past; these sites are (see Figure 10):

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- Duynefontyn
- Thyspunt
- Bantamsklip
- Brazil
- Schulpfontein



Figure 8: Potential sites for the new nuclear plants

To align the strategy with the Integrated Resource Plan 2025 (IRP25), Duynefontein and Thyspunt are the primary sites being pursued for the Nuclear Installation Site Licence (NISL) applications, as well as the Environmental Impact studies, while Bantamskielip remains an alternative site to the Thyspunt Environmental Authorisation application. The Bantamsklip NISL application will only be initiated once a decision has been taken to include the Bantamsklip in the Environmental Authorisation (EA) and once the NISL application for both Duynefontyn and Thyspunt has been concluded. However preparatory work to establish monitoring programs on the Bantamsklip site, as well as the procurement of resources to update the Bantamsklip Site Safety Report, should start in parallel whilst awaiting finilasation of the NISL process for Thyspunt and Duynefontyn. No Environmental Impact assessment (EIA) has been performed on the Brazil and Schulpfontein sites.

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Furthermore, no detailed site characterisation studies have been performed on these two sites. These sites will not be characterised further until the decision on Thyspunt, Bantamsklip and Duynefontyn has been finalised. This is to ensure that Eskom spends its resources on sites prioritised for utilisation to support the IRP timelines.

Regarding the implementation of the Small Modular Reactor (SMR) in South Africa, the Coal to Nuclear Strategy allows Eskom to conduct a Strategic Environmental Assessment (SEA) on the 13 coal sites earmarked for decommissioning between 2026 and 2040. These studies are ongoing and will be followed by detailed studies to further characterise those sites for the environmental authorisation processes and the Nuclear Installation License application. In addition, SMRs have been included in the envelope for the Thyspunt and Bantamsklip EIA.

9.2.4 SITING SCENARIOS/OPTIONS

In 2016, Eskom received the Environmental Authorisation (EA) for 4000 MWe of Nuclear at the Duynefontyn site, with the decision being appealed. Following the appeals process, the DFFE upheld the EA decision for the Duynefontyn site. The decision has now been reviewed in court, and a final decision is expected in 2027. The following scenarios have been assessed to mitigate the risks associated with siting:

Scenario 1: EA for Duynefontyn site retained following appeals process

If the Duynefontyn site is retained following the EIA legal review process, steps have been taken to accelerate finalisation of the NISL application for the Duynefontyn site. The NISL or NIL is not necessarily needed for the procurement process but provides certainty on the site's licensing from a nuclear regulatory point of view. The National Nuclear Regulator is expected to make a final decision on the NISL application in late 2027 or early 2028.

The NISL application for Thyspunt should still be concluded to allow for the banking of the Thyspunt site in line with the Nuclear Energy Policy of 2008. A new EIA for the Thyspunt site, with Bantamskilp as an alternative, has been initiated and is expected to be concluded in late 2027. If a vendor and/or reactor technology has been identified prior to NISL conclusion, Eskom can terminate the NISL process and apply for a NIL to site, construct and operate a nuclear installation(s).

Scenario 2: EA for Duynefontyn is reversed following the appeals process

Should the environmental authorisation for the Duynefontyn site be reversed following the appeals process, and the authorisation granted for Thyspunt site, no additional actions will be required as

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the NISL application is already at an advanced stage. A new EIA may be performed for any additional future installations that are not accommodated by the granted authorisation.

Due to these challenges, and the likelihood that some permits and regulatory positions will not be available before the bidding process, the potential Nuclear Power Plant supplier must be made aware of the site risks during procurement, and the risk must be mitigated during the contracting phase.

9.2.5 AUTHORISATIONS FOR EXISTING SITES

9.2.5.1 NUCLEAR AUTHORISATION

In 2016, Eskom applied for Nuclear Installation Site Licences (NISLs) for the Thyspunt and Duynefontyn sites to locate new nuclear installation(s) with planned capacity of up to 4 000 MWe and an eventual total site capacity of up to 10 000 MWe, in accordance with the National Nuclear Regulator Act (Act No. 47 of 1999) and the Regulations of Licensing of Sites, R.927. As part of the regulatory review of the NISL application, Eskom requested that the National Nuclear Regulator prioritise the review of the Thyspunt NISL application at that time, as Thyspunt had been the preferred site for Nuclear-1, as recommended by the EIA.

The NNR has progressed the review of the Thyspunt NISL application. It is expected that the NNR will hold additional public hearings before a decision is made on the Thyspunt NISL application. A decision on NISL is expected in 2027/2028. Further to this, NNR is working on the NISL application for the Duynefontein site. The final decision on the review is expected to be made late in 2027/2028. Although a NISL could be granted for any one of the two sites (i.e. Duynefontyn or Thyspunt), or for both sites, Eskom can still decide to pursue any of the other selected sites in the future for further development of nuclear power plants. In addition, a new site selection process may be required to further align to the nuclear energy policy of South Africa, i.e. to establish a strategy reserve of nuclear sites.

9.2.5.2 ENVIRONMENTAL AUTHORISATION

Eskom, in 2007 initiated an Environmental Impact Assessment (EIA) process to construct and operate Generation III Pressurised Water Reactor (PWR) type nuclear power plant (known as Nuclear-1) of up to 4 000 MWe and its associated infrastructure. The EIA was based on five sites: Duynefontyn, Thyspunt, Bantamsklip, Brazil, and Schulpfontein, which Eskom selected in the 1980s

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(see Figure 10). Environmental authorisation (EA) was granted for the Duynefontyn site by the Department of Forestry, Fisheries and the Environment (DFFE). The authorisation has since been appealed in terms of NEMA section 43(7) and is awaiting the outcome of the appeals process.

Key to implementing the nuclear project is finalising the Environmental Authorisation process. A detailed roadmap of siting options to support 5200 MWe for Conventional Reactors (large scale) is presented in Table 2.

Depending on DFFE's appeals decision on the EA, both the Duynefontyn and Thyspunt sites can accommodate a nuclear programme of up to 5200 MWe. The review and update of the Integrated Resource Plan has no impact on sites that have been considered, provided they can accommodate the required capacity.

The finalisation of the EA legal review is critical to the successful implementation of the programme; therefore, more effort should be made to obtain the decision from DFFE timeously. To provide certainty on the nuclear regulatory processes, the finalisation of the site licence application with the National Nuclear Regulator must also receive urgent attention.

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Table 2: Summary of Approval Status of Selected Site

Site	NIL/NISL	EA	Timeframes to authorisation
Duynefontyn Site confirmation stage	NISL application in progress NISL Decision expected in 2027	Environmental authorisation granted for Duynefontyn. Under legal review following the appeals process.	12 Months based on the agreed NNR schedule.
Thyspunt Site confirmation stage	NISL application review in progress; the application is currently undergoing the public consultation process, expected to end in January 2027.	New EA in progress; scoping completed; the project is currently undergoing specialist studies, with the final decision from the DFFE expected in 2027, in line with the NEMA-regulated process and timelines. This does not account for potential appeals.	Both EA and NISL decisions expected in the final quarter of 2027.
Bantamsklip Site assessment stage	Site evaluation studies are reported in the BSSR, excluding completed seismic hazard studies. The BSSR requires an update, including updated seismic studies. Additional detailed studies will only be	Bantamsklip is used as an alternative site to Thyspunt, decision on the EA application expected in 2027 as part of the Thyspunt EA work.	EA decision expected in 2027, whilst Eskom will progress the NISL application only once a decision on both Thyspunt and Duynefontyn on are finalised.

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Site	NIL/NISL	EA	Timeframes to authorisation
	implemented once the NISL and EA are finalised.		
Brazil Site selection	Site evaluation process to characterise the site and derive site-specific design parameters, to be conducted following Bantamsklip.	New EIA will be required Site excluded from Nuclear-1 EIA scoping phase on recommendation from DFFE.	Site evaluation studies, including seismic hazard analysis, could take 24 – 36 months. NIL/NISL process will take another 18 months approximately.
Schulpfontein Site selection	A site evaluation process to characterise the site and derive site-specific parameters will be conducted.	New EIA will be required. Site excluded from the Nuclear-1 EIA scoping phase on the recommendation of DFFE.	Site evaluation studies, including seismic hazard analysis, could take 24 – 36 months. NISL process will take another 18 months approximately.
Coal to Nuclear	Strategic Environmental Assessment (SEA) to rank and screen preferred sites to be concluded in 2027. This will be followed by detailed site characterisation studies and the EIA, followed by the Nuclear Installation license application	SEA is in progress; once completed, reconnaissance studies will be performed, followed by the EIA.	EA and NIL to be implemented following conclusion of detailed site studies once preferred sites are finalised in March 2027.

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9.3 POTENTIAL SITING OF SMALL MODULAR REACTORS

The Thyspunt and Duynefontyn sites are characterised and advanced in terms of regulatory decisions, with limited work required to license or obtain the Environmental Authorisation as opposed to new sites. Their status makes them potential sites to support the implementation of the SMR component of the nuclear build programme. Eskom has also initiated a Strategic Environmental Assessment (SEA) on the 13 coal sites earmarked for decommissioning between 2030 and 2040. These studies are ongoing and will be followed by detailed studies to further characterise those sites for the environmental authorisation processes. In addition, SMRs have been included in the envelope for the Thyspunt and Bantamsklip EIA.

9.3.1 POTENTIAL FOR SITING SMALL MODULAR REACTORS

The Duynefontein site provides two footprints that are open for consideration. Siting SMR(s) on the Nuclear 1 footprint will require an application for an EIA amendment to the standing EA. If a decision is made to go with an alternative footprint on the Duynefontyn site (previously earmarked for PBMR), a new EIA application will be required. The Thyspunt EIA application includes the deployment of SMRs. Therefore, if a decision is taken to award the Nuclear 1 EA to the Thyspunt site, there will be no need to further amend the EA. The NISL application for both the Dynefontyn and Thyspunt sites does not require amendments to include SMRs. However, at the next application phase (e.g., construction application), the applicant must demonstrate that the SMR technology falls within the Plant Parameter Envelope.

9.3.2 SITING RISK FOR SMALL MODULAR REACTORS

The Thyspunt and Duynefontyn sites are available for the immediate siting of SMRs provided that the design under consideration falls within the existing Plant Parameter Envelope (PPE). If the current PPE does not encompass certain design parameters of an SMR technology, additional studies may be required to assess the impact of the site on the environment and vice versa. To mitigate this potential delay, it is proposed that an early gap analysis of the current PPE be performed, and any studies required to update the PPE be undertaken.

9.3.3 TAKE-AWAYS ON SMR SITING

Siting SMR(s) on the Duynefontein site will require an application for an EIA amendment to the standing EA for the Nuclear 1 footprint. The location at the site previously earmarked for PBMR will require a new EIA application.

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The Thyspunt site EIA includes both large conventional PWS and SMRs; therefore, there will be no need to amend the EIA for Thyspunt if granted.

The applicant for the construction license only needs to demonstrate that both the large conventional PWRs and the SMR technology fall within the Plant Parameter Envelope, without needing any amendments to the current NISL applications.

9.4 SITING FOR FUTURE NUCLEAR PROGRAMMES

The Duynefontyn and Thyspunt sites should be adequate to accommodate the proposed 5 200 MWe of nuclear. However, if South Africa is to realise the goals of the Nuclear Energy Policy of 2008, in particular, the identification, selection, qualification and banking of sites for future use, additional sites would be required.

Eskom has initiated the SEA for coal-to-nuclear with the intention of repowering and repurposing some of the coal sites earmarked for decommissioning within the IRP 25 window. The Pelindaba site can also be further assessed through a detailed site characterisation study to qualify it for SMR technology.

Considering ongoing changes in energy sources, the sufficiency of the reserve of sites shall be assessed continuously in accordance with the most recent IRP requirements. The Transmission Development Plan (TDP) shall be used as an input to inform the location of new nuclear plants and which sites need to be prioritised.

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10. TRANSMISSION GRID INFRASTRUCTURE READINESS

For the electricity generated by the proposed nuclear power station to be made available to end-use customers, it needs to be transmitted from the high-voltage yard at the power station through a network of high-voltage transmission lines and then distributed to the end user at a lower voltage. Previously, transmission evaluated the integration of 4 000 MW in the Eastern Cape and Western Cape; however, since then, more than 4 700 MW of renewable energy generation has been connected to these parts of the network. As such, the proposed transmission network may not be adequate, and a new grid integration application is required per site to determine the applicable transmission infrastructure for the nuclear plant.

10.1 GRID INTEGRATION APPLICATION PROCESS

As mentioned, significant changes have occurred to the electricity grid since the previous studies for Nuclear-1 were performed, due to significant renewable energy expansions. The electricity network and power needs in the various regions/provinces have changed dramatically, which means previous grid studies cannot be used as approximations for this report. The new studies that are required assess the following factors:

- System reliability and quality of supply;
- Integration considerations; and
- Future potential for generation in the respective regions/provinces.

In terms of integration, the availability of high-voltage lines to evacuate the power from the site needs to be evaluated. If high-voltage line capacity is not available, new high-voltage transmission lines (400 kV and/or 765 kV) may be required at a high additional cost. In addition, the grid expansion would likely require additional servitudes to be acquired, as well as additional environmental authorisations for the transmission grid expansions (EIA). This process could take more than 10 years before the required grid upgrades are completed.

It is also preferable to integrate large power capacity as close as possible to where the load requirements exist to ensure grid stability and limit load losses when evacuating the power. If the power is not needed and utilised in the region/province of the new nuclear power station, the excess

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power needs to be evacuated to an area with power demand, which affects the quality and reliability of the supply.

10.2 CURRENT STATUS

Eskom has submitted grid integration applications for both the Duynefontyn and Thyspunt sites. The applications include provision for a 300 MW SMR on these sites and 2400 MW of PWR. Grid integration is stipulated to be required by 2035. In addition, the accountability for obtaining the transmission environmental authorisations, servitudes and as resolved. Site acquisitions is still to be agreed. However, in the interim, the National Transmission Company of South Africa has reviewed the applications, and feedback has been provided to Eskom on the scope of studies required for grid planning.

Based on the current grid infrastructure status, initial indications are that extensive grid infrastructure expansions will most likely be required for both the Duynefontyn and Thyspunt sites to accommodate the new power stations and evacuate the planned generated electricity. Should additional nuclear sites be identified, additional grid integration applications will have to be prepared in accordance with the process described above.

10.3 RISKS RELATED TO GRID INFRASTRUCTURE

The following risks have been identified related to grid infrastructure for new nuclear build plants:

- Grid expansions will require separate EIAs for the transmission infrastructure. If the transmission infrastructure encroaches on environmentally sensitive areas, this could significantly increase the complexity of the EIAs.
- The applicants for grid expansion EIAs need to be agreed upon.
- In addition, these grid expansions will require servitudes, which Eskom may not own, and the acquisition of applicable land is a notable risk.
- Alternative large PWR and/or SMR sites will require separate grid integration applications and studies, including associated application fees.

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11. FUEL CYCLE FRONT END

This section is based on the Policy requirement of a Pressurised Water Reactor (PWR) or High Temperature Reactor (HTR). It considers the uranium-based fuel cycle. Based on the current waste management policy (see section 13), South Africa operates an open fuel cycle, as shown in Figure 11, under the implementation of the IAEA Non-Proliferation Treaty (NPT).

Unlike fossil fuel power plants where the fuel costs make up the majority of the Levelised Cost of Energy (LCOE), fuel costs for nuclear power plants comprise a smaller portion (~20%) of the LCOE. In addition, the volume and mass of fuel used in nuclear power plants are almost a million times less than those of fossil fuel plants, implying that fuel supply security can be achieved through early purchase and easy stockpiling. Manufacturing nuclear fuel and handling spent fuel are technologically advanced processes consisting of the steps shown in Figure 11 below.

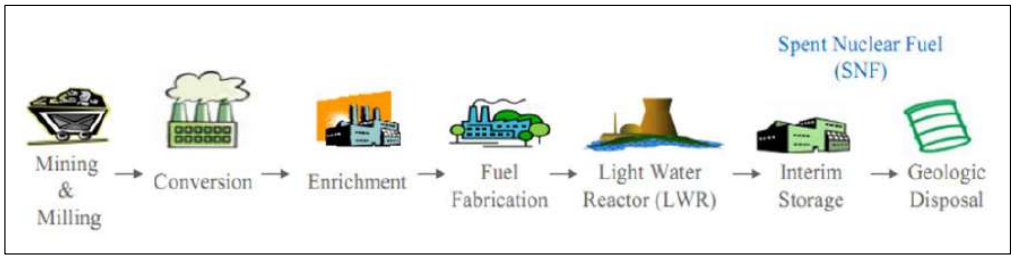

Figure 9: Open fuel cycle for uranium

Uranium mining makes up almost 51% of the cost of nuclear fuel, with enrichment the second largest at 27%. A full Strategy for the Nuclear Fuel Cycle is covered by the strategy developed by NECSA. The Nuclear Energy Policy of 2008 calls for the beneficiation of uranium through an investigation into establishing capabilities to carry out conversion, enrichment, and fuel fabrication as part of the nuclear programme. Since 2008, the Government, through Necsa, has conducted several investigations and feasibility assessments to establish these facilities in South Africa. Prior to 2017, the NEPIO sub-working group on the fuel cycle front end considered various fuel cycle documents and proposals from Eskom, the then Department of Mineral Resources, and Necsa, and produced two consolidated fuel cycle strategy reports. Given the change in capacity of the nuclear new build programme from 9.6 GWe to 5.2 GWe, the previous reports were considered as inputs into this report and the necessary updates and adjustments were made for the reduced capacity programme.

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The ensuing subsections give a brief outline of the salient points of each aspect of the front end of the nuclear fuel cycle to justify and explain the optimum front-end fuel cycle.

11.1 MINING AND MILLING

South Africa has a uranium mining industry which has been commercially active since 1952. Production peaked in the 1980s at 6 000 tU p.a., representing about 14% of world production at that time. Since then, production has steadily declined to a low of less than 600 tU in 2012, representing about 1.5% of world production. It has further decreased to 200 tU during 2022 (with an average of less than 400 tU pa between 2013 and 2022) (see UxC report on uranium production). This decline can be attributed to the reduction of gold mine production activities and the reduction in the uranium price globally from a high of over $120 per pound in 2007/2008 to a low of $20 per pound around 2017/2018; it has since recovered to about $92 per pound in 2024 (UxC report, 2024). The former is primarily caused by much lower costs for uranium extraction in Australia (open-pit mining) and Kazakhstan (heap-leaching mining), which were exploited first.

South Africa's uranium production is projected to grow at a 2% Compound Annual Growth Rate (CAGR) by 2030. The Uranium requirement for the 7 GWe nuclear power, that is, assuming 5 200MW plus 1 860 MW in the IRP 2025, yields approximately 931 tU/annum, which is just over triple the current domestic production rate of 200 tU/annum. The uranium production rate is insufficient to cover the demand; however, South Africa's identified uranium resources are sufficient to provide for the existing and envisaged South African 5.2 GWe nuclear expansion programme (IRP2025).

In addition to the above forecasted low production rate and the risks mentioned above, there are also risks that the uranium produced in South Africa will not be available for local use, e.g. if locally produced uranium is contracted to international buyers. The identified South African resources are mainly present in the quartz-pebble conglomerates of the Witwatersrand Basin and in gold mine tailings dams. The identified resources can be categorised as follows:

- 62% hosted in quartz-pebble conglomerates of the Witwatersrand Basin;
- 22% hosted in the gold mining tailings;
- 12% hosted in the Springbok Flats Basin (mainly coal-hosted); and
- 4% as part of the Karoo Basin

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A significant portion, i.e. 74% (or 96% of the uranium in the mine tailings), of the identified resources in South Africa are linked to co-production with other minerals. This implies that if mining of the "hosting" mineral is interrupted, discontinued, or not viable for any reason, the associated uranium resources could become stranded, resulting in a situation where South Africa has insufficient uranium resources to support its envisaged nuclear expansion programme. All of South Africa's uranium is currently produced as a by-product of gold production. The uranium contained in the mine tailings (currently ~22% of South Africa's uranium resources) is owned by the mine owner and can thus become stranded if the owner chooses not to recover it. The owner can also sell forward the uranium not yet extracted from the mine tailings to other customers if the company (owner) so selects.

A detailed study Special Consulting Report on National Uranium Policies. Ux Consulting procured by Eskom **Holdings on behalf of the Department of Energy. July 2013.** was undertaken by an independent consultant on international uranium policies to determine the optimum strategic approach for South Africa to secure its supply of uranium for beneficiation. Given that uranium production in South Africa (SA) is decreasing and becoming increasingly less competitive relative to other international uranium production markets, it is unlikely that locally produced uranium will be feasible for supply to South African nuclear power plants in future. The feasibility for supply of locally produced uranium to South African nuclear power in future should be investigated as part of the Nuclear Industrialisation Plan.

11.2 CONVERSION

Uranium Conversion is the conversion of the natural U_3O_8, also known as yellow cake from uranium mining and milling to the chemical form UF6, which is a solid at room temperature. This form of uranium is useful for enrichment, as it can be converted to a gaseous form at higher temperature and pressure and fed to the enrichment plant. The details pertaining to this section are left out for Necsa's inclusion in their own strategy and plan.

The following recommendations are therefore made:

- Investment in the construction of a conversion plant is not feasible for a 5 200 MWe nuclear expansion. A Nuclear Fuel Cycle Strategy and nuclear Industrialisation Plan (NIP), which are currently underway, will address this question.

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- Further investigation into larger capacities and the viability of establishing a conversion plant is outside the scope of the Report and should be done at a strategic level by Necsa.

11.3 ENRICHMENT

An enrichment plant (or isotope separation plant) is an installation for separating uranium isotopes to increase the concentration of 235U. The main isotope separation processes used in enrichment plants are gas centrifuge technology, with gaseous diffusion being gradually phased out globally. The capacity of enrichment plants is measured in “separative work units” (SWU). SWU is a complex unit that indicates the energy input relative to the amount of uranium processed and the degree of enrichment, i.e., the extent of increase in the concentration of the ^{235}U isotope relative to the remainder.

An enrichment facility in South Africa would have to comply with the requirements of the Nuclear Energy Act, the National Nuclear Regulator Act, the South African Council for Non-proliferation of Weapons of Mass Destruction, the Nuclear Non-proliferation Treaty (NPT), the Nuclear Suppliers Group (NSG), the Zangger Committee and the African Nuclear Weapons Free Zone Treaty (ANWFZ Treaty). As with the conversion, details about the Enrichment Strategy are not part of this report's scope. This will be addressed by Necsa’s Nuclear Fuel Cycle strategy.

11.4 CONVENTIONAL PWR FUEL FABRICATION

Fuel fabrication consists of 3 steps, the first being a chemical process to convert enriched UF6 into UO2 (uranium dioxide) powder. This powder is then compressed into cylindrical pellets the size of a pencil eraser. Lastly, the pellets are stacked into thin, 4m-long metallic zirconium alloy tubes, which are arranged into a hexagonal or square assembly known as a fuel assembly. This process is diagrammatically illustrated in Figure 12 below.

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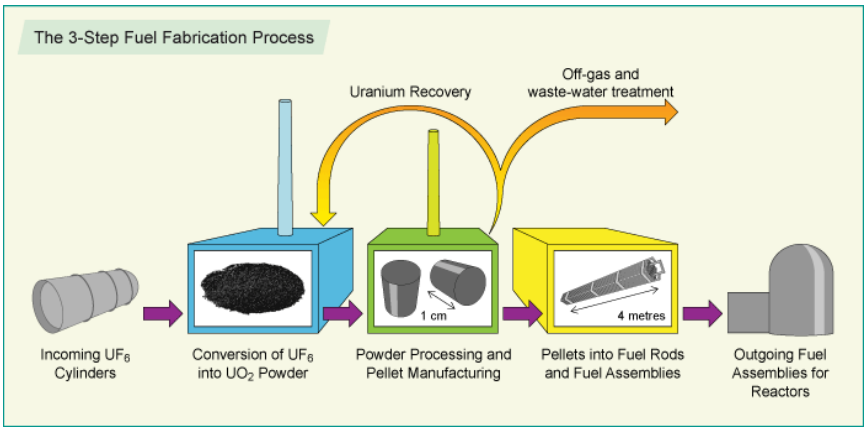

Figure 10: Fuel Fabrication Process from Enrichment Product to Fuel Assembly

Necsa previously possessed fuel fabrication capability at the BEVA fuel fabrication plant, which operated in 1980-90s and supplied 330 PWR fuel assemblies for the Koeberg reactors. Around 300 people were employed in this plant. Fuel fabrication technology was transferred from Framatome (AREVA), and a facility was constructed at Pelindaba after the Koeberg nuclear power plant was procured. Local demand was too low to support continued operation, and the plant was scrapped for economic reasons. Once the plant was closed, the equipment was sold to China.

In recent years, a focused effort was made to re-establish the manufacturing of nuclear fuel components for export. The required quality systems have been developed, and the factory shop that was previously used for this purpose was commissioned (without any machines). Necsa has been registered on the supplier lists of Westinghouse (International) and Korea (Korean Nuclear Fuel) for the supply of fuel components. KNF is at present in the process of qualifying Necsa as a supplier of fuel pin end plugs. Investment in the construction of a PWR Fuel Fabrication plant is not feasible for a 5,200 MW nuclear expansion. Further investigation into larger capacities and the viability of establishing a PWR Fuel Fabrication plant is outside the scope of this report and should be done at a strategic level for Necsa.

11.5 HTR FUEL FABRICATION

Necsa's experience in manufacturing TRISO-coated particles is based on Eskom's activities under the PBMR Company. In 2008, 9,6% enriched fuel particles produced from the Fuel Development Lab (FDL) were shipped to the USA for independent testing to determine the fuel integrity under

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operating conditions at the Idaho National Laboratory. A further 16 graphite spheres were shipped to Russia in 2009 for similar testing. The results confirmed the fit-for-purpose use of the locally produced fuel particles. Necsa therefore seeks to leverage on the facilities and experience related to the PBMR project.

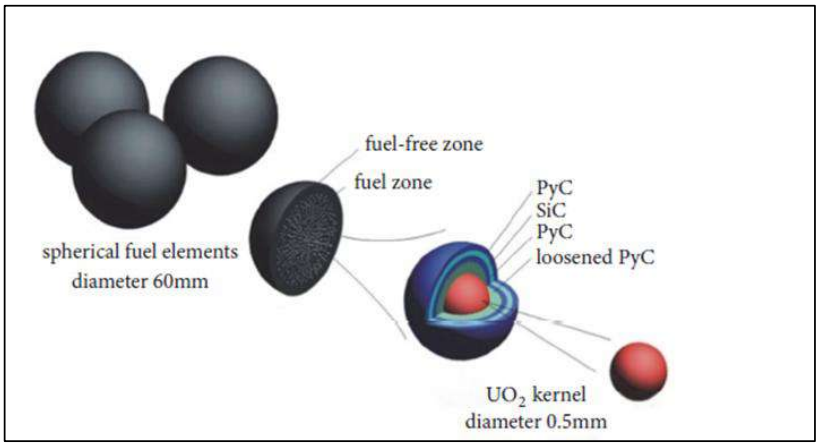

Figure 11: Illustration of the TRISO Coated Fuel Particles

11.5.1 ASSESSMENT OF FINANCIAL VIABILITY OF THE HTR FUEL FABRICATION PLANT

Necsa has evaluated the financial viability of establishing fuel production capabilities for a 200 MWe High Temperature Reactor. If viability is demonstrated, Necsa is expected to leverage the fuel development technological infrastructure and capabilities currently under care and maintenance (part of the possible transfer of the PBMR technology platform from Eskom to Necsa) to develop a brownfield commercial fuel plant to supply a 200 MWe HTR. The PBMR technology platform is at various technology readiness levels (TRLs), with the fuel development package having been successfully demonstrated.

The financial model approach was based on the 2002 PBMR report, which was updated to 2024 and 2033. The scope of this report does not cover the detailed costs, as the focus is only on the 5 200 MWe.

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12. RADIOACTIVE WASTE MANAGEMENT

The cornerstone of South Africa's approach to radioactive waste management is the National Policy and Strategy for Radioactive Waste Management, approved and issued in November 2005 by government. The strategic intent of the Policy and Strategy is to ensure a comprehensive radioactive waste governance framework by formulating, in addition to nuclear and other applicable legislation, a policy and implementation strategy in consultation with all role players and stakeholders.

The Policy Framework defines the respective roles of Government, Regulators, Waste Generators, and Operators, and provides for the development of institutional and financial arrangements to implement long-term waste management solutions in a safe, environmentally sound, comprehensive, cost-effective, and integrated manner. The Policy establishes two management structures for radioactive waste management: the National Committee on Radwaste Management (**NCRWM**) and the National Radwaste Disposal Institute (**NRWDI**). The NCRWM oversees the effective implementation of the policy, while the NRWDI is the implementing body directly responsible for siting, constructing, and operating waste disposal and related facilities.

This section deals with matters of the back end of the fuel cycle, which can proceed for another 300 years after the shutdown of the nuclear installations. Unlike during the historic programmes, today's nuclear operating environment requires making provision for the cost of these activities upfront to avoid an undue financial burden on future generations and to enforce the globally accepted "polluter pays principle".

The Department recently completed a Back-end Fuel Cycle Strategy for industries that produce nuclear and radiological waste. Radiological waste is produced during the operational and decommissioning phases of installations associated with the operation of nuclear reactors, and with the production and use of radioactive materials in the fields of research, medicine, industry, agriculture, commerce, education, and the extraction, processing, and combustion of raw materials containing naturally occurring radioactive materials. The strategy is in the process of being presented to impacted stakeholders; this will thereafter be shared widely. Due to the hazardous nature of radioactive waste, such waste is disposed of in regulatory authorised disposal facilities specifically designed to ensure that the waste is isolated from people and the environment

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(biosphere and geosphere) until such time that the radioactivity has decayed to the extent that it poses no further hazard to people and the environment.

The next subsections deal with the major aspects of the nuclear programme end-of-life cycle, namely the management of the various classes of radioactive waste, including low-level waste, intermediate-level waste, and high-level waste, used (Spent) Nuclear Fuel.

12.1 LOW AND INTERMEDIATE LEVEL WASTE MANAGEMENT

For the purposes of this document, Low and Intermediate Level Waste (LILW) means the same as Low and Intermediate-Level Waste (Short-lived) (LILW (SL)) as defined in the Radioactive Waste Management Policy and Strategy for the Republic of South Africa (DoE, 2005).

South Africa has extensive knowledge and experience in managing and disposing of low-level waste. Low-level waste represents ~95% by volume of all radioactive waste generated in the nuclear industry. LLW has been disposed of since November 1986 at the National Disposal Facility for low-level waste, Vaalputs. The disposal concept at Vaalputs is based on near-surface disposal in trenches up to 8 metres deep, but above the groundwater table. The disposal facility safety incorporates the Multiple Barrier System (MBS) approach and includes the Natural Barrier System (NBS) (i.e., the near field, geosphere and biosphere) and Engineered Barrier System (EBS) (i.e., the conditioned waste form, the waste container and any other engineered enhancement).

Safety assessments, which incorporate the near-field, geosphere and biosphere, have demonstrated that the disposal facility is being operated without compromising the safety of current and future generations by, amongst others:

- Providing a high level of operational and long-term safety.
- Demonstrating compliance with performance standards.
- Preventing or delaying movement of radionuclides toward the accessible environment (i.e., biosphere and geosphere).
- Can be safely closed once all operations have ceased, given that the necessary
- aftercare measures are taken within the institutional control period.

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Vaalputs, being the National Radioactive Waste Disposal Facility for LILW, shall remain operational until all South Africa's LILW has been disposed of on the site. Vaalputs has adequate disposal capacity to accommodate the LILW disposal requirements for past, current, as well as future authorised nuclear installations in South Africa. The estimated operational period for Vaalputs until 2120 [62] is linked to the current disposal capacity available for operational and decommissioning LILW from past, current, and future authorised nuclear installations.

12.2 HIGH LEVEL WASTE MANAGEMENT

High Level Waste (HLW) means heat-generating radioactive waste with high concentrations of long- and short-lived radionuclides. Used Nuclear Fuel is defined as nuclear fuel permanently removed from a reactor core following irradiation that is no longer usable in its present form because of depletion of fissile material, poison build-up or radiation damage. Used Nuclear Fuel is classified as HLW and is ~ 3% by volume of all radioactive waste generated in the nuclear industry.

The lack of a demonstrated solution for spent nuclear fuel disposal is one of the greatest challenges for public acceptance of nuclear energy. This may be more about public awareness of the facts than about the actual solution to the problem. However, some countries, such as Finland, have made significant progress with the construction of Onkalo as the world's first permanent disposal facility for spent nuclear fuel. Most countries do not have a demonstrated solution for the disposal of spent fuel because:

- Only 5% of nuclear fuel is used in the reactor, and 95% remains and can be disposed of or recycled. Most companies and countries therefore do not seek to dispose of the fuel immediately if it could be used again in the future. Most recently, France has changed its policy on disposal and is requiring that fuel disposal sites have the option of recovery.
- Public Opposition to the use of nuclear sites for disposal, such as Yucca Mountain in the USA, due to fears of inaccessibility to land for generations to come, has no scientific or economic basis to support these fears.

By the end of 2019, over 400 000 tHM of used (spent) nuclear fuel (UNF/SNF) had been discharged globally from nuclear power reactors. About two-thirds (~ 301 300 tHM) of this amount remains in storage, while one-third (~98 700 tHM) has been reprocessed [61]. At the end of December 2019,

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35% of spent fuel was stored in dry storage facilities, and 65% was stored in wet storage facilities. 47% of the global spent fuel inventory remains onsite at Reactor (AR) storage facilities, while 53% is stored at Away from Reactor (AFR) storage facilities. For Away from Reactor (AFR) storage facilities, about two-thirds (67%) is dry storage and about one-third (~33%) is in wet storage. While initial storage relied on wet technology, various dry technologies have been developed since the mid-1980s and are now widely deployed.

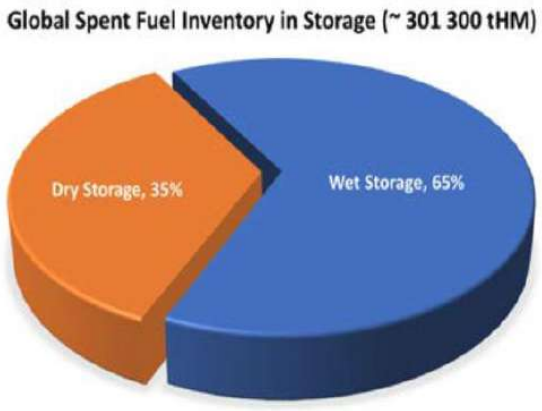

Figure 12: Distribution of the global UNF/SNF inventory between wet and dry storage, 2019.

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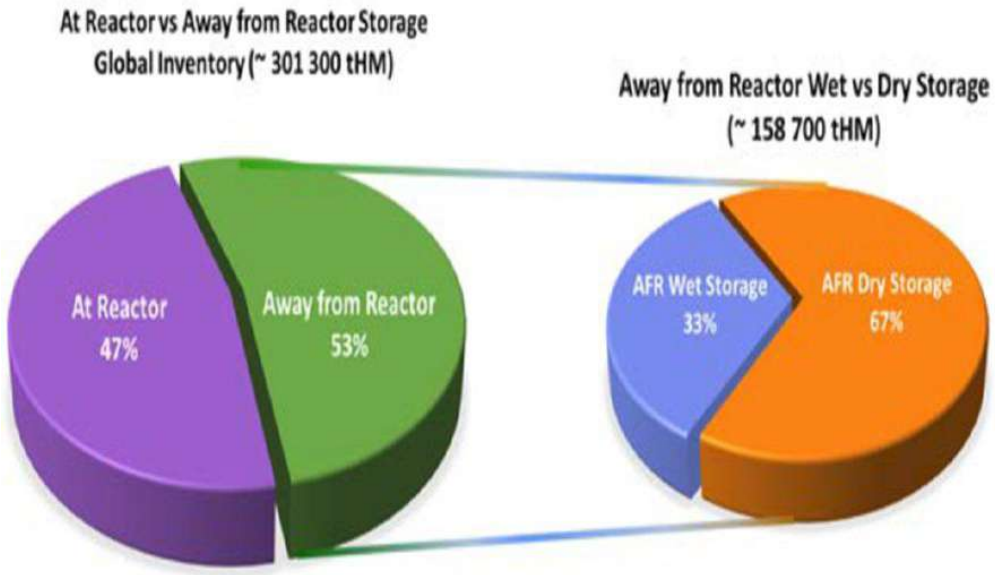

Figure 13: Distribution of the global UNF/SNF inventory between AR and AFR storage facilities (wet and dry), 2019.

Most countries with nuclear power programs assume that the eventual disposal of used (spent) fuel and high-level radioactive waste will require underground repositories, hundreds of meters deep, where the surrounding media (rock, clay, or salt) offers a natural barrier to the escape of radioactivity. Many analysts expect emplacement of containers of spent fuel, high-level waste, or plutonium waste into well-designed geological repositories that could reliably prevent the escape of radioactive materials to the biosphere for at least several thousand years.

In South Africa, each Koeberg unit discharges a third of its fuel inventory from its reactor core on a 16- to 18-month cycle. The discharged fuel is temporarily stored in spent fuel pools for initial cooling and radioactive decay until it is safe to move into dry storage casks. In the early 2000s, the spent fuel storage pools were re-racked to expand their storage capacity, as it was anticipated they would be full before 2000. During re-racking, four dry storage casks were obtained for transferring old SFAs from the spent fuel pools and for subsequent use as additional storage capacity. Various options exist for waste storage, including:

- Long-term above-ground storage on an off-site licensed facility;
- Reprocessing, conditioning and recycling; and

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- Deep geological disposal.

Transmutation has been excluded as an option due to the major investment needed for this technology. However, the South African government will continue to monitor developments internationally.

Recently, the Department developed a study on the back end of the fuel cycle strategy, with a thorough assessment of options for future spent fuel storage and disposal. The study included an assessment of all previous work done by Necsa, Eskom, and the NNR, as well as recent international experience in spent fuel management. The following key learnings have transpired from the analysis of various countries' used fuel and high-level waste strategies:

- The Pre-Feasibility Study Review of the Reprocessing of Spent Nuclear Fuel in South Africa [60] has evidenced that establishment of a local reprocessing capability is a costly enterprise and would only be commercially viable for a nuclear fleet of approximately 50 GW
- The primary motivation for reprocessing in countries that currently undertake reprocessing is security of supply of fresh fuel. South Africa has established a comprehensive front-end strategy that addresses this and aims to ensure self-sufficiency in this regard.
- Commercial reprocessing services in other countries are currently only offered by the Russian Federation and France. It is noted that several countries that previously had reprocessing policies have now revised them away from this option. Countries in this position include Germany, Spain, the United States and Switzerland.
- Voluntary and consultative processes for siting of geological repositories have been more successful than top-down decision-making;
- Most countries have adopted dry cask storage as an interim strategy since no deep geological repository is operational.;
- In some countries, the politics of waste repository siting have become entangled with the larger issue of the future of nuclear power.

The two major options for used nuclear fuel management have developed to a stage where South Africa can make an informed policy decision on the strategy the country wishes to pursue. The choice between these options is therefore a matter of national policy, not one made by the nuclear industry in isolation from the public and government. In fact, it involves strategic, political, economic,

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and technical issues, and because the strategic and political issues are often the most important, the choice is often decided by government.

However, considering the envisaged nuclear new-build programme, it is worthwhile to establish what implications the choice of any option would have for South Africa's national policy on nuclear fuel cycle backend management. It is difficult to establish future implications, since any predictions can be superseded by reality. South Africa’s Radioactive Waste Management Policy and Strategy is robust and provides flexibility in management options for a UNF and HLW strategy; therefore, there is no immediate need to commit to a particular nuclear fuel cycle (open or closed).

The 2011 Fukushima event has heightened public concern about long-term onsite storage in pools and dry casks. The amount of UNF stored onsite should therefore be minimised by removing UNF as soon as feasible to a centralised off-site storage facility. Centralised off-site long-term storage has the following positive attributes:

- Could assist utilities to avoid building additional dry/wet storage facilities at the operating reactor sites.
- It would provide the nation with flexibility to consider alternative policies and technologies.
- Consolidation would decrease the complexity of securing and overseeing used fuel at various reactor sites.
- Reducing decentralised radioactive inventory.

The following technical outcomes are required regardless of the UNF and HLW strategy chosen:

- First, a centralised off-site long-term storage facility will be needed to store the UNF until facilities for treatment and final disposal of the fuel are ready.
- Second, regardless of the interim storage option selected, a deep geological repository will be required for the ultimate disposal of high-level waste and wastes from recycling and/or direct disposal of UNF.

In 2017, the then Minister of Energy established a Steering Committee for a Centralised Interim Storage Facility (CISF) to provide guidance and oversight of the project, which was intended to ensure away-from-reactor management of spent fuel. Following the Committee's recommendation in 2019, the Minister endorsed the National Radioactive Waste Disposal Institute (NRWDI) to initiate the project and become the eventual owner and operator of the facility. The project is being pursued

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collaboratively through a Framework Agreement comprising of key stakeholders, namely, Eskom, Necsa, NRWDI, and the Department of Electricity and Energy.

Since 2019, project management of the CISF has followed the National Treasury Framework for Infrastructure Delivery and Procurement Management (FIDPM), under which the Prefeasibility Study was completed in 2021, and the draft Feasibility Study underwent Gateway Review in 2022. In order to meet the outstanding requirements of the feasibility stage, a Preliminary Design was approved by NRWDI in March 2026, which envisages the project proceeding through three Phases:

- Phase 0: Storage Capacity for up to 32 Dual Purpose Canister Based Dry Storage Casks by 2030
- Phase 1: Storage Capacity for at least 128 additional storage equivalent to Dual Purpose Canister Based Dry Storage Casks by 2045
- Phase 2: Spent fuel, handling, treatment and conditioning facilities for maintenance of canisters and fuel and preparation for Deep Geological Disposal by 2065.

The CISF Feasibility Study and Environmental Impact Assessment is intended to be completed in 2027, with a Nuclear Installation Site License application envisaged in early 2028. Construction is expected to commence by 2030, with operation expected within the year.

The National Back End Strategy gives the following direction:

- The establishment and operationalisation of the Radioactive Waste Management Fund (RWMF) is necessary to ensure sustainable funding and that the polluter pays principle is ensured for South Africa’s long- term used nuclear fuel waste management program.
- The siting process for the back-end facilities must be consultative, open, and transparent, and all stakeholders (i.e. interested and affected parties) must be included.
- The adoption of the direct disposal option for management of Used (Spent) nuclear fuel (no reprocessing) as per the approved back-end strategy.
- As directed by Section 7.9 and Section 13.1.C of the Radioactive Waste Management Policy and Strategy, the direct disposal route for UNF/SNF shall provide for a defined period during which retrievability will be possible. The reason for this is not to rule out the possibility of the use of future radioactive waste technology advancements for better management options and not for reprocessing

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The recommended Way-forward is that:

- The establishment of the Radioactive Waste Management Fund (RWMF) should be expedited to ensure the sustainable funding for South Africa's long- term waste management program.
- The siting process for the back-end facilities must be consultative, open, and transparent, and all stakeholders (i.e. interested and affected parties) must be included.
- The adoption of the direct disposal option for management of Used (Spent) nuclear fuel (no reprocessing) as per the approved back-end strategy.
- As directed by Section 7.9 and Section 13.1.C of the Radioactive Waste Management Policy and Strategy, the direct disposal route for UNF/SNF shall provide for a defined period during which retrievability will be possible. The reason for this is not to rule out the possibility of the use of future radioactive waste technology advancements for better management options and not for reprocessing

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13. DECOMMISSIONING AND DISMANTLING

Decommissioning is the final stage in the life of a nuclear installation and comprises a whole set of activities aimed at bringing the facilities to a permanent shutdown and decontaminated state and possibly dismantling and disposing of in a manner that is safe to the personnel, to the public and benign to the environment. Decommissioning of the plant is considered in a feasibility study as a cost item. Decommissioning is a necessary but costly step that needs to be considered in the planning and implementation of a nuclear project. Its cost will depend on the type of capitalization, on the technology options selected and on the environmental impact that the process entails.

Eskom has provided strategic principles for decommissioning the proposed nuclear power plants as part of the Environmental Impact Assessment Revised Draft **Environmental Impact Assessment Report for the Eskom Nuclear Power Station and Associated Infrastructure (Nuclear-1). Arcus GIBB (Pty) Ltd. March 2011. Available online and on CD supplied (290 files, 37 folders).**These do not go into much detail at estimating the exact costs given the long timescales (60+ years) and difficulty at predicting technological and regulatory advancements by this time.

The Study of the Cost of Nuclear Power, conducted by Ingerop for the former Department of Energy in October 2013, is one of the first South African studies to consider the full cost of decommissioning based on actual experience of decommissioning projects. The study provides a useful reference point for treating decommissioning as an upfront cost item in the programme, rather than relying only on the high-level strategic principles in the Nuclear-1 Environmental Impact Assessment.

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14. SAFEGUARDS

This chapter provides input on the Safeguards requirements in response to the planned new nuclear power plants with a capacity of 5 200 MW, as pronounced under the gazetted Integrated Resource Plan 2025. The implementation of the nuclear programme will require the acquisition of significant quantities of nuclear material (which source & Special fissionable material), equipment, and technology through International nuclear trade to generate electricity over the plants' long operational lifetimes.

The IAEA Safeguards, export and import control mechanisms therefore become critical to provide the requisite assurances that nuclear material and technology remain in peaceful use, in line with international obligations undertaken by the State. The IAEA apply safeguards, which are technical measures on nuclear material and activities, to independently verify that States are living up to their undertakings under the NPT (Art III.1) to use nuclear material, facilities and related technologies for peaceful purposes. States need to accept the safeguards measures in line with the Safeguards Agreements (INFCIRC/153) concluded by the State, which provide for:

States undertaking: "*to accept safeguards on all source or special fissionable material in all peaceful nuclear activities…*" (para. 1) and the IAEA's right and obligation: "*to ensure that safeguards will be applied on all source or special fissionable material in all peaceful nuclear activities*…" (para. 2) The nuclear material is categorised into Source and Special fissionable material, and technology. Source material includes natural uranium and depleted uranium, and Special fissionable material includes enriched uranium, plutonium, and nuclear facilities.

Therefore, the pronouncement of the implementation of 5 200 MW (and a possible first phased procurement package within the 5 200 MW IRP 2025 allocation) of the Nuclear New Build programme in the Integrated Resource Plan (IRP) of 2025 implies an increase in Nuclear Safeguard responsibilities in South Africa. Taking this into account, South Africa needs a plan to develop or strengthen the national safeguards infrastructure to fulfil the increasing safeguards responsibilities associated with all nuclear material, facilities, and technology in the territory.

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15. LEGISLATIVE FRAMEWORK

15.1 INTERNATIONAL FRAMEWORK

South Africa ratified the Nuclear Non-Proliferation Treaty (NPT), in July 1991 and subsequently concluded the Comprehensive Safeguards Agreement (INFCIRC/394) with the International Atomic Energy Agency (IAEA), pursuant to Article III of the NPT, which states that -" Each Non-Nuclear Weapon State party to the Treaty undertakes to accept safeguards as set forth in an agreement to be negotiated and concluded with the IAEA"

15.1.1. COMPREHENSIVE SAFEGUARDS AGREEMENT (INFCIRC/394)

The objective of safeguards is the timely detection of diversion of significant quantities of nuclear material from peaceful nuclear activities to the manufacture of nuclear weapons or of other nuclear explosive devices or for purposes unknown, and deterrence of such diversion risk by early detection.

15.1.2 ADDITIONAL PROTOCOL (AP) (INFCIRC/394.ADD1)

In September 2002, South Africa entered into force the Additional Protocol (AP) (INFCIRC/394.Add1) to the Safeguards Agreement, which provided for additional measures beyond the CSA by increasing the IAEA's scope to verify the peaceful use of all nuclear material in a State with a CSA, for instance, access to information and locations.

In March 2011, the IAEA drew a Broader Conclusion based on the evaluation of all the information available to it, that all nuclear material in South Africa remained in peaceful activities. A broader conclusion of the absence of undeclared nuclear material and activities in the state as a whole allows the IAEA and South Africa to implement a new Integrated Safeguards (IS) approach, which started in 2015.

15.1.3 OTHER RELEVANT TREATIES

In addition to the NPT, CSA and AP, South Africa concluded and is implementing the Pelindaba Treaty (1996), the Comprehensive Test Ban Treaty (CTBT) (1999) and the Treaty on the Prohibition of Nuclear Weapons (TPNW) (2021) and UNSC 1540, which support the objectives of the NPT and reaffirm South Africa's Non-Proliferation and safeguards commitments.

Nuclear export and import controls (Nuclear Suppliers Group (NSG) (1994) and Zangger Committee (ZC) (1993)) are also necessary to implement the above international nuclear obligations.

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South Africa became a member of the ZC in 1993, which established guidelines for implementing the export control provisions of Trigger List items.

South Africa became a Participating Government (PG) of the NSG and subsequently adopted the guidelines (2 sets) into national laws. NSG Part 1 – (Trigger list items), administered under the Nuclear Energy Act, 46 of 1999 of the Department of Electricity and Energy (DEE), while the NSG Part 2 – Nuclear Related Dual Use items, administered in terms of the Non-Proliferation of Weapons of Mass Destruction Act, 87 of 1993 of the Department of Trade, Industry and Competition.

Zangger Committee (ZC) and Nuclear Suppliers Group (NSG) ensure that transfers of nuclear material and certain equipment and technology (whether imports or exports) take place in a secure, safe and environmentally responsible manner and that such transfers do not directly or indirectly assist any non-nuclear weapon State or any unauthorised person in developing or acquiring nuclear weapons.

15.2 NATIONAL FRAMEWORK

The national obligations required to fulfil the international obligations

15.2.1 NUCLEAR ENERGY ACT, ACT 46 OF 1999

In terms of the Nuclear Energy Act, Act 46 of 1999, Chapter III, South Africa makes an undertaking to accept safeguards on all its source or special fissionable nuclear material in all peaceful nuclear activities within its territory, under its jurisdiction or carried out under its control for the exclusive purpose of verifying that such material is not diverted to nuclear weapons or other explosive devices **[Section 33(1)],**

Assignment of the safeguards implementation role to Nuclear Safeguards Management (NSM) to fulfil South Africa's undertakings under the Comprehensive Safeguards Agreement and Additional Protocol (in terms of delegation of authority) **[Section 33(2)(a) (i – viii].**

Authorisations required for nuclear material and activities: Authorisations to acquire, possess, import, transport and export of, and certain activities related to source and special fissionable material - **[Sect's 34, 35],**

Inspections, audits and enforcement provisions to ensure compliance with licence conditions - **[Sections 37, 38, 35]**

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The management of radioactive waste and storage of irradiated nuclear fuel in South Africa - **[Sect's 44 -50]**

15.2.2 NON-PROLIFERATION OF WEAPONS OF MASS DESTRUCTION ACT 87, OF 1993

To provide for control over weapons of mass destruction; and the establishment of a Council to control and manage matters relating to the proliferation of such weapons in the Republic; to determine its objects and functions; to prescribe the manner in which it is to be managed and controlled; and to provide for matters connected therewith.

15.2.3 NUCLEAR ENERGY POLICY OF 2008

The Policy lays down the principles that guide the development or use of nuclear energy in the country and the Government's vision for an extended nuclear energy programme. Among the principles are provisions requiring all facets of the nuclear energy sector to be subject to appropriate safeguards and security measures, in conformity with South Africa's international obligations, and to the fulfilment of all multilateral obligations and commitments under the relevant international non-proliferation instruments.

15.2.4 REGULATIONS

Government Notice 207 of 27 February 2009, under the Nuclear Energy Act as amended in 2023, defines nuclear material and nuclear reactors to ensure alignment with controls under the NSG Part 1 Trigger List items.

The Nuclear Non-Proliferation Regulations, Gazette No.11554 of 10 March 2023 – provides for guidelines for safeguards implementation.

15.3 STATE SYSTEM OF ACCOUNTING AND CONTROL (SSAC)

The SSAC is the States infrastructure established for the application of safeguards obligations. The SSAC further establishes the State Regulatory Authority (SRA) for practical implementation/ and maintenance of SSAC. South Africa has a well-established SSAC, since the conclusion of the CSA in 1991, which further established the SRA, the Necsa Nuclear Safeguards Management (NSM). The NSM department was assigned the role of safeguards implementation, in order to fulfil the South Africa's undertakings in terms of the Nuclear Energy Act, Section 33(2)(a) (i – viii.).

15.3.1 SSAC FUNCTIONS

Accountancy: System(s) for keeping records and reporting to IAEA of nuclear activities on the Nuclear Material Accounting and Control (NMAC)

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Control: Inspections and compliance measures in accordance with Legislation and requirements (laws, regulations etc.) to implement accountancy and control systems at facility level, Licensing etc.
NDA (Measurements): System to determine quantities of material existing in/added to/removed from inventories
Supporting functions: management systems, resourcing, mandate, funding, expertise, technology.

15.4 SAFEGUARDS STAKEHOLDERS

The stakeholders, responsible to fulfil the safeguards obligations during the 5 200 MW implementation include:
Government /Minister of the Department of Electricity and Energy
Department of International Relations and Cooperation
Department of Trade and Industry and Competition
State Regulatory Authority (SRA), - Nuclear Safeguards Management (NSM)
International Atomic Energy Agency (IAEA)
Owners and operators of nuclear Facilities
Power Plant Vendor/s (Designers/builders) and
Equipment providers.

The stakeholder's roles are at various phases of the project lifecycle (design, approval, construction, oversight, operation, and safeguarding of the nuclear facility).

While the Government is responsible for the establishment of the NEPIO, and concluding all relevant treaties, the SRA and the Owner operator are responsible for the planning; systematically developing and integrating the necessary technical and administrative competences on timescales consistent with the development of the nuclear power programme:

Government: Needs to ensure adequate legal and regulatory framework and the effective implementation of the requirements therein that control the import, transport, possession, use, management and export of nuclear material, as well as the construction, operation and decommissioning of nuclear facilities.
SRA (NSM): Needs to be able to collect, correct and complete information from Owner Operator for the timely submission to the IAEA. The information includes but not limited to the facility design

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information, import–export notifications, nuclear material accounting records and reports, and other declarations and reports.

Operator (Eskom): Needs to provide the above information as early as possible and in as much detail to SRA, particularly the facility design information which is further submitted to the IAEA. The operator needs to also implement the adequate facility level controls over the access to, use of and movement of nuclear material.

Designer/builder: Needs to design a facility/ies according to the Safeguards Authority guidelines and owner/operator's specification. IAEA and Operator involvement is imperative at design phase to influence the design of new and future equipment, which will minimise potential cost of "off-the-shelf" equipment.

Material and Equipment Provider: Need to supply nuclear material, related equipment and components in accordance with the Nuclear Suppliers Group and Zangger Committee export control requirements and the safeguards reporting requirements.

15.5 DESIGN INFORMATION

Information regarding planned new facilities to be constructed during the implementation of the 5 200 MW is required early in the project phase. The type of information required is the design information to provide adequate lead time for the IAEA and the Safeguards Authority to cooperate in preparing the safeguards approach and implementation of the measures.

The communication between the IAEA and the State must begin at the planning phase. The State must notify the IAEA of the plans for new facilities to ensure Safeguards by Design, a concept where the safeguards measures are integrated during design stages to address among the others, the cost considerations.

When South Africa anticipates building a facility, the preliminary information about the planned facility must be made available to the IAEA in a template (Design Information Questionnaire (DIQ)) or as free text in a letter. This early notification can include only very basic information, such as "two light water reactors, approximately 100 MW each" and can be updated as and when necessary, as the project progresses.

The IAEA has set requirements for both reporting design information and access as follows:

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Facility Design Stages

The IAEA conducts comprehensive design information verifications (DIV) to affirm the declared status of a facility over its lifetime. When the IAEA verifies the conditions at a facility that is revising its status, it needs to have a technical basis for confirming that the facility has changed its declared status.

15.6 PROLIFERATION RESISTANCE AND PHYSICAL PROTECTION (PR&PP)

Methodology development on SMR's

The PR&PP methodology was developed to address one of the goals identified for future nuclear energy systems (i.e., next-generation power reactor designs that will see commercial deployment beyond 2030): Generation IV nuclear energy systems will increase the assurance that they are a very unattractive (i.e., present significant barriers) and the least desirable route for diversion (i.e., removal by a State from a declared safeguarded facility, or used to produce undeclared nuclear material) or theft of weapons-usable materials, and provide increased physical protection against acts of terrorism.

15.6.1 PR&PP taken into account with Small Modular Reactors

Small modular reactors and micro reactors based on the six Generation-IV system designs do have unique traits that should be considered in a PR&PP analysis. The small size, modularity of operations, and advanced safety systems need to be considered when examining PR&PP and designing appropriate Safeguards and Security systems.

15.6.2 Relation between PR&PP and IAEA Safeguards

PR&PP incorporates International Atomic Energy Agency (IAEA) Safeguards as external components (sometimes referred to as extrinsic measures) of the nuclear energy system being assessed. PR&PP can be used by designers at an early stage to assess where and how one might implement Safeguards, in order to guide conceptual design decisions. Safeguards is one feature of

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a good design that enables the detection of proliferation. PR&PP assessment assures that this detection is timely by accounting for technical difficulty, time to achieve success, and material type.

15.6.3 Staying abreast with the latest developments and new technologies

RSA is part of the Generation IV International Forum's current membership and is also an IAEA member State with CSA and AP in place. These forums assist RSA to keep up with ensuring that the spread of such technologies is controlled to meet Nuclear Safeguards obligations.

15.7 CONCLUSION

The effective implementation of the Agency’s safeguards system is a critical element of the global nuclear non-proliferation regime. It contributes to international peace and security. South Africa continues to cooperate effectively with the Agency to implement our Safeguards obligations under the Integrated Safeguards approach. The Agency’s Safeguards Implementation Reports continue to maintain the broader conclusions that our country’s nuclear programme is exclusively for peaceful purposes.

The non-compliance to the safeguards requirements in South Africa is contravention of the Nuclear Energy Act and can result in prosecution. The CSA provides for Agency's right and obligation to ensure that safeguards will be applied, in accordance with the terms of the Agreement, on all source or special fissionable material in all peaceful nuclear activities within the territory of the State, under its jurisdiction or carried out under its control anywhere, for the exclusive purpose of verifying that such material is not diverted to nuclear weapons or other nuclear explosive devices.

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16. SECURITY

The purpose of this chapter is to provide inputs regarding nuclear security requirements for the implementation of the 5 200 MW (earlier work and a possible first phased procurement package within the 5 200 MW IRP 2025 allocation) Nuclear New Build Programme in the Republic of South Africa. The implementation of the programme will require security measures during the acquisition of significant quantities of nuclear source materials, special nuclear materials and equipment from suppliers' countries to achieve electricity generation over the operational lifetime of the plants. The State is required in terms of its international obligations in the field of Nuclear Security to have measures in place to protect the nuclear materials during international transport, domestic use, domestic storage and domestic transport. Protection is against theft, unauthorised access, illegal transfer and any other malicious acts. This is to ensure that nuclear materials remain in peaceful use and do not fall into the wrong hands, both state and non-state actors.

At national level different legislation is utilised to regulate and control various aspects of physical protection of nuclear materials and related facilities. Different institutions have different mandates in the various aspects of physical protection or nuclear security. The responsibility for the establishment, implementation and maintenance of a physical protection regime within a State Party rest entirely with that State.

16.1 LEGISLATIVE FRAMEWORK

16.2 INTERNATIONAL FRAMEWORK

South Africa is a signatory to the original Convention on the Physical Protection of Nuclear Material (INFCIRC/ 274/Rev 1) since May 1981 and ratified on 17 September 2007. This Convention is the legally binding international instrument in the area of physical protection of nuclear material. The Convention aims to ensure physical protection of nuclear material during international transport, enhancement of cooperation in protection and recovery of stolen nuclear material as well as criminalisation of offences such as theft or robbery of nuclear material. South Africa has recently in February 2024, ratified the Amendment to the Convention on Physical Protection of Nuclear Material. In terms of the Amendment, it is legally binding for State Parties to protect nuclear material and facilities in peaceful domestic use, storage and transport. It also provides for expanded cooperation between and among States regarding rapid measures to locate and recover stolen or

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smuggled nuclear material, mitigate any radiological consequences of sabotage, prevent and combat related offences. Furthermore, the Convention provides for the criminalisation of new and extended specified acts, the sharing of information on potential or actual attacks on nuclear facilities as well as the provision of assistance should such attacks occur. Currently, the Country is in the process of implementing the requirements of the Amended CPPNM. In terms of the requirements for the Nuclear New Build Programme, the IAEA Nuclear Security Series No.13 (INFCIRC/225/Rev5) requires that the security plan be implemented during all phases of a nuclear power plant life cycle, including siting, planning, construction, operation, commissioning and decommissioning.

16.3 NATIONAL FRAMEWORK

There are several pieces of national legislation that governs physical protection or nuclear security in South Africa, namely the Nuclear Energy Act (Act No 46 of 1999), National Key Point Act (Act No of 102 of 1980) or Critical Infrastructure Protection Act (Act No 8 of 2019), National Strategic Intelligence Act (Act No 39 of 1994) and National Nuclear Regulator Act (Act 46 of 1999).

16.4 NUCLEAR ENERGY ACT

In terms of Nuclear Energy Act, Act No 46 of 1999 Section 33(3) provides for the implementation and maintenance of the prescribed physical protective measures in respect of nuclear material. Sections 34 and 35 of the same Act provides for Authorisations required for nuclear material and activities; authorisations to acquire, possess, import, transport and export of, and certain activities related to source and special fissionable material (the authorisations have physical protection conditions by which holders must comply to). In terms of Nuclear Energy Act, Act No 46 of 1999 sections 35, 37, 38 provides for conducting Nuclear Security Inspections, audits and enforcement provisions to ensure compliance to license conditions.

The Department of Electricity and Energy is responsible for the development and maintenance of the Design Basis Threat document.

16.5 CRITICAL INFRASTRUCTURE PROTECTION ACT, NO 8 OF 2009

Replaced the National Key Point Act, Act No 102 of 1980 or Critical Infrastructure Protection Act (Act No 8 of 2019) provides for the protection of National Key Points. The CIPA aims to identify infrastructure as critical infrastructure, ensuring its protection, safeguarding, and resilience. It is

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driven by the need to secure public safety, national security, and the continuous provision of basic public services.

16.6 NATIONAL STRATEGIC INTELLIGENCE ACT, NO 39 OF 1994

The Act aims to protect and promote the National Interest of the Republic by identifying and addressing any threats or potential threats to national security; supplying intelligence to relevant authorities such as National Intelligence Coordinating Committee (NICOC); to inform policy and decision making; advising cabinet on matters related to National Security and Intelligence policy.

16.7 NATIONAL NUCLEAR REGULATOR ACT, NO 47 OF 1999

The primary mandate of the NNR Act is to protect persons, property, and environment against nuclear damage. This includes ensuring the safety of nuclear installations through the establishment of safety standards and regulatory practices. Exercise regulatory control over the siting, design, construction, operation, manufacture of components parts, and decontamination, decommissioning, and closure of nuclear installations. This control extends to ensuring physical security and safety of nuclear facilities.

16.8 ROLE PLAYERS IN NUCLEAR SECURITY

16.8.1 DEPARTMENT OF ELECTRICITY AND ENERGY

The Minister of Electricity and Energy is the competent authority responsible for the administration of all matters related to nuclear energy in the country. The Department of Electricity and Energy (DEE) establishes and maintains a legislative and regulatory framework to govern the physical protection of nuclear material and associated facilities supported by relevant institutions. International nuclear security obligations assert legislative responsibility on the State to ensure the establishment of designated institutions to undertake various roles and responsibilities as defined.

The national nuclear security framework provides a coherent and integrated implementation of nuclear security by relevant State Institutions to enhance effective physical protection, preparedness and response to all matters of nuclear security and physical protection requirements. The department has a responsibility to ensure proper coordination and cooperation among the institutions in relation to their respective roles and to information exchange on a secure basis. The following institutions are designated to carry out one or more nuclear security functions. The Department of Electricity and Energy administers the Nuclear Energy Act (Act no.46 of 1999).

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16.8.2 DEPARTMENT OF INTERNATIONAL RELATIONS AND COOPERATION

The Department of International Relation and Cooperation (DIRCO) is entrusted with the formulation, promotion and execution of South Africa's foreign policy and with the daily conduct of South Africa's international relations. DIRCO has the primary responsibility for discharging South Africa's international obligations, including those in the nuclear disarmament, nuclear security and non-proliferation arena. DIRCO is the primary contact between the state and international community regarding international obligations on physical protection.

16.8.3 NATIONAL NUCLEAR REGULATOR

The National Nuclear Regulator (NNR) is mandated to provide for the protection of persons, property and environment against nuclear damage as per NNR Act (Act No. 47 of 1999) as amended. NNR assures that authorisation holders comply with the requirements and/or licensing conditions for the safety of facilities, nuclear or radioactive material or associated activities such as transportation of nuclear or radioactive material.

16.8.4 STATE SECURITY AGENCY

The State Security Agency provides intelligence support services to the operators and the competent authority through the Strategic Intelligence Act (Act No.39 of 1994).

16.8.5 SOUTH AFRICAN POLICE SERVICES

The South African Police Service (SAPS) is the protection authority of nuclear installations classified as Critical Infrastructure (National Key Points) in the country. SAPS also has security regulatory role in terms of National Key Point requirements, National Key Point Act, (Act No. 102 of 1980)/Critical Infrastructure Protection Act (CIPA) which requires that CIPA should establish a Joint Planning Committee which comprises of all law enforcement stakeholders.

16.8.6 NUCLEAR OPERATORS

The nuclear operators are authorized to operate licensed nuclear facilities and are responsible for the physical and digital (cyber) protection of nuclear material and facilities under their control in use and storage including during transportation.

16.9 NUCLEAR SECURITY GOVERNANCE

The Nuclear Security governance process refers to the system of structures, mandate, responsibilities, and obligations by which nuclear security implementation in South Africa will be directed and controlled. The governance structure specifies the carrying out of responsibilities

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among different stakeholders such as the Department of Electricity and Energy, Regulators, Operators and support institutions such as Law enforcement and intelligence agencies.

16.10 REQUIREMENTS FOR THE NUCLEAR NEW BUILD PROGRAMME

The physical protection requirement for the Nuclear New Build Programme is that a security plan be developed and implemented during all phases or stages of a nuclear power plant life cycle including siting, planning, construction, operation, commissioning and decommissioning in line with IAEA Nuclear Security Series No. 13 (INFCIRC/225/Rev5). This is the primary responsibility of the nuclear operator.

16.11 CONCLUSION

Based on the current and historic nuclear programmes in the country, there is adequate legislative, regulatory and established nuclear security framework to support the proposed Nuclear New Build Programme. South Africa has capability and/or capacity to deliver the Security plan during each phase of the life cycle of this project including Planning, Siting, Design, Construction, Commissioning, Operations and Decommissioning. A security plan for each phase of the Nuclear New Build Programme has to be developed based on the current threat assessment. South Africa has more than 50 years of experience in protecting nuclear installations, i.e. Koeberg Nuclear Power Station and Necsa’s nuclear facilities.

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17. INTRODUCTION TO CARBON BORDER ADJUSTMENT MECHANISMS

Carbon border adjustment mechanisms (CBAMs) are mechanisms that aim to increase the consistency in the application of carbon pricing between goods produced in different jurisdictions but traded between those jurisdictions.

It is the European Union's (EU) Growth and industry strategy that seeks to accelerate the decarbonisation of the EU economy and make them the first carbon-neutral continent by 2050. The overarching aim is for CBAM to protect European companies from unfair competition and prevent carbon leakage (for reasons of cost related to climate policies, businesses may transfer production to other countries with "Laxer" emission constraints). It is intended to equalise the price of carbon between EU products and imports, ensuring importers face similar conditions to EU manufacturers and that the EU climate objectives are not undermined by carbon leakage. CBAM initially covers imports of iron and steel, cement, aluminium, fertiliser, hydrogen, and electricity.

Other countries such as the UK, US, Canada, and Japan are also considering the implementation of carbon border adjustment measures.

17.1 IMPACT ON EXPORTS AND EFFECTS ON TRADE

i) Practically, this could mean that South African exports of carbon-intensive goods would face an extra carbon cost liability in the European Union (EU).
ii) Africa Climate Foundation and the Firoz Lalji Institute for Africa at the London School of Economics and Political Science (LSE):
    - The EU is a particularly important export market for African countries, accounting for 26% of Africa's exports of fertiliser, 16% of iron and steel, 12% of aluminium and 12% of cement, and because Africa's exports of several important commodities to the EU are relatively more carbon intensive than Africa's competitors.
    - The CBAM could cause a fall in exports from Africa to the EU of aluminium by up to 13.9%, iron and steel by 8.2%, fertiliser by 3.9% and cement by 3.1%.

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- In a hypothetical model in which the CBAM is applied to all imports, it was forecast to reduce total exports to the EU from African countries by 5.72% and to reduce Africa's GDP by 1.12% (equivalent to £31 billion at 2021 levels of Africa's GDP).

iii) The introduction of the CBAM will increase the costs of South African exports in European markets, reducing their competitiveness and hence the likely value of future exports.

iv) Carbon border tax on embedded Green House Gas (GHG) emissions of carbon-intensive products imported into the EU.

v) The main intent is to equalise the price of carbon between EU products and imports.

vi) Ensuring importers face similar conditions to EU manufacturers and that the European climate objectives are not undermined by carbon leakage.

vii) The CBAM with the EU was set into force in October 2023 for iron and steel, cement, fertiliser, aluminium, hydrogen, and electricity.

- For the transitional period, namely October 2023 to end of 2025, the burden will be administrative rather than financial, as importers will only report direct GHG emissions embedded in their imports.
- However, from 2026, the carbon pricing associated with CBAM will be gradually ramped up, reaching full force in 2034.

viii) The burden of complying with the CBAM will fall mostly on EU importers, which will have to report carbon emissions associated with their imports and, after a transitional period, will have to purchase CBAM certificates. Foreign producers will have to provide EU importers with the relevant data on carbon emissions. To this end, they would have to calculate their carbon emissions in accordance with the formulae contained in Annex IV to Regulation (EU) 2023/956.

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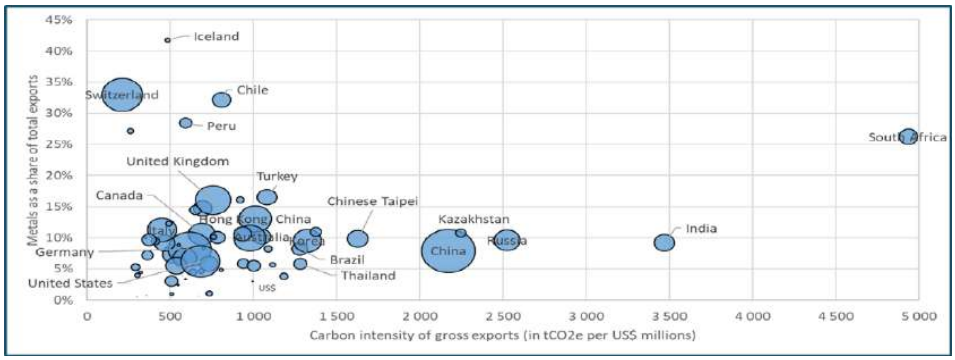

Figure 14: Metals export per country per carbon intensity (in tCO2e per US$ million), share of exports (in percentage of the country's total exports) and export value (relative scale).

(Source: TIPS, based on data from the OECD, dataset on Co2 emissions embodied in international trade, downloaded from https://stats.oecd.org in March 2020).

In terms of carbon intensity, Figure 16 above shows that metals exports out of South Africa face a dire challenge as South Africa is an extreme outlier, South Africa's coal-based electricity supply, associated with a (relatively) energy inefficiency, largely explains the position of the domestic metals industry, which primarily relies on coal and electricity to fire foundries, smelters and (metal) refineries.

17.2 CARBON/ INDUSTRIALISATION CHALLENGE

Opportunity for nuclear energy as net zero carbon technology

South Africa is facing a substantial carbon challenge. In terms of South Africa's obligation to reduce greenhouse gas emissions, the updated Nationally Determined Commitments (NDCs) aims to achieve emissions reduction of between 398-510 MtCO2e by 2025, and to between 350-420 MtCO2e by 2030. South African manufacturing has a relatively high carbon intensity, and companies are increasingly having to absorb the costs of various forms of carbon pricing, primarily in the form of carbon tax domestically and carbon border adjustment mechanisms (CBAMs).

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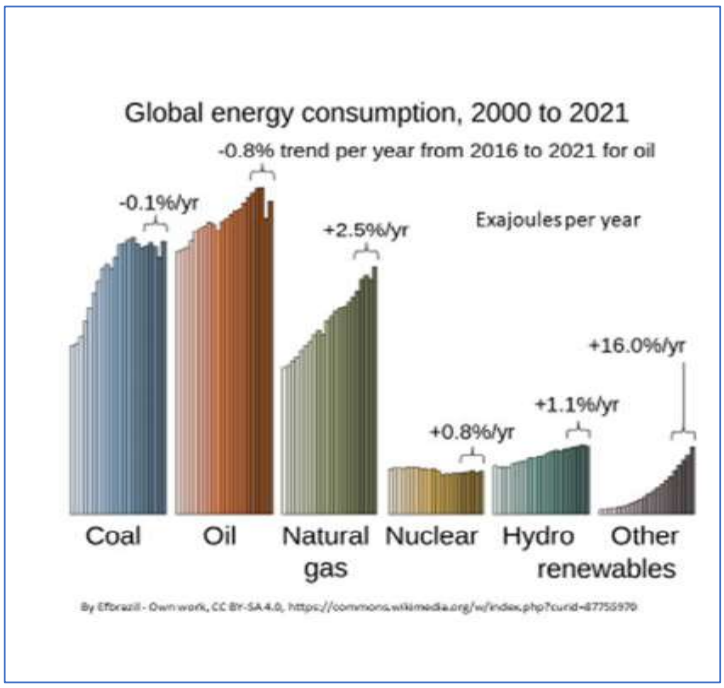

Figure 15: Global energy consumption 2000 to 2021

With a future looking focus, the situation calls for decisive action to reduce the carbon intensity of the South African economy & diversify the structure of exports to low(er) carbon products, whilst duly noting the opportunity for nuclear energy as a net zero carbon technology to be included in the Just Energy Transition (JET) Framework and its implementation Plan. The CBAMs therefore represent both a threat to the domestic economy, as well as an opportunity for nuclear energy where the goal is 'Net Zero by 2050'. Given South Africa's aspirations to boost exports and the opportunity for the National Industrialization Participation Programme (NIPP) to deliver on this aspiration, it will be essential to maintain South Africa's competitiveness and market access going forward. Despite some progress more is required to reduce vulnerability to climate change regulations and set the country on a sustainable pathway.

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18. CHARACTERISTICS OF SUCCESSFUL NUCLEAR PROGRAMMES

Nuclear power plants are based on complex technology, and they are intensive in capital expenditure and in know-how. The development of a solid industrial infrastructure necessary to support the: Design, Manufacture, Construction, Operation, Maintenance and Safeguards for nuclear power plants (NPPs) can only happen in stages. Benchmarking of 18 countries with nuclear power programmes to ultimately develop an industry with the ability to adopt technology, train technicians and specialists and construct a high standard nuclear capability with expert operation teams and high national participation in the development of nuclear power plants indicates the following requirements:

i. A long-term political nuclear program and a strong government commitment that can stretch over multiple legislation periods and changes in administration and governments. This applies for both scenarios where 1) the government is centralising the energy policy, governs, and supports the different localisation programs; and 2) in countries where the private utility and the suppliers' industry are the ones governing the process alongside the involvement of the local industry.
ii. The originally planned nuclear localisation only succeeded where the country's economy and financial resources can support the implementation of nuclear energy as planned over the long term.
iii. A long-term and sustainable nuclear strategy and program that is sufficiently large (fleet approach) – where a fleet approach means 10 to 15 NPPs of similar technology.
iv. Sufficient demand from a new build program to support industrial investment and return on investment [ROI]). Sufficiently strong economy to provide necessary financial resources over decades.
v. Local nuclear industry that is competitive in the global nuclear market.
vi. Experience and references in supply of goods and services in the home country as well as general competencies and experience together with economic competitiveness and acting in international markets.

The initial strategy found that South Africa could strive to achieve 80% localisation by the third nuclear power plant (or 6th reactor unit), and at least 60% by the commissioning of the second

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power plant should a fleet procurement programme be followed. The programme has however been scaled down to a total capacity not exceeding 5.2 GW. This means that limited local industrial opportunities remain as the fleet benefit is not available to drive industrialisation. As will be indicated, it does not mean that industrial development is not plausible. The suggested approach is that the opportunity to add value to the local economy should be optimised. Significant economic value add will be possible with large numbers of local job opportunities. A breakdown of the localisation achievable for the first NPP as determined is shown in Figure 18 below.

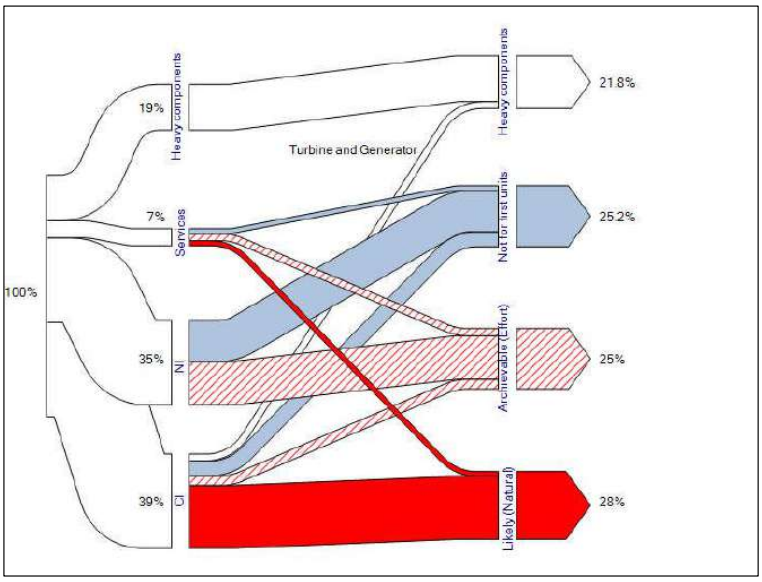

Figure 16: High level breakdown of localisation achievable by the first two nuclear reactor units Localization Study for First Two Units of the South African Nuclear New-Build Programme. Worley Parsons for the Department of Trade and Industry. June 2011. Available

A separate macroeconomic study by PwC on the “Fleet Effect” revealed that 80% localisation by 4th reactor is achievable through a fleet procurement in the UK (See Figure 19 below), and that 40% is achievable for a “non-fleet” approach. At the time the UK had 16 operational nuclear units and 29 in permanent shutdown. It should also be noted that the UK had a large pool of industry players and expertise in many fields that could be transferred to a new program.

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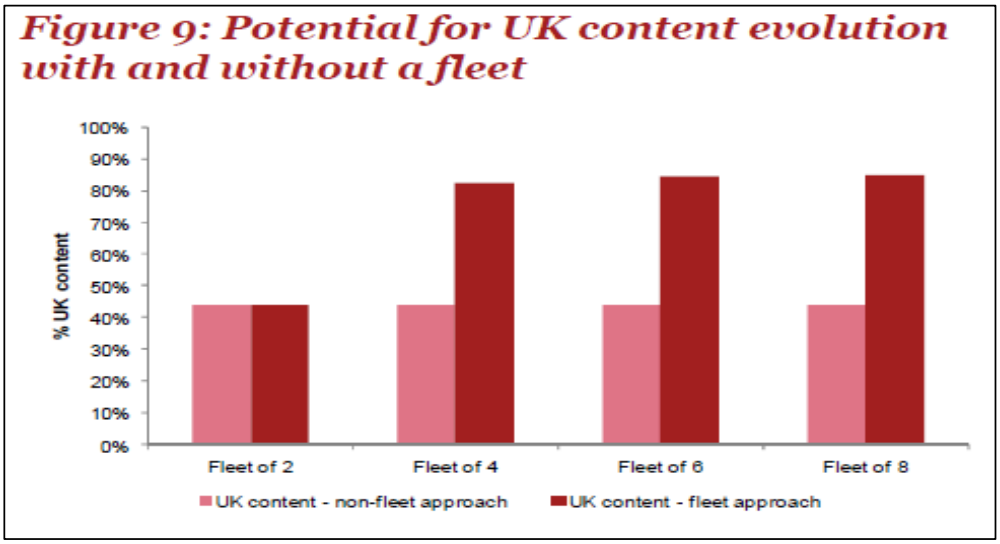

Figure 17: Fleet Effect to Increase Localisation Content in the UK The fleet effect: The economic benefits of adopting a fleet approach to nuclear new build in the UK. Price Waterhouse Coopers. November 2012.

It is important to note that the percentage local content indicated is not based on a standard measurement approach. That is, the Ingerop research indicated that none of the 18 countries benchmarked used a formal or standardised definition of "Local Content". It is more practical to use a monetary value as an indicator rather than a percentage. The sections to follow will elaborate on this assertion. Notably, the Independent Power Producer Procurement Programme (IPPPP) working in collaboration with **the DTIC,** has experience of the many pitfalls involved in the setting of localisation targets and the measurement and reporting of these targets.

18.1 CURRENT ASSUMPTIONS

Based on the above and other inputs in the NEPIO workshops, the current nuclear build is characterised as follows:

Consideration of the various nuclear reactor technologies revealed that the PWR technology is the best choice for large nuclear generation units as envisaged in this case. PWRs are the largest proportion (>62%) of operating reactors in the world. PWR technologies also have the largest

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number of competing suppliers, which favours market competition factors to reduce the cost of the nuclear power plants.

In terms of the promulgated IRP 2025 the nuclear 5200MW build programme will comprise of 4 800MW Pressurised Water Reactor (PWR) technology and remaining capacity of 400MW dedicated to Small Modular Reactor (SMR) technology, see Eskom's Feasibility Report [64].

The following assumptions were taken into consideration in this chapter:

- No fleet build programme.
- Cost of the build to be borne by the bidder.
- Eskom to be the buyer of the electricity.
- Bidders to be compensated by means of the electricity tariff that Eskom agrees to pay.

The Ingerop study indicates the following capital cost for a single nuclear power plant and localisation value based on an estimated 42% local value add.

Category no.	Main categories	Cost Distribution (USD Million)		Localisation Value (USD Million)	
1	Buildings and structures	USD 1 298	22%	USD 1 298	100%
2	Reactor equipment	USD 950	16%	USD 106	11%
3	Reactor auxiliary systems	USD 590	10%	USD 106	18%
4	Turbine plant	USD 696	12%	USD 89	13%
5	Electrical equipment and I&C	USD 897	15%	USD 89	10%
6	Circulation water system	USD 174	3%	USD 83	47%
7	HVAC	USD 177	3%	USD 30	17%
8	Miscellaneous systems	USD 295	5%	USD 59	20%
9	Laboratory equipment	USD 9	0%	USD 0	0%
10	Training center	USD 30	1%	USD 10	33%
11	Engineering activities	USD 608	10%	USD 608	100%
12	Commissioning activities	USD 177	3%	USD 0	0%
	GRAND TOTAL (CAPITAL COST FOR UNIT 1)	**USD 5 902**	**100%**	**USD 2 477**	**42%**
	ROE R18: USD	R106 229		R44 581	
	ROE R25: USD	R147 540		R61 918	

Figure 18: The Ingerop study depicting capital cost for a single nuclear power plant and localisation value based on an estimated 42% local value add.

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The capital cost and local content is illustrated for two rates of exchange. Should the currency depreciate from R18 to R25 to USD over the period of the project, the 42% local content target will increase with a ZAR value R17 337 million. This complexity will result in high risk for bidders resulting in massive cost increase should the percentage local content target be used. It therefore makes sense to use an initial ZAR value to remove this risk. It is anticipated that the modelling being to be developed by the Department for its Socio-economic and Cost Benefit Study will require a benchmark percentage to factor localisation into the models. Adjusting for deindustrialisation in the South African context, the maximum achievable localisation percentage is currently estimated at 30%.

18.2 LOCAL CONTENT DEFINITIONS, MEASUREMENTS AND APPLICATION

UTILITY SCALE PROJECTS

18.2.1 SANS 1286:2017

The thresholds and targets are calculated using the South African Bureau of Standards' (SABS) approved technical specification, SANS 1286:2017 (Local goods, services and works – Measurement and verification of local content). This is similar to the approach followed with designation in terms of the Preferential Procurement Policy Framework Policy Act (PPPFA). The main difference is that the IPP procurement is in the hands of private investors whereas with designation, the procurement is done by a procuring organ of state. The designation instrument cannot legally be applied with the IPP.

According to the document (SANS 1286:2017), local content is defined as "… *that portion of a tender price that is not included in the imported content, provided that local manufacturing takes place and is calculated with the local content formula." It is, therefore, necessary to first compute the imported value of a product to determine its local content.* The formula used is:

$$LC = \left(1\right.$$

Where X is the imported content in Rand (ZAR) and Y is the tender price in Rand (ZAR).

"*Imported content is that portion of a tender price that is represented by:*

The cost of imported components.

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The cost of parts or materials which have been or are still to be imported.
Inclusive of the costs abroad, plus freight and other indirect importation costs (landing costs, import duty, dock duties, etc.) excluding VAT."

The SANS 1286 proved to be effective to determine the local content of a specific product, a shoe, for example. The instrument can be effectively used to ensure that regular procurement of specific products, especially consumables, are procured from local manufacturers that have sufficient capacity. It proved extremely problematic when applied to energy generation projects where literally thousands of specialized items or products are required: (i) Massive, if not impossible, administrative load to calculate actual local content, a long term project is measured vs a product, definition problems (DOE following cost items were typically included: development fees, Success Payments, Net VAT (input VAT on construction costs less VAT refunds expected during construction period), Interest during construction, Borrowing costs (arranging fees, facility fees, etc.) (excluding VAT), Debt Service Reserve Account, Maintenance Reserve Account, etc). These are clearly not supporting manufacturing. It was originally proposed that the SANS 1286 be used to measure local content that will support industrial development.

The SANS 1286:2017 requires that local manufacturing must take place for any local value-add to qualify. The definition of local manufacturing in the Technical Standard is: "any kind of working or processing, including assembly or specific operations". This definition appears to be a very weak attempt at defining manufacturing as even packaging; inspection; etc. can be regarded as manufacturing under this definition. It is however understood that this weak definition stems from the fact that it is not possible to generally define manufacturing in such a way that it can be applied to all products.
Keynote: The Benchmark study found that none of the 18 countries that formed part of the benchmark research had a definition of "Local Content" for the nuclear industry.
Investment required for localisation includes the following:
The amount of investment per component/family assumes that the investment needed to develop an industry is commensurate to the revenue expected from selling localised equipment for one unit. R is the ratio between the sales of a certain equipment for one unit, and the required investment to localise this equipment/activity; R depends upon the complexity of localising the component.

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The investment includes the cost of the use of the Intellectual Property for manufacturing the equipment in South Africa for the local market. In case of the exportation of nuclear equipment manufactured in South Africa, a value of 3% has been added to the selling price to cover the license fees. Based on the consultant's knowledge, the following values (Table 4) were used:

Table 4: Investment assumptions for localisation of equipment and activities

	Option	Type of equipment/activity	R
Investment required to develop an industry according to different scenarios	1	Equipment already localised and production infrastructures enable the country to supply without any additional investment the nuclear program	0%
	2	Equipment partially localised in the country, but a specific investment must be done in training, QA, certification etc. to reach the nuclear standards	30%
	3	The manufacturing capabilities are non-existent, and the local industry must fully develop its infrastructures for the nuclear program	100%
	4	Same as scenario (3) but in the case of heavy components, where the investment cost is higher because of the technical sophistication	200%
	5-10	For specific components that require very high investment leading to limited added value for the country (Simulator…).	X%

The same structure is applied for both local industry and local suppliers. It is assumed that these investments shall be paid for, on average, two years before ordering the equipment. The finding supports the approach that established local industries and industries that are able to ramp up at low cost to produce equipment should be supported and encouraged.

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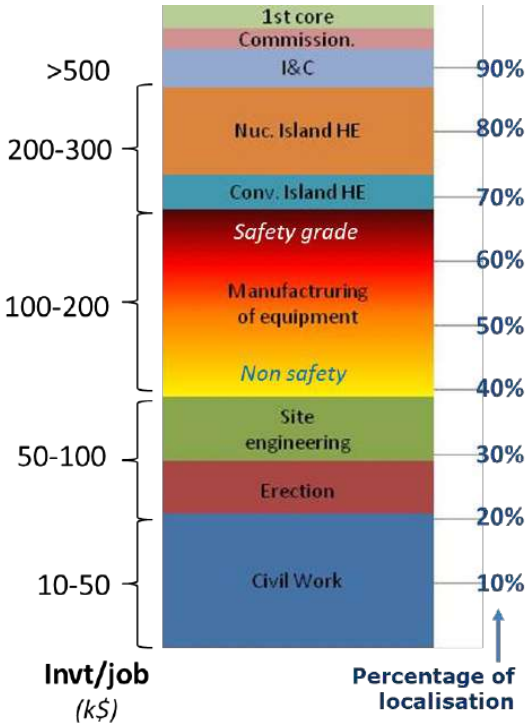

Figure 19: An Excerpt from the Department's study showing investment/job against localisation content conducted by Ingerop.

The international practice limits investments to about 40% of the capital cost, thereby impacting on the number of jobs created.

- Limited benefit for industry and no opening to the export market
- Sensitive points:
  - Training of some categories of workers (welders...)
  - Transfer of knowhow and of experience from unit to unit and from site to site
  - Some sensitive technologies:
    - High reinforced concrete
    - Prestressing

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- Some hatches and wall openings

- A two-year period between successive units would allow the transfer of experienced people between units.

18.2.2 LOCALISATION CONSIDERATIONS

The DTIC team has identified a number of refinements and improvements to the localisation approach on electricity generation projects. Critically, it must be borne in mind that this debate is not purely about localisation of all inputs as the end goal, rather it is **a strategic choice of what to localise effectively, efficiently, and sustainably**. It is also about industrialisation and building a robust and competitive economy; one which can survive amidst global economic volatility. This is to be noted in addition to the short-term transient construction related jobs that are being created in the construction phases of these projects - therefore ultimately increasing employment opportunities and productivity on an economy wide basis for South Africa.

Of importance for this communication therefore are the following summarised key elements:

- A definitional focus change, from local project spend to localised industrialisation.
- A more focused approach for scoring based on “targeted” elements with high potential for localised industrialisation combined with material / and or process requirements; incentivised scoring for “future” targeted items and no dilution of scoring for “natural” localised activities (e.g., foundations, groundworks etc.).
- The more targeted approach to include a minimum threshold or floor - the level of which to be informed by the technical work group.
- The refined approach to be applied fully or partially for other technologies (in terms of cross-cutting elements e.g., site preparation etc.).
- More detailed reporting of information requirements aligned with the more focused approach on specific cost elements.
- More formal and stringent burden of proof; and

Gaps still exist in the utility-scale market related to the predictability of future government procurement and the capability of local manufacturing to supply at the scale, quality, and cost

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required to meet localisation goals. The analysis revealed that sustainable large demand, which would enable attainment of economies of scale, is one of the key prerequisites for attracting investments into the expansion of existing and establishment of new local manufacturing capacities. The stop-and-go approach with respect to the deployment of the IRP is not conducive for the industry's growth. It is recommended that the industrial localisation focus be centred on products and industries that have a significant presence in South Africa. The typical focus should be on sectors that serve a broad market that can also include nuclear.

18.2.3 LOCALISATION TARGETS AND REPORTING

The Ingerop study and other research indicates a high-level localisation target of 40% for a non-fleet approach. As indicated the measurement will be complex using the SANS.
Regardless of the approach that is ultimately followed to achieve the optimal localisation, reporting on the economic contribution/ local value add of infrastructure development will be essential.

The Department is in the process of conducting a Socio-Economic and Cost Benefit Analysis study which will provide amongst others a monetary value that will be the best option to provide a practical and cost-effective approach to setting and measuring local value add. The following indicators in ZAR and number of jobs should be considered:

i) Value of investment ZAR.
ii) Additional local manufacturing or economic output ZAR.
iii) Additional manufacturing exports ZAR.
iv) Number of jobs supported.
v) Number of new jobs created.
vi) Number of jobs supported, or new jobs created in Black Industrialists firms.

18.3 WORKFORCE REQUIREMENTS, SKILLS DEVELOPMENT AND HUMAN CAPITAL

The Industrialisation and Localisation Subworking Group of the NEPIO developed a desk-top study for which a draft workforce requirement, skills development and human capital report was drafted [64]. The approved 5,200 MW Nuclear New Build Programme (NNBP) offers an opportunity to strengthen South Africa's energy security while developing a sustained national base of engineering, construction, technical, regulatory and operational expertise. Workforce readiness should therefore

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be treated as a strategic programme enabler and an element of nuclear industrialisation, rather than solely as a source of temporary construction employment.

18.3.1 INTERNATIONAL WORKFORCE BENCHMARKS AND INDICATIVE EMPLOYMENT

The supporting Workforce Review benchmarks nuclear projects and programmes in the United Kingdom (Hinkley Point C), Bangladesh (Rooppur), Egypt (El Dabaa), Belarus (Ostrovets), the Republic of Korea, China and the United States (Vogtle Units 3 and 4). These examples illustrate the large temporary workforce required for nuclear construction, the smaller specialist workforce required for operations, and the value of sustained training and technology transfer. The benchmarks differ in project configuration, workforce definitions and reporting periods and should not be applied as directly comparable employment ratios.

For preliminary strategic planning, the review identifies a potential peak direct construction workforce of 15,000–25,000 personnel, cumulative direct construction employment opportunities of 25,000–40,000 over the programme, and an indicative permanent operational workforce of 2,500–3,500 personnel. The cumulative figure represents opportunities over time, not simultaneous jobs. These ranges are assumptions for policy-level assessment, not vendor-certified staffing requirements, approved Eskom establishments or employment guarantees. They will depend on the selected technology, number of sites, unit sequencing, delivery model and degree of localisation.

18.3.2 NATIONAL SKILLS BASE AND PRIORITY GAPS

South Africa has an established nuclear skills foundation through Koeberg, Eskom, Necsa, the National Nuclear Regulator (NNR), universities and specialist training institutions. However, experience in operating existing facilities is not equivalent to recent experience in developing and constructing new nuclear power stations. A national nuclear skills audit should assess qualifications, demonstrable competence and availability, with particular attention to nuclear construction management, owner’s engineering, coded welding, fabrication, electrical and instrumentation installation, nuclear-grade quality assurance, commissioning, contract management and nuclear safety assessment.

18.3.3 NATIONAL NUCLEAR HUMAN RESOURCE DEVELOPMENT PROGRAMME

It is proposed that a coordinated National Nuclear Human Resource Development Programme be established to align workforce demand with education, training, recruitment, certification, deployment, retention and succession planning. The Department of Electricity and Energy should

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provide policy coordination, while Eskom, as programme owner and prospective operator, should lead project-specific workforce planning. Necsa, universities, TVET colleges, SETAs and industry partners should support specialist training and apprenticeships. The NNR must develop independent regulatory capability, separate from the owner and technology vendor.

A Nuclear Construction Skills Academy or equivalent network of existing training facilities should be considered, focusing on nuclear-grade welding, fabrication, mechanical and electrical installation, instrumentation, inspection, quality assurance, construction supervision and commissioning. Procurement arrangements should incorporate measurable vendor obligations for training, South African placements, instructor development, simulators, competence certification and technology transfer.

18.3.4 LOCALISATION AND SKILLS TRANSFER

The Workforce Review proposes, for further validation, South African participation of at least 60% in construction employment, progressing towards 70%, and at least 80% in permanent operational employment. These are proposed workforce participation targets, not adopted government commitments. They must be tested against the domestic skills audit, supplier capacity, nuclear quality requirements and procurement strategy. They are conceptually distinct from the Case for Nuclear industrial local-content benchmarks, which measure local value addition or procurement content rather than employee nationality.

The programme should prioritise sustainable transfer of competence to South African engineers, technicians, artisans, managers and suppliers, while preserving nuclear safety and quality standards. Training outcomes should be measured through recognised qualifications, workplace experience, independent competence assessment, local supplier qualification and retention of skills after construction.

18.3.5 PHASED MOBILISATION AND INSTITUTIONAL READINESS

Indicative planning window	Priority workforce action
2026–2028: preparation	National skills audit; programme governance; skills and institutional baseline

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Indicative planning window	Priority workforce action
2028–2031: procurement and design	Specialist training; vendor partnerships; owner's engineering; supplier qualification
2031–2036: construction	Apprenticeship and artisan mobilisation; construction oversight; technology transfer
2035–2039: commissioning and readiness	Operator qualification; simulator training; regulator and commissioning readiness
2039 onwards: sustainability	Retention, succession, maintenance capability and future project pipeline

These dates are indicative planning windows from the Workforce Review, not confirmed project milestones. They should be reconciled with the approved procurement, construction and commissioning schedule and with Eskom's detailed feasibility and implementation work.

18.3.6 WORKFORCE RISKS AND IMPLEMENTATION CONDITIONS

Priority risks include shortages of experienced nuclear construction professionals and specialist artisans; competition for scarce skills; inadequate regulatory capacity; dependence on overseas vendors; insufficient local nuclear-grade manufacturing capability; loss of trained personnel during programme delays; and disruption to existing nuclear operations through staff transfers. Mitigation should include early skills audits, sequenced training, contractual technology-transfer deliverables, independent regulator resourcing, supplier development, retention measures and periodic workforce readiness reviews at programme decision gates.

Detailed staffing costs, productivity assumptions, procurement package labour estimates and affordability implications will be developed through Eskom's separate feasibility and implementation assessments.

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19. NUCLEAR SAFETY LICENSING

Although modern nuclear installations (such as power plants and research reactors) are designed with inherent safety features to minimise the risk of an accident, it is a standard safety practice to further reduce risk by having the safety of the installation continuously verified by an independent nuclear safety regulator(s). A nuclear installation goes through the lifecycle phases such as siting, design, manufacturing, construction, commissioning, operation, and decommissioning. The nuclear safety regulator reviews various phases prior to the commencement and during implementation of each phase to ensure independent scrutiny of safety of the nuclear installation.

In South Africa, the National Nuclear Regulator (NNR) is the nuclear safety authority responsible for protecting people, property and the environment from the harmful effects of radiation (see section 4.5). The NNR reviews the Safety Case, issues authorisation for each phase of the lifecycle and conducts regular inspections to ensure compliance with licence conditions, thereby entrenching the Safety Case. Like the UK safety authority, the NNR aims to be goal setting and, so far as practicable, non-prescriptive, and the nuclear licensing system conforms to this principle. The licence requirements set out generic expectations of any licensee without prescribing detail. The onus is on the licensee, as the user of the installation, to demonstrate that risks are properly controlled and have been reduced as Far As Is Reasonably Practicable (SFAIRP). By contrast, other regulators, such as the US Nuclear Regulatory Commission (USNRC), apply a prescriptive licensing process in which the Safety Case must be formulated using prescribed codes, standards and calculation methods.

As the NNR operates in a non-prescriptive manner, several process options exist for the safety licensing of new nuclear installations and are described in more detail in the subsections below. Salient issues such as streamlined regulatory oversight, increased resourcing and capacitation of the regulator are essential to reduce the regulatory risk for the nuclear programme and are discussed in the NNR Strategy Document on Licensing of New Nuclear Power Plant Strategy on **Licensing of New Nuclear Power Plant. NNR-SD-003 Rev 0. National Nuclear Regulator. April 2012.**

It is important to understand that in all countries' licensing regimes, especially those party to some nuclear liability convention, one thing remains common: the **applicant for the license is always the owner of the installation**. In most cases, the owner is also the operator (the owner-operator),

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and in South Africa, legislation does not allow separation of these roles, so the owner is always the owner-operator.

Regarding licensing and liability issues, and considering the Public Private Partners model may be considered as a potential scenario, the guiding principle, consistent with IAEA guidelines and international nuclear liability conventions, is that liability for nuclear damage lies with the owner and operator of the nuclear installation. It was therefore resolved that, with Eskom as the licence applicant and operator, liability is channelled solely to Eskom, even where the shareholder(s) are private. In line with the Nuclear Energy Policy, Eskom is the owner and operator of nuclear power plants in South Africa. The final liability arrangements depend on the ownership structure eventually decided on by government and on the nature of the agreements in place. Eskom is the owner-operator for the Nuclear Power Plants in South Africa in accordance with the Nuclear Energy Policy, thereby rendering it responsible for the limited 3rd party liability cover. To give effect to the principle of strict nuclear liability, South Africa should accede to an international nuclear liability convention, a process that is already underway.

19.1 DESIGN STAGE (LICENSING STRATEGY)

The licensing stage for the Design is part of the phased licensing approach that can be employed, as is a modern licensing practice, to reduce licensing time for construction and operation. In essence, a standardised or Reference Design of a nuclear installation is assessed by the regulator independently of a construction licence for a particular site. The regulator assesses the design's safety case, and if successful, the applicant is given a Design Authorisation. The key benefit of a Design Authorisation is that it can be used to streamline licensing (cutting down the time by more than 50%) of the same nuclear installation at more than one site, provided the bounding conditions of the site are suited to meet those of the Reference Design.

The NNR process of Design Authorisation is similar to the USA Nuclear Regulatory Commission’s (NRC) Design Certification process, and the UK Office for Nuclear Regulation’s (ONR) Generic Design Assessment (GDA) process. Design Authorisation is meant to give investors, owners, and designers confidence by reducing licensing uncertainty and lowering installation costs.

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19.2 NUCLEAR INSTALLATION LICENSING

Design Authorisation is another step in the National Nuclear Regulator's Nuclear Installation Licensing process. It helps speed up the licensing process; primarily as an input, it does not necessarily replace the conventional licensing stages of a nuclear installation lifecycle, especially those for constructing and operating a nuclear installation.

The NNR has a clear strategy for licensing new nuclear power plants: the Strategy on Licensing of New Nuclear Power Plants**. NNR-SD-003 Rev 0. National Nuclear Regulator. April 2012.** Released in April 2012 in preparation for the new nuclear build programme. The strategy, however, is for conventional reactors. Licensing comprises many stages, but the NNR's non-prescriptive framework would allow the applicant to apply for combined licensing (i.e. more than two stages simultaneously). The stages of licensing, as extracted from the NNR Strategy on Licensing of New Nuclear Power Plant, **NNR-SD-003 Rev 0. National Nuclear Regulator. April 2012.** are shown in Table 5 below.

Table 5: Stages of Nuclear Installation Licensing Strategy on Licensing of New Nuclear Power Plant. NNR-SD-003 Rev 0. National Nuclear Regulator. April 2012.

Stage	Activity	Minimum Authorisation Required	Mandatory/ Optional
1(a)	Site Establishment – placement of security operator, temporary offices, fencing and gates, removal of overburden, drainage.	Permission	Mandatory
1(b)	Early Site and Construction Activities – earthworks and levelling, construction of offices and access control, road preparation, and installation of water, electricity, sewage, and other services.	Nuclear Installation License to Site	Mandatory
1(c)	Early Construction Activities – Dewatering, Diaphragm Wall installation, Excavation and	Nuclear Installation License to Site	Mandatory

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Stage	Activity	Minimum Authorisation Required	Mandatory/ Optional
	clearance to bedrock (preparation for first nuclear grade concrete)		
2(a)	Design Authorisation (see section 19.1 – Design STAGE (NNR NEW BUILD (NB) LICENSING STRATEGY)) – Quality Management of design organisation with Reference Design that is not site specific and would meet regulatory requirements.	Design Authorisation	Optional
2(b)	Manufacturing Authorisation Manufacturing of Components for Nuclear Installations. PP-0012, Rev 0. National Nuclear Regulator. – Quality Management system of Manufacture as well as alignment to codes and standards.	Manufacturing Authorisation	Mandatory for Long Lead Items and Materials
3	Construction – component manufacturing, civil works, installation of systems, cold and hot commissioning.	NIL for Construction	Mandatory
4	Operation – fuel loading(s), maintenance, and operation.	NIL for Operation	Mandatory
5	Decontamination and Dismantling (D&D) – returning to a state of no regulatory control.	NIL for D&D	Mandatory

Eskom has already applied for Nuclear Installation Site Licences (NISL) for the Thyspunt and Duynefontyn sites in accordance with the NNR Act 47 of 1999 and the Regulations of Licensing of Sites, R.927. The regulator is expected to decide on the application in 2027, following the public consultation process and review of the supporting documents.

The indicative timelines for licensing reviews are as displayed in Figure 22 below.

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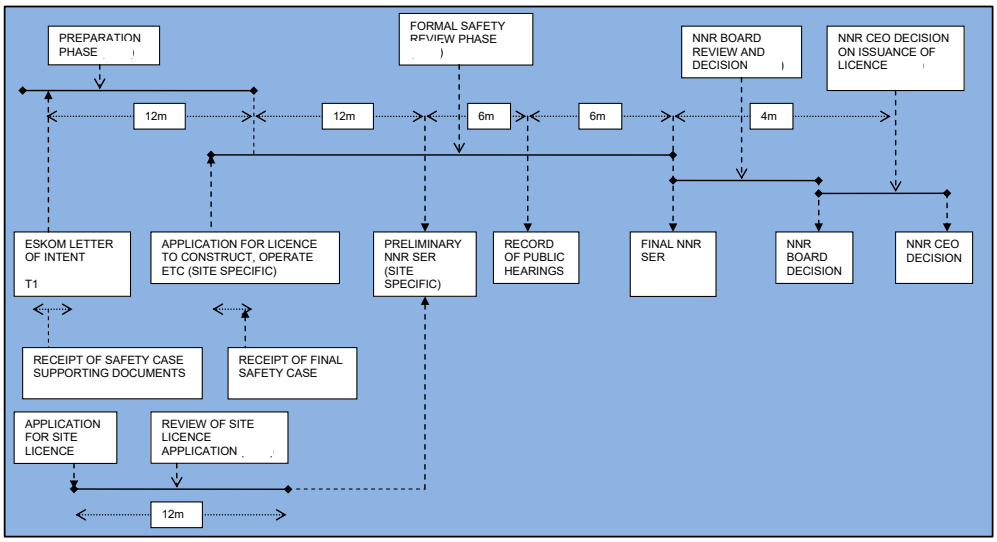

Figure 20: NNR New Build Licensing Strategy on Licensing of New Nuclear Power Plant. NNR-SD-003 Rev 0. National Nuclear Regulator. April 2012. Not Classified/Unrestricted.

19.3 LICENSING OF SMRS

Over the last decade, the Global Nuclear Industry has seen Small Modular Reactors (SMRs) gain significant attention for their reduced footprint, lower power output, modularity, and innovative features. This also includes recognition that these new nuclear technologies can be sited where needed, partner well with renewable energy sources, and offer additional flexibility to support decarbonisation beyond the power sector, including hard-to-abate industrial sectors. They could also play a critical role in revitalising retired fossil and brownfield sites and in enabling timely, efficient licensing of nuclear power.

SMRs are a class of small nuclear fission reactors, designed to be built in a factory, shipped to operational sites for installation and then used to power buildings or other commercial operations. The first SMR was invented by a team of nuclear scientists at Oregon State University (OSU) in 2007. They have the potential, by design, to be used for different applications, including electricity, hybrid energy systems, heating, water desalinisation, and steam for industrial applications.

However, the licensing of SMRs would play a significant role in their successful deployment. Unfortunately, the literature and current regulatory framework on these technologies are inadequate and often fragmented, and they fail to address the licensing aspects distinctly. Due to the variation

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in SMRs' sizes, design features and cooling types, which are categorised into 5 such as integral pressurised water reactors, molten salt reactors, high-temperature gas reactors, liquid metal cooled reactors and solid state or heat pipe reactors, this poses a serious challenge and potential nuclear licensing barriers that can influence the deployment of SMRs.

19.4 SMR LICENSING BARRIERS

Licensing barriers are likely to affect the deployment of SMRs and will require collaboration among multiple organisations. The licensing barriers include: (1) existing legal and regulatory framework; (2) prescriptive regulatory framework; (3) novelty in the technology; (4) regulatory fragmentation; and (5) absence of in-factory certification. The licensing challenges are: (1) regulatory capability gaps; and (2) lengthy licensing duration. The identified barriers and challenges affect the project timeline and cost, consequently affecting the overall economics of the SMR.

19.5 IAEA FACILITATING INTERNATIONAL LICENSING OF SMALL MODULAR REACTORS

IAEA has launched two interconnected mechanisms: the IAEA Platform on SMRs and their Applications (SMR Platform) and the Nuclear Harmonisation and Standardisation Initiative (NHSI). The purpose is to support Member States towards the safe and secure deployment of small modular reactors (SMRs), which can enhance energy security while helping to achieve global climate goals. According to the IAEA, the SMR Platform serves as the focal point for the IAEA's activities in SMRs and their applications. It provides coordinated support and expertise from across the entire Agency, encompassing all aspects relevant to the development, early deployment, and oversight of SMRs.
The SMR Platform is designed to facilitate cooperation and collaboration among Member States and other stakeholders, supporting the safe and secure deployment of SMRs worldwide. The SMR Platform is a valuable resource for Member States looking to advance their SMR programmes. It offers a range of services, including technical assistance, capacity building, information sharing, and coordination of research and development efforts. Through collaboration and knowledge exchange, the SMR Platform aims to accelerate the development and deployment of SMRs, helping to strengthen energy security while also mitigating climate change.

The NHSI is a complementary initiative that aims to advance the harmonisation and standardisation of SMR design, construction, regulatory and industrial approaches. The initiative comprises two

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separate but complementary tracks: the NHSI Regulatory Track and the NHSI Industry Track. The goal of the NHSI Regulatory Track is to increase regulatory collaboration among Member States, avoid duplication of efforts, increase efficiency, and facilitate the development of common regulatory positions without compromising nuclear safety and national sovereignty. To achieve this goal, the NHSI Regulatory Track has developed ambitious but feasible programs of work that build on previous activities and progressively take important steps toward harmonising regulatory approaches.

The NHSI Industry Track, on the other hand, focuses on developing more standardised industrial approaches for SMR development, manufacturing, construction, and operations. By establishing common standards and best practices, the NHSI Industry aims to help reduce licensing timelines, costs and ultimately deployment times for SMRs. Through this initiative, the IAEA is bringing together top-level decision makers from governments, regulators, designers, technology holders, operators, non-traditional end-users, and other international organisations and associations to collaborate under one framework. The National Nuclear Regulator (NNR) is also a participant on this platform to ensure it develops its regulatory framework to address the licensing of SMRs in South Africa.

19.6 NNR SMR LICENSING READINESS

NNR has currently developed an SMR Project to formulate a regulatory basis for the licensing of Small Modular Reactors, with the following specific actions:

- identify international SMR committees/programmes as well as applicable NNR bilateral organisations involved in SMR regulatory developments,
- perform benchmarking against regulatory frameworks and international standards,
- determine NNR’s readiness in regulating SMRs,
- review the adequacy of draft regulations and guidance documents and propose areas of improvement in the regulatory framework for licensing of SMR’s,
- revise regulations to incorporate changes and
- improve the NNR regulatory capability and knowledge base relating to SMR.

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In addition to the above, the NNR is also developing the New Build Licensing Strategy with the following purposes:

- Review and optimisation of licensing philosophy and regulatory approach
- Review of regulations, guides, and internal procedures using past experience, regulatory experience and international practice
- Current standards applicable to new builds, no more requirements documents
- Implement licensing framework including timelines commensurate with regulatory constraints.
- TAGs, inspection guidance adapted to siting, commissioning and construction phase.
- Organisation and staffing requirements (recruitment and staffing) and TSO, use of bilaterals
- Strategic plans and budgetary implications
- Stakeholder implications (local and foreign)

The Regulator's SMR licensing processes will be subject to the proposed NNR New Nuclear Build Licensing Strategy, as indicated in Figure 22 above.

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20. STAKEHOLDER ENGAGEMENT

20.1 PROBLEM STATEMENT

The communication environment is influenced by diverse factors that affect the nature and outcomes of communication processes. Managing these factors is integral to the communication strategy, since communication processes are often impeded by one or more of these factors. Even though the public expects a stable energy supply, there are fears about nuclear power, which are fuelled by organised groups. There are overwhelming unbalanced media reports around nuclear generation capacity expansion, which further inflate negative public perceptions.

The earthquake and tsunami that struck Japan exacerbated emotive perceptions against nuclear and reassessment of the safety of existing nuclear installations. Public uncertainty exists due to the magnitude of the programme and the associated up-front costs, and this has attracted negative media coverage.

Some commentators have reported concerns that if construction and cost-overrun challenges experienced in several large infrastructure projects are replicated in a nuclear build programme, it would not be affordable for South Africa.

Organised labour remains concerned about fears of mining sector job losses, whereas nuclear will create jobs and does not necessarily replace coal production.
People living near nuclear installations such as Koeberg and Necsa are regularly informed about safety measures through quarterly Public Safety Information Forums.

20.2 COMMUNICATION OBJECTIVES

The strategic objectives of nuclear communication and stakeholder engagement around the nuclear programme are to:

- Promote nuclear as clean energy, assisting in reducing greenhouse emissions and contributing to the green economy.
- Communicate nuclear energy within the context of the 20-year electricity security plan – the “Integrated Resource Plan (IRP)”.
- Raise public awareness and mobilise society to rally behind the government nuclear programme.

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- To facilitate a proper engagement process concerning the implementation of the Nuclear Energy Policy.
- To ensure that the public has clear, reliable and accurate information to participate effectively in public debates on nuclear energy issues.
- To ensure that the public has accurate information for effective debate on matters relating to nuclear safety.
- To promote transparency on how nuclear installations are regulated to ensure safety.
- To ensure public awareness of emergency and evacuation procedures.
- To develop partnerships on meeting the objectives of nuclear strategies.

20.3 COMMUNICATION STRATEGIC APPROACH

In 2012, the Cabinet approved the Short-Term Communication and Stakeholder Engagement Strategy. This was followed by the approval of the 2019 Nuclear Communication Strategy with the associated Activity Plan. The 2019 Strategy was recently revised and approved by the Minister of Electricity and Energy in October 2026 to reflect changing technological and environmental dynamics.

The purpose of the strategy is to create basic awareness of nuclear energy and demystify the technology. The strategy is implemented by sharing nuclear technology and energy information on various platforms, including but not limited to newspapers, radio, social media platforms, digital platforms, exhibitions, and schools outreach programmes.

As part of the strategy, the Department of Electricity and Energy (DEE), in collaboration with the nuclear-aligned state-owned entities, conducts community outreach events around Vaalputs, Koeberg, and Thyspunt.

A strategic approach is essential to effectively communicate the potential implementation of 5200MW of nuclear power, including the Small Modular Reactors (SMRs) option, to enhance and augment the current electricity supply.

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20.4 NUCLEAR COMMUNICATIONS KEY PILLARS

Key pillars on nuclear communications and stakeholder engagements are to:

- Emphasize Efficiency and Safety: Highlight the efficiency, safety, and environmental benefits of nuclear using clear and evidence-based data and utilising channels like public forums, social media, and educational workshops for effective communication.
- Engage Stakeholders: Build a supportive network by engaging with stakeholders such as government officials, industry leaders, and community groups. Host informational sessions and Q&A panels to address concerns and misconceptions.
- Promote Transparency: Be transparent about the implementation process, including site selection and operational protocols, to build trust and confidence among the public. Share successful case studies from other regions where nuclear programmes have been successfully implemented.
- Incorporate Community Feedback: Listen to and incorporate feedback from the community to enhance acceptance and support for nuclear. Highlight the potential for job creation, economic growth, and reduced carbon emissions to strengthen the case for nuclear acceptance.
- Maintain Open Dialogue: Foster an open, honest dialogue and provide comprehensive information throughout the implementation of the nuclear programme.

20.5 NUCLEAR STAKEHOLDER MAPPING

Stakeholders continue to form an integral part of this report, and understanding each stakeholder and the role they play is fundamental.

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21. FINANCING OF NUCLEAR PROGRAMME

21.1 OWNER-OPERATOR AND FINANCING STRUCTURE FOR NUCLEAR POWER PLANTS

The Nuclear Energy Policy of 2008 specifies that Eskom shall be the main owner and operator of nuclear power plants (NPP) in South Africa. This was also confirmed by the South African Government Cabinet decision taken on 27 November 2012 and reaffirmed in November 2016, endorsing the designation of Eskom as the owner-operator, as per the Nuclear Energy Policy of 2008.

The Nuclear Energy Sub-Working Group (NESWG) on Corporate Finance and funding under the leadership of the Department of Energy engaged the services of consulting company Ingerop to assess the different ownership models that can be considered for the construction of 9.6 GW nuclear capacity as per the IRP 2010-2030 in accordance with the Study on **Owner-Operator and Financing Structures for New Build Nuclear Fleet Programme. Ingerop for Department of Energy. 30 April 2013.** The study included benchmarking and analysis of twenty nuclear projects undertaken over the past twenty years. These models were analysed in detail, and their pros and cons were considered.

Historical option only: the August 2013 owner-operator recommendation considered an Eskom-majority joint venture using Koeberg assets or cash flows as equity for the earlier programme. It is not an approved financing assumption for the 5 200 MW programme. The recommended appraisal baseline is Eskom control without a Koeberg asset contribution; alternative structures remain subject to Departmental confirmation, legal review, market testing and affordability assessment. Any proposed contribution, encumbrance or transfer of existing assets must undergo a separate independent valuation, operational and nuclear-liability risk assessment, creditor and contractual review, and applicable corporate, executive-authority, Treasury and regulatory processes before a decision.

Approval discipline. Treasury's section 54 guidance requires notification to the relevant treasury and executive-authority approval for the specified significant public-entity transactions, including significant partnerships and asset transactions; it does not replace other legal approvals. The financing submission should include a transaction-specific legal opinion on PFMA borrowing, guarantee and commitment restrictions, including sections 66 and 70, and the applicable PPP,

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budget and procurement controls. National Treasury section 54 guidance; PFMA, Chapter 8 (accessed 9 November 2026). No approval is represented as having been obtained as yet.

Table 6: Historical Koeberg joint-venture option — potential effects, not approved risk allocation

Pros	Cons

• Potential diversification of equity funding; fiscal savings are not demonstrated.
• Potential sharing of project risks, subject to enforceable contractual allocation.
• Harnesses private sector expertise.
	• Dilution of ownership and control for Government;
	• Higher minimum return on equity is required by the private investors, i.e., agree up-front on the minimum level of tariffs required; certainty on tariffs and the regulatory environment required;
	  • Termination exposure depends on negotiated terms and approvals; it is not automatically borne by Government.
	  • No overall State guarantee is assumed; instrument-specific caps and approvals must be established.

The following structures are historical appraisal alternatives, not an endorsed ranking or a commitment to government guarantees. Each requires an updated assessment of ownership, voting control, risk allocation, procurement route, affordability and policy compliance:

Joint Venture without KNPS: In this case, outside partners who will become minority shareholders and investors are invited for the delivery of the project/programme, including design, procurement, financing, construction, and lifetime operations (with Eskom acting as a majority equity partner, and potential off-taker, in addition to operator or co-operator) on the assumption of a power purchase agreement (PPA) featuring a tariff formula and take-or-pay obligations by the off-takers (whether Eskom or the Integrated System Market Operator or other third parties)

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Historical alternative Eskom corporate financing: debt would be raised on Eskom's balance sheet. The amount and terms of any equity, loan or guarantee support must be assessed and separately approved; sovereign backing is anticipated though not presumed, per se.

Eskom Business-as-Usual (BAU), in which Eskom raises debt on the strength of its balance sheet (i.e., a corporate finance approach). Given Eskom's weak balance sheet, this will require that government make a substantial fiscal contribution and provide extensive guarantees to support the utility. The South African Government will be expected to provide guarantees to support the nuclear programme. A good example of such backing is the sovereign guarantees given by the United Arab Emirates (UAE) Abu Dhabi State in support of its nuclear build. In 2009, the successful bid of a South Korean consortium in the United Arab Emirates surprised many vendors in more established markets as well as the nuclear industry in general. The Abu Dhabi Project in the Emirates is owned by a Special Purpose Vehicle (SPV) comprising shareholders, namely the Abu Dhabi State and the state-owned utility of Korea. Thus far, the complex financing structure put in place has not been closed, and the project is financially viable only because it receives a 100% sovereign guarantee from the State. Furthermore, an established, sound, and robust nuclear regulatory regime will need to be put in place. Investors are also likely to require a secured off-taker or power purchase agreement that provides for a cost-reflective tariff.

Build, own, operate, and transfer, which is similar to the NPP project in which, in May 2010, Russian and Turkish heads of state signed an intergovernmental agreement for Rosatom to build, own and operate (BOO) the Akkuyu nuclear power plant of four 1200 MWe AES-2006 units as a US$ 20 billion project.

21.2 STUDY ON COST OF NUCLEAR POWER STUDY OF THE COST OF NUCLEAR POWER.

There has been much public debate about the cost of nuclear power locally and globally. Much of it has focused only on the large upfront capital costs of nuclear power plants. Of all power plants, Nuclear Power Plants (NPPs) require the largest quantum of capital to build, owing to their size (>1000MW), long construction times (>6 years) and the high cost of technologically advanced equipment. Combined with political sensitivity and the risk of cost escalation and delay, these factors have historically made private investors and multilateral lenders reluctant to finance NPP construction, although investors have remained keen on already constructed plants, where operational risk is low and returns are attractive. The global finance landscape has changed,

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however. Multilateral institutions such as the World Bank, which previously excluded nuclear energy from their lending, have revised their policies and now accept nuclear power as a legitimate low-carbon option eligible for financing. This shift is also visible locally, where commercial banks such as Standard Bank have changed their policies towards financing nuclear projects. These developments widen the pool of potential financiers for the Nuclear New Build Programme and improve prospects for competitive, bankable financing structures. The terms, scope and conditions of such financing must still be confirmed through engagement with the relevant institutions and tested at the relevant decision gates.

The 2010–2013 studies are historical planning evidence, not a current affordability conclusion. Long asset life and low fuel costs do not by themselves establish a low delivered tariff or fiscal affordability; those conclusions require updated whole-life and system modelling. The Department of Electricity and Energy has conducted many studies on the cost of nuclear power to carry out energy modelling and planning, and to assess the affordability of upfront capital costs for the utility or plant owner.
The costs were from:

- EPRI report of 2010, which was used as the baseline for the first round of the IRP2010-2030 These costs were conservatively increased by 40% to address fears of underestimation based on isolated cost and schedule overruns from 2 projects in Europe, namely Finland and France. The net result was that nuclear power remained competitive and stayed at 9.6GW during the second round of the IRP, which was endorsed by cabinet.
- EPRI report of 2012, as an update of the 2010 report, was used in the Integrated Energy Plan 2013 modelling. The costs of nuclear power had since increased due to inflation and the impact of Fukushima, resulting in the shift away from Generation II reactors.
- Ingerop study of October 2013, which took all global studies and trends into account to arrive at an updated cost of nuclear power as indicated in the
- below.

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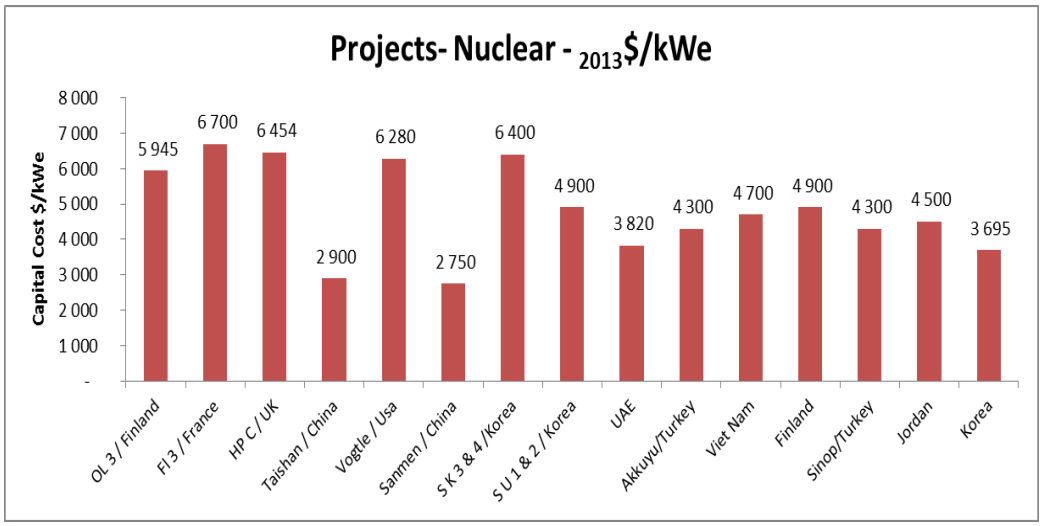
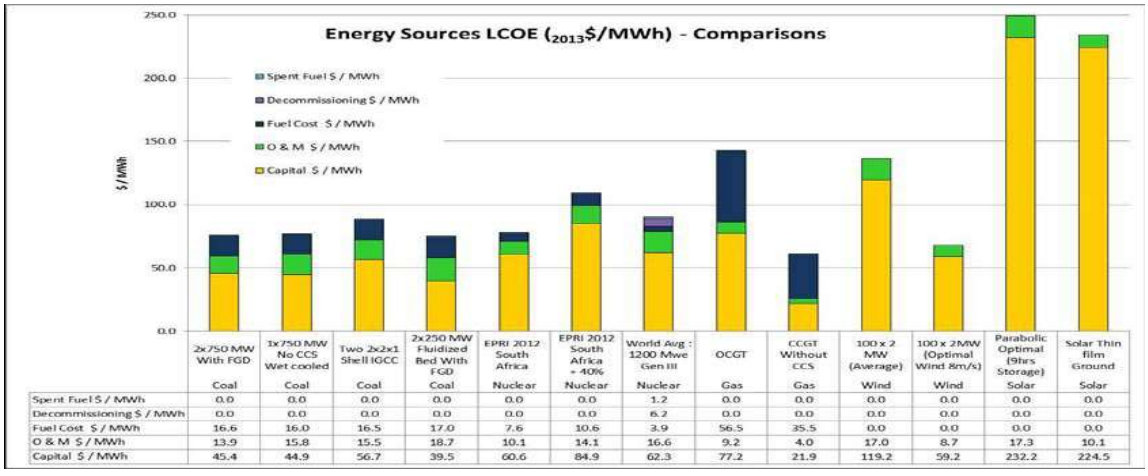


Figure 21: Historical overnight capital-cost variations in the October 2013 Ingerop study — not a current programme estimate

Figure 23 illustrates the point that there is a high variation in overnight capital costs, which is one of the key drivers for the overall or Levelised Cost of Energy for nuclear power. The study therefore focused on obtaining an average global cost to determine the Levelised cost as shown in Figure 24 below.



	2x750 MW With FGD	1x750 MW No CCS Wet cooled	Two 2x2x1 Shell IGCC	2x250 MW Fluidized Bed With FGD	EPRI 2012 South Africa	EPRI 2012 South Africa + 40%	World Avg : 1200 Mwe Gen III	OCGT	CCGT Without CCS	100 x 2 MW (Average)	100 x 2MW (Optimal Wind 8m/s)	Parabolic Optimal (9hrs Storage)	Solar Thin film Ground
	Coal	Coal	Coal	Coal	Nuclear	Nuclear	Nuclear	Gas	Gas	Wind	Wind	Solar	Solar
Spent Fuel $ / MWh	0.0	0.0	0.0	0.0	0.0	0.0	1.2	0.0	0.0	0.0	0.0	0.0	0.0
Decommissioning $ / MWh	0.0	0.0	0.0	0.0	0.0	0.0	6.2	0.0	0.0	0.0	0.0	0.0	0.0
Fuel Cost $ / MWh	16.6	16.0	16.5	17.0	7.6	10.6	3.9	56.5	35.5	0.0	0.0	0.0	0.0
O & M $ / MWh	13.9	15.8	15.5	18.7	10.1	14.1	16.6	9.2	4.0	17.0	8.7	17.3	10.1
Capital $ / MWh	45.4	44.9	56.7	39.5	60.6	84.9	62.3	77.2	21.9	119.2	59.2	232.2	224.5

Figure 22: Historical results of the October 2013 Ingerop cost study

The following statements describe conclusions of the 2013 study only; they must not be read as current findings:

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Historical finding: the study compared its costs with an earlier EPRI estimate escalated by 40%. That adjustment is not a validated contingency for the present programme.

Historical finding: the study ranked nuclear against coal, wind and solar under its then assumptions. This ranking is not adopted for current decisions without a common price basis and comparable reliability and emissions outcomes.

Corrected historical UK comparator: the Hinkley Point C terms agreed in October 2013 were a contract-for-difference strike price, not a wholesale spot price or a directly comparable levelised-cost estimate. The official UK account specifies £92.50/MWh in 2012 prices (9.25 pence/kWh), reducing to £89.50/MWh (8.95 pence/kWh) if the specified Sizewell C investment condition is met. The earlier “90 British Pennies per kWh” notation would equal £900/MWh and is incorrect for this comparator. The US$0.14/kWh conversion and “60% higher” claim are not retained because a dated exchange rate and comparable study basis have not been established. UK Government: Hinkley Point C (accessed 9 November 2026). The following legacy explanations are retained only as historical commentary, not verified current cost drivers:

- The cost of establishing a waste disposal site to deal with the waste from these plants has been included in the upfront capital cost price. This is usually recovered during operation through fuel use, resulting in lower interest and finance costs.
- The Hinkley Point site for deployment of these power plants is a complex site requiring much more site work to adjust the site to be suitable for the nuclear power plant. This has pushed up the cost.
- The UK Government could not undertake a competitive process with another supplier as the site had been auctioned off to EDF a few years ago and they have the sole rights to the site.

The UK contract illustrates a distinct revenue-support arrangement; it does not establish the affordability or preferred structure of the South African programme.

21.3 FINANCING OPTIONS, MODELS, AND SOLUTIONS STUDY

A refreshed, independently reviewed financial model is required. The existing studies and RFI responses have different dates, scopes and assumptions and cannot sustain a current affordability finding without reconciliation. Record source date, price year, currency, net or gross electrical capacity, overnight versus financed cost, exclusions, escalation, tax, exchange-rate convention,

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discount rate and financing assumptions for every reused figure. Separate the full 5 200 MW programme from the first procurement phase, whose capacity, unit mix and scope remain to be confirmed.

The Department's non-binding 2020 RFI is historical market information, not a binding offer or an approved budget for the present programme.

21.4 THE 2020 COST INDICATIONS

An Extract from the department report addressing NERSA suspensive conditions report and data submitted to IRP 2023. In line with decision 8 of IRP 2019, the Department issued a non-binding request for information (RFI) in 2020 to test market appetite for implementation of the nuclear new build programme. The data (see Figure 26) from the 2020 RFI shows a range of costs for conventional PWR and SMR, respectively.



Figure 23: A range of capital costs (in red) per technology as extracted from the RFI responses

The historical RFI comparison used ZAR15 per US dollar, described in this report as a 2021 conversion basis. This is not a current exchange-rate assumption or a verified common price year.

The Eskom Energy Planning assisted the Department in calculating capital costs, looking at nuclear and other technologies such as closed-cycle gas turbines, battery energy storage system + PV, and coal technologies.

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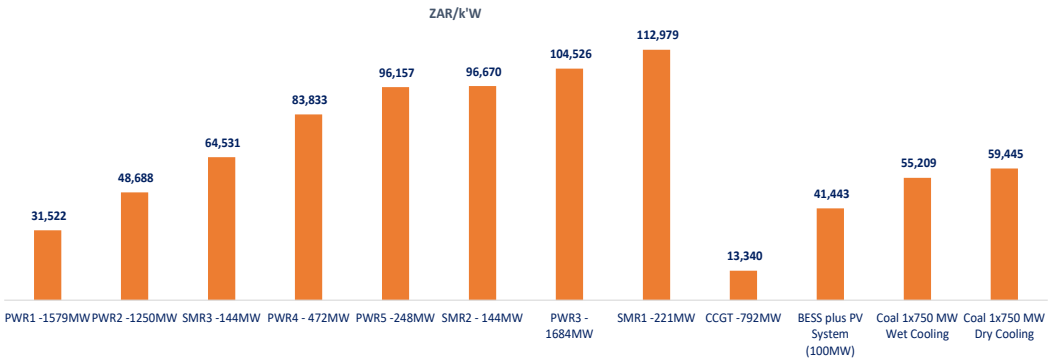

Figure 24: Capital Costs of Nuclear and other Technologies

Nuclear technologies data were provided by the Department as obtained from the 2020 RFI[1] and excluded owner's development costs. Capital costs for closed-cycle gas turbines, battery energy storage system + PV, and coal technologies are sourced from the 2021 EPRI (Electric Power Research Institute) report prepared for Eskom.[2]

Arithmetic check of the displayed historical Rand values at ZAR15/US$: ZAR31 522/kWe = US$2 101.47/kWe; ZAR112 979/kWe = US$7 531.93/kWe; and ZAR104 256/kWe = US$6 950.40/kWe. This corrects the inconsistent upper-end dollar rounding. The original RFI response schedules, scope exclusions and price dates have not been independently verified here. These capital-cost indications exclude owner development costs as stated above; they do not establish whole-life cost, portfolio value or affordability. Historical unit-size screening is not an approved constraint for the present programme.[3]

Historical arithmetic check: ZAR48 688/kWe at ZAR15/US$ equals US$3 245.87/kWe, rather than US$3 245/kWe at whole-dollar rounding; ZAR13 335/kWe equals US$889.00/kWe. The nuclear RFI and 2021 EPRI comparator figures do not share a demonstrated common scope or firm-capacity basis. Their capital costs must not be used to rank portfolios without normalisation.

Current portfolio testing must use the same demand trajectory, commissioning window, reliability

[1] The RFI data originate from the 2020 RFI analysis and will require revision based on new market dynamics.

[2] These figures are from the 2021 EPRI report prepared for Eskom and may require updating.

[3] Eskom will be commissioning a full scope estimate with a declared price date, currency, confidence level and independent review for inclusion in the detailed Business Case prior to an affordability confirmation.

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standard, emissions constraint, currency and price year, discount convention and study horizon. Compare nuclear-inclusive portfolios with feasible non-nuclear portfolios including the required renewables, storage, dispatchable capacity, demand response and transmission. Report total discounted system costs, delivered tariffs, unserved energy, firm capacity, emissions and fiscal exposure. Test exchange rates, interest rates, construction slippage, capital overruns, availability and demand, individually and in combined downside scenarios.

21.5 LCOE ANALYSIS BASED ON RFI RESPONSES

The levelised cost of electricity (LCOE), expressed as rand per megawatt hour, is an important economic metric for determining relative costs of a generating plant. It is the total cost to build and operate a power station over its lifetime divided by the total electricity output dispatched from the plant over the same period.

Figure 27 below looks at the LCOE for the 5 PWR and 3 SMR examples, extracted from the RFIs. Assuming a discount rate after tax of 11.5%, the figure indicates LCOE ranging from R636/MWh to R1,756/MWh. This value includes spent fuel costs but excludes decommissioning costs. A sensitivity analysis was run on LCOE using a lower discount rate of 8.5%. The results indicate that targeting financing for nuclear plants at a lower cost of capital would be beneficial. This is evident in the lower LCOE range from R500/MWh to R1,364/MWh.

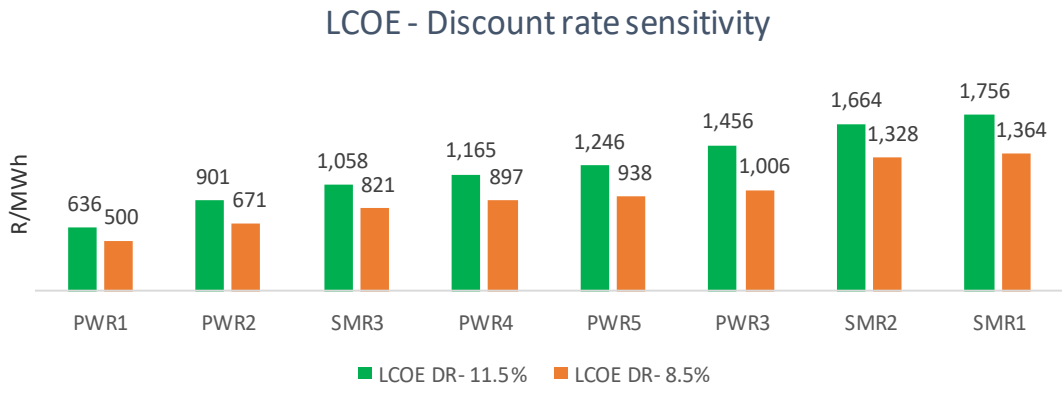

Figure 27. LCOE-Discount rate sensitivity (11.5% and 8.5%)

Nuclear power plants (PWR and SMR) and coal tend to provide reliable baseload supply and have capacity factors of 85-95%. On the other hand, CCGT and coal provides less energy output in relation to PWR, while contributing extensively to CO2 emissions; coal more so than gas. Research

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findings in Hmiel et al. (2020) indicate that natural gas conversion is not carbon neutral in the long term. Methane leakage is a concern for natural gas, given that methane is much more potent at trapping heat than is CO2, particularly over a shorter time horizon (20 years).

Further, South Africa does not yet have a gas mining industry or LNG terminals at its ports. Consequently, this may mean higher levelised costs for gas generation, with gas prices subject to gas market volatility, exchange-rate risks from a weak rand, and geopolitical challenges, e.g., the current Middle East and Russia-Ukraine conflict. If South Africa is to achieve a net-zero carbon system by 2050, then nuclear is non-negotiable as a baseload.

Although the share of renewables in South Africa's electricity system has grown in recent years, South Africa does not face an immediate risk of a "duck-curve" problem (the timing discrepancy between peak demand, 5pm-9pm in South Africa, and solar generation). This is because South Africa has relatively low levels of renewable energy penetration. However, the timing discrepancy problem will grow as the Schedule 2 amendment of the ERA (encouraging private investment in renewables) takes effect. Renewables are an important addition to the grid and will certainly help South Africa in the near term. However, capacity factors for wind and solar are only 15%-40%, making them wholly unsuitable for baseload capacity. No country in the world relies on wind and solar for baseload power, and South Africa cannot either. The lower the capacity factor, the more susceptible the source is to performance fluctuations.

Impact on Tariff

The impact of the nuclear option on electricity tariffs depends on which tender is approved, which financial model is used, and which plant is built. Although the economics of the SMR option are currently difficult to determine exactly, the proposal for a single lead unit at Necsa's Pelindaba site (approximately 100MW) would have limited impact on tariffs. If one assumes a PPA of R2/kWh for a first unit SMR (which is similar to the support for Bid Window 1 & 2) it would have a negligible impact on the tariff. In fact, at this rate, it would be virtually the same as some RMIPPP bids, which are up to R1.88/kWh.

The key issue for PWR reactors is export credit agency (ECA) funding. Export nuclear builds enjoy massive ECA benefits, sometimes over 80% of project value, with potentially near-zero risk for the purchaser, given favourable loans, repayable over 18 years after first power to the grid. A typical

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example is the Egyptian nuclear build programme for 4 units of 1,200 MW capacity each. The nominal interest rate for ECA financing is normally below 4% in the currency of origin; an inflation rate of 2% in that currency is a reasonable assumption. The discount rate for the actual cash flow and the exchange rate in the South African environment is as used in IRP 2019, 8.2% real and R13.57/$1, respectively.

To determine costs, key factors include: a site construction time of 60 months (nuclear concrete to fuel load); operating and maintenance costs of $25/MWh; a load factor of 90%; and decommissioning costs of 15% of the EPC contract value.

Given the above, along with an EPC contract value of $5,500/kWe and an owner's cost of 10%, one derives an LCOE of R1.00/kWh. However, if we consider the lowest EPC contract cost submitted to the DMRE in a 2020 RFI by a major global nuclear vendor, an LCOE below R0.75/kWh is derived. Contrast this to an LCOE of around R1.30/kWh if ECA financing is ignored. However, there is no reason to ignore the massive benefits of ECA financing and the huge savings for the country and the customer under real economics.

Nuclear power plants (PWR and SMR) and coal tend to provide reliable baseload supply and have capacity factors of 85-95%. On the other hand, CCGT and coal provide less energy output in relation to PWR, while contributing extensively to CO2 emissions; coal more so than gas. Research findings in Hmiel et al. (2020) indicate that natural gas conversion is not carbon neutral in the long term. Methane leakage is a concern for natural gas, given that methane is much more potent at trapping heat than CO2, particularly over a shorter time horizon (20 years).

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The historical information contained in this report, based on the RFI and on the studies commissioned by the department over the years of developing the nuclear new build programme, is for illustrative purposes only. These require to be updated with new information from the nuclear industry market. The appropriate financing and funding model will need to be investigated by Eskom as the owner-operator of the nuclear power plants. It should be noted that Eskom, as the owner-operator, will investigate the financing and funding approach for the 5200MW nuclear new build programme.

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22. NUCLEAR READINESS

South Africa is a member state of the International Atomic Energy Agency. The country is not a newcomer to operating nuclear power plants. Operating experience at Koeberg for over 40 years has positioned South Africa well and ready to implement the nuclear new-build programme. However, South Africa last built a nuclear power plant about 50 years ago, and it will need to address the nuclear construction skills gap through targeted training interventions and by following international best practices to implement the nuclear programme. South Africa has adopted the IAEA infrastructure milestones approach to implement the nuclear programme, as illustrated in Figure 28.

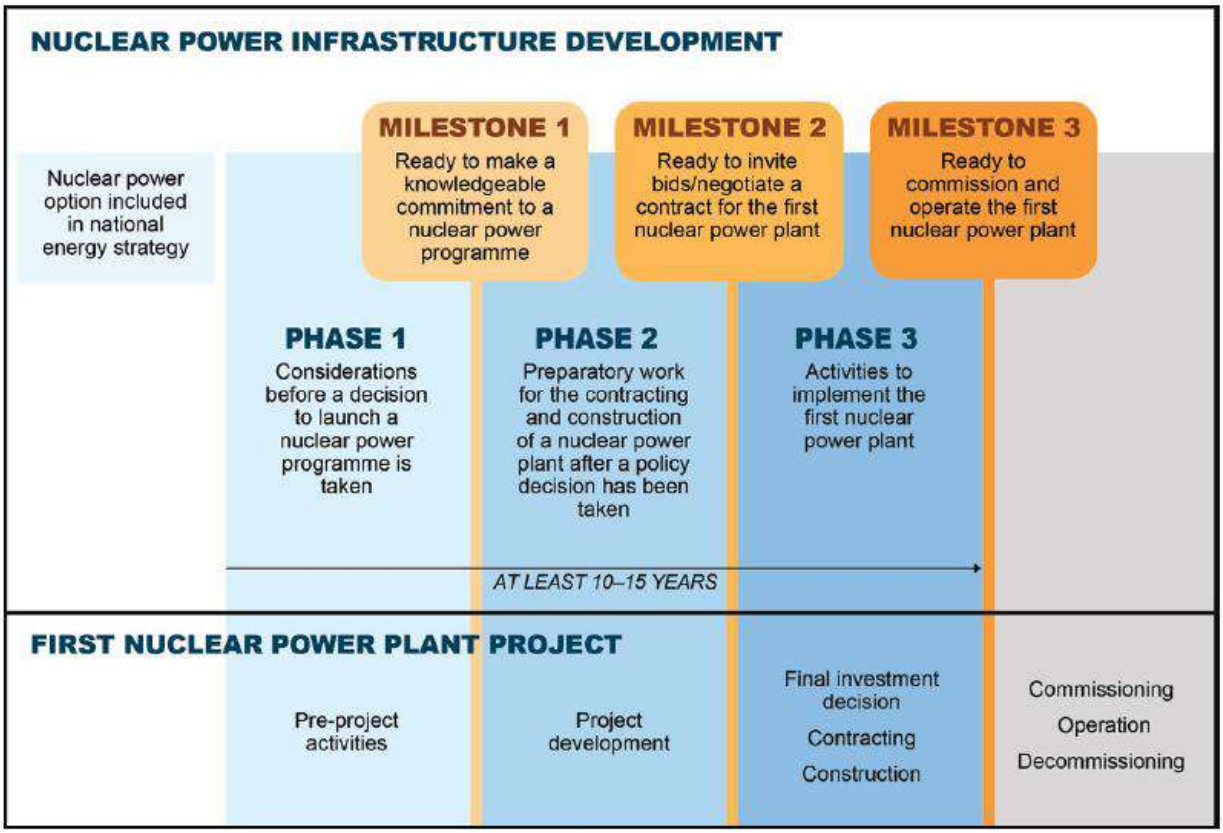

Figure 28: IAEA Milestone approach and SA nuclear readiness

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22.1 INTEGRATED NUCLEAR INFRASTRUCTURE REVIEW (INIR) AND ACTION PLAN

The decision to conduct an Integrated Nuclear Infrastructure Review (INIR) was first considered in May 2010 through an Inter-Ministerial Committee on Energy meeting. Following this, the Department of Energy led various other Departments, and the relevant state-owned entities nominated members to form part of the national Integrated Nuclear Infrastructure Review team. The team comprises representatives of the Department of Mineral Resources, National Treasury, Department of Science and Technology, Department of Environmental Affairs, Department of Public Enterprises, Department of Trade and Industry, Eskom, National Nuclear Regulator, and South African Nuclear Energy Corporation.

After several meetings, workshops, and revisions of the draft report, the local team completed the INIR self-evaluation in May 2012, after which, in June 2012, the Minister of Energy officially requested the IAEA Director General to conduct a full-scale INIR mission in South Africa. The IAEA and the Department of Energy agreed on 30 January to 8 February 2013 for the full-scale mission, with a pre-mission to be conducted on 15-17 October 2013.

Both the pre-mission and mission were conducted successfully, culminating in a preliminary draft report, which the Department reviewed and returned to the IAEA on 11 April 2013. The IAEA sent the final report on 27 May 2013, and the Department received it on 30 May 2013.

The report provides detailed information on each of the 19 milestones and makes 10 recommendations and 11 suggestions for South Africa to improve its readiness for the nuclear programme.
As part of our self-evaluation, the then Department of Energy identified most of these gaps in 2011-12 and already commenced work on them as part of the Phased Decision-Making Approach endorsed by Cabinet in November 2012.

22.2 OTHER INFRASTRUCTURE REVIEWS

Other reviews, including EPREV, must be covered in a verified mission inventory. The legacy statement that EPREV was requested for the next financial year is undated and is not treated as a current status. Obtain the request, mission and follow-up dates, report version, finding identifiers and closure records before assigning a closure percentage.

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23. RISK MANAGEMENT

Risk management is one of the fundamental cornerstones of project management in ensuring successful delivery of projects throughout the project lifecycle within budget, quality, schedule and scope objectives. One principle of Project Risk Management is that risk should be borne by the party best positioned to manage it. Project financiers are interested in the risks associated with the project they are financing and would incorporate a risk premium into the financing costs. Project owners pursue projects to realise benefits which are captured in their business case. Realisation of these benefits can be adversely affected if risks are not properly identified and managed. A risk management framework was applied to manage risks that can materialise throughout the project lifecycle.

23.1 GENERAL CATEGORIES OF RISKS INCLUDE

Other important factors to consider include regulatory requirements and technology risks, especially First of a Kind (FOAK). Lack of execution and project delivery experience is one such factor. The guidelines from the International Atomic Energy Agency indicate that for a country to execute this kind of project, political support is very important. Frequent changes in Government administration have also proved to be a challenge, as different governing parties have different appetites and their policies may therefore deviate from those of their predecessors. The geopolitical developments are impacting the government's choice of policies to the point of policy uncertainty.

This section outlines the risks identified in the case for the 5 200 MW Nuclear New Build Programme. The risks are categorised and classified under 4 segments: NNBP itself, internal risks, immediate outside risks to the programme, and external risks over which DEE and its response stakeholders have no direct control.

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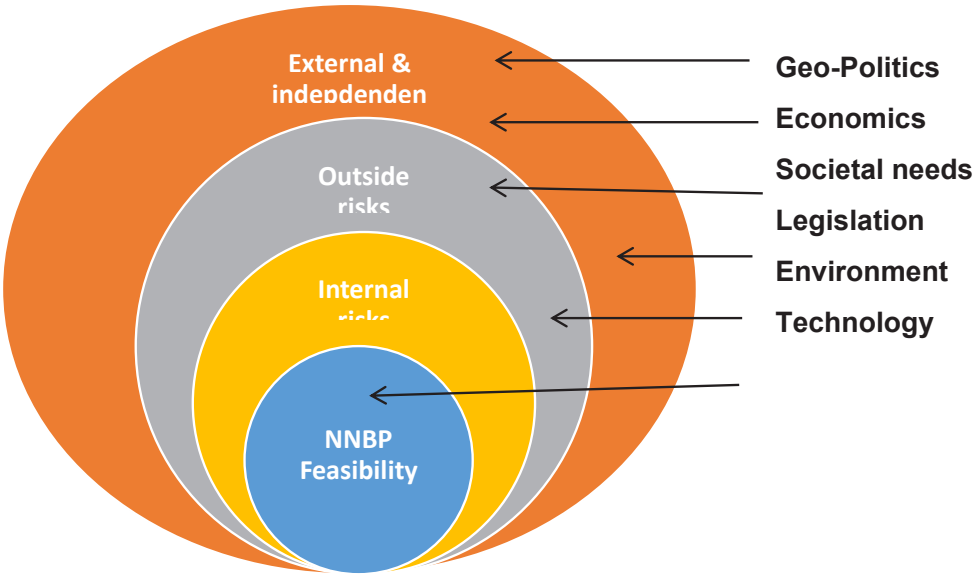

Figure 29: Map of risk categories which have been assessed in this report

Areas of applicability discussed in the report are:

- Policies and Legislation
- Geopolitics and International Agreements
- Technology selection
- Nuclear Infrastructure readiness & recommendations from the IAEA peer review missions
- Nuclear Fuel Cycle- front- and back-end, including decommissioning processes
- Siting, Nuclear Safety & licensing, emergency preparedness & response
- Stakeholder involvement & participation & Communication
- Research and Development
- Funding and Financing of the NNBP
- Project Risk Management schedule, Procurement stage, delivery stage, operational stage
- Risks associated with capacitating the project team

The risk assessments followed a process outlined in Figure 27, which is self-contained

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23.2 RISKS ASSESSMENT PROCESS FOLLOWED

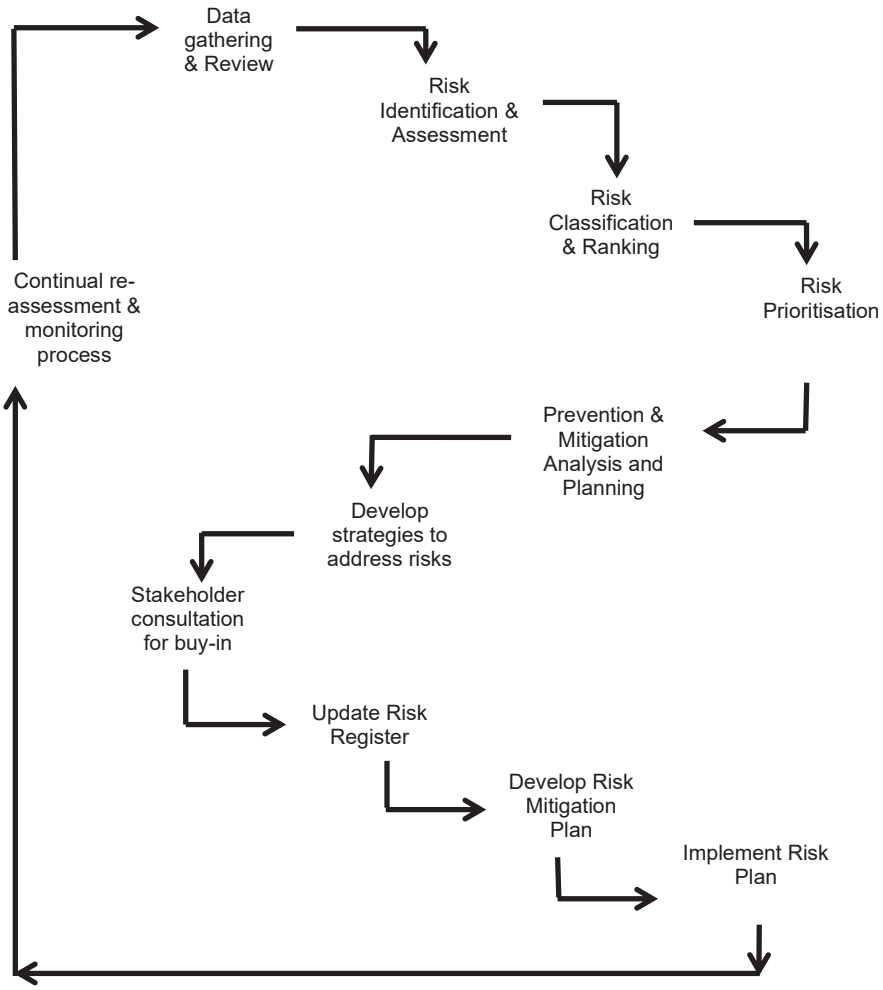

Figure 30: Risk management process for the implementation of the NNBP

23.3 RISK ASSESSMENTS

23.3.1 POLICIES AND LEGISLATION

Of particular interest are the Nuclear Energy Policy 2008 (NEP 2008) [2], the Integrated Resource Plan (IRP 2025), and the new generation regulations for procuring new power generation capacity. The NEP 2008 assigns Eskom as the owner and operator of nuclear power installations. This means Eskom must play a central role in procuring new nuclear energy generation sources. Any deviation

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from the NEP 2008 would require sound, well-founded rational grounds. Failure to support such an averment will create policy uncertainty. This policy risk needs to be outlined and interrogated fully in the report, or a business case should be developed at a later stage.
The IRP 2025 is clear on the assignment of nuclear as a new generation source but does not specify the mode in which this energy source could be procured. The procurement is addressed under separate procurement legislation.

23.3.1.1 RISK MITIGATION AND RECOMMENDATIONS

South Africa's policies and regulations on nuclear energy technology consider current energy dynamics in line with net zero imperatives and climate change objectives, with greater emphasis on Small Modular Reactors (SMRs).

23.3.2 GEOPOLITICS AND INTERNATIONAL AGREEMENTS

World politics are more strongly polarised than ever before. Geopolitical risks are, at most, speculative.
South Africa has concluded several bilateral and multilateral agreements on nuclear energy. Liability for nuclear damage is addressed nationally through the National Nuclear Regulator Act, 1999 (Act No. 47 of 1999), under which the holder of a nuclear authorisation, as the owner and operator of the nuclear installation, bears liability for nuclear damage. The Act also provides for determining liability cover and categorising nuclear installations for purposes of third-party liability. This existing framework informs the costing, funding and financing structures of the Nuclear New Build Programme and the allocation of risk between the owner-operator and suppliers during procurement, including for the transport of Structures, Systems and Components (SSC) to the Republic.

23.3.2.1 RISK MITIGATION AND RECOMMENDATIONS

Politics and International Agreements do not significantly impair the procurement process once the national position is made known, communicated and accepted by other United Nations Member States Mitigation activities.

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23.3.3 TECHNOLOGY SELECTION

The Republic must mitigate risks by broadening technology options and increasing competitiveness in the nuclear supplier market by considering several potential vendor countries. There are at least six types of reactors under development, classified by their generations:

- Pressurised Water Reactor (PWR) – Gen II, III, IV
- Boiling Water Reactor (BWR) – Gen II, III, IV
- Pressurised Heavy Water Reactor (PHWR) – Gen II, III
- Gas Cooled Reactor (GCR) – Gen II, IV
- Molten Salt Reactor (MSR) – Gen II, IV
- Light Water Graphite Reactor (RBMK) – Gen II

However, NEP 2008 has selected PWR and GCR nuclear technologies that the Republic needs to consider for future procurement.

Strategies for the Nuclear Fuel Cycle front-end and back-end have been developed. These strategies need to be updated to remain relevant and close out any potential risks. The decommissioning policy is under development. However, the NNR has issued a requirement document (RD-0026: Decommissioning of Nuclear Facilities) on the decommissioning process to be followed by the licence holders for the decommissioning of the nuclear installations, when required by the Regulator.

23.3.4.1 RISK MITIGATION AND RECOMMENDATIONS

The risks will be addressed during the revisions of the front- and back-end strategies.

23.3.5 SITING, NUCLEAR SAFETY AND LICENSING, EMERGENCY PREPAREDNESS AND RESPONSE

Established licensing arrangements do not eliminate delivery risk for a new-build programme. Verify the selected technology's licensing pathway, NNR review capacity and schedule, site permissions, emergency preparedness and response arrangements. Record unresolved issues and evidence of closure at the relevant decision gates; do not infer readiness from an intention to develop a framework.

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23.3.5.1 RISK MITIGATION AND RECOMMENDATIONS

Siting remains a key risk at this stage. Environmental authorisation was granted for the Duynefontyn site and, following appeals, the Record of Decision was reaffirmed in 2025; however, the re-emergence of additional litigation should be addressed. Nuclear Installation Site Licence (NISL) decisions by the National Nuclear Regulator for the Duynefontyn and Thyspunt sites are still pending, with a decision expected in 2027, and the position on the Thyspunt environmental authorisation is still to be finalised. Remaining regulatory approvals, potential legal challenges and the outcome of the grid integration studies could still affect the timing and the final siting choice. The other areas mentioned above do not pose a significant risk to implementing the programme.

23.3.6 STAKEHOLDER INVOLVEMENT, PARTICIPATION AND COMMUNICATION

The success of any nuclear programme depends fundamentally on most of the public supporting nuclear power, especially communities around the sites of current and future nuclear installations. Failure to communicate timely and accurately to help stakeholders make meaningful decisions on the programme would simply delay it.

23.3.6.1 RISK MITIGATION AND RECOMMENDATIONS

Strategies and plans have been previously established, and they need to be reconsidered and implemented.

23.3.7 RESEARCH AND DEVELOPMENT

South Africa has a well-established nuclear research, development and innovation capacity as well as the infrastructure. Since the Nuclear New Build Programme might be delivered mainly as a turnkey programme, risks associated with the research and development may be low at this stage

23.3.7.1 RISK MITIGATION AND RECOMMENDATIONS

Depending on the final selection of the nuclear power technology, the R&D infrastructure is capable of managing programme risks.

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23.3.8 FUNDING AND FINANCING OF THE NNBP

Several studies have been commissioned before to determine the funding and financing arrangements for the Nuclear New Build Programme. The report outlines various options that still need to be tested. Once an optimal model is identified and approved by the vendors, National Treasury, etc., the risk register will be updated.

23.3.8.1 RISK MITIGATION AND RECOMMENDATIONS

The risks will be considered and addressed by the relevant sub-working group and Eskom as the owner-operator of the nuclear power plants.

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24. WAY FORWARD AND CONCLUSION

This Case for Nuclear report, Eskom's Feasibility Study and several infrastructure assessments, including the IAEA's Integrated Nuclear Infrastructure Review Mission, confirm that South Africa is well positioned to advance to the next phase of its nuclear programme. Because a nuclear programme spans many infrastructure areas, close coordination among South African organisations, particularly government departments, will be a key strength. Keeping the NEPIO under the oversight and leadership of the Department of Electricity and Energy working structures throughout the programme, especially during the critical next ten years, will secure this coordination and underpin the programme's success.

The programme is ready to move into market engagement. Testing market appetite and commitment through at least one round of a procurement process will provide the information needed to address the remaining key issues. On this basis, Eskom can finalise its feasibility study and business case with confidence and take an informed decision on the nuclear programme. The Case for Nuclear report also notes that several gaps can be closed through the procurement process, with the support of supplier organisations.

The recommendation is to proceed with a coordinated evidence and approvals package that builds a firm and bankable foundation for the programme, rather than committing before current market conditions have been tested. The full 5 200 MW envelope and the first phase will each be taken through their own scope, affordability and readiness decisions, which allows the programme to advance step by step and with confidence. Cost ranges, State support arrangements, asset contributions and commissioning dates will be confirmed through the approvals process. Supporting the proposed Ministerial section 34 determination is the enabling step that allows Eskom to test the market and obtain the information required to procure the nuclear new build programme.

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26. ABBREVIATION LIST

Table 11: Abbreviation list

Abbreviation	Definition
AFR	Away From Reactor
ALARA	As Low As Reasonably Achievable
ANWFZ	African Nuclear Weapons Free Zone
AP	Additional Protocol
AR	At Reactor
BWR	Boiling Water Reactor
CBAM	Carbon Border Adjustment Mechanisms
CCS	Carbon Capture and Storage
CI	Conventional Island
CIPA	Critical Infrastructure Protection Act, No 8 of 2009
CPPNM	Convention on the Physical Protection of Nuclear Material
CSA	Comprehensive Safeguards Agreement
CTBT	Comprehensive Test ban Treaty
DEE	Department of Electricity and Energy
DFFE	Department of Forestry, Fisheries and the Environment
DIRCO	Department of International Relation and Cooperation
DTIC	Department of Trade Industry and Competition
EA	Environmental Authorisation
EBS	Engineered Barrier System
EIA	Environmental Impact Assessment
ERA	Electricity Regulation Act
EU	European Union
FBR	Fast Breeder Reactor
FDL	Fuel Development Lab
FOAK	First-of-a-Kind

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Abbreviation	Definition
GCR	Gas-Cooled Reactor
GDP	Gross Domestic Product
GHG	Greenhouse Gas
HLW	High Level Waste
IAEA	International Atomic Energy Agency
IDP	Integrated Development Plan
IPCC	Intergovernmental Panel on Climate Change
IRP	Integrated Resource Plan
IS	Integrated Safeguards
JET	Just Energy Transition
KNF	Korean Nuclear Fuel
KNPS	Koeberg Nuclear Power Station
LCOE	Levelised Cost of Energy
LILW	Low and Intermediate Level Waste
LILW (SL)	Low and Intermediate-Level Waste (Short-lived)
LTO	Long Term Operation
LWGR	Light Water Graphite Reactor
MBS	Multiple Barrier System
MPR	Multi-Purpose Reactor
MSWU	Million Separative Work Units
NBS	Natural Barrier System
NCRWM	National Committee on Radwaste Management
NDA	Non-Destructive Analysis
NDC	Nationally Determined Commitment
NEA	Nuclear Energy Act, No. 46 of 1999
Necsa	South African Nuclear Energy Corporation Limited
NEP	Nuclear Energy Policy of 2028

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Abbreviation	Definition
NEMA	National Environmental Management Act 107 of 1998
NEPIO	Nuclear Energy Programme Implementation Organisation
NERSA	National Energy Regulator (of South Africa)
NFC	Nuclear Fuel Cycle
NI	Nuclear Island
NICOC	National Intelligence Coordinating Committee
NIL	Nuclear Installation License
NISL	Nuclear Installation Site Licence
NMAC	Nuclear Material Accounting and Control
NNBP	Nuclear New Build Programme
NNR	National Nuclear Regulator
NNRA	National Nuclear Regulator Act, No. 47 of 1999
NPP	Nuclear Power Plant
NPT	Nuclear Non-proliferation Treaty
NRWDI	National Radioactive Waste Disposal Institute
NSG	Nuclear Suppliers Group
NSM	Nuclear Safeguards Management
NSS	Nuclear Siting Studies
NTCSA	National Transmission Company South Africa
PBMR	Pebble Bed Modular Reactor
PCLM	Project Life Cycle Model
PFMA	Public Finance Management Act, No. 1 of 1999
PHWR	Pressurised Heavy Water Reactor
PPE	Plant Parameter Envelope
PPP	Public Private Partnership
PR&PP	Proliferation Resistance and Physical Protection
PRIS	Power Reactor Information System

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Abbreviation	Definition
RWMF	Radioactive Waste Management Fund
PwC	PricewaterhouseCoopers
PWR	Pressurised Water Reactor
RFI	Request for Information
RFQ	Request For Quotation
ROD	Record of Decision
ROI	Return on Investment
SAFARI-1	South African Fundamental Atomic Research Installation
SAPS	South African Police Service
SFA	Spent Fuel Assembly
SEA	Strategic Environmental Assessment
SOE	State-Owned Entity
SMR	Small Modular Reactor
SNF	Spent Nuclear Fuel
SSAC	South African State System of Accounting and Control
SRA	State Regulatory Authority
SWU	Separative Work Units
TPNW	Treaty on the Prohibition of Nuclear Weapons
TRISO	Tri-structural isotropic
TRL	Technology Readiness Levels
tEUP	Tonnes of Enriched Uranium Product
tHM	Tonnes of Heavy Metal
tU	Tonnes of natural Uranium
UK	United Kingdom
UNF	Used Nuclear Fuel
USA	United States of America
WAC	Waste Acceptance Criteria

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Abbreviation	Definition
ZC	Zangger Committee

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