

Sudan Nuclear Power Programme

Status, Challenges and Future Opportunities for Nuclear Energy Applications Beyond Electricity

Eng. Ammar Mohammed Hassan Ahmed

Director, Technical Directorate
General Directorate of Nuclear Power Generation
Sudanese Thermal Power Generating Company Ltd.
Ministry of Energy and Petroleum, Republic of Sudan

Presentation Overview



Introduction

The Strategic Imperative for Nuclear Energy in Sudan



Peaceful Nuclear Energy Applications in Sudan

Sudan's History of Peaceful Nuclear Applications



Programme Journey

Milestones and achievements since 2007



Challenges

What stands ahead of the Nuclear power programme



Beyond Electricity

The opportunity for nuclear cogeneration



Conclusions

Introduction: The Strategic Imperative for Nuclear Energy in Sudan



14%

annual growth in
national electricity demand

*Conventional generation alone cannot
keep pace with residential and industrial
growth.*

Sudan faces a critical juncture in its energy development path. With a population approaching 50 million and a land area of 1,879,358 square kilometer, the country is experiencing rapidly growing demand for electricity. The national energy landscape presents significant challenges:

- **Declining conventional resources:** Declining oil reserves, since the separation of South Sudan in 2011, constrain the future expansion of fuel-based generation.
- **Limited hydropower options:** Opportunities to expand hydropower are limited by geography and shared-water considerations.
- **Regional demand growth:** Sustained exceptional growth rates in electricity consumption that conventional sources struggle to meet

These factors make nuclear power a strategic imperative, not merely an option for securing Sudan's energy future and enabling the comprehensive reconstruction and development agenda.

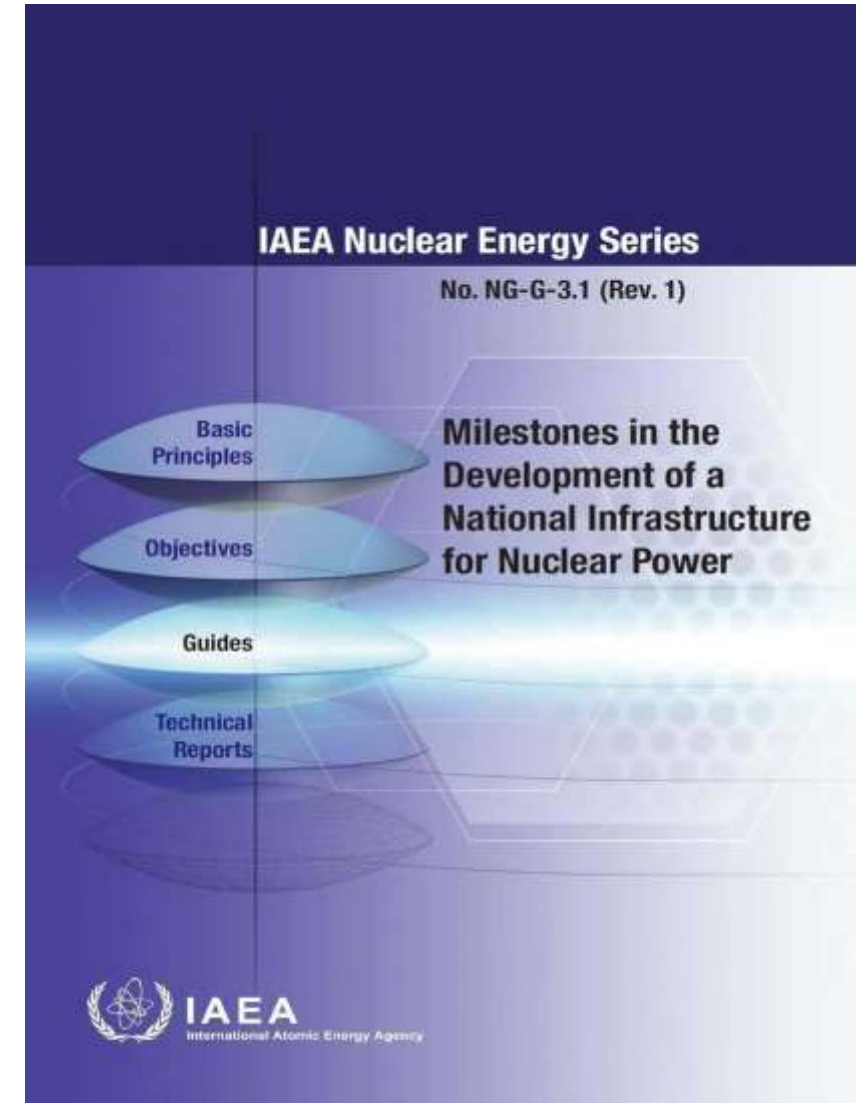
History of Peaceful Nuclear Energy Applications in Sudan



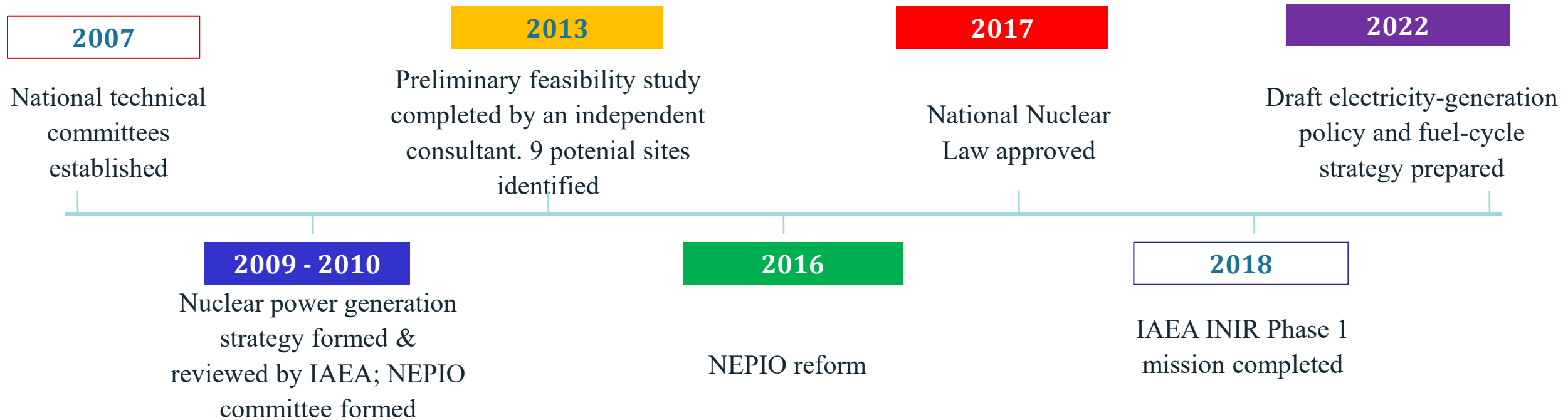
- ❑ Sudan's relationship with nuclear science and applications has been developing for decades.
- ❑ in 1958, Sudan joined the IAEA, demonstrating early commitment to international nuclear cooperation
- ❑ Nuclear medicine and isotope applications have been used since the 1960s for cancer diagnosis and treatment.
- ❑ The current cooperation with the International Atomic Energy Agency focuses on supporting the public health, agricultural research, and veterinary sectors, as well as building the foundational infrastructure for electricity generation.

The Milestone Approach & Nuclear Infrastructure Development

- ❑ Sudan began considering nuclear power generation as early as 2007.
- ❑ Throughout the development of the program, the IAEA's Milestone Approach , which addresses 19 interrelated infrastructure issues spanning strategic, legal, technical, human resource, and environmental dimensions , has been systematically adopted, providing a comprehensive framework for assessing national readiness.
- ❑ Considerable progress has been achieved in developing the country's nuclear infrastructure, including the establishment of an independent regulatory body, the approval of the national nuclear law, and the completion of an Integrated Nuclear Infrastructure Review (INIR) mission.



Sudan Nuclear Power Programme: Almost Two Decades of Institutional Progress



Institutional Framework and Stakeholders

Nuclear Energy Program Implementation Organization (the general directorate of nuclear power), serves as the effective program coordinating body.



National Partners

Ministry of Energy and Petroleum, Ministry of Higher Education, Ministries of Interior affairs and Defense, General Intelligence Service, National Environment Council, Ministry of Justice and Ministry of Foreign Affairs, Ministry of Finance and Economic Planning, Ministry of Minerals and Geological Research Authority, Sudan Atomic Energy Commission, National Regulatory Authority (SNRRA)



International Partners

- ❖ IAEA and Arab Atomic Energy Agency
- ❖ China National Nuclear Corporation (CNNC)
- ❖ Rosatom

Status: Feasibility Study and Candidate Sites

Technology	Plant Capacity	Construction Cost	Levelized Cost
ACP1000	2 × 1000 MW	US\$ 6.2 – 7.4 bn	3.5 – 4.7 ¢/kWh
ACP600	2 × 600 MW	US\$ 4.0 bn	6.47 ¢/kWh

Preliminary feasibility study (2013) confirmed the technical and economic viability. The Chinese reactor designs was recommended, based on technology availability and strategic considerations.

9 Candidate Sites Identified

Across Red Sea State, Northern State, and River Nile State (Dongola and Abu Hamad areas).

Nile-proximate sites are favoured for lower transmission losses and stronger grid voltage.

Challenges



Political instability

Political instability has periodically disrupted programme continuity and delayed key decisions



Financing

Securing sustainable, large-scale investment for reactor construction and supporting infrastructure.



Human Capacity

Scaling specialized training for engineers, operators, and regulators in addition to ensuring retention of trained personnel

Challenges



Regulatory Maturity

Continuing to build an independent, technically capable regulator



Technology-Partner Decisions

Finalizing the path forward across parallel cooperation tracks with potential vendors.



Public & Institutional Support

Sustaining awareness and confidence in nuclear energy through a period of national reconstruction.



Institutional Coordination

Keeping alignment across the many ministries and agencies involved in the programme.



Opportunities for Nuclear Energy Applications Beyond Electricity

- ❑ Small Modular Reactors (SMRs) represent a growing technology pathway, offering the potential for faster, more standardized construction and greater siting flexibility compared to conventional large reactors.
- ❑ Sudan is following developments in SMR technology, given its suitability for smaller grids and for non-electric applications such as desalination.
- ❑ The technology could help address water scarcity in Sudanese coastal cities such as Port Sudan through nuclear-powered desalination.
- ❑ Sudan's nuclear infrastructure is still in its early development stages. As it matures, under the nuclear power programme, it could pave the way for further applications, including water desalination.



Opportunities for Nuclear Energy Applications Beyond Electricity



A Coastal City Under Water Stress



- ❑ Port Sudan, capital of Red Sea State and Sudan's principal seaport, sits in an arid coastal climate with little rainfall and limited freshwater resources.
- ❑ Population growth, expanding industry, and the city's growing role in national trade and reconstruction are increasing pressure on an already-strained water supply.
- ❑ The Red Sea region has already been identified in Sudan's nuclear siting studies as a candidate area, opening the door to future cogeneration potential , including desalination.

Conclusion

- ❑ The Sudan Nuclear Power Programme represents a strategic national project with the potential to deliver transformational benefits for energy security, economic reconstruction, and sustainable development.
- ❑ Sudan has made progress in building the institutional, legal, and human resource infrastructure for peaceful nuclear power, following IAEA guidelines and international best practices.
- ❑ The integration of nuclear power with water desalination and industrial applications could offer a compelling opportunity to address multiple national challenges simultaneously.
- ❑ For water-stressed coastal regions like Port Sudan, Nuclear technology could provide sustainable solutions to water shortages while meeting growing electricity demands.



Thank You For Listening!