# APPLICABILITY OF KENYA’S LEGAL FRAMEWORK TO SUPPORT THE DEPLOYMENT OF SMALL MODULAR REACTOR

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**Abstract**

The advancement of Small Modular Reactor (SMR) technologies has garnered increased interest from embarking countries considering introducing nuclear power in their energy mix. This is attributed to the unique characteristics associated with SMR technologies such as: fitness for smaller electricity grids; suitability for non-electric application; scalability; and site flexibility. Both the technology developers and the technology recipient countries are developing and enhancing the existing and new infrastructure to support the deployment of SMR technologies. Despite the efforts to accelerate the deployment of the SMR, technology recipient countries face numerous obstacles including legal and regulatory issues, standardizations and supply chain. Kenya, an embarking country, has adopted the IAEA Milestone Approach for the implementation of its nuclear power programme and it is currently in phase II. According to the national energy master, Kenya plans to introduce about 300 MWe, SMR, to its national grid by 2036 and two (2) additional similar sized units to be added in subsequent years. To achieve the set timelines, Kenya initiated the development of a new and enhancement of existing legal framework to support safe, secure and peaceful utilization of nuclear technology. This includes development of the nuclear regulatory act, drafting of the nuclear policy and ratification of the requisite treaties and conventions. This paper assesses the adequacy of the aforementioned framework, the Nuclear Regulatory Act, to determine its suitability to support the deployment of the SMR in Kenya. The assessment identified areas of compatibility and gaps taking into consideration the international standards and the novel aspects of SMRs. The findings of this research shall form a basis for the development of a comprehensive legal and regulatory framework for the deployment of SMRs in Kenya.

KEY WORDS: Small Modular Reactor, Legal framework, Technology Recipient Countries, Nuclear Policy, Milestone Approach.

## INTRODUCTION

A decision to embark on a Nuclear Power Programme should be based on a commitment to safe, secure, and peaceful application of nuclear technology. This commitment necessitates the need to establish a sustainable national infrastructure that provides governmental, legal, regulatory, managerial, technological, human resource, industrial, and stakeholder support for the programme throughout its life cycle. A country should for a country to demonstrate compliance with international legal instruments, internationally accepted nuclear safety standards, nuclear security guidelines, and safeguards requirements is essential in establishing a responsible Nuclear Power Programme.

Small modular reactors (SMRs) are advanced reactors designed to generate typically up to 300 MWe per unit, whose components and systems can be factory-built and transported as modules to the sites for installation as demand arises. The development of SMR is driven by the need for flexible power generation, replacing ageing fossil-fired units, enhancing safety performance, and offering better economic affordability. Despite the aforementioned SMR attributes, their deployment faces various hurdles including legal and regulatory issues, standardizations and supply chain. At present, nearly 80 SMR designs are under development and licensing stages, and a few of them are at deployment and operational stages. Most of the SMR designs, under development and licensing stages, target deployment in the 2030s timeframe. To achieve this, both the technology developers and the technology recipient countries are developing and enhancing the existing and new infrastructure to support the deployment of SMR technologies.

Kenya adopted the IAEA milestone approach for the development and implementation of its Nuclear Power Programme and currently Kenya is in Phase II. According to the national energy master, Kenya plans to introduce about 300 MWe to its national grid by 2036 and two (2) additional similar sized units to be added in subsequent years[1],. Based on the recently concluded reactor technology assessment, Kenya is targeting SMR technologies that will be commercially available in the next 3 to 5 years. As an embarking country seeking to include SMRs technology as part of its energy mix, Kenya has to adhere to all relevant international legal instruments, treaties and conventions, in the areas of nuclear safety, security, safeguards, and civil liability for nuclear damage. Moreover, Kenya is required to develop and implement a comprehensive national legal and regulatory framework addressing the unique aspects associated with the deployment of SMRs. This necessitates the need to understand and analyse the existing national legislative and regulatory framework to support the deployment of SMRs and address any potential gaps.

Recognizing the potential of nuclear energy to address its growing energy needs and enhance energy security, Kenya embarked on a comprehensive plan to establish a robust legal and regulatory framework in line with international legal instruments and best practices. As part of its commitment to establish a robust legal and regulatory framework, Kenya has ratified various international legal instruments on nuclear security and non-proliferation as tabulated in Table 1: Moreover, Kenya is in an advanced stage in the ratification of international legal instruments on nuclear safety and nuclear liability.

Table 1: Ratified Conventions and treaties

|  |  |
| --- | --- |
| CONVENTIONS RATIFIED | |
| NUCLEAR SECURITY CONVENTIONS | The Convention on the Physical Protection of Nuclear Material (the CPPNM). |
| The 2005 Amendment to the Convention on the Physical Protection of Nuclear Material. |
| The International Convention for the Suppression of Terrorist Bombings (the Terrorist Bombings Convention). |
| International Convention for the Suppression of Acts of Nuclear Terrorism (the Nuclear Terrorism Convention). |
| The International Convention for the Suppression of the Financing of Terrorism. |
| The 1988 Convention for the Suppression of Unlawful Acts against the Safety of Maritime Navigation (the 1988 SUA Convention). |
| The Protocol for the Suppression of Unlawful Acts against the Safety of Fixed Platforms located on the Continental Shelf (the 1988 Fixed Platforms Protocol). |
| The 2005 Protocol to the Convention for the Suppression of Unlawful Acts against the Safety of Maritime Navigation 1988. |
| The 1996 Protocol to the Convention on the Prevention of Marine Pollution by Dumping of Wastes and Other Matter (the LC PROT 1996). |
| NON-PROLIFERATION CONVENTIONS | The Treaty on the Non-Proliferation of Nuclear Weapons (the NPT). |
| The Comprehensive Safeguards Agreement under the Treaty on Non-Proliferation of Nuclear Weapons (the CSA). |
| Protocol Additional to Agreement(s) between States and the IAEA for the Application of Safeguards (the Additional Protocol). |
| The African Nuclear- Weapon Free Zone Treaty (the Treaty of Pelindaba). |
| The Partial Test Ban Treaty (the PTBT). |
| The Convention on the Prevention of Marine Pollution by Dumping of Wastes and Other Matter, as amended (LC PROT 1996). |

Various studies have been conducted to assess the applicability of the current international nuclear legal framework to facilitate the accelerated deployment of SMRs. A 2022 preliminary study by Van Kalleveen, A. on Applicability of the international nuclear legal framework to small modular reactors (SMRs) [2],, reviewed the international nuclear legal framework and its applicability to support the deployment of SMRs technology (ies), concluding that the current international legal framework does not exclude SMRs (except certain types), however, there is need for adjustment and/or interpretation to cover all SMRs.

## KENYA LEGAL FRAMEWORK HIERARCHY

Kenya legal hierarchy applicable in application of nuclear technology starts from the constitutional level for establishing basic legal and institutional setup, second the statutory level to enact specific laws through parliament, third level consisting of regulations consisting of in-depth provision of technical rules for control or regulation of activities as specified by statutory instruments. The Kenya Nuclear Regulatory Authority (KNRA) responsible for development and implementation of the regulations. The fourth level consists of optional guidelines to facilitate implementation of the above rules and guidelines as shown in Figure 1.



Figure 1: Legal Structure in Kenya

## ASSESSMENT OF THE NATIONAL NUCLEAR LEGAL FRAMEWORK

Assessment of the applicability of Kenya's nuclear regulatory framework to support the deployment of Small Modular Reactors (SMRs) involved examining various aspects of the existing framework ( Nuclear Regulatory Act of 2019) [3],, including its comprehensiveness, adaptability, and alignment with international standards. The Nuclear Regulatory Act of 2019 provides provision for the regulation of safe, secure and peaceful utilization of atomic energy and nuclear technology; the production and use of radiation sources and the management of radioactive waste. The Assessment of the various provisions of the Nuclear Regulatory Act to support the deployment of the planned SMRs in Kenya. as tabulated in Table 1

Table 2: Assessment of the Issues addressed in the Regulatory Act

|  |  |  |
| --- | --- | --- |
| **ISSUE** | **SCOPE** | **REMARKS** |
| **Siting** | SMR designs presents unconventional siting from conventional large NPPs. These include: underground, sea-bed based and remote locations lacking basic infrastructure. The Nuclear Regulatory Act provides provision that can be applied for the siting of both conventional large NPPs and SMRs technologies. However it is limited to land based SMR technology. | Given that Kenya has not yet concluded the selection of a suitable reactor technology, There is a need to develop a comprehensive legal framework taking into account the possible siting options for its future SMR technologies. |
| **Licensing** | The licensing process for nuclear installations is divided into different stages viz. site selection, design, manufacturing, construction, commissioning, operation and decommissioning. The licensing process of SMRs may also require additional considerations such as manufacturing of SMR modules, their offsite commissioning and transportation, onsite commissioning of multiple reactor types at one project site, different operating concepts of SMRs, and onsite & offsite decommissioning. The existing legal framework supports the licensing process from siting and site evaluation, Design; Construction; Commissioning; Operation; Decommissioning; and Release from Regulatory control. However, the deployment of SMR technologies will require additional licensing provisions on Manufacturing of SMR Modules; Offsite Commissioning; Transportation; and Offsite Decommissioning. | The current licensing framework for LRs involving design certification, early site permit and a combined construction and operating license can be adapted for SMRs by including the concepts such as modularization, different SMR operating conditions and changes in safety requirements for innovative SMR designs. |
| **Emergency Preparedness And Response** | SMR technologies feature a smaller EPZ compared to conventional large NPPs, making them advantageous for placement near densely populated areas. Most small modular reactors (SMRs) designs aim for designs that do not require off-site EPZ which would reduce the burden on the population living in the vicinity of an SMR allowing, at the same time, SMRs to be located closer to the end-users.  The Nuclear Regulatory Act on emergency preparedness and response is designed to ensure that nuclear and radiological emergencies are effectively managed to protect public health and safety, the environment, and property. It provides for the provision on the assessment and formulation and plan for adequate Emergency Preparedness and Response (EPR) arrangements, in particular the size of Emergency Planning Zones (EPZs). | The legal framework on Emergency Preparedness and Response can support the deployment of land based stationary SMR technologies. However, there is a need to provide provisions on EPR for  TNPP and technology and floating types. |
| **Nuclear security** | Security challenges may arise based on the SMRs’ design, transportability, potential siting and deployment. Security arrangements need to be made with these unique SMR characteristics in mind. Deployment of SMRs might have fewer nuclear security needs compared to their larger counterparts given that SMR incorporates the concept of security by design.  The provisions on nuclear security as per the Nuclear Regulatory Act of 2019 are applicable for SMR technology. However there is a need to address the unique security aspects associated with siting the SMR in remote areas, TNPP SMR designs and the cyber security due to high level of digitization and automation, increased automation, remote supervisory control and remote maintenance. | There is a need for developing a legal framework on nuclear security that is proportionate and specific to the circumstances (SMR technology, location, etc.). |
| **Decommissioning** | SMRs offer the option of both onsite and offsite decommissioning. Offsite decommissioning offers a viable approach to managing the end-of-life phase of these reactors, leveraging specialized facilities and expertise to enhance safety and efficiency. However, it requires planning, robust legal and regulatory frameworks, and coordinated efforts across multiple stakeholders to address the associated challenges.  The Nuclear Regulatory Act doesn't explicitly have provisions on the offsite decommissioning of nuclear installation. | There is a need for inclusion of the provisions on offsite decommissioning in the legal and regulatory framework. |
| **Safeguards** | Most of the SMR designs, that are still at conceptual or under design stage, incorporate various safeguards features by design. SMR technologies incorporated factory-fueled reactor cores in their designs. Kenya's legal framework is not comprehensive in addressing safeguards challenges associated with the deployment of SMRs given that the design has the capability of being factory-fueled reactor cores. | There is a need to develop provisions on safeguards of SMR design. With their use of High Assay Low Enriched Uranium, prospects of higher enrichment, safeguards become a huge concern in terms of regulations for the entire lifetime of the nuclear power plant. This includes operation, decommissioning and disposal. |
| **Radioactive Waste and Spent Fuel Management** | Most of the LWR SMRs use the same fuel as their conventional counterparts, hence they will generate spent fuel and radioactive waste. The legal framework provides for the provision for management of the radioactive waste and spent fuel with spent fuel considered as radioactive waste. | There is a need to develop regulations for radioactive waste, including fuel leasing, export for reprocessing of spent fuel, waste management plan establishment, and implementing provisions stated in the Joint Convention on the Safety of Spent Fuel Management and on the Safety of Radioactive Waste Management |

## CONCLUSION AND RECOMMENDATIONS

The development of Kenya's legal and regulatory framework (Nuclear Regulatory Act) focused on supporting the deployment of a large nuclear power plant. The various provisions of the Nuclear Regulatory Act discussed above have to be reviewed to support the deployment of SMR technology. We highlight 7 key areas that require strong regulatory and licensing requirements for deployment of SMR technology in Kenya. With many vendor countries developing SMRs with the aim of prototype deployment in near future, it will be of great importance for Kenya to investigate on their design requirements and licensing development of host or technology deployed countries for adoption of key areas identified. SMR technology provides an avenue for clean reliable electricity that requires legal and regulatory infrastructure to be developed in advance in preparation for future bids of acquiring the technology in Kenya. Key convention highlighted once ratified and IAEA general safety requirements adopted in future regulations will be of great importance for SMR licensing together with vendor country licensing and regulatory requirements.

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