**Name: Berihun Asfaw Arega Organization: Ethiopian Technology Authority, Email:** **berihuna@yahoo.com** **Title:  Integration of Safety and Sustainability in the Application of Nuclear Science and Technology**

1. **Abstract**

The applications of radioactive sources for peace full purposes are steadily increasing globally in health, agriculture, water resource management, energy and industrial sectors, research institutes and other areas. The users of radiation technology should establish their national framework and infrastructure, regulations, policy and strategy in line with international radiation safety standards since they are key enablers and a pre-condition for sustainable application of nuclear science and technology. According to GSR Part 1, a regulatory body shall perform its functions in a graded approach commensurate with the radiation risks associated with facilities and activities to ensure safety and enable sustainability. In view of this, the primary task before any application of nuclear science and technology is to ensure safety and enhance sustainability so as to contribute nine SDGs. Graded approach regulatory function implementation is also playing an important role to discharge responsibilities according to safety significance and complexity for sustainable utilization of the technology with minimized risks. Due to the applications of different categories of radiation sources in various sectors, a regulatory body should prioritize and implement its activities in accordance with a graded approach to optimize resources and enhance the efficiency and effectiveness of the regulatory control.

This paper presents the integration of policy, strategy, regulation and sustainability,implementation of the regulatory activities in a graded approach integrating with the regulatory function technical aspects, the role of leader ship and decision-making to ensure Safetyand enhanc sustainability and conclusions.

1. **Introduction**

Ethiopia has been cooperating with the IAEA through the TC programme based on the needs identified through its Country Programme Frameworks (CPFs), national development plans, and strategic frameworks. The national umbrella plan in which the sectorial plans and strategies emanated is the Ten-Year Development Plan which has been implemented from 2021 to 2030. Radiation and radioactive sources have been used in the country mainly in the areas of health agriculture, industry, water resource management and others. The Government is committed and established an independent Regulatory Body to control the use of radiation sources through appropriate regulatory frame work. In view of this, Proclamation 1025/2017, Enforcement policy ,draft Radioactive Waste Management and Nuclear Safety and Security Policies, , draft regulation and Radioactive Waste Management Strategy as well as QMS are developed, which provide a shared responsibility and accountability to ensure safety for sustainable utilization of nuclear science and technology. In addition to the international legal instruments that the country is a party, Conventions on Nuclear Safety, Assistance in the Case of a Nuclear Accident or Radiological Emergency,Early Notification of a Nuclear Accident, Physical Protection of Nuclear Material and the Joint Convention on the Safety of Spent Fuel Management and on the Safety of Radioactive Waste Management ratification documents are submitted to the Ministry of Foreign Affairs for approval. These legal instruments are deriving wheels for fostering international cooperation to strengthen the development and implementation of global safety regime, information exchange regarding national nuclear and radioactive material accidents as well as to create awareness and disseminate knowledge on the integration approach of safety and sustainability. However, the slow approval process of the legal instruments and policies is a bottle neck for implementation.

The then Ethiopian Radiation Protection Authority now Ethiopian Technology Authority had hosted an IRRS mission in 2017 to review its radiation safety regulatory framework and activities against the relevant IAEA safety standards, which enhanced the national legal, governmental and regulatory framework for radiation safety, radioactive waste management and national arrangements for emergency preparedness and response. The regulatory body has also revised the regulation, the safety and security policy, directives and associated procedures to enhance the technical capability of notification and authorization, inspection, enforcement and radioactive waste management in a graded approach to ensure the safety of the public, the environment and its properties from undue radiation risks.

The commitment of the Government regarding the implementation of SDGs aligning with its national policies and strategies is demonstrated by presenting its first and second Voluntary National Reviews (VNRs) on SDGs in 2017 and 2022 respectively at the High-Level Political Forum in New York. In connection with this, the report of 2022 specially addresses the efforts made in all the 17 SDGS in which the contribution of nuclear science and technology plays its role to achieve the goals of some relevant fields [4]. In general, the national efforts to ensure safety for sustainable utilization of nuclear science and technology is improving through continuous awareness creation among decision makers, stakeholders and the public as well as practical demonstration of the achievements and impact on socioeconomic development.

1. **The Interrelationship of Policy, Strategy, Regulation with Sustainability**

The purpose of creating national, regional and international cooperation framework for the application of nuclear science and technology among national institutes and countries through identifying and prioritising cooperation modalities is to contribute for the sustainable development of socioeconomic development. When the thinking of the application of nuclear science and technology for example in the areas of health, agriculture, energy, industry or any other field is initiated the primary issue that comes at the for front is ensuring the availability of basic safety infrastructure, resources, appropriate policies, regulations and strategies to ensure safety among other factors and in turn to enable sustainability. The application of nuclear science and technology cannot be realized with the effort of one or two organizations in a country. It requires synergetic approach among varies actors such as the Government, Regulatory Body, operators, stakeholders and the general public with clear responsibilities and accountability to avoid duplication of efforts, minimize cost and bring ownership for sustainability. Hence, the establishment of policies, proclamation, regulations, strategies and regulatory framework is instrumental to create conducive environment for all actors to discharge their responsibilities with clear directions for the safe management of radioactive sources, decommissioning, environmental protection, and remediation for sustainable utilization of the technology as per the international safety standards. However, the Proclamation No. 1025/2017 does not provide the safety principles for protecting people and environment including justification, optimization and limitations of risks as required by GSR Part 1 Requirement 2 para 2.5. The regulatory body recognizes these deficiencies as important factors for sustainability and incorporated in the draft regulation and directives accordingly.

The Radioactive Waste Policy of Ethiopia is consistent with the requirements of the national legislative system, the basic principles for the safe management of radioactive waste, relevant international principles, and international binding and non-binding agreements to which Ethiopia is signatory [5].. The policy also incorporated repatriation of disused radioactive sources to the country of origin or export to another country for reuse and recycling as the first option to enable sustainability. The second option is storage followed by permanent disposal in a suitably designed disposal facility to ensure safety. The draft Radioactive Waste management strategy is also developed to implement the policy and it is essential especially for policy makers to legitimize a decision to proceed with a particular primary course of action such as approval of deep geological disposal site selection and construction in the long term. The draft safety and security .policy also captures the long term commitment of the Government to safety and binding international legal instruments such as conventions and other relevant international instruments though the conventions mentioned above are not yet ratified. It also considers the fundamental safety objective and the fundamental safety principles, provisions for promoting the leadership and management for safety, including safety culture and provisions for ensuring adequate human and financial resources as the basic safety requirements for a regulatory infrastructure in TSA1. When these policies, strategy and the conventions are approved and functional the regulatory function will be more effective and efficient to sustainable utilize nuclear science and technology for peace full applications.

1. **Graded Approach Regulatory Functions Implementation to Enhance Safety and Sustainability**

GSR Part 3 (2.18) states that “The government shall ensure that a graded approach is taken to the regulatory control of radiation exposure, so that the application of regulatory requirements is commensurate with the radiation risks associated with the exposure situation’’. In accordance with this general requirement, the Ethiopian Technology Authority has been trying its best to implement its regulatory activities in a graded approach. Graded approach performance of regulatory activities ensures to optimize safety functions of the Authority so that it confirms operational limits and conditions are not challenged. It also provides confidence to the Authority, operators and stakeholders that additional risks will not be imposed on the public, workers and the environment for sustainable utilization of science and technology. To ensure effective regulatory control of different facilities and activities with radiation sources, the Authority applies a graded approach in a way that the degree of implementation of the regulatory requirements commensurate to the associated radiation risks [2].

Resources are limited particularly in a developing country like Ethiopia. Hence, it is mandatory for the Ethiopian Technology Authority to structure its organization and manage its resources so as to discharge its responsibilities and perform its functions effectively in a graded approach. If regulatory control activities are not prioritized in graded approach, human and financial resources will be wasted in less important areas, which will diminish the safety and sustainable utilization of the risk informed facilities or practice. However, it doesn’t mean that safety should be compromised in other low category sources.

Ethiopian Technology Authority (ETA) has developed a range of authorization application forms and requirements to guide applicants to apply for authorization of different facilities and activities. The Proclamation 1025/2017 requires that the applicants submit a detailed safety assessment report. The license issued by Authority includes expiration dates and conditions of the authorization. A pre-authorization inspection is conducted in a graded approach with radiation risks before an operational license is issued or renewed for facilities and activities. License certificates are also issued to Service Providers to conduct safety assessment for low category sources but for high risk informed sources of category 1 and 2. National registry of ionizing radiation sources is also established and regularly updated in IAEA RAIS 3.2 software. The proclamation provides for a graded approach in authorization in the form of registration or licensing, or exemption. The Authority is currently updating specific guides for conducting site evaluation, design, construction; commissioning, operation, shutdown and decommissioning ensure safety for risk informed facilities to avoid inconsistency in applying graded approach authorization

The Ethiopian Technology Authority carries out inspections of radiation facilities and activities including radioactive waste management facilities, transport of radioactive materials and import/export of radioactive substances. The Authority has an inspection procedure to guide the inspectors on inspection. It has also developed an inspection methodology for radiation sources in a graded approach. Annual inspection plan is prepared, which includes announced and unannounced inspections. It also conducts reactive inspections, mainly upon receiving complaints about non-compliance or unlicensed activities. It also carries out pre-authorization inspections before issuing authorization for risk informed Category 1 and 2 facilities and activities, as well as inspections that are conducted at the request of an authorized party. The target frequencies on the inspection plan range from once every year to once every 4 years, depending on the level of risk associated with the facility or activity in a graded approach to ensure safety. For example, the Authority has targeted to conduct more than 350 planned inspections on average in the previous years. This number does not include the reactive inspections. The number of planned inspections per year does not correspond with the number of available inspectors, time and resources. Because of this deficiency, the Authority is improving the implementation of the inspection programme of its regulatory activities in graded approach for optimum utilization of resources and economic benefit to enhance the efficiency and effectiveness of the the regulatory system for sustainablity.

The Proclamation 1025/2017 provides the Authority with the legal basis to carry out enforcement actions in accordance with a graded approach. The Proclamation confers enforcement powers on ETA to act in the case of non-compliance with the legal requirements. It has also an approved enforcement policy and procedures to implement its enforcement action. The enforcement actions provided for include revocation of a license, suspension or amendment of an authorization, prosecution or closure. Inspectors are empowered to take enforcement actions in cases where safety is compromised, and mandated to take an immediate action such as closure of the facility. However, according to Article 18 (6) of the proclamation an enforcement action will have no effect if the head of the license issuing department of fails to approve within 30 days. This implies that facilities and activities where safety is compromised may resume even in cases where no corrective action has been carried out because of this time gap. ETA should consistently confirm that the licensee has effectively implemented all necessary corrective actions in response to its findings as per GSR Part 1 Requirement 31, para 4.60 to ensure safety and enhance.

1. **Relation Ship Between Safety and sustainability in Leadership and Decision-making**

According to the IAEA Safety Standard GSR Part 2, leadership for safety can be expressed among other issues through establishing vision, mission, values, establishing behavioral expectations and fostering a strong safety culture. In this regard, the Authority demonstrates its commitment through senior officials by setting its mission to enable the Ethiopian people highly protected against radiation hazards and to create favorable conditions for the contribution of radiation and nuclear technology towards accelerating sustainable national development. An integrated management system is also established, applied and continually improved in order to ensure safety and enable sustainability. A communication strategy is in place to facilitate Interaction with stakeholders and other interested parties through television, radio, and social media and other channels taking in to consideration confidentiality of information. The decision making processes are taking place from top down or bottom up depending on the level of decision as per the established management system procedure. For example, , the licensee has the right to appeal to the Director General in the case of an enforcement action taken by the inspector based on enforcement procedure. The DG decides relevant facts and information collected from inspection reports and the licensee

1. **Conclusion**

The Ministry of Innovation and Technology has established a Science, Technology and Innovation Policy, which has a provision for the application of nuclear science and technology in varies sectors with the primary focus on Safety in all research and development activities, and technology applications. Despite the fact that the Ethiopian Technology Authority has developed regulation, Radioactive Waste Management policy, Safety and Security policy and conventions to facilitate its regulatory activities, the documents are not approved yet. Hence, the Ministry and other concerned bodies should demonstrate their commitment in approving the documents since time is a critical factor for safety. The Ethiopian Technology Authority has a number of formalized coordination and liaison arrangements with other authorities with assigned responsibilities with MoU for safety; however, regular performance evaluation of assigned responsibilities forms should be arranged.

**7. References**

1.GSR Part 3

2. GSR Part 1 (rev.1)

3. GSR Part 2

4.VNR 22 Report of Ethiopia

5. Draft Radioactive Waste Management Policy

6. Draft Radioactive Waste Management Strategy

7. Nuclear and Radiation Proc.1025/2017