



**The United Republic of Tanzania**

**Ministry of Communication, Science and Technology**

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**The National Nuclear Technology Policy**

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2013

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# 1. INTRODUCTION

## 1.1 Background

Since 1980s, Tanzania has undertaken structural economic reforms aimed at promoting socio-economic development. The National Development Vision 2025, outlines attributes which Tanzania should attain by the year 2025. These attributes include building a competitive economy capable of producing sustainable growth and shared benefits. It envisages Tanzania graduating from a least developed country to a middle income country, having eliminated abject poverty. To attain this noble vision, Tanzania recognized the importance of raising productivity and efficiency in all sectors of the economy through the use of science and technology. One of the technologies whose use has to be expanded in various sectors of the economy is nuclear technology.

Nuclear technology is the application of radiations from atom particles (nucleus and outer shells) to perform specific tasks of social and economic value in different sectors. Globally, peaceful use of nuclear technology has expanded over the years. The well-known achievement of the use of these technology include:- (i) increasing the yield of food crops and preserving agricultural produce; (ii) treatments and diagnosis of diseases (iii) mapping of underground natural resources such as minerals and water (iv) control of plants and animal pests and diseases and; (v) generation of electricity. There is strong evidence that nuclear technology contributed significantly in improving the economic performance in most of the industrialized countries. For example, South Korea operates 21 nuclear power plants which produce 36% of its total electricity of 73,000 MW. In order to meet its future electricity demand Korea is currently constructing seven new reactors and is planning to build more to enable it achieve its target of producing ~60% of its electricity from nuclear technology by 2030. Use of nuclear power plants has largely contributed to South Korea's economic competitiveness by keeping its electricity price low and stable for the last 32 years. Other developing countries which have benefitted from the use of nuclear technology include; China, India, Pakistan, Malaysia, Ghana, Egypt, and South Africa.

In Tanzania, sectors which have so far benefited from the use of nuclear technology include agriculture, livestock, health, industries and natural resource. In addition, nuclear as a source of power is mentioned in the current Power System Master Plan (2009) suggesting a

possibility of using it to generate electricity in the future. There are indications that the use of nuclear technology in Tanzania might increase in the health sector because of the increasing number of cancer cases. Notwithstanding, the immense benefits which are derived from the use of nuclear technology, its use requires proper coordination and regulation in order for the country to optimally benefit from the technology while complying with international safety and security requirements. Because of the inherent risks associated with nuclear technology to public health and the environment, its use is heavily regulated and monitored by the international community through the International Atomic Energy Agency (IAEA).

Thus, peaceful use of nuclear technology requires the country to establish a suitable legal framework for governing the activities. The legal framework includes comprehensive national policy guidance, legislation and international legal instruments to which the state is party. Policy and legislative framework establishes the national infrastructure, including an independent regulatory body and empowers the regulatory body to undertake clear functions in relation to the licensing, inspection and enforcement of legislative and regulatory provisions. Specifically, the policy provides guidelines on areas for technology promotion and commits the government on safe and peaceful use of nuclear technology. In addition, the policy establishes the basis for the legislation which promulgates the general principles of nuclear law and provide for the main requirements covering such diverse areas as nuclear safety and security, safeguards and civil liability for nuclear damage. The IAEA Convention on Nuclear Safety Article 8 requires each member state which is aspiring to expand the use of nuclear technology to establish or designate an independent regulatory authority which should be provided with adequate authority, competence and financial resources to fulfil its responsibilities. A well designed and operated safety regime can minimize chances of nuclear technology accidents. South Korea provides a good example of an effective nuclear safety framework, which has made South Korea expand its use of nuclear technology for 32 years without any significant accident.

Therefore, the National Nuclear Technology Policy 2013 is formulated to bridge the gap which has been observed based on the experience accumulated since 1976 when Tanzania joined the International Atomic Energy Agency in the area of nuclear technology promotion and regulation. This policy aims at providing guidance on promoting the use of nuclear technology in the country and strengthening the coordination and regulation mechanisms. Other objectives of the Policy are; enhancing national capacity by expanding and promoting

human resource and physical infrastructures related to use of nuclear technology; taking sufficient safety measures for the development and use of nuclear technology and to enhance public awareness about its benefits, risks and safety; strengthening the existing institutional and legal framework to allow peaceful application of nuclear technology in the country; enhancing international and regional cooperation in the use of nuclear technology; and strengthening the financing mechanisms of the nuclear based programmes in the country.

In the implementation of this policy, the Government will emphasis on public safety and environment protection while prioritising the contribution of nuclear technology in achieving the goal of the National Strategy for Growth and Reduction of Poverty.

## **1. 2. Situation Analysis**

### **1.2.1 Current Status of Nuclear Technology Use in Tanzania**

The use of nuclear technology in Tanzania dates back since colonial era when conventional X-ray machines were introduced in hospitals as medical imaging tools for diagnosing different medical problems. After independence their applications were expanded into cancer treatment, computer tomography (CT-scan) and studying drug resistance and malnutrition. While X-ray machines are used almost in all major hospitals in the country, Ocean Road Cancer Institute (ORCI) is the first designated institute for cancer treatment. Currently, a second cancer treatment centre is being established at Bugando Medical Centre in Mwanza.

Although national cancer statistics are sketchy, the Ocean Road Cancer Institute estimates that there was a fifty-fold increase in the number of patients reporting for treatment at the institute between 1975 and 2010. The present data suggest that use of radiation therapy will enormously increase so as to meet the demand of the growing number of cancer patients in the country.

Over the last decade, the use of nuclear technology in agriculture sector has also expanded from application in soil research to commercial application in breeding improved crop varieties. Currently, this technology is used at Sokoine University of Agriculture and Kizimbani Agriculture Research Institute - Zanzibar to breed improved crop seeds. Selian Agricultural Research Institute in Arusha is involved in breeding improved barley seeds by using the radiation technique. Due to successful results obtained so far, other agricultural institutes are expanding their capacity to use nuclear technology. In addition, some crop plantations in the country, for example Ubena Tea Company in Njombe region are using nuclear technology for soil management. It is expected that in order for Tanzania to achieve food security as envisaged under the KILIMO KWANZA initiative, nuclear technology will be further employed for food preservation and food safety. These will include the introduction of food irradiation to reduce the current levels of post harvest losses for grains, horticultural crops, and livestock products.

In livestock sector, Tanzania is credited for successfully using nuclear technology (Sterile Insect Technique) to eradicate tsetse flies in Zanzibar, which was declared a tsetse-free Island in 1997. To replicate this success, plans are underway to expand the use of this technique

against tsetse flies, fruit flies and other crop pests in other parts of the country. Also, nuclear technology is being used in a number of industries and construction projects as a non destructive method for material testing. In water resource management, use of isotope hydrology have expanded from the initial underground water recharge studies in Kondo /Makutopora system to Ruvu basin, Usangu basin and Victoria basin. Indeed, as the search for ground water resource becomes necessary due to increased water demand, use of isotope hydrology in the country will equally expand.

### **1.2.2 Sources of Ionizing and Non- Ionizing Radiation in Tanzania**

The main source of radiation in the country is from the medical field in the form of medical applications especially X-ray machines, radio frequency towers from the telecommunication sector and mining activities. Out of 500 registered facilities/institutions with radiation sources, 70% are from medical applications, while 11%, 5%, and 14% are from industry; research/teaching; and other applications, respectively. By June 2012, a total number of 709 radiation sources were registered by the Tanzania Atomic Energy Commission (TAEC) in all the operating institutions, with 60% registered for medical application. The registered application sources included; sealed sources, unsealed sources, non-medical X-ray machines, and diagnostic X-ray generators. From the year 2000 to 2010 the Commission registered an increase of 118% and 98% of radiation facilities and radiation sources, respectively.

On the other hand, Tanzania has experienced an expansion in the communication and electronic media industry, with a big number of radio and television stations being built in many parts of the country. This expansion has increased the number and coverage of radiofrequency towers and transmitters which are non ionising radiation sources. Besides there is also increase in industrial application of non ionizing radiations.

Mining activities are another important source of radiation in Tanzania due to natural occurring radioactive materials. Radiations emanating from mines are capable of causing harm to miners and the general public. In view of the rapid growth of mining industry in Tanzania, TAEC has been making concerted efforts to inspect all the mines with the view of ensuring that radiations levels in our mines remain within the internationally accepted limits. Recent discovery of uranium deposits which is a radioactive mineral and the expected mining, milling and its transportation have introduced an added responsibility of radiation monitoring. It is well understood that undertaking active exploration, mining and milling of

radioactive ore influence the background levels of radiation in the environment and can result into health problems. Furthermore, the mining of radioactive ore comes with the challenges of handling radioactive mining waste and tailings which are capable of emitting radiations many years after the closure of the mines.

In order to monitor and regulate the potential effects of radiation on health and the environment it is important to formulate a guiding policy. The National Nuclear Technology Policy will provide the required guidance on requirements for notification, authorization, inspection, enforcement, responsibilities of licensees; dose limits, occupational exposure, medical exposure, public exposure, safety and security of sources, radioactive Waste Management, emergency intervention, and transport of radioactive materials.

### **1.2.3 Regulation of Nuclear Technology in Tanzania**

Appreciating the potentials of applications of nuclear technology and emphasis on safety, the Government of United Republic of Tanzania (URT) joined the International Atomic Energy Agency in 1976. In 1983, the Government enacted the Protection from Radiation Act which established the National Radiation Commission with the mandate to protect the public against effects of radiation. By the year 2003, recognizing the increase in the application of nuclear technology in the country, the Government expanded the mandate of the Commission by repealing the Protection from Radiation Act and replacing it with the Atomic Energy Act Number 7 of 2003. The Atomic Energy Act of 2003 established the Tanzania Atomic Energy Commission as an independent regulatory body with a mandate not only of protecting the public against radiations but also regulating all aspects of nuclear technology as well as promoting the development of nuclear technology.

In order to comply with International requirements for safe use of radiation and nuclear technology the Government of United Republic of Tanzania, has signed and ratified a number of international treaties and conventions. These treaties and conventions include:

- Convention on the Physical Protection of Nuclear Material (CPPNM); 2005
- Convention on Assistance in the Case of a Nuclear Accident or Radiological Emergency; 2004;
- The Comprehensive Nuclear – Test – Ban Treaty (CTBT), 2004;
- ;



- Convention on Early Notification of a Nuclear Accident; 2004;
- Treaty on the Non-Proliferation of Nuclear Weapons (NPT); 2004;
- The International (IAEA) Safeguards Agreement; 2004;
- The Additional Protocol to Safeguards Agreements; 2004;
- International Convention for the Suppression of Terrorist Bombings (UNGA Resolution 52/164, Annex) (1997);
- Non-proliferation of Weapons of Mass Destruction (UNSC Resolution 1540 (2004)).
- Small Quantity Protocol and Amendment to the Small Quantity Protocol; (2007; 2009)
- The African Nuclear Free Zone Treaty (The Pelindaba Treaty), 1999;

As Tanzania increases the use of Nuclear Technology and position itself to start uranium mining, it is important that it strengthens its regulatory framework and international undertakings.

## **2.0 RATIONALE AND JUSTIFICATION**

Nuclear technology has a wide range of applications in important sectors of the economy and if effectively used can contribute in attaining the objectives of MKUKUTA. Nuclear technology applications in agriculture can produce visible impact on poverty reduction by improving production and reducing post-harvest losses. Health sector continue to benefit from the use of nuclear technology in diagnosis and treatment of disease. Indeed, if adopted, nuclear technology is capable of turning Tanzania into electricity exporting country from the current situation of power shortage. The general policy guidance for the application of science and technology is provided in the National Science and Technology Policy 1996. However, the National Science and Technology Policy does not address the unique aspects of safety and safeguards for nuclear technology applications which are demanded and monitored by IAEA, of which Tanzania is a member since 1976. It is also true that policies for sectors where nuclear technology is widely applied do not address the safety and safeguards aspects.

In order to maximize the benefits derived from use of nuclear technology for peaceful purposes as in various sectors of the economy, it is necessary for the United Republic of Tanzania to have a National Nuclear Technology Policy that will provide proper guidance on development and safe management of nuclear technology. Formulation of this policy is

timely for Tanzania so as to enhance its preparedness to meet the health and environmental challenges which might result from commercial uranium mining. Under international agreement, Tanzania is obliged to adopt international standards for a consistent approach to environmental, health and safety issues in all aspects of uranium mining operations; and to respect its international obligations and commitment to nuclear non-proliferation.

This policy will also be the platform for utilizing bilateral arrangements and local institutions for strengthening internal human and physical capacity needed to safely use nuclear technology. Therefore, the National Nuclear Technology Policy will address the national and international legal regimes for peaceful uses of nuclear energy, including international trade in nuclear materials and equipments.

### **3.0. Vision, Mission and Policy Objectives**

#### **Vision**

To have nuclear technology as one of the key catalyst and driver for national development

#### **Mission**

Promote safe application of nuclear technology in broad sectors of the economy

#### **Overall Objective**

To provide policy guidance for promotion of peaceful use of nuclear technology and strengthening safety, security, coordination and regulation mechanisms for socio-economic development.

#### **Specific Objectives**

- i. To enhance public awareness about benefits and risks of nuclear technology
- ii. To improve safety, safeguard and security in using nuclear technology
- iii. To promote peaceful use of nuclear technology for socio- economic development
- iv. To strengthen the financing mechanism for nuclear programmes
- v. To strengthen international and regional cooperation in the use of nuclear technology
- vi. To strengthen institutional and legal framework for peaceful application of nuclear technology
- vii. To enhance national human resource capacity for using nuclear technology
- viii. To protect the environment against possible negative effects of using nuclear technology

### **3.1 Policy Issues and Statements**

In the light of the vision and mission presented above, the following seven areas of focus of the policy have been identified for articulation:

- i. Public perception and awareness
- ii. Strengthening safety, safeguards and security measures
- iii. Promotion of nuclear technology
- iv. Financing of nuclear technology programmes
- v. International cooperation and collaboration

- vi. Strengthen Legal and regulatory framework
- vii. Cross cutting issues: (Human resource development, gender and environment)

### **3.1.1: Improve public perception and awareness**

Despite the great benefits of nuclear technology to socio-economic development, globally the nuclear technology suffers from negative public perception due to low level of awareness and prejudice. The low level of awareness and prejudice in Tanzania is not insignificant. Sustainable mainstreaming of nuclear technology in the economy will require a reasonable level of acceptance by the public. Due to the lack of awareness, the large section of the public associate nuclear technology with development and use of nuclear weapons and few but highly dramatized nuclear accidents. The memory of the bombing of Hiroshima and Nagasaki in Japan during the Second World War and the Chernobyl accident in Russia are the most referred to incidents. In addition, the recent accident at a nuclear power plant in Fukushima in Japan which occurred as a result of a powerful earthquake and Tsunami in March 2011 has strengthened the view of nuclear technology skeptics. This public outcry and concerns need to be addressed through enhancing public understanding of the economic benefits and genuine risks and safety measures available. Indeed, addressing public misconception about risks associated with nuclear technology will enhance its social acceptance.

#### **Policy objectives**

To promote public awareness about benefits, risks and safety of applications of nuclear technology

#### **Policy Statements**

Policies to achieve the objectives above will include:-

- i. The government will ensure that different groups of people in the country are sensitized about benefits, risks and safety of nuclear technology application
- ii. Public education initiatives shall be encouraged and supported to ensure accurate and balanced information on nuclear technology application
- iii. The Government will create a fully fledged public education unit within TAEC

### **3.1.2 Improvement of safety, safeguard and security measures**

The safety issues in using nuclear technology are fundamental. Every aspect of the operation of a nuclear facility/radiation source has to be closely supervised and scrutinized to ensure safety at every stage. Nuclear safety measures are designed and implemented to protect workers, the environment and the public at large. The fundamental principle applied to the safety of nuclear facilities is the concept of *defence-in-depth*, which means having in place multiple levels of protection. On the other hand, in order for Tanzania to comply with the International safety and security requirements for use of nuclear technologies it is important to strengthen its regulation framework so as to enhance safeguard and security measures. The current regulatory framework does not clearly provide mechanism for enhanced safeguard, security and emergency responses.

#### **Policy objectives**

To protect workers, public and the environment against undesirable effects from use of nuclear technology

#### **Policy Statements**

Policies to achieve the objectives above will include:-

- i. Strengthening an appropriate regulatory control of nuclear and radioactive materials;
- ii. The Government shall ensure that the international treaties for the safety, safeguard and security of nuclear and radiation, to which the country is a part, are implemented and national integrated system of database established as well as registration and necessary information to relevant international organizations are supplied in time;
- iii. The Government shall establish an emergence response unit for quick and efficient response in case of a radiological accident or emergency ;
- iv. The Government shall ensure that beneficial international treaties and conventions are ratified timely;

### **3.1.3 Promoting the use of Nuclear Technology**

Nuclear technology can play a major role in addressing current and emerging priority development needs of Tanzania. It can be used in a multitude of ways, for example in

improving healthcare; enhancing food security; generation of electricity; management of water resources and environment, as well as in various industrial applications. For healthcare, nuclear technology provides unique capabilities in the diagnosis, prevention and treatment of diseases. For example, radiotherapy is one of the most effective means of treating cancer.

In agriculture sector, the sterile insect technique (SIT) is an important method of pest control used world-wide for the control or eradication of harmful pests of crops and livestock. Radiation mutation is a technology used to breed improved crop varieties with high yields, drought and/or disease resistance attributes. Food irradiation is another method of increasing shelf life of crops and animal products. On the other hand, nuclear power plays an important role worldwide in generating electricity to support socio-economic development. About 17% of electricity worldwide is generated from nuclear power reactors and its share is on the increase as more countries consider building new plants. In Tanzania, the use of nuclear technology is still largely limited to agriculture and health sectors.

### **Policy Objectives**

Promote use of nuclear techniques and technology in different sectors of the economy

### **Policy Statements**

Policies to achieve the objectives above will include:-

- i. To optimize the use of nuclear techniques and technology to improve healthcare delivery in the country;
- ii. To enhance the use of nuclear techniques and technology to improve agriculture productivity in the country;
- iii. To introduce the use of nuclear technology to improve energy security in the country;
- iv. To optimize the use of nuclear techniques and technology to improve industrial productivity and natural resource management;
- v. To promote safe application of nuclear technology for social economic development (food security, health, agriculture, power etc).
- vi. Establish nuclear technology centre in the country

### **3.1.4 Financing of nuclear technology programmes**

Due to safety considerations and technological sophistication, nuclear programmes are expensive to undertake, thus, require reliable financing mechanism. Over the years the financing of nuclear technology programmes in Tanzania has been done jointly by the government and the IAEA. However, in order to expand the use of nuclear technology, the government needs to increase its budgetary allocation to nuclear technology development programmes and encourage the involvement of the private sector at the local and international level in accordance with the National Policy on Public-Private Partnership.

### **Policy Objectives**

Ensure adequate financing in nuclear technology development programmes

### **Policy Statements**

Policies to achieve the objectives above will include:

- i. The government will ensure availability of funds to priority nuclear technology development programmes;
- ii. Create conducive environment to attract funding from the private sector and development partners;

### **3.1.5: Participation of Tanzania in strategic regional and international nuclear technology partnership**

There is a need to strengthen partnership and collaboration between Tanzania and other regional and international organizations in the area of nuclear technology. Despite the close cooperation and valuable assistance which Tanzania has received from the IAEA and other development partners, there is a need to expand this partnership within the region and globally. Through regional cooperation, possibilities can be explored of having joint nuclear technology programmes and information sharing in order to reduce cost and optimally use of the available expertise and resources.

### **Objectives**

- i) Promote strategic partnership and collaboration between the government, regional and international development partners, including the United Nations agencies like IAEA;
- ii) Strengthening collaboration between the nuclear promotion and regulatory institutions, other research institutions and regional and international

regulatory bodies.

### **Policy Statements**

Policies to achieve the objectives above will include:

- i. Establish and strengthen strategic partnerships, collaboration and working relationships between the nuclear promotion and regulatory institutions, government and regional/international development partners;
- ii. Developing mechanisms for fostering bilateral international cooperation for the transfer of nuclear technology for socioeconomic development different sectors;
- iv. Strengthening of information sharing among different players in the region and internationally.

### **3.1.6: Strengthening Legal and Regulatory Framework**

Peaceful use of nuclear technology requires that a country establishes adequate legal framework for governing the activities. The legal framework includes international legal instruments to which the country is party, comprehensive national legislation, and implementing regulations. Legislation establishes the national infrastructure, including independent regulatory body(s). The Tanzania Atomic Energy Commission established by the Atomic Energy Act No. 7 of 2003 is the regulatory body charged with among other activities, performing inspections and enforcement for ionizing radiation safety and security and coordination and facilitation of nuclear technology transfer and atomic energy utilization. However, under the Atomic Energy Act the Commission has no mandate to regulate nuclear power plants as it is required under the IAEA guideline. Regulation of a nuclear energy plant requires the establishment of a specialized organization. Furthermore, TAEC performs both regulatory and promotions activities, which in principle are conflicting.

### **Policy Objectives**

Establish an effective legal and institutional framework to regulate and promote use of nuclear technology.

### **Policy Statements**

Policies to achieve the objectives above will include:

- i) Review Acts that established TAEC and other relevant laws



- ii) In short term restructure TAEC to strengthen the promotional and regulatory functions; and establish two bodies in long term perspective.
- iii) Review other sectoral policies to incorporate use of nuclear technologies;

### **3.1.7 Cross - Cutting Issues**

#### **3.1.7.1 Improve human skills**

Tanzania has a shortage of trained manpower in different specialities of nuclear sciences and techniques. Similarly, Tanzania lacks specialized laboratories and training institutions for nuclear and radiations specialists. Consequently, the country may have to incur huge costs for recruiting foreign experts if it decides to undertake a major nuclear technology programme. Therefore, it is important to develop adequate expertise in nuclear sciences and techniques.

#### **Policy objectives**

To develop and sustain optimum human resources capacities in nuclear technology

#### **Policy statements**

Policies to achieve the objectives above will include:

- i. Develop and implement development pathway for nuclear technology experts;
- ii. Promote the introduction of nuclear technology programmes in selected local technical colleges and Universities;
- iii. Create conducive environment for attracting and retaining human resource in the area of nuclear technology;

#### **3.1.7.2 Equitable participation in nuclear technology programmes**

The government has put in place policies, laws and action plans for equitable distribution of social and economic opportunities including those related to nuclear technology opportunities, education and training. However, there are still wide disparities within the population in terms of employment and training opportunities in the nuclear sector. Therefore, a need to redress these disparities.

#### **Objectives**

To eliminate all factors for inequality in the application of nuclear technology

### **Policy statements**

Policies to achieve the objective above will include:

- i. Ensure equitable access to employment and training opportunities in nuclear sciences and technology;
- ii. Reduce exposure risk to radiations for all groups in the society;

### **3.1.7.3 Environmental protection against the effect of nuclear technology application**

Human actions have been environmentally destructive, leading to concerns about sustainable development despite a number of policies formulated by the government on environment issues. Safety measures during the application of nuclear technology if not adhered to can result into environmental contamination with devastating effects on human health and biodiversity.

### **Objectives**

Protect the environment against radiations and radioactive waste contamination due to nuclear technology applications

### **Policy Statements**

Policies to achieve the objective above will include:

- i. Ensure that nuclear technology application abide to the environmental policies, laws and regulations;
- ii. Ensure regular assessment and monitoring of nuclear technology application with regard to their impact on environment;

## **4.0 INSTITUTIONAL FRAMEWORK**

The Ministry responsible for science and technology has a leading role for coordination of the implementation of this Policy. The Ministry will determine policy orientation, review the policy and prepare conducive environment for sectoral coordination and integration. This policy recognizes different sectoral policies, as they are important in achieving its objectives. The implementation of this policy will be harmonized with other sectoral policies and coordinated with the work of different stakeholders interested in the aspects being addressed by the policy.

### **4.1 Roles and responsibilities of other key stakeholders**

#### **4.1.1 Ministry responsible for national economic planning**

As strategic think-tank in managing the economy on long term basis, the institution responsible for national economic planning (currently President's Office - Planning Commission) will play a strategic role in reviewing and assessing the impact of this policy in the national development plan.

#### **4.1.2 Ministry responsible for environment protection**

In collaboration with the National Environmental Management Council (NEMC), the Ministry responsible for the environment protection will ensure that all activities using or generating ionizing radiations will be carried out in conformity with the existing laws and regulations aimed at protecting the environment.

#### **4.1.3 Ministry responsible for finance**

To ensure steady flow of fund which will facilitate the implementation of projects and programs aimed to foster the safe use of nuclear technology in various sectors of the economy.

#### **4.1.4 Ministry responsible for public service management**

The success in the implementation of this policy is dependent upon the availability of qualified and competent staff in the field of nuclear technology. This will be achieved by ensuring that there is sustainable programme for nuclear technology human resource development in the country.

#### **4.1.5 Ministry responsible for constitutional affairs and justice**

The Ministry responsible for Constitutional affairs and justice has a vital role in the implementation of this policy through reviewing and providing legal advice as well as formulation of harmonious legislations and regulations as may be required in the course of implementing of this policy. Ensure compliance to international treaties and conventions.

#### **4.1.6 Ministry responsible for education**

Has a responsibility of introducing curricula which give emphasis on training Tanzanians in nuclear science and technology at the relevant pedagogical levels.

#### **4.1.7 Ministry responsible for energy and minerals**

Promote safe mining of radioactive minerals and review the energy policy so as to include the use of nuclear technology to produce electricity

#### **4.1.8 Ministry responsible for local government**

Participate in awareness promotion and allocate resources for nuclear technology application

#### **4.1.9 Ministry responsible for health**

Expand the use of nuclear technology for diagnosis and treatment of diseases in order to improve healthcare delivery.

#### **4.1.10 Ministry responsible for agriculture**

Expand the use of nuclear technology in agriculture sector for breeding new crop varieties, introduce food irradiation in order to reduce postharvest losses and use SIT for controlling pests and diseases.

#### **4.1.11 Ministry responsible for industries and commerce**

Expand the use of nuclear technology in different industrial activities in order to boost productivity. Promote commercialization of nuclear technology produced goods and services.

#### **4.1.12 Ministry responsible for foreign affairs**

Promote strategic cooperation and collaboration in the field of nuclear science and technology

#### **4.1.13 Ministry responsible for information**

Engage in public awareness on promotion programmes of benefits, risks and safe use of nuclear technology

#### **4.1.14 Tanzania Atomic Energy Commission**

It will play as a national coordinator of all issues related to generation and application of nuclear technologies for socio-economic development. TAEC will continue to perform both regulatory and promotional roles until the current legal framework is reviewed as recommended by this Policy in order to separate the conflicting roles. Also, will continue to engage in creating public awareness on benefits, risks and safe use of nuclear technologies.

#### **4.1.15 Development partners and private sector**

Support the development and use of nuclear technology for socio-economic development as well as development of human capital required for generation and application of Nuclear Technology and Radiations.

#### **4.1.16 Civil societies**

Engage in public awareness promotion of benefit, risk and safe use of nuclear technology

**4.1.17 Learning and Research Institutions** Engage in training experts and conducting research in nuclear technology

#### **4.1.18 Tanzania Commission of Science and Technology (COSTECH)**

Engage in coordinating research and dissemination of research outcomes.

#### **4.1.19. Private sector**

Engage in commercializing nuclear technologies and providing services to the public

## **5.0 IMPLEMENTATION OF THE POLICY**

### **5.1 Structures for policy implementation**

Schedule for the implementation plan of this policy that addresses all strategies identified for each policy statement will be developed. The implementation plan will identify activities to be performed, the timeframe and the responsibilities. Principal actors in the process of implementation of the activities as earmarked in the policy strategies include the Ministry responsible for science and technology, other Ministries, Local Government Authorities (LGAs), Attorney General, TAEC and all other key stakeholders. The coordination for the implementation of this policy remains with the Ministry responsible for science and technology.

### **5.2 Policy monitoring and evaluation**

Monitoring and evaluation are essential activities to ensure that the policy is properly implemented. Simultaneously, evaluation of the extent at which the policy is being implemented as well as measuring the impact of the Policy. Therefore, there is a need to develop and implement an appropriate monitoring and evaluation programme for nuclear science and technology development and utilisation. In this context, the Ministry responsible for science and technology shall develop and implement the monitoring and evaluation framework.

### **5.3 Review and revision of the National Nuclear Technology policy**

An evaluation of the outcomes of this policy will provide information on the extent to which the policy is being implemented and the progress being made in achieving the Policy objectives. An overall policy review will be undertaken after every three years. The responsibility for the overall review is assigned to the Ministry responsible for science and technology.

## GLOSSARY

**Atom** is a basic unit of matter that consists of a dense, central nucleus surrounded by a cloud of negatively charged electrons

**Atomic energy** is the energy resulting from potential differences in the nuclear force

**Defence-in-depth** means having in place multiple, redundant and independent levels of protection

**Global warming** is the increase in the average temperature of Earth's near-surface air and oceans that causes corresponding changes in climate and may result from the greenhouse effect

**Greenhouse gas emission** is a process that produces gases responsible for loss of ability of the earth to radiate the heat it received from the sun and its interior to space or what is called global warming

**Ionizing radiation** is radiation composed of particles that individually can liberate an electron from an atom or molecule, producing *ions*, which are atoms or molecules with a net electric charge. These tend to be especially chemically reactive, and the reactivity produces the high biological damage caused per unit of energy of ionizing radiation

**Isotope Hydrology** is a field of hydrology that uses isotopic dating to estimate the age and origins of water and of movement within the hydrologic cycle. The techniques are used for water-use policy, mapping aquifers, conserving water supplies, and controlling pollution

**Non-ionizing radiation** refers to any type of electromagnetic radiation that does not carry enough energy per quantum to ionize atoms or molecules—that is, to completely remove an electron from an atom or molecule. Instead of producing charged ions when passing through matter, the electromagnetic radiation has sufficient energy only for excitation, the movement of an electron to a higher energy state. Nevertheless, different biological effects are observed for different types of non-ionizing radiation

**Nuclear energy** is energy released by the nucleus of an atom as the result of breaking up (nuclear fission), combining with another nucleus (nuclear fusion), or radioactive decay

**Nuclear power** is a type of nuclear technology involving the controlled nuclear reactions to release energy for work including propulsion, heat and the generation of electricity

**Nuclear safeguards** are measures to verify that States comply with their international (i.e. Treaty) obligations not to use nuclear materials for nuclear explosives. Global recognition of the need for such verification is reflected in the Treaty on the Non-Proliferation of Nuclear Weapons (the NPT)

**Nuclear safety** covers the actions taken to prevent nuclear and radiation accidents or to limit their consequences. This covers nuclear power plants as well as all other nuclear facilities, the transportation of nuclear materials, and the use and storage of nuclear materials for medical, power, industry, and military uses

**Nuclear science** is the study of properties and reactions nuclei of atoms

**Nuclear security** are actions relating to the prevention and detection of, and response to, theft, sabotage, unauthorized access and illegal transfer or other malicious acts involving nuclear material and other radioactive substances and their associated facilities

**Nuclear technology** is technology that involves the reactions of atomic nuclei. Like nanotechnology and biotechnology, this is a broad-based technology because it has a wide range of economic applications in various sectors of the economy: energy, transport, agriculture, medicine, industry, mining and natural resource management

**The sterile insect (SIT)** technique is a method of biological control, whereby overwhelming numbers of sterile insects are released. Insects are mostly sterilized with radiation, which might weaken the newly sterilized insects. Repeated release of insects can eventually wipe out a population, though it is often more useful to consider controlling the population rather than eradicating it. There have also been many successes in controlling species of fruit flies, most particularly the Mayfly, and the Mexican fruit fly



**Tomography** refers to imaging by sections or sectioning, through the use of any kind of penetrating wave. A device used in tomography is called a tomograph, while the image produced is a tomogram. The method is used in radiology, archaeology, biology, geophysics, oceanography, materials science, astrophysics and other sciences