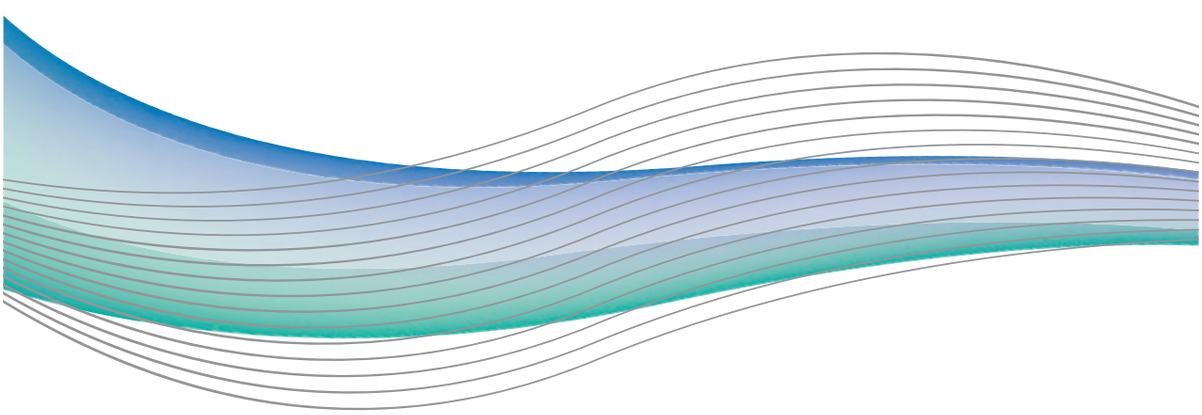
REPUBLIC OF NAMIBIA

MINISTRY OF HEALTH AND SOCIAL SERVICES

NUCLEAR SCIENCE AND TECHNOLOGY POLICY



MINISTRY OF HEALTH AND SOCIAL SERVICES

NUCLEAR SCIENCE AND TECHNOLOGY POLICY

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Compiled by: Directorate: Atomic Energy & Radiation Protection Authority
Ministry of Health and Social Services
Harvey Street
Private Bag 13198
Windhoek
Tel: +264 61 203 2417
Fax: +264 61 230 424
E-mail: aerpr@mhss.gov.na

FOREWORD

In 2012 Government commissioned the fourth National Development Plan (NDP IV) with the overarching goals to enhance economic growth, increase employment and address the current income inequality. In order to achieve these goals, the NDP-IV defines basic enablers that are necessary to stimulate and sustain economic growth. These basic enablers include institutional environment, education and skills, health, reduction of extreme poverty and public infrastructure while the economic priorities include logistics and distribution, tourism, enhancing manufacturing capability, and agriculture.

Nuclear Science and Technology has the potential to make a meaningful contribution to some of the basic enablers, most notably the institutional environment, health, education and skills which in turn will help to stimulate economic priorities such as agriculture and manufacturing capabilities. The competitive, unique and complimentary role of nuclear technology in socio-economic development is well documented. It is therefore necessary to appropriately align and place nuclear science and technology in the framework of our national developmental priorities whilst also being mindful of the potential negative effects associated with this technology.

I am pleased to note that during the third National Development Plan we have successfully enacted and introduced the legislative and institutional framework which provides for the protection of people and environment against the potential harmful effects of radiation exposure; the safe and secure utilisation of facilities and source of radiation and the safeguarding of nuclear material. We shall endeavour to improve this capacity and ensure that all the initiatives under this policy are pursued under a robust regulatory framework.

As is the case with the fourth National Development Plan, this policy will be instrumental in establishing the foundation for significant contribution to subsequent National Development Plans. I therefore call on the support and collaboration of role players identified in this policy.

Ministry of Health and Social Services
Office of the Minister

DR RICHARD NCHABI KAMWI, MP
MINISTER

PREFACE

The National Radiation Protection Policy, which was approved in 1994, culminated in the enactment of the Atomic Energy and Radiation Protection Authority (Act No 5 of 2005). Under this Act, the Ministry of Health and Social Services has established the National Radiation Protection Authority as regulatory body and the Atomic Energy Board as advisory body to Government on matters pertaining to radiation sources and nuclear energy.

The promotional and developmental aspects of nuclear technology are coordinated by the Ministry and have been limited to the technical cooperation with the International Atomic Energy Agency (IAEA). By its nature the technical cooperation with the IAEA is focusing on technology transfer and does not establish the institutional framework and capacity for the sustainable utilisation of nuclear technology in the country. Namibia does not have adequate national capacity and infrastructure to ensure that when nuclear technology is acquired, it can be used on a sustainable basis and make a positive impact in terms of developmental priorities.

The Ministry of Mines and Energy, with the contribution from this Ministry, has developed the Nuclear Fuel Cycle Policy, which takes care of nuclear and radiation safety issues, nuclear non-proliferation, nuclear power, uranium production cycle, uranium processing, spent fuel and waste management and radiological emergency response issues. By definition, this Nuclear Fuel Cycle Policy does not include areas of nuclear science and technology applications, such as in nuclear medicine, radiation therapy, radioisotope production, analytical and technical services, environmental protection, food security, food safety, crop production, water resource management, and others identified in this policy.

Therefore this policy seeks to (i) address the policy gap as described above, and (ii) facilitate the development of national capacity to conduct research, development and innovation in all nuclear science and technology disciplines within the framework of our national development priorities. Both these two objectives cut across diverse fields of application of nuclear science and technology and therefore their achievement will strengthen our capability for collaboration and networking.

I therefore wish to acknowledge and appreciate the involvement of all the partners in the development of this policy, including the Directorate: Atomic Energy & Radiation Protection, Atomic Energy Board, Directorate: Tertiary Health Care and Clinical Support Services, Ministry of Mines & Energy, Ministry of Foreign Affairs, Ministry of Agriculture, Water & Forestry, Ministry of Education, Ministry of Environment & Tourism, University of Namibia, Polytechnic of Namibia, and International Atomic Energy Agency experts.

PERMANENT SECRETARY
11 MAR 2015
Republic of Namibia
MINISTRY OF HEALTH AND SOCIAL SERVICES

MR ANDREW N. NDISHISHI
PERMANENT SECRETARY

Table of Contents

FOREWORD ii

PREFACE iii

List of Abbreviations vi

Chapter 1: INTRODUCTION 1

1.1 JUSTIFICATION 1
1.2 METHODOLOGY OF POLICY FORMULATION 2

Chapter 2: SITUATION ANALYSIS 3

2.1 BACKGROUND 3
2.2 CONCEPTUAL FRAMEWORK 3
2.3 CURRENT POLICY FRAMEWORK 4
2.3.1 National Radiation Protection Policy 4
2.3.2 Nuclear Fuel Cycle Policy 5
2.4 LEGAL FRAMEWORK. 5
2.4.1 Atomic Energy and Radiation Protection Act 5
2.5 INSTITUTIONAL FRAMEWORK 5
2.5.1 Atomic Energy Board. 5
2.5.2 National Radiation Protection Authority 6
2.5.3 Directorate: Atomic Energy and Radiation Protection Authority 6
2.6 NATIONAL DEVELOPMENT PRIORITIES and NUCLEAR TECHNOLOGY 6
2.6.1 Linkages with National Developmental Initiatives 6
2.6.2 Nuclear Science and Technology in Namibia 7
2.6.3 Nuclear Science and Technology beyond Namibia 7

Chapter 3: POLICY FRAMEWORK 8

3.1 PURPOSE OF THE POLICY. 8
3.2 SCOPE OF THE POLICY 8
3.3 STRATEGIES 9
3.3.1 Building Capacity for Nuclear Technology Support 9
3.3.2 National Education and Training Strategy 9
3.3.3 Infrastructure Development 10
3.3.4 Nuclear Medicine 10
3.3.5 Radiation Therapy 11
3.3.6 Crop Production & Soil and Water Management Techniques 11
3.3.7 Food Safety 12
3.3.8 Animal Health and Livestock Production 13
3.3.9 Water & Environmental Sustainability 13
3.3.10 Radioactive Waste Management 14
3.3.11 Nuclear Fuel Cycle 14
3.3.12 International Legal Instruments 15
3.3.13 Nuclear and Radiation Safety Regulatory Infrastructure 15
3.3.14 Radiation Protection 16
3.3.15 Partnerships 16

Chapter 4: INSTITUTIONAL FRAMEWORK FOR POLICY IMPLEMENTATION 17

4.1 STAKEHOLDERS' ROLES AND RESPONSIBILITIES 17
4.1.1 Ministry of Health and Social Services 17
4.1.2 Atomic Energy Board. 17
4.1.3 National Radiation Protection Authority 17
4.1.4 Ministry of Mines and Energy 18
4.1.5 Ministry of Environment and Tourism 18
4.1.6 Institutions of Higher Learning 18
4.1.7 Communications Regulatory Authority of Namibia (CRAN) 18
4.1.8 National Commission on Research, Science and Technology 18
4.1.9 Nuclear Science and Technology Centre 19
4.1.10 Ministry of Agriculture, Water & Forestry. 19
4.1.11 International Atomic Energy Agency. 19
4.1.12 Ministry of Trade and Industry 19
4.1.13 Ministry of Fisheries and Marine Resources 19
4.1.14 Other Bilateral Partners and Multilateral Organisation 20
4.2 NUCLEAR SCIENCE AND TECHNOLOGY INFORMATION AND NETWORKING CENTRE. 20
4.2.1 Strategic Direction of the Nuclear Science Information and Networking Centre 20
4.2.2 Purpose of the Nuclear Science Information and Networking Centre 21
4.2.3 Nuclear Science and Applications Laboratories 21

Chapter 5: POLICY ANALYSIS 23

5.1 RISK ASSESSMENT 23
5.1.1 Radiological Risk 23
5.1.2 Relevance of the Technology 23
5.1.3 Inter-Sectoral Collaboration. 23
5.2 FINANCIAL RESOURCES 23
5.3 HUMAN RESOURCES 24
5.4 TECHNICAL INFRASTRUCTURE 24

Chapter 6: IMPLEMENTATION, MONITORING AND EVALUATION 25

6.1 PROJECT DEVELOPMENT AND IMPLEMENTATION 25
6.2 MONITORING & EVALUATION 25
6.2.1 Monitoring 25
6.2.2 Performance Indicators and Evaluation 25

ANNEXURE I: PLAN OF ACTION 26

ANNEXURE II: PROPOSED FRAMEWORK FOR NUCLEAR SCIENCE AND TECHNOLOGY RESEARCH AND DEVELOPMENT INITIATIVES. 28

GLOSSARY 30

REFERENCES 32

List of Abbreviations

AEB	Atomic Energy Board
CVL	Central Veterinary Laboratory
DAERPA	Directorate: Atomic Energy & Radiation protection Authority
ELISA	Enzyme Linked Immunosorbent Assay
IAEA	International Atomic Energy Agency
MDG	Millennium Development Goal
MAWF	Ministry of Agriculture, Water & Forestry
MHSS	Ministry of Health and Social Services
MME	Ministry of Mines & Energy
MTI	Ministry of Trade & Industry
MFMR	Ministry of Fisheries & marine Resources
NDP IV	fourth National Development Plan
NPC	National Planning Commission
NPHL	National Public Health Laboratory
NFC	Nuclear Fuel Cycle
NSI	Namibian Standards Institution
NST	Nuclear Science and Technology
NRPA	National Radiation Protection Authority
PCR	Polymerase Chain Reaction
PoN	Polytechnic of Namibia
O/M/As	Offices/Ministries/Agencies
UMC	Uranium Mining Cycle
UN	United Nations
UNAM	University of Namibia
VCF	Veterinary Cordon Fence

Chapter 1: INTRODUCTION

The application of radiation-based technologies in Namibia has traditionally been confined to the use of x-ray imaging technology in the health sector, sealed sources in the road construction and mining industry; and the extraction of uranium from ores. The Ministry of Health and Social Services is cognisant of the potential of nuclear applications as a tool that can contribute meaningfully to other developmental priorities, including healthcare, food security, food safety, energy security, water security, value addition in raw products, health and safety, and environmental sustainability.

Many of the areas of nuclear science and technology in Namibia are limited in scope and mostly driven by the Technical Cooperation Programme with the International Atomic Energy Agency. By its nature the IAEA technical cooperation programme is not designed to make a large scale and sustainable contribution to the development of socio-economic priorities in the country, but merely serve as means of technology transfer. In the context of the national developmental framework this status quo needs to be reconsidered to allow for nuclear science and technology to contribute meaningfully to national development, where feasible.

The desired outcome of a nuclear science and technology programme is to ensure that it makes a larger, safe, beneficial and sustainable contribution to some of the priority areas identified in the fourth National Development Plan. Therefore a broad policy and strategic framework is necessary to stimulate and facilitate the integration and sustainable use of nuclear technology in national developmental programmes.

1.1 JUSTIFICATION

While every State has the unalienable right to have access to nuclear technology through the IAEA cooperative mechanism, it is the responsibility of every state to establish its own capabilities and infrastructure to ensure that the technology is developed, operationalised and sustainably utilised and contributes meaningfully to its developmental priorities.

The IAEA technical cooperation programme has been instrumental in assisting Namibia to introduce nuclear-based technologies in many sectors such as health, food security and safety, water resources management and energy, but significant progress has been limited due to the lack of national infrastructure to take ownership and harness the beneficial use of the technology on a sustainable manner.

The notable progress for Namibia has been in the area of developing the national regulatory infrastructure for radiation safety, which has been successfully established and operationalised. This progress was as a result of the Radiation Protection Policy of 1994, which led to the establishment of the Atomic Energy Board and National Radiation Protection Authority. However the current developments and needs have overtaken the scope and purpose of the Radiation Protection Policy, hence the need to redefine the policy framework.

Furthermore the Nuclear Fuel Cycle Policy has been developed in 2014 with the intention to provide policy guidance on the exploitation of the uranium mining cycle, nuclear fuel enrichment,

processing and production, nuclear power for electricity generation, radioactive waste and spent fuel management as well as strengthening the nuclear and radiation safety and security regulatory regime. This clearly leaves a gap in terms of addressing the non-nuclear fuel cycle activities and hence the need to establish policy guidance relating to other nuclear applications which are not addressed in the nuclear fuel cycle policy.

1.2 METHODOLOGY OF POLICY FORMULATION

The Ministry of Health and Social Services, through the Directorate: Atomic Energy & Radiation Protection Regulator, as the national focal point and coordinator of the use of nuclear technology assumed the lead in the development of this policy. The Atomic Energy Board, as advisor to Government on radiation and nuclear energy matters provided the necessary guidance and advice during the formulation of the policy.

The fourth National Development Plan (NDP IV) served as the primary guiding tool for the identification of the national needs and opportunities that may be met by deploying nuclear technology in some of these areas. Therefore the custodians of each of the priority areas listed in the NDP IV have been identified and consulted during the formulation of this policy framework.

The IAEA is the leading international organisation in nuclear science and technology with vast experience and knowledgeable in the safe and beneficial application of nuclear technology the world over. Hence the input directly from the IAEA and experts nominated by the IAEA has been an important resource in the development of this policy.

It was considered prudent to ensure that the policy is developed, understood and supported by various stakeholders that have a common purpose to realise the priorities identified in the NDP IV, both from a national developmental perspective and technological perspective.

The stakeholders were identified as the policy makers, the technical staff, national partners who may be affected and international partners who could make a contribution to the development and implementation of this policy. Policy makers have been consulted to ensure that the necessary policy direction is achieved and specifically that resources for infrastructure and human resource development will be supported. The technical experts have also been consulted in support of the policy since their capabilities and commitment would be instrumental in driving the implementation strategy forward. Lastly other partners that may be custodian of certain technologies or potential sources of funding have been identified and their expert advice has been sourced in the development of this document.

Chapter 2: SITUATION ANALYSIS

2.1 BACKGROUND

Soon after independence the Ministry of Health and Social Services assumed the responsibility of coordinating and facilitating the use of nuclear science and technology in Namibia in collaboration with local partners and the International Atomic Energy Agency (IAEA). The IAEA is an independent international organisation related to the United Nations system and the main pillars that underpin its mission are: (i) Safeguards and Verification; (ii) Nuclear Safety and Security and (iii) Nuclear Science and Technology. As a member of the IAEA, Namibia participates in all three pillars of the IAEA's scope of work.

One of the conditions prior to introducing nuclear science application is that there must be a functional regulatory infrastructure for nuclear and radiation safety and security, covering the major thematic safety areas. For this reason the Ministry has over the past ten years worked on the enactment of the Atomic Energy & Radiation Protection Act, including the establishment of the Atomic Energy Board and National Radiation Protection Authority. All these instruments are the results of the National Radiation Protection Policy, which mainly articulated Government's intent on the regulation of radiation source, radioactive and nuclear material.

A second aspect of nuclear science is nuclear non-proliferation and Namibia continues to work with the IAEA in this area to give assurance that Namibia's nuclear technology applications are meant solely for peaceful purpose only and that there is no diversion of nuclear material to non-peaceful purpose.

Thirdly, with regard to the peaceful uses of technology, the Ministry of Health and Social Services merely serves as focal point of cooperation between the Government and the IAEA. The Ministry of Health and Social Services, as foal point with the IAEA, collaborates with national partners to ensure that Namibia benefits from nuclear technology while also seeking to conform to the IAEA recommendations and standards that promote safety, security and peace. Over the past 20 years, the technical assistance provided to Namibia through the IAEA technical cooperation programmes amounted to 4.8 mil USD, which is mainly towards the health and agriculture sectors.

2.2 CONCEPTUAL FRAMEWORK

It is now more than twenty years that the Ministry of Health and Social Services is coordinating the use of nuclear technology in Namibia, but nuclear science and technology has not made a significant impact in terms of addressing social and economic challenges in the context of national development priorities. The scope of nuclear science and technology remained limited to the IAEA technical cooperation programme, which is designed mainly for the transfer of certain technologies to its Member States and thus has limitations in terms of ensuring sustainability and large scale investment in infrastructure. Even with the limited resources provided through the IAEA cooperative mechanism Namibia has not fully been able to absorb all the support. Some of the challenges that have been

recognized include the lack of educational skills or expertise, lack of institutional environment and poor infrastructure to facilitate research and development on a large and sustainable manner. If these challenges are not addressed Namibia will continue in the same cycle for the foreseeable future as was the case during the past 20 years.

Nuclear science certainly has the technological edge over other technologies in some cases, which can be successfully exploited provided the potential negative risks are managed effectively. Therefore value addition through optimization is the corner stone, that is to ensure that Namibia derives maximize benefit from the technology while minimize the hazards.

In the context of the above, it would be absolutely essential to quantify the unique value of nuclear technology in order to demonstrate that in specific cases nuclear technology is complimentary, superior and sometimes the only option to address certain national challenges. The following would be essential steps in order to achieve this: (i) to review the current status quo; (ii) analyse the needs of the customers, based on the national development plans, and therefore ensure that the policy address a high priority area; (iii) analyse the different conventional technologies in an honest and objective manner and compare this with nuclear technology in order to demonstrate its superior value; (iv) collaborate to create the necessary infrastructure and capabilities for nuclear technology and technology to add value to national priorities. Hence a policy framework to drive these processes as articulated in this document.

In the development of this concept this document provides in section 2.3 to 2.5 the current institutional framework in terms of existing policy framework, legislation and institutional capacity. Under Section 2.6 it also reflects on the national priorities in the context of the fourth National development plan and the relevance of nuclear technology. Chapter 4 provides insight in terms of the current capabilities and the aspiration in various areas of the national priorities where nuclear technology can make a contribution. Chapter 5 makes recommendations on how to improve the institutional infrastructure while Chapter 6 provides the mechanism by which collaboration can be enhanced.

2.3 CURRENT POLICY FRAMEWORK

2.3.1 National Radiation Protection Policy

The National Radiation Protection Policy was finalised in 1994 and its main purpose was to create the framework for the assessment, control and regulation of radiation hazards to the workers, public and the environment. While the policy made reference to promoting research and expanded use of nuclear sciences, its main focus was on radiation protection and matters related to it. The main objective of the policy was to facilitate the establishment of the regulatory framework, including the enactment of a law and regulations, as well as the establishment of the regulatory body and the Atomic Energy Board. This outcome has been successfully accomplished with the enactment of the Atomic Energy and Radiation Protection Act (Act No 5 of 2005) in 2005; the establishment of the Atomic Energy Board in February 2009 and the establishment of the National Radiation Protection Authority in October 2009.

2.3.2 Nuclear Fuel Cycle Policy

The Nuclear Fuel Cycle Policy stems from the Governments aspiration to investigate the potential benefits associated with the conversion and enrichment of uranium ore concentrate and the potential to develop nuclear power generation capability. The Nuclear Fuel Cycle Policy covers the full nuclear fuel cycle from uranium exploration, mining, ore processing, mine closure and rehabilitation, conversion, enrichment, fuel fabrication, nuclear power generation, radioactive waste and spent fuel management. The associated activities include transportation, handling, possession, transfers, storage, import and export of nuclear or radioactive material and sensitive nuclear technology in the nuclear fuel cycle including decommissioning of facilities and temporary cessation of activities. This policy has been finalised and approved in 2014.

2.4 LEGAL FRAMEWORK

2.4.1 Atomic Energy and Radiation Protection Act

The Atomic Energy Act was enacted in May 2005,its purpose being (i) to minimize the exposure of persons and the environment in Namibia to the effects of harmful radiation (ionising and non-ionising); (ii) to ensure that adequate control is exercised over the possession, production, processing, sale, export and import of radiation sources and nuclear material; and (iii) to create the necessary mechanisms to facilitate compliance with the obligations of Namibia under international agreements relating to nuclear energy, nuclear weapons and protection against the harmful effects of radiation. The Act further established the Atomic Energy Board and National Radiation Protection Authority. The Act, with its Radiation Protection and Waste Disposal Regulations was fully operationalised in January 2012 and is administered by the Directorate: Atomic Energy and Radiation Protection Regulator.

2.5 INSTITUTIONAL FRAMEWORK

2.5.1 Atomic Energy Board

The Atomic Energy and Radiation Protection Act established the Atomic Energy Board in February 2009 to advise Government on matters pertaining to radiation sources and nuclear energy. The Board is composed of representatives nominated by the Ministers responsible for Health, Mines & Energy, Labour, Foreign Affairs, Environment and an additional person who is competent in radiation protection matters as required by the Act. The Board does not have executive power and merely acts as an advisory body on matters relating to radiation sources, nuclear energy, nuclear non-proliferation, requirements for radiation safety and nuclear security.

2.5.2 National Radiation Protection Authority

The National Radiation Protection Authority was established pursuant to the provisions made under the Atomic Energy & Radiation Protection Act. The Director of the National Radiation Protection Authority (NRPA) is the Secretary of the Atomic Energy Board, and as such develops and provides technical advice to the Board. The NRPA is also mandated with the administration of the Atomic Energy & Radiation Protection Act, including (i) establishing programmes for the assessment and determination of risk associated with radiation exposure; and (ii) regulatory activities in accordance with the provisions of the Act; and (iii) ensuring compliance with international legal instruments in the sphere of nuclear and radiation safety.

2.5.3 Directorate: Atomic Energy and Radiation Protection Authority

The *Directorate: Atomic Energy & Radiation Protection Authority* derives its mandate from the *Atomic Energy and Radiation Protection Act (Act No 5 of 2005)*. The Act established the Atomic Energy Board and the National Radiation Protection Authority. The Act directs that the Ministry provides staff to do the work of the Atomic Energy Board while also stipulating that the National Radiation Protection Authority and its staff act independently in the exercise of the technical and scientific functions within the scope of the Act. Noting that the Act does not provide for the establishment of a juristic person, the Directorate was established for the purpose of providing the institutional framework in support of the Board and the Authority and thus functions administratively as a Directorate in the Ministry of Health and Social Services.

2.6 NATIONAL DEVELOPMENT PRIORITIES and NUCLEAR TECHNOLOGY

2.6.1 Linkages with National Developmental Initiatives

The fourth National Development Plan (NDP IV) identifies the institutional environment, education and skills, health, reducing extreme poverty and public infrastructure as basic enablers necessary to accelerate economic and social development. The economic priorities identified in the NDP IV include logistics, tourism, manufacturing and agriculture. These basic enablers and economic priorities are the pillars of the current NDP and have specifically been formulated to stimulate high and sustainable economic growth, create employment and reduce income inequality.

Radioisotope, radiation and nuclear technology have potential to meaningfully contribute to many of the basic enablers and some of the economic priorities. The applications include the following areas: health (nuclear medicine, radiation therapy; stable isotopes used in control of communicable diseases (HIV/TB, Malaria),nutrition; agriculture (crop production, animal health, water resource management); industry (manufacturing of radioisotopes, food safety, technical and analytical services); energy (uranium mining, uranium enrichment, processing, nuclear power); and sustainable environment management practices.

Nuclear technology, for example, can make a contribution in terms of developing the institutional infrastructure and particularly to enhance research, development and innovation, which is an area that has been identified as lacking in most areas of the NDP and has therefore been prioritised. Similarly education and skills development is lacking across all fields, and the same applies in as far as it relates to the successful application of nuclear technology. These two enablers are strategic areas that must be strengthened during the current NDP IV in order to strengthen and enlarge its contribution of nuclear science and technology to health and other economic priorities such as manufacturing and agriculture.

Noting that the NDP IV interventions are primarily intended to serve as the foundation for strong growth in NDP V, NDP VI and NDP VII through education, health and infrastructure interventions, the intervention of nuclear science and technology are proposed with a similar approach for future growth.

2.6.2 Nuclear Science and Technology in Namibia

The use of nuclear or radiation-based technologies in Namibia is found in the health sector (diagnostic radiology, nuclear medicine, radiation therapy), industrial applications (quality control, process control, non-destructive testing), mining (uranium mining & milling), and the use of stable isotopes in the agriculture and water sectors. Some of these applications have become a reality as a result of the technical cooperation with the International Atomic Energy Agency. It appears that historically the development of the peaceful applications of nuclear technology has been confined to the technical cooperation with the IAEA. In its current delivery mechanism, the nuclear science and technology applications in Namibia do not make significant contributions to national development goals, as they lack the required infrastructure and tools to make them meaningful and sustainable.

The expansion of the technologies highlighted above, together with the introduction of new techniques, has the potential to make a meaningful contribution to the fourth National Developmental enablers and economic priorities. Most significantly, the further development of nuclear science and technology applications could contribute meaningfully to the following areas identified in NDP IV: Research, Development & Innovation, Education & Skills, Food Safety & Food Quality, Sustainable Environment Management, Mineral Beneficiation, and Improving Access to Quality Health Care.

2.6.3 Nuclear Science and Technology beyond Namibia

Some of the IAEA member states have fully fledged nuclear science and technology programmes that have been developed with the assistance of the IAEA and subsequently implemented these technologies within their national programmes, supported by nuclear science centres. Often these countries have well developed nuclear science research and development capability, including infrastructure and human resources. For example countries like South Africa, Nigeria, Egypt, Algeria, Tanzania and Ghana all have institutions in place to promote research and development in nuclear science and technology and these seem to be faring well in some of the nuclear applications. On the contrary, other countries' nuclear science and technology programmes are dictated by the cooperation with the IAEA. These have shown to be limited in terms of their nuclear science capabilities and Namibia is one of such countries. Namibia appears to compete fairly well in as far as it concerns Nuclear Safety & Security and Safeguards & Verification. However, in as far as it concerns promotion of nuclear science and technology, Namibia is lagging behind.

Chapter 3: POLICY FRAMEWORK

3.1 PURPOSE OF THE POLICY

The overall purpose of this policy is to enhance the sustainable application of nuclear science and technology and enlarge its contribution to the national developmental priorities with the following specific objectives:

i Facilitate the development of capabilities and infrastructure under which the contribution of nuclear science and technology can be accelerated and enlarged as a complementary tool to attain some of the priority areas identified in the National Developmental Plans

ii Strengthen research, innovation and development capacities in nuclear science and technology to address agricultural productivity and food security, food safety, improvement of human health, water resource management; manufacturing capabilities, technical and analytical services, sustainable environmental management, management of the marine and terrestrial environments and industrial applications using radioisotopes and radiation technology

iii Provide for the interfacing between the governments, institutions of higher learning, industry, international organisations, bilateral partners on all matters related to planning, programming, programme implementation, monitoring and evaluation of nuclear science projects

3.2 SCOPE OF THE POLICY

The Nuclear Fuel Cycle Policy has been formulated to provide policy guidance in terms of activities related to mining, processing and use of uranium ore products in Namibia and matters incidental to it. The Nuclear Fuel Cycle Policy also takes into account nuclear safety, radiation safety, radiation protection and radioactive waste management, which are also applicable to non-nuclear fuel cycle activities.

Noting that the Nuclear Fuel Cycle Policy is silent on matters beyond its scope, this policy is formulated to provide policy guidance on activities outside of the nuclear fuel cycle, which include the following: diagnostic radiology, nuclear medicine, radiation therapy, use of nuclear techniques to achieve MDGs, crop production, irradiation technologies for research and quality improvement, calibration services, isotope production, education and training in nuclear science and technology, research in all the applications of nuclear science and technology, water resource management and pollution studies.

3.3 STRATEGIES

3.3.1 Building Capacity for Nuclear Technology Support

Human Resource Development
Human resource capacity is a critical component to initiate and sustain growth in any sector of the social and economic development, including in nuclear science and technology. It is recognised in the NDP IV as an area which is lacking in all the sectors, especially the capacity to research, innovate and adopt new technologies. It is equally the case in nuclear science and technology as evidenced in the history of the technical cooperation programme with the International Atomic Energy Agency. The human resource skills and capacity continues to be of very low capacity and not able to sustain the successful introduction and implementation of nuclear technology based projects.

Objective
To build human resources capacity in order to support the research work, developmental initiatives and innovation in nuclear science and technology in line with the priority areas identified in the NDPs.

Promoting Human Resources as a Building Block for Growth in Nuclear Science and Technology
The Ministry, cooperation with the line O/M/A, shall facilitate the assessment of baseline information, identify the human resources gaps and needs in each area of nuclear science and technology and collectively propose a human resource plan.

3.3.2 National Education and Training Strategy

As is the case with most developmental initiatives, education and training is an important backbone and catalyst for the development of nuclear science and technology. Nuclear science and technology has great potential to contribute meaningfully to most of the national developmental priorities if it is natured with the appropriate educational and training framework.

For long Namibia has relied on the support of the IAEA for training of specialists and skills development in support of nuclear based technologies in Namibia. This has become inadequate and largely contributed to the poor performance of these projects. This may therefore be addressed by developing the national capacity for education and skills development in the following areas: nuclear & radiation safety, nuclear engineering, reactor physics, medical physics, radiography (nuclear medicine and radiation therapy), agriculture research, radiation therapy and nuclear medicine specialist and law enforcement.

Objective
To develop the technical expertise and skills for the successful and sustainable delivery of nuclear science and technology programmes and projects

Enhancement of National Competencies and Skills in Nuclear Science and Technology
The Ministry shall facilitate and coordinate with stakeholders to ensure that a strategy for education and training in nuclear science and technology is developed and implemented. The strategy shall take into account the national needs based on the implementation of the Nuclear Fuel Cycle Policy and Nuclear Science & Technology Policy.

3.3.3 Infrastructure Development

Second to human resource capacity is the lack of physical infrastructure to stimulate the development of nuclear science and technology. There are many nuclear technologies from which Namibia stands to benefit if these are introduced and sustained locally, but the physical infrastructure is often lacking. Equally many professional within O/M/A have been sensitised to the technology and its benefits, but the overall framework to support the development of infrastructure is lacking. There is therefore need to work together with O/M/A to identify projects, assess the feasibility of the technology to address the challenges and to jointly collaborate in building the necessary infrastructure that will enhance research, development and innovation in many of the priority areas identified in the NDPs.

Objective
To create the physical infrastructure through which nuclear technology can contribute meaningfully to development, research and innovation in the context of the priorities identified in the National Developmental Plans.

Infrastructure Development for Nuclear Technology Support
The Ministry shall collaborate with relevant O/M/A to identify priority areas where nuclear technology can make a meaningful role, quantify the challenges and jointly work on feasibility studies for project development along the lines proposed in Annexure II.

HUMAN HEALTH
One of the objectives of Vision 2030 is to build a healthy, food-secure and breastfeeding nation, in which all preventable, infectious and parasitic diseases are under secure control and in which people enjoy a high standard of living, with access to quality health care. While the control of communicable diseases continues to be of high priority to the Ministry, both the morbidity and mortality rates due to non-communicable disease are increasingly coming under the spotlight with cancer becoming a major global health problem. As of the year 2011 the average morbidity rate due to cancer is 2454 per 100 000 while the mortality rate is 219 per 100 000 of the population. Cancer control is addressed by various stakeholders through preventative measures, early detection, diagnosis and rehabilitation. Nuclear medicine and radiation therapy are established and proven nuclear technologies that offer competitive options in terms of the diagnosis of many diseases and management of cancer conditions.

3.3.4 Nuclear Medicine

Nuclear medicine is an alternative and complimentary diagnostic tool that has the potential to uniquely provide diagnostic capability as a functional technique as opposed to other morphological techniques. This specialist discipline should be placed at the centre of the public health systems of Namibia and therefore relevance and applicability should be considered within the broader context of delivering quality health care at all levels, especially at referral hospitals.

As of January 2013, there were three nuclear medicine facilities in Namibia. These include one in the private sector, one at the Windhoek Central Hospital and a third nuclear medicine facility at the Intermediate Hospital Oshakati. Currently about 4000 studies are performed at these facilities per annum and mostly, these studies include investigations involving thyroid scans, bone scans, hepatobiliary and ventilation perfusion scans.

Objective
To introduce, strengthen and maintain diagnostic and therapeutic capability using radiopharmaceuticals in major health care facilities in order to improve quality of health care and increase accessibility

Nuclear Medicine as a Complimentary Diagnostic Tool in the Health Care System
The Ministry shall introduce nuclear medicine services at medical facilities based on research findings in terms of the potential impact on health care delivery; its relevance and competitiveness of nuclear medicine in relation to other technologies. The current and desired capabilities as well as the strategy to address the gaps with reference to institutional capability, infrastructure, technology and human resource capabilities shall provide further guidance in the implementation of this policy.

3.3.5 Radiation Therapy

Combined with surgery and oncology, therapeutic uses of radioisotopes and radiation generating beams provide a unique and complementary technique for the treatment of cancer conditions. As of January 2013, there was one radiation therapy facility at the Windhoek Central Hospital while an additional facility at Intermediate Hospital Oshakati was under consideration. It is estimated that there is currently an incidence rate of 2000 cancer cases per year while the treatment capability is only 500 patients per year. Furthermore the technology is not being exploited to the fullest with the current capability being limited to treatment with Cobalt-60 and high doserate brachytherapy, respectively. There are still patients that are referred abroad, others have to wait for up to three months before treatment and some have to travel for up to 800 km to access the services.

Objective
To improve, maintain and where appropriate, introduce new radiation therapy services at major health care facilities in order to enhance quality of health care and improve access to health care services.

Radiation Therapy as a Complimentary Tool in the Cancer Control Programme
The Ministry shall strengthen the current capacity and introduce new radiation therapy services within the context of a national cancer control programme, based on the identified gaps with due regard to disease burden. Infrastructural capacity, institutional capability, technological relevance, relevant treatment modalities and human resources capacity and expertise shall be investigated and inform the further implementation of this policy.

AGRICULTURE AND FOOD SECURITY
The Government considers agriculture as a strategic sector because of its growth and employment-generation potential with a large portion of the population depending on agriculture for their livelihoods. Some of the identified challenges in this sector include insufficient food security, weather misfortunes and lack of access to markets for livestock above the Veterinary Cordon Fence (VCF). Nuclear technologies have a unique and complimentary role to play in terms of producing more, better and safer food, while also promoting the sustainable use of agricultural resources.

3.3.6 Crop Production & Soil and Water Management Techniques

The NDP IV highlights food security as a key priority in the agriculture sector and also proposed various measures to overcome the challenges as a means of becoming self-sufficient. Some of these challenges include floods and droughts, and wildlife such as mammals, birds and other pests that destroy crops.

Nuclear techniques have a complimentary role in the following areas relating to food security: (i) improving the yield of crops; (ii) developing crop varieties that are resistant to disease, drought and salinity; (iii) developing techniques that can help to optimise the management of soils in terms of efficient nutrient and water utilisation; and (iv) suppressing or eradicating insects such as fruit flies, screw worm flies, etc.

Some research work is currently in progress to improve crop varieties in Northern Namibia and there are already positive indications that this technology could be successful. Therefore options should be considered to expand this technology and also to consider the introduction of other new nuclear technologies highlighted above.

Objective
To adapt, adopt and apply nuclear based technologies to improve crop production, develop crops that are resistant to diseases, drought and salinity, and to improve efficient resources (water, fertiliser, soil) in crop production

Promoting the Use of Irradiation Technologies for Food Security
The Ministry, in cooperation with the Ministry of Agriculture, Water and Forestry, shall facilitate the creation of the necessary nuclear based institutional framework and research capability for the use of nuclear and isotopic methodologies to enhance crop production including: molecular analysis, finger printing and DNA profiling and irradiation of seeds.

3.3.7 Food Safety

The Ministry as custodian of health has the mandate to control the manufacture, sale, import and export of food, and to guarantee the safety of food as articulated in its Food Safety Bill. Contaminants in the food chain pose a potential threat to human health and could also be a threat to the export markets. Therefore ensuring the safety and quality of food has become an important element for international trade and protection of the local consumer.
At the technical level National Standards Institute (NSI) and the National Public Health Laboratory (NHPL) provides the networking mechanism for analytical work relating to food safety. Among the many analytical methodologies nuclear applications and isotopic techniques provide a unique option for food traceability and quality assurance which could compliment and support the efforts of the NSI and the NHPL.
In addition to analytical tools, post-harvest application of food irradiation can also be used to destroy microorganisms that carry diseases in food, thereby reducing food safety risks and extending the shelf life of foods. [IAEA]

Objective
To complement the national efforts in food safety by applying nuclear applications and isotopic techniques to detect, monitor and control contaminants for the purpose of identifying and implementing corrective actions.

Deploying Nuclear Analytical and Irradiation Techniques in the Food Supply Chain
The Ministry shall investigate the feasibility of introducing nuclear analytical techniques and irradiation technologies in the food chain and if feasible establish the technical infrastructure and capability for the use of radioisotopes as tracer to investigate food contaminant, irradiate food and to improve laboratory management and control programmes.

3.3.8 Animal Health and Livestock Production

Livestock farming is an important source of animal based food products and income, thus contributing substantially to national food security and the economy. Some of the strategies adopted in the NDP IV to address food security are to increase livestock production and to improve access to markets for livestock for famers above the Veterinary Cordon Fence (VCF).

The Ministry of Agriculture, Water and Forestry, through its Central Veterinary Laboratory (CVL), has successfully introduced nuclear techniques such as Polymerase Chain Reaction (PCR) and Enzyme Linked Immunosorbent Assay (ELISA) to diagnose major animal diseases, which has been critical in controlling diseases, which may limit productivity and trade. In addition to animal health nuclear techniques also play an important role in the management of animal nutrition, reproduction and breeding. The institutional and technical infrastructure of the CVL is reasonably responsive to adapt and adopt these technologies and should therefore be supported.

Objective
To assist in the integration of isotopic techniques for optimised livestock productivity such as development of appropriate selection criteria for genetically improved livestock, improving animal nutrition, improved animal reproduction, and to strengthen the capability for diagnosis and control of major endemic animal diseases.

Isotopic Techniques as Complimentary Tool for Diagnosis of Animal Diseases and Production of Livestock
The Ministry shall provide the necessary technological advice to the Ministry of Agriculture, Water and Forestry to ensure that the available isotopic techniques are investigated and integrated into the strategies to improve productivity, reproductive efficiency and diagnosis of animal diseases.

3.3.9 Water & Environmental Sustainability

The NDP IV accords environmental protection high priority, both as an enabler and driver of economic development. This stems from the State Principle articulated in the Namibian Constitution which states that *we must maintain our ecosystems, essential ecological processes and biological diversity of Namibia and utilize our living natural resources in a sustainable manner for the benefit of all Namibians, both present and future.* This principle is firmly anchored in the Environment Management Act, which further embodies various principles of environmental management.

The NDP IV identifies the following as environmental challenges in Namibia: freshwater scarcity, land degradation, deforestation, unsustainable use of coastal and marine resources, and vulnerability to climate change. Nuclear technology is an option that helps to enrich the understanding and management of water resources and the environment, including the use of radiotracers and nuclear techniques in the following areas: studies to assess the flow, discharge, recharge mechanism and quality of ground water; evaluation of soil degradation and soil losses and to assess the effectiveness of soil and water conservation strategies in retaining water and applied nutrition for food production; measurement of environmental radioactivity and tracking of heavy metals and pollutants in the marine environment and foodstuff; and measurement of air borne particulates for air pollution studies.

Objective
To introduce and facilitate the application of nuclear techniques in the assessment of activities which may have significant effects on the environment or the natural resources in the overall interest to promote sustainable use of natural resources.

Nuclear Techniques as a Tool for Preservation and Sustainable Use of the Environment
The Ministry shall ensure that the national capacity in terms of infrastructure and use of nuclear technology is in place for the assessment of activities which may have significant effects on the environment using radiation-based technology, with due consideration to the national mandates and expertise of various Ministries and Agencies.

3.3.10 Radioactive Waste Management

As a principle of radioactive waste management, the waste generator is responsible for the management of radioactive waste on its site, which is currently enforced under the framework of the Atomic Energy & Radiation Protection Act. The State has the responsibility to ensure that an institutional infrastructure is in place for the safe and secure management of radioactive waste, especially radioactive waste that are not under regulatory control or that which needs to be disposed of. Most of the radioactive waste cannot be disposed of unless these have decayed to be below levels that are acceptable for conventional disposal. Other radioactive wastes have long half-lives making it unsafe to dispose of conventionally. This underscores the need for a centralised waste storage facility to be established for the management of radioactive waste from facilities and radioactive waste that are not under regulatory control.

Objective
To ensure that radioactive waste is managed in such a manner as to secure an acceptable level of protection for human health, protection of the environment with due regard to impacts on the health of current and future generations.

Protecting Current and Future Generations against the Harmful Nuclear Waste
The Ministry shall establish the operational framework and institutional capacity to ensure that radioactive waste is safely and securely managed, including the construction and management of a central waste management facility to ensure that the current and future generations are adequately protected against the harmful consequences of radioactive waste.

3.3.11 Nuclear Fuel Cycle

The Ministry of Mines & Energy led the development of the national policy that articulates Government's intent on both the regulatory and promotional aspects relating to the nuclear fuel cycle activities. The policy articulates Government's intent on the establishment of a single regulatory authority for nuclear and radiation safety and security, nuclear-non-proliferation, uranium production cycle, further processing of uranium, electricity production through nuclear power, international legal instruments, nuclear waste management and nuclear emergency response.
While the policy makes Government policy clear on its intention, there still remains the need to conduct investigations for the purpose of providing authoritative advice and making appropriate recommendations that will assist Government to make informed decisions about the implementation of some of the themes identified in the policy.

Objective
To conduct research and advice Government on the appropriate measures to adopt in relation to the nuclear fuel cycle, including nuclear energy technology appropriate for Namibia and related economics, national infrastructure and human resource development

Beneficial, Safe and Secure Exploitation of the Nuclear Fuel Cycle
The Ministry of Health and Social Services shall assume full responsibility for the implementation of the themes within its mandate and as assigned in the Nuclear Fuel Cycle Policy. It shall further provide the technical advice, through research when and as requested, in terms of the technological advances and options relating to the implementation of the nuclear fuel cycle policy.

3.3.12 International Legal Instruments

Article 96 of the Constitution encourages the State to ensure that in its international relations it promotes amongst others (i) international cooperation, peace and security; and (ii) foster respect for international law and treaty obligations. There are twenty international agreements relating to nuclear energy, nuclear weapons and protection against the harmful effects of radiation, which may be of relevance and benefit to Namibia's nuclear science and technology programme. These may be considered within overall spirit and letter of the Constitution of the Republic in cooperation and in consultation with the relevant parties.

Objective
To promote international cooperation in the area of nuclear science and technology in such a manner that accession and ratification of international agreements contribute to the attainment of the principles articulated in the Constitution of the Republic and in alignment with its vision and national developmental priorities.

Promotion of International Peace, Security and Respect for International Law
The Ministry shall facilitate consultation and coordinate the accession to and adherence to international agreements within the scope of nuclear science and technology, only if these are demonstrated to be in the interest of the Nation.

3.3.13 Nuclear and Radiation Safety Regulatory Infrastructure

The presence and use of radiation sources, radioactive/nuclear material and nuclear applications has become common and continues to grow as the beneficial applications become more useful for development. While the promotion and development of these applications is justified, they equally demand a responsive framework to ensure that the health and environmental risks be quantified, and appropriate measures instituted for the adequate protection and safety against the potential harmful effect associated with these risks. This current framework includes the Atomic Energy & Radiation Protection Act which provides for the institutional and operational framework to achieve and maintain a high level of radiation safety, protection, nuclear security and safeguarding of nuclear material. It is however essential that the regulatory infrastructure and institutional capacity continues to adapt and improve to be responsive to the changing environment. This regulatory framework also recognises the importance of the use of sources of non-ionising radiation and the emerging health threats that are associated with the use of devices that emit non-ionising radiation.

Objective
To maintain a high level performance in terms of health, protection, safety and security by regulating, monitoring and controlling all nuclear and radiation-based technologies and practices, including sources of ionising and non-ionising radiation.

Protecting People and the Environment against Harmful Effects of Radiation Exposure
The Ministry shall pursue the establishment of a single, independent Nuclear and Radiation Safety Regulatory Authority with adequate technical competencies and resources, consistent with international standards and recommendations, taking into account the scope, nature and extent of nuclear or radiation based technologies in Namibia.

3.3.14 Radiation Protection

The occurrence of natural and man-made sources of radiation exposure is common, wide-spread and in varying magnitudes and may be of notable health concern if it is above recommended levels. There are two key technical areas that should be developed in order to provide a fair comparative analysis of the hazards and associated health effects or environmental impact for the purpose of appropriately prioritising it as a public health issues or environmental concern. These include assessment of the physical quantities relating to radiation and the biological effects associated with ionising and non-ionising radiation exposure

Objective
To establish the extent of occurrence of radiation exposure in all spheres of lives in terms of physical quantities and provide comparative analysis for decision making. Under this programme the objective will also be to determine the health impact due to exposure from ionising and non-ionising radiation among the general population and workers in selected areas with a view to adopting appropriate intervention measures.

Establishing the Extend and Magnitude of Harmful Radiation Exposure in Namibia
The Ministry shall strengthen the institutional and technical capacity for the assessment, monitoring and quantification of the physical quantities and biological effects associated with radiation (ionising & non-ionising radiation) exposure in order to provide mitigatory measures where necessary.

3.3.15 Partnerships

Leveraging on the experiences of others and the sharing of information allows collaborators to optimise the use of available resources and key strengths. This is a strategic option that should be considered at bilateral or multilateral level with other nations and international organisations based on mutual benefits with Namibia, participating as an equal partner and deriving measureable benefit from its participation in such agreements. These may include exchange of human resources, joint training programmes and facilities, developing infrastructure, joints projects, sharing of technical information and infrastructure

Objective
To establish contact for information exchange, sharing of experience and optimising the use of resources and streamlining of roles and responsibilities amongst partners at national, regional and international levels, in the application of the peaceful uses of nuclear technology in Namibia.

Building Partnership for Technical Cooperation
The Ministry shall serve as the focal point on all matters pertaining to nuclear science and technology and facilitate the coordination of all initiatives in Namibia and beyond, particularly those undertakings that are within the scope of this policy.

Chapter 4: INSTITUTIONAL FRAMEWORK FOR POLICY IMPLEMENTATION

4.1 STAKEHOLDERS' ROLES AND RESPONSIBILITIES

This policy calls for robust partnership and networking mechanisms as a foundation for strengthening and enlarging the contribution of nuclear science and technology to national development. For its success it is imperative that the roles and responsibilities of the collaborating partners are unambiguous and appropriate to each institution. These are illustrated schematically below, with a brief role of the scope of involvement of each of the stakeholders in the implementation of this policy.

4.1.1 Ministry of Health and Social Services

The Ministry takes full ownership of this policy and shall provide the overall guidance in its implementation and also lead resource mobilisation initiatives. This oversight shall include financial resources, infrastructure development and human resource development, establishment of cooperative arrangement and seeking Government support in the implementation of this policy.

4.1.2 Atomic Energy Board

The Atomic Energy Board is established pursuant to Section 3 of the Atomic Energy & Radiation Protect Act and serves as an advisory body to Government on all matters pertaining to nuclear and radiation matters. It has the responsibility to set standards, develop regulations while also mandated to provide advice on the peaceful applications of nuclear technology. In this regard the Board shall assume responsibility to consult broadly and advise the Ministry on the appropriateness of the policy and how best to implement it, including matters relating to financial resource mobilisation, infrastructure development, human resource development, partnership building, monitoring and evaluation of implementation of this policy.

4.1.3 National Radiation Protection Authority

The Authority is established pursuant to Section 33 of the Atomic Energy & Radiation Protect Act and is primarily tasked with the regulation, monitoring and controlling of the facilities and practices involving nuclear or radiation based technologies. The Authority shall take full responsibility for the implementation of the policy statement as articulated under Section 3.3.10 of this policy. In the performance of its work, it shall involve all the relevant and potentially affected O/M/As in as far as it concerns this policy statement, including the Office of the President, Ministries of Ministry of Mines & Energy, Safety & Security, Environment & Tourism, Foreign Affairs, Labour & Social Welfare, and Health & Social Services.

4.1.4 Ministry of Mines and Energy

The Ministry of Mines and Energy has the responsibility of developing and implementing the Nuclear Fuel Cycle Policy and shall be responsible for the policy statement in Section 3.3.8 of this policy. The regulatory aspect of the Nuclear Fuel Cycle Policy shall be as assigned in that policy whilst the promotional aspect of the Nuclear Fuel Cycle Policy shall be led by the Ministry of Mines and Energy.

4.1.5 Ministry of Environment and Tourism

The Ministry has the mandate to promote the sustainable management of the environment and the use of natural resources. It shall therefore exercise overall oversight in terms of managing the environmental impacts that may arise during the implementation of this policy as provided for under the Environment Management Act.

4.1.6 Institutions of Higher Learning

The institutions of higher learning, including the University of Namibia and Polytechnic of Namibia, shall take responsibility for the production of human resources skills in support of the implementation of this policy and the Nuclear Fuel Cycle Policy. This shall include the development and delivery of relevant undergraduate curricula and postgraduate educational programmes that will serve to stimulate research, development and innovation in nuclear science and technology.

4.1.7 Communications Regulatory Authority of Namibia (CRAN)

The Communications Act, 2009 (Act 8 of 2009) established the Communications Regulatory Authority of Namibia (CRAN) to regulate the communications industry in Namibia. The scope of application of this Act includes device that emit electromagnetic frequency radiation and how these may be deployed beneficially for the advancement of society. The Atomic Energy & Radiation Protect Act also regulates sources of electromagnetic radiation and in particular the monitoring and control of the associated health impacts. In this connect the CRAN and the National Radiation Protection Authority shall collaborate to ensure that the use of sources of electromagnetic radiation is optimized, that is to promote the beneficial use thereof and minimizing the harmful effects.

4.1.8 National Commission on Research, Science and Technology

The Research, Science and Technology Act, 2004 (Act No. 23 of 2004) provides for the promotion, co-ordination and development of research, science and technology in Namibia. The Act has established the National Commission on Research, Science and Technology which amongst others facilitates, coordinates, monitor and supervise the promotion and development of research, science and technology in all sectors in Namibia, and to minimize overlapping in the fields of research, science and technology. This policy therefore recognizes the role of the Commission and undertakes to work closely with the Commission for the advancement of nuclear science and technology within the framework of the Research, Science and Technology Act.

4.1.9 Nuclear Science and Technology Centre

The Nuclear Science Centre shall serve as a national focal point of networking and collaboration in nuclear science and technology. This centre shall provide technical expertise and advice, infrastructure support, and promote training, research and development in all areas of nuclear science and technology in collaboration with all stakeholders.

4.1.10 Ministry of Agriculture, Water & Forestry

The Ministry shall take responsibility for the development of its strategic areas such as crop production, animal health, animal production, water resources management, food safety and food security as defined in the national development plans. In support of the nuclear science and technology programme, the Ministry shall make its human resource expertise and infrastructures available, to ensure that the optimal utilisation of resources is achieved in the interest of attaining the desired outcomes under this policy.

4.1.11 International Atomic Energy Agency

The International Atomic Energy Agency, as the major international collaborator, shall provide technical advice and support through its technical cooperation programme with Namibia in the implementation of this policy. This collaboration shall be defined in the Country Programme Framework, which is agreed by the two parties and the focus shall be on technology transfer, including provision of expert services, equipment, fellowships and scientific visits.

4.1.12 Ministry of Trade and Industry

The Industrial Policy articulates Namibia's intentions to enlarge the contribution of the manufacturing and services sectors to the Gross Domestic Product (GDP) and at the same time to transform the country to an exporter of processed goods. In the context of the Industrial Policy, the Ministry of Trade and Industry shall assist the implementers to ensure that where feasible nuclear technology can make a meaningful contribution towards the industrial and economic sector development.

4.1.13 Ministry of Fisheries and Marine Resources

The Ministry of Fisheries and Marine Resources has the responsibility to ensure that responsible utilisation, protection and promotion of marine resources on a sustainable basis. Nuclear techniques have an important role to play in understanding the aquatic environment, making it possible to map changes, monitor current conditions and predict future trends. At the same time the aquatic environment may be at risk of radionuclide contamination which may threaten the marine resources. Hence the Ministry of Fisheries and Marine Resources shall cooperate with the promoters and implementers of this policy to ensure that nuclear techniques contribute meaningfully to preservation of the marine resources.

4.1.14 Other Bilateral Partners and Multilateral Organisation

The development of the nuclear science and technology programme is dependent on strong relations with partners who have the technology and may also provide resources in the implementation of key aspects of this policy. Their roles and responsibilities shall be clearly defined in cooperative agreements, which shall be formulated such that they serve the interests of Namibia, while also satisfying the wishes of its partners within acceptable constitutional boundaries.

4.2 NUCLEAR SCIENCE AND TECHNOLOGY INFORMATION AND NETWORKING CENTRE

The establishment of sound technical and institutional infrastructure in nuclear science is essential and indeed a pre-requisite for the successful implementation of this policy. At present there is some capacity in the areas of radiation safety, crop production, water resources management, analytical services and in the health sectors. However this capacity is not optimally utilised in that acquisition of resources and execution of functions are being duplicated by stakeholder in many cases. In other cases the stakeholders have stated their intention to establish new capabilities without the necessary consultation which may lead to further duplication and overlapping in functions. This current trend is perpetuating 'silos' among stakeholders with similar objectives and functions, which may not be in the best interest of the country.

In light of the above an institutional infrastructure and mechanism should therefore be created to enhance access to nuclear information from all sectors, educate stakeholders on the beneficial and safe uses of nuclear technology; and to facilitate networking among the stakeholders for the optimal utilisation of all resources and expertise relating to nuclear science and technology in the country. Such infrastructure and networking mechanism would be highly dependent on technical services supported by a core number of qualified and skilled technical and professional cadres.

Therefore the Ministry shall establish a Nuclear Science Information and Networking Centre with the objective to serve as focal point for information, education, training and research work in all areas within the scope of the mandate of this policy and in collaboration with all the stakeholders. Therefore the strategic direction of the Centre shall be as follow:

4.2.1 Strategic Direction of the Nuclear Science Information and Networking Centre

I Vision:
A vibrant, innovative and competitive nuclear industry based on local initiatives responding to national needs and thereby contributing maximally and meaningfully towards key national developmental and Vision 2030 goals.

II Mission
Promote research in nuclear sciences and enhancing the development of nuclear techniques among stakeholders by creating the enabling and operational framework through the nuclear science and technology centre.

4.2.2 Purpose of the Nuclear Science Information and Networking Centre

The purpose of the Centre is to:

i *strengthen the national research and development capacities* to address agricultural productivity and food security, food safety, improvement of human health, increase availability of water resources, management of the marine and terrestrial environments and industrial applications using radioisotopes and radiation technology

ii *serve as the principal focal point of technical advice to the Government*, through the Atomic Energy Board, on all matters pertaining to the beneficial application of nuclear technology for the integration of these into national developmental plans

iii *ensure that benefits of nuclear applications are known and understood* by relevant sectoral units of government, universities and scientific institutions, and end-users

iv *serve as a resource centre for knowledge about nuclear applications* and advise on the appropriate technological advances, innovations and feasibility of nuclear related projects in the context of National Developmental Plans

v *serve as the interface between the Government O/M/As*, Institutions Of Higher Learning, Industry, International Organisations, UN Agencies, Bilateral Partners on all matters related to planning, programming, programme implementation, monitoring and evaluation of nuclear science projects

vi *provide technical backstopping to O/M/As* using nuclear techniques in their programmes, as well as to support institutions of higher learning and industry with emphasis on project management, analytical services, calibration services, irradiation services, and capacity building

4.2.3 Nuclear Science and Applications Laboratories

With due consideration to the role and functions of the National Public Health Laboratory and other existing technical capability relating to nuclear science and technology, the Centre shall introduce new technologies and where appropriate strengthen existing ones with a focus on: (i) applied research and development; (ii) training and capacity building; and (iii) technical and analytical services. The role of the Centre shall ultimately be able to ensure that the objectives of this policy are fulfilled and where viable, ensure that the following technical capabilities are in place:

i **Irradiation Technologies:** Use of gamma radiation, electron beam and x-ray technology for various applications such as sterilization of medical products, disinfestations of food grains, and irradiation of food products;

ii **Food and Environmental Protection:** facilitates compliance with regulatory guidelines for international markets through provision of methodologies for determining veterinary drug and pesticide residues, study of non-nuclear contaminants in foodstuff, and use radioisotopes and isotopes as environmental tracers;

iii **Nuclear Spectrometry and Dosimetry:** Enhance the use of nuclear instrumentation and nuclear spectrometry based analytical techniques in environmental pollution monitoring and other applications; assessment of physical qualities in radiation protection and environmental monitoring;

iv **Insect Pest Control:** develop environmentally friendly methods of pest control (e.g. sterile insect technique) for area wide control of identified pests;

v **Animal Production and Health:** Strengthens the productivity of indigenous and exotic livestock breeds through genetic characterisation and disease diagnosis;

vi **Soil and Water Management and Crop Nutrition:** Develop methodologies for the cost effective optimisation of water and fertiliser usage;

vii **Plant Breeding and Genetics:** Focus on radiation induction and 'fingerprinting' of novel plant varieties with improved yield and hardiness under local conditions, such as disease resistance, salinity and drought tolerance;

viii **Production of Radioisotopes and Radiation Technology:** Facilitate the development of technologies for the supply of radiopharmaceuticals such as Molybdenum-99 and Technetium-99m for local use and possible export market;

ix **Radiation Medicine Technology:** investigate advanced technology options for the management of cancer conditions

x **Dosimetry:** quantify the physical and biological effects of radiation exposure and assess the risk on human health and to the environment

Chapter 5: POLICY ANALYSIS

5.1 RISK ASSESSMENT

5.1.1 Radiological Risk

The policy seeks to strengthen and enlarge the contribution of nuclear science and technology to the national developmental programmes. With this initiative it is inevitable that the use of radiation technology, specifically, the use of radioactive material, may increase. This presents a foremost challenge with the management of radioactive waste, which often requires long-term storage of the radioactive waste. This risk will be managed in accordance with the policy positions articulated in Sections 3.3.7 and 3.3.10 of this document. These include the establishment of the regulatory capacity and institutional capacity to ensure that all radioactive waste is safely and securely managed.

5.1.2 Relevance of the Technology

The identified challenges and strategic areas in the National Developmental Plans served as important elements that shaped the formulation of this policy. Importantly the current National Development Plan is intended to serve as a foundation for strong growth in the subsequent development plans. This policy is developed with a similar approach in mind to ensure that it remains relevant and meaningful to the national developmental priorities as we address Vision 2030. Therefore the key strategic areas for this policy are infrastructure and human resources development, without which, attainment of the overall objective would remain evasive.

5.1.3 Inter-Sectoral Collaboration

The policy is intended to provide a clearer role of nuclear technology in support of a number of some strategic areas identified in the National Development Plan. These strategic areas are owned by other Ministries and role players and therefore, the role of this policy is intended to be complimentary and unique in each of the strategic areas. In order to minimise duplication and avoid gaps, strong networking capabilities are emphasised in this policy in order to streamline or enhance integration.

5.2 FINANCIAL RESOURCES

The development of this policy is pursued under the fourth National Development Plan and the subsequent development plans, and has the potential to contribute meaningfully to the following priority areas: institutional environment, health, skills and education. Research, development and innovation are areas that have been identified as challenges in most priority areas of the NDP IV. In this context, this policy is formulated with a strong emphasis on research, development and innovation to support many of the aforesaid priority areas. Therefore, it is expected that the Government will

support this initiative through development funds to establish the required infrastructure and technical capabilities. Furthermore, a project proposal will be submitted to the National Planning Commission, which would include the options for the development of infrastructure, procurement of equipment and development of human resources. The initial phase may include the setting up of office and laboratory space and subsequent project proposals will address specific projects under this policy, provided these are viable.

5.3 HUMAN RESOURCES

Human resources are is a key deliverable for the successful implementation of this policy. As is the case with the physical infrastructure and equipment, there exists limited technical skills and expertise in the identified areas of nuclear technology. There is a need to provide the infrastructure and networking capability to ensure that these skills are optimally utilised. There is also the need to increase the number of skills and expertise in many of the areas of nuclear science and technology. This would require funding the training of available and new employees within the various Ministries and agencies to acquire the technological expertise to carry out the functions within the scope of this policy. Having developed a core number of skilled employees, these will be deployed for the local production of skills, research and development activities. As part of the initiatives under this policy an education and training strategy will be developed based on evaluation of skills available and required to determine the needs and the gaps, and propose the options to ensure that the human resources capacity is available and fully capable to implement this policy.

5.4 TECHNICAL INFRASTRUCTURE

There already exist technical capabilities in some O/M/As, which in some cases may have been established through the International Atomic Energy Agency technical cooperation programme. However for the successful implementation of this policy the current capabilities need to be strengthened and the introduction of new technologies could be introduced if considered viable. The existing capability may be strengthened, where there is demonstrated evidence of commitment of resources to ensure the sustainable application of the technology. In cases where the technology is non- existent and where there is a history of non-sustainable utilisation of resources committed in the past, then it may be justified that the Ministry sets up the technical capabilities, including physical infrastructure and equipment, which may be supported through a capital project under the national development fund. However, a comprehensive inventory of the current capabilities is necessary, which will be followed by a needs assessment based on the feasibility of the projects that are proposed under this policy.

Chapter 6: IMPLEMENTATION, MONITORING AND EVALUATION

6.1 PROJECT DEVELOPMENT AND IMPLEMENTATION

The implementation of this policy will be phased into projects identified based on the strategic initiatives identified under Section 3.3 of this document. These will be supported by additional action plans that will include a human resource development plan and infrastructure development plan, which will clearly define the targets to be achieved over each year of the National Developmental Plans. These plans will also include specific action steps and will be monitored on a six monthly period to ensure that the attainment of the target remains under surveillance and appropriate interventions can be made when needed. A detailed action plan is provided in Annexure II.

Furthermore the conceptual framework for linking the NDP IV priorities with the role of nuclear technology is proposed in Annexure III. A four phase approach is suggested which will include: *(i) Quantifying the Challenge / Problem in the Context of the NDP; (ii) Assessing the merit of Nuclear Technology to Address the Challenge / Problem; (iii) Detailed Feasibility Study; (iv) Project Development; and (iv) Project Implementation*

6.2 MONITORING & EVALUATION

6.2.1 Monitoring

The implementation shall be led by the Ministry of Health and Social Services with the Atomic Energy Board providing the technical advice in its implementation. The Secretary to the Board shall provide the operational support in the implementation of the policy. The Secretariat shall draw its resources from the current and future institutional infrastructure as established under the Atomic Energy & Radiation Protection Act and supported by the Ministry. The Board shall ensure that the operational plans are developed and regularly report to the Ministry on the progress of implementation of this policy. The monitoring and evaluation shall not only take into account the progress of implementation, but shall also pay due consideration to the relevance and competitiveness of nuclear technology in the framework of the national development priorities.

6.2.2 Performance Indicators and Evaluation

Each of the strategic initiatives shall be benchmarked against the applicable national or international standards. Where such standard does not exist the benchmarking shall be done by adopting best practices in the industry concerned. The assessment shall be done on an annual basis by (i) evaluating the current status; (ii) define the desired state or standards; and (iii) proposing plans of action to make progress towards the desired objective. This performance evaluation shall be done annually by the Secretariat of the Board and shall also be subjected to independent audits by a professional entity on a bi-annual basis.

Annexure I: PLAN OF ACTION

Item	Project	Strategic Intervention	Expected Output	Responsibility for Action	Time Frame	Resource Requirements
1	National Policy Framework on Nuclear Science and Technology	facilaitate the development a policy framework in alignment with national priorities	Policy Framework responsive to national needs, including action plan	-MHSS (DAERPA) -AEB	3Q2014 – 4Q2014	-Stakeholder input and advice -Expert Advice -Printing of final policy document
2	Nuclear Science and Technology Network and Information Centre	establish and equip information centre for nuclear science and technology	network and information centre to serve all stakeholders on issues relating to nuclear and radiation sciences	-MHSS (DAERPA) -AEB -IAEA	4Q2014-1Q2015	-physical infrastructure -information, communication and technology infrastructure (i.e networks, IT hardware; demonstration models, etc) -nuclear science and technology resources
3	Human Resources Development for Nuclear Technology Support	develop education and training strategy to produce comptencies and skills to implement nuclear science and technology policy	education and training strategy that supports the development of comptent and skilled human resources delivering outputs as expected under policy framework	-MHSS -AEB -Institutions of Higher Learning -IAEA -MAWF -MME -Industry -MoE	1Q2015 – 4Q2018	-expert advice for the development of an education and training strategy -responsive staff establishment for each of the strategic initiatives in the policy -training of selected staff for postgradute training in specialist fields of nuclear science and technology -capacitating training institutions to provide institutional capacity for production of human resources in nuclear science and technology in aligment with education and trainiing strategy -funding for implementation of education and training strategy
4	Nuclear and Radiation Regulatory Infrastructure	review and update legislative and regulatory framework, benchmarking with IAEA Standards for all relevant thematic areas	legislative and regulatory framework responsive to the needs of the country and in conformity with international standards	-MHSS (DAERPA) -AEB IAEA -MME	1Q2015 – 4Q2018	-NRPA and stakeholders to conduct self-assessment and draft legislation and regulations -IAEA to provide expert advice on appropriatenes of draft legislation and regulations -IAEA to provide capacity building for self-assessment of infrastrucre and training in nuclear law -MME to provide input i.t.o appropriateness of nuclear fuel cycle legislation
5	Implementing and maintaining nuclear / radiation regulatory activities	build the human and technical capacity to ensure effective and efficient implementation of the regulatory infrastructure	high performance i.t.o maintain control over and monitoring the impacts from the use of radiation sources, nuclear and radioactive material	-MHSS (DAERPA) -AEB -NRPA -IAEA	1Q2015 – 4Q2018	-MHSS to provide human resources, funding and logistical support -IAEA to provide technical advice, training and minor equipment for the assessment and implementation of all the thematic safety areas to attain compliance with the IAEA safety and security standards
6	nuclear technology in support of the national cancer control programme	assess the current capabilities, needs, desired outcomes and facilitate institutional development to achieve and maintain desired outcomes	responsive human resources and infrastructure for nuclear medicine and radiation therapy supporting the national cancer control programme	-MHSS -IAEA	1Q2015 – 4Q2018	-IAEA/MHSS to conduct assessment, needs, and propose desired outcomes -IAEA PACT to assist with development of action plan based on report of imPACT mission -IAEA to provide support for training of key personnel and expert advice on infrastructure development -MHSS to provide human resources and physical infrastructure
7	nuclear techniques in support of the agriculture sector (crop production, water resources management, animal production and health)	assess the current capabilities, needs, desired outcomes and facilitate institutional development to achieve and maintain desired outcomes	technical infrastructure to support research and development activities in various areas of agriculture	-MAWF - MHSS (DAERPA) -IAEA	1Q2015 – 4Q2018	-MHSS (DAERPA) in cooperation with MAWF to conduct assessment of current infrastructure, needs and desired outcomes -IAEA/MAWF/MHSS to provide technical advice in terms of the feasibility of introducing specific technical infrastructure -MAWF/MHSS to facilitate the development of physical infrastructure and expertise to introduce and maintain the technology
8	nuclear technology in support of food safety and food security	assess the role of nuclear technology in the food supply chain by evaluating risks, current capabilities, needs, desired outcomes and facilitate institutional development to achieve and maintain desired outcomes	nuclear institutional and technical infrastructure that supports safety and security in the food supply chain	-MHSS -MAFW -MTI -IAEA	1Q2015 – 4Q2018	-MHSS to provide resources for the assessment of baseline information on the risks in the food supply chain and the standards that must be maintained -MAWF to provide support in terms of assessing the production, consumption and risks factors which compromise food security -MTI to provide support in terms of the infrastructure that facilitate trade in food -IAEA / MHSS (DAERPA) to provide technical support for the assessment of nuclear technology in responding to the challenges in the food supply chain
9	nuclear technology in support of analytical services, research and educational programmes	review the different nuclear analytical and irradiation technologies in the framework of research, service provsion and education	institutional and technical infrastructure to support local service provision in terms of analytical work, research and teaching	- MHSS (DAERPA) -Institutions of higher learning -Industry -MAFW, MFMR, MME	1Q2015 – 4Q2018	-MHSS (DAERPA) in cooperation with stakeholders to conduct an inventory and assessment of current capabilities - MHSS (DAERPA) in cooperation with stakeholders to assess the viability of introducing and maintaining new technologies - MHSS (DAERPA) to establish and maintain a network of collaboration among stakeholders involved in analytical work, research and teaching -IAEA to provide technical advice and resources for introduction of new technologies -MHSS to provide resources for infrastructure development and human resources -MFMR, MAWF, MME to provide access to existing facilities for use by network of stakeholders
10	radionuclide and/or radiopharmacy manufacturing and supply	investigating the merits of local production of radiopharmaceuticals for local and export market	infrastructure to ensure security of supply of radiopharmaceuticals for the local and export market	-MHSS -MTI -IAEA	1Q2015 – 4Q2018	-MHSS to assess supply and demand network locally and beyond -MHSS with partners (IAEA), if justfied to assess the appropriateness of technologies and proposed infrastructure for local production of radiopharmaceuticals

Annexure II: PROPOSED FRAMEWORK FOR NUCLEAR SCIENCE AND TECHNOLOGY RESEARCH AND DEVELOPMENT INITIATIVES

Conceptual Framework to address the Priorities identified in the NDIV through the use of Nuclear Technology

Some of the socio-economic priorities identified in the NDP IV that may be addressed through the complimentary role of nuclear techniques include: health (nuclear medicine, radiation therapy; stable isotopes used in control of communicable diseases (HIV/TB, Malaria), nutrition; agriculture (crop production, animal health, water resource management); industry (manufacturing of radioisotopes, food safety, technical and analytical services); energy (uranium mining, uranium enrichment, processing, nuclear power); and sustainable environment management practices. It is therefore essential that a link be established between the national priority area and the possible nuclear technology that may be deployed to address the challenge. The following conceptual framework is suggested in order to initiate and sustain initiatives through which nuclear technology can address national challenges

Phase I: Quantifying the Challenge

It is imperative that a comprehensive and clear overview of the problem be developed which is a challenge to Namibia. In many cases this challenge may already have been identified and quantified by the counterpart O/M/A. It is essential that at this stage a counterpart O/M/A engages in a partnership with the promoters of the technology at national level. The parties may cooperate and jointly quantify the problem and its impact on development. The critical expertise here is that of the counterpart O/M/A who will mainly assist the promoters to gain a good understanding of the challenge.

Phase II: Assessing the merit of Nuclear Technology to Address the Challenge

While the challenge may necessitate a national response, it may not be obvious that nuclear technology would be the appropriate and most effective tool to address the challenge. Therefore the competiveness of the technology in relation to other technologies should be assessed. This would require an in-depth knowledge of the various technologies to make an objective assessment before embarking a project. The expertise of the IAEA and other partners would be critical at this stage.

Phase III: Feasibility Study

Having quantified the challenge and justified the use of nuclear technology, a joint study should be commissioned, consisting of partners from the counterpart O/M/A, the promoter and may include the IAEA or any other bilateral partner. The study will consider all the variables, including human resources needs and capacity, financing; infrastructure development, partnership, environmental issues, nuclear regulatory issues, sustainability and impact in the context of the relevant NDP IV priority. The study, in the context of the proposal delivering optimal impact should lead to a project proposal. The required expertise may in include staff with a good aptitude for research with some background in project management and nuclear applications. Therefore the study should be under the leadership of the promoters, cooperating with the counterpart O/M/A and may be executed by private consultants or research students.

Phase IV: Project Development

Based on the feasibility study a project proposal is developed with clear objectives, outcomes, outputs, indicators, time frames and allocation of responsibilities. An essential part is the establishment of a project clear with a project team that includes all the relevant stakeholders such as the promoters, the counterpart O/M/A, IAEA, private partners or bilateral partners. An essential skill is project development among all the stakeholders that are identified.

Phase IV: Project Implementation

The project leader and team shall make use of the project document as a resource mobilisation tool for consideration by Government, private partners, internal or regional partners. A review and monitoring mechanism shall be put in place to ensure that the project achieves its objectives. Essential skills include advocacy, resources mobilisation and project management

GLOSSARY

Disposal: Emplacement of waste in an appropriate facility without the intention of retrieval

Dose: A measure of the energy deposited by radiation in a target.

Effectiveness: the extent to which the project specific objective (outcome) is achieved, or expected to be achieved, taking into account its relative importance.

Efficiency: measures the productivity of the implementation process and how economic resources (funds, expertise, time, etc.) are converted into results.

Evaluation: a process which attempts to determine as systematically and objectively as possible the relevance, efficiency, effectiveness and impact of projects, programmes and processes.

Exposure: The act or condition of being subject to irradiation

facilities and activities: A general term encompassing nuclear facilities, uses of all sources of ionizing radiation, all radioactive waste management activities, transport of radioactive material and any other practice or circumstances in which people may be exposed to radiation

Fissile material: Uranium-233, uranium-235, plutonium-239, plutonium-241 or any combination of these radionuclides.

Fissile: Capable of undergoing fission by interaction with slow neutrons.

Half-life: the time required for the activity to decrease, by a radioactive decay process, by half.

Deterministic health effect. A health effect of radiation for which generally a threshold level of dose exists above which the severity of the effect is greater for a higher dose.

Hereditary health effect. A radiation induced health effect that occurs in a descendant of the exposed person

Stochastic health effect. A radiation induced health effect, the probability of occurrence of which is greater for a higher radiation dose and the severity of which (if it occurs) is independent of dose.

Irradiation installation: A structure or an installation that houses a particle accelerator, X ray apparatus or large radioactive source and that can produce high radiation fields.

Management system: A set of interrelated or interacting elements (system) for establishing policies and objectives and enabling the objectives to be achieved in an efficient and effective manner.

Millennium Development Goals: The eight goals adopted in the United Nations Millennium Declaration in 2000: eradication of extreme hunger and poverty, achievement of universal primary education, promotion of gender equality, reduction of child mortality, improvement of maternal health, combating HIV/AIDS, malaria and other diseases, ensuring environmental stability and development of a global partnership for development

Monitoring: the process of providing a more or less continuous review of the financial and physical implementation process of a project or programme.

Nuclear: relating to or using energy released in nuclear fission or fusion.

Nuclear facility: A facility (including associated buildings and equipment) in which nuclear material is produced, processed, used, handled, stored or disposed of.

Nuclear fuel: Fissionable nuclear material in the form of fabricated elements for loading into the reactor core of a civil nuclear power plant or research reactor.

Nuclear Fuel Cycle: All operations associated with the production of nuclear energy, including:(a) Mining and processing of uranium or thorium ores; (b) Enrichment of uranium;(c) Manufacture of nuclear fuel; (d) Operation of nuclear reactors (including research reactors);(e) Reprocessing of spent fuel;(f) All waste management activities (including decommissioning) relating to operations associated with the production of nuclear energy; (g) Any related research and development activities.

Nuclear material: Plutonium except that with isotopic concentration exceeding 80% in plutonium-238; uranium-233; uranium enriched in the isotope 235 or 233; uranium containing the mixture of isotopes as occurring in nature other than in the form of ore or ore residue; any material containing one or more of the foregoing.

Ionizing radiation: radiation capable of producing ion pairs in biological material(s).

Project: an undertaking or intervention with a specific objective (outcome) that addresses an identified problem or gap in a specific area.

Radiation: the term radiation normally refers only to ionizing radiation

radiation risks: Detrimental health effects of exposure to radiation (including the likelihood of such effects occurring); Any other safety related risks (including those to ecosystems in the environment)

radioactive material: material designated in the Atomic Energy & Radiation Protection Act as being subject to regulatory control because of its radioactivity

Radioactivity: The phenomenon whereby atoms undergo spontaneous random disintegration, usually accompanied by the emission of radiation.

Radioactive waste: waste that contains, or is contaminated with, radionuclides at concentrations or activities greater than clearance levels.

Radioactive waste management: All administrative and operational activities involved in the handling, pretreatment, treatment, conditioning, transport, storage and disposal of radioactive waste.

Relevance: the degree to which project objectives are consistent with end users' requirements, country needs, and partners' and donors' policies.

Risk: is the probability that an event or condition may adversely affect the achievement of a project.

Stakeholder: an agency, organization, group or individual that has a direct or indirect interest

Sustainability: refers to the continuation of benefits after the completion of a project; the probability of continued long term benefits; the resilience to risk of the net benefit over time.

Source: anything that may cause radiation exposure — such as by emitting ionizing radiation or by releasing radioactive substances or material — and can be treated as a single entity for protection and safety purposes

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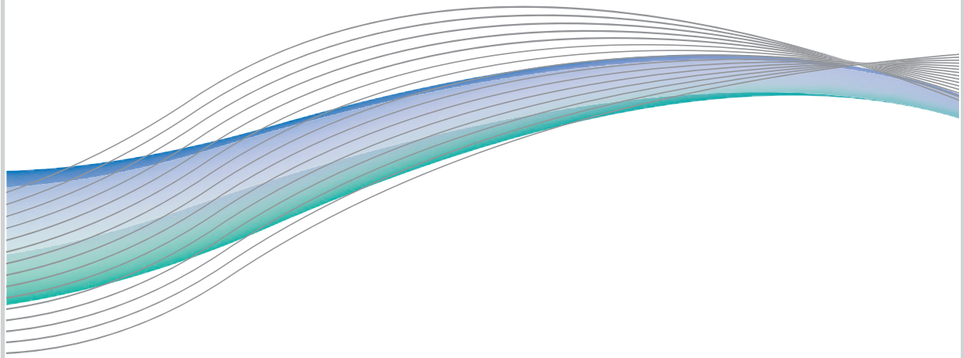

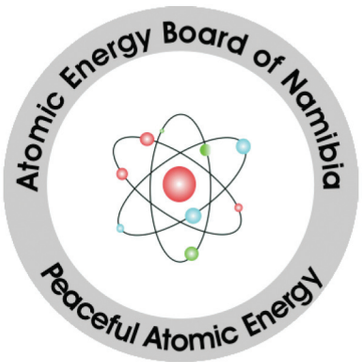

Directorate: Atomic Energy & Radiation Protection Authority
Ministry of Health and Social Services
Harvey Street
Private Bag 13198
Windhoek
Tel: +264 61 203 2417
Fax: +264 61 230 424
E-mail: aerpr@mhss.gov.na