THE REPUBLIC OF BOTSWANA FIRST NATIONAL REPORT ON IMPLEMENTATION OF THE OBLIGATIONS UNDER THE JOINT CONVENTION ON THE SAFETY OF SPENT FUEL MANAGEMENT AND ON THE SAFETY OF RADIOACTIVE WASTE MANAGEMENT

October 2017
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Section A: Introduction

The Republic of Botswana acceded to the Joint Convention on the Safety of Spent Fuel Management and on the Safety of Radioactive Waste Management (the Joint Convention) on the 14 August 2015 and become a Contracting Party on 12 Nov 2015. There were no declarations or reservations attached to the instrument of accession. This is Botswana’s first National Report to the 6th Joint Convention Review Meeting.

Botswana is a country that has no nuclear industry, no research reactor or other facility generating radioactive substances. There is no nuclear fuel or spent fuel liquid waste on Botswana territory. Therefore, many of the requirements of the Joint Convention do not apply to Botswana.

In 2006, Botswana signed the Nuclear Non-Proliferation Treaty Additional Protocols and Safeguards Agreements to demonstrate the country’s commitment to world peace and stability as a consequence of eradication of nuclear weapons.

The first legislation in Botswana on radiation protection was passed in 2006 and its regulations were passed in 2008 and the two laws are being reviewed to close the identified regulatory gaps and to align them to prevailing international instruments that have been ratified or are going to be ratified, including the Joint Convention. The legislations covers all relevant radiological safety issues, in line with the IAEA safety standards.

With the Radiation Protection Act and the Regulations in place, the foundation is fully established for proper monitoring and supervision of safe management of radioactive waste during National Development Plan (NDP) 11.

The total amount of radioactive waste in Botswana is very low, as the current regulatory requirement is that licensees are required by Law to return their spent sealed sources to suppliers and/or manufacturer for disposal or proper management. As such, Botswana does not have a national final radioactive waste disposal facility. However, there is a temporary steel cargo container storage facility, for impounded and confiscated sealed sources, built in 2011, with the assistance of the USA-Department of Energy, under their global threat reduction initiative. Efforts are being made by the government to construct a centralised national storage and conditioning facility, such that all spent sources kept at end-user’s facilities are collected and stored at national storage for proper management and accountability of sealed sources in the country.

Nuclear technology in Botswana is used mainly in health, agriculture, mining, academic and research institutions, manufacturing and construction industries. As such, the above named sectors are the generators of radioactive waste in the country, albeit, at limited scale. As of October 2017 there were 308 registered facilities (licensees) that uses radiation sources in Botswana.

This is Botswana’s first national report and is presented to the 6th Joint Convention Review Meeting to be held in May 2018 in Vienna. The report was prepared by the Radiation Protection Inspectorate (Regulatory Body), whose mandate is to regulate the safe use of atomic energy and nuclear technology and matters incidental there to. The aim of this national report is to demonstrate that Botswana meets its obligations of the Joint Convention and the report is prepared in accordance with the Guidelines regarding the Form and Structure of National Reports (INFCIRC/604/Rev.3) revised by the Contracting Parties under Article 29 of the Convention at the Extraordinary Meeting at the IAEA May 2014.
Section B: Policies and Practices

This section covers the obligations under Article 32 (Reporting), paragraph 1. It includes a statement outlining the national policy for spent fuel management and a description of national practices pertaining to spent fuel management, together with a statement outlining the national policy for radioactive waste management and a description of national practices pertaining to radioactive waste management, including spent sources. It also specify the criteria used to define and categorize radioactive waste in the country.

B1: Spent fuel management policy and practices

As stated in Section A, above, there are no nuclear reactors or nuclear fuel facilities on Botswana territory.

B2: Radioactive waste management policy

Radioactive waste on Botswana territory is regulated within the existing regulatory framework and is consistent with the relevant international principles in the management of radioactive waste. Where the management of radioactive waste involves toxic chemical wastes, biological ones and/or any other hazardous wastes; the management methods have to comply with the requirements of the relevant national environmental regulations/legal framework. The safety standards for radioactive waste management are in conformance with the recommendations of the International Atomic Energy Agency (IAEA) and have the following aims:

a) Protection of individuals and the environment;
b) The detriment foreseen for the health of future generations is not greater than the currently acceptable standards;
c) Not to impose undue burden upon the next generations;
d) The trans-boundary possible effects for human health and the environment not greater than the accepted for the country;
e) Management in accordance with appropriate legal framework;
f) Generation of radioactive wastes as low as possible;
g) Protective measures for reducing risks associated with past practices, not regulated ones, and remediation of contaminated sites shall be justified and optimized in a way that yields maximal benefit reasonably achievable;
h) During the operation of facilities for radioactive wastes management, adequate provisions shall be in place for their protection and safety;
i) An adequate reciprocal dependency between radioactive wastes generation and the rest of the management stages, including final disposal.

The Radiation Protection Act, 2006 and Radiation Protection regulation, 2008, covers provision of safe management of radioactive waste. Section 31 of the Act stipulates that: (1) a person who is licensed to generate, keep or manage radioactive waste shall:

a) be responsible for the safe management of radioactive waste generated by the practice or source for which he or she is authorized;
b) when purchasing a sealed source, make contractual arrangements for the return of the spent sealed source to the manufacturer; and

c) appoint a technically competent person to be a Radiation Waste Management Officer in order to assist the licensee in the safe and efficient on-site management of radioactive waste,
Furthermore, Regulation 60, of the Radiation Protection Regulations, stipulates that: Licensees shall be responsible for the safe management of the radioactive waste generated by the practices or sources for which they are authorised and shall take all necessary steps to this aim, including:

a) keeping the generation of, both, the activity and volume of radioactive waste to the minimum practicable by suitable design, operation and decommissioning of its facilities;
b) ensuring that radioactive waste is managed by appropriate classification, segregation, treatment, conditioning, storage and disposal, and maintain records of such activities;
c) ensuring that disposal of radioactive waste is not unnecessarily delayed; and
d) reporting to the Inspectorate required information at intervals as may be specified in the licence.

The current prevailing regulatory requirement is that licensees are required by the Act to return their spent sealed sources to suppliers and/or manufacturer for disposal or proper management, as the country does not have a national final radioactive waste disposal facility. As such, when purchasing a sealed source, licensees should make contractual arrangements for the return of the spent sealed source to the manufacturer. However, licensees are required to securely store those sources that they cannot send back due to some reasons, like situations where suppliers are no longer in business. Currently, there are no nuclear medicine facilities in the country that utilise open sources for diagnostic purposes. However, two hospitals are in the process of operating such facilities in future. There is only one private hospital that uses a sealed source, Ir-192 for cancer therapy (brachy-therapy) and they manage their spent source by returning it back to the supplier, after every three months, i.e. after the source has decayed to exemption levels.

In 2011, the country constructed a temporary steel cargo container, with the assistance of the USA-Department of Energy, under their global threat reduction initiative, to store impounded and confiscated sealed sources by front-line officers. The facility is operational. However, efforts are being made by the government to construct a centralised national storage and conditioning facility during National Development Plan 11, such that spent sources kept at end-user’s facilities are collected and stored at national storage for proper management and accountability of sealed sources in the country.

**B3. Radioactive waste management practices**

**B3.1 Management of Different Types of Radioactive Waste**

**B3.1.1 Liquid Waste**

Liquid waste should be collected, segregated and characterized as far as possible at the point of origin according to its physical, chemical, biological and radiological properties in order to facilitate treatment, conditioning and transportation operations and to minimize the volume requiring subsequent storage and disposal. It is necessary to segregate liquid wastes into the following main categories according to their properties:

- Activity and radionuclide content;
- Short-lived radionuclides suitable for decay storage;
- Long-lived liquid waste requiring conditioning, subsequent storage and final disposal;
- Organic liquids;
- Aqueous liquids;
- Non-homogeneous waste (sludge/mud);
- Infectious liquids;
- Chemically hazardous liquids;
However, currently there are limited facilities that generate radioactive liquid waste in the country.

**B3.1.1.1 Decay storage prior to discharge**

a) Practical experience shows that storage for decay is often suitable when waste is contaminated with radionuclides with relatively short half-lives, usually less than 100 days but potentially as long as one year. Decay storage of waste to achieve an activity below the authorized discharge level or clearance level is the preferred management option, both technically and economically.

b) The optimum decay storage period of the waste should be evaluated prior to storage. If storage space allows, the store can be divided into areas according to half-life and decay storage period. Segregation of waste in this way can simplify waste discharge operations and administration. Storage for decay of liquid wastes containing longer-lived radionuclides (i.e. with half-lives longer than 100 days) may not be judged to be appropriate because of the long storage times involved and associated safety considerations (especially with unconditioned radioactive wastes).

**B3.1.1.2 Effluent discharges**

a) Approval should be obtained from the Radiation Protection Inspectorate before radioactive effluent is discharged to the environment (i.e. sewage system);

b) It is important to ensure that discharged effluent is homogeneous, readily dispersible in water and the activity levels are within authorized limits;

c) Effluent containing suspended solids or sediments should be filtered and fully characterized prior to discharge;

d) Non-aqueous and mixed (hazardous) wastes should not be discharged to the sewage waste systems unless they have been appropriately treated and the discharge has been approved by the Radiation Protection Inspectorate.

e) The discharge of liquid effluent should be strictly controlled by a combination of quality assurance techniques (records, procedures, etc.) and direct measurement. All the information concerning individual discharges should be recorded.

**B3.1.2 Solid Wastes**

Operational solid waste generally consists of trash, and is therefore likely to contain only a relatively small proportion of the initial radionuclide inventory associated with a particular operation. Solid waste also includes decommissioning waste (refurbishment) arising;

**B3.1.2.1 Segregation**

a) Solid waste should be characterized, collected and segregated as far as possible at the point of origin according to its physical, chemical, special hazard and radiological properties. This is to facilitate treatment, conditioning and transportation operations and to minimize the volume requiring subsequent storage and conditioning,
b) Segregation of solid waste should be carried out in accordance with the facility waste management strategy. In general, solid waste should be segregated into the following main categories:

- Activity and radionuclide content suitable for decay;
- Pathogenic;
- Toxic (heavy metals, cyanide, etc.);
- Dangerous (explosive, pyrophoric, etc.);
- Sharp (broken glass, hypodermic needles, etc.);
- Wet/moist solids;
- Presence of absorbed liquid waste (flash points >60°C);
- Combustible/non-combustible (if applicable);
- Compactable/non-compactable (if applicable).

c) Segregation of waste is required in order to minimize potential hazards and to facilitate subsequent operations. Segregation at the point of origin is more efficient than performing segregation after mixing. Chemically incompatible wastes (e.g. tissues and pyrophoric metals) should be collected separately in order to avoid uncontrolled chemical reactions.

d) Waste containing radionuclides with relatively short half-lives (e.g. <100 days) should be segregated at source to facilitate decay storage and disposal.

e) Solid wastes can be collected in simple containers lined inside with a durable plastic bag (about 0.5 mm thickness) which can be sealed (using a radio-frequency (RF) welder or tied with adhesive tape) and transferred to a larger container (also lined) when necessary.

f) Sharp wastes should be collected separately and stored in rigid, puncture-resistant containers (preferably metal) which have been clearly labelled "sharps".

g) Potentially pathogenic waste, such as animal carcasses, should be segregated, stored separately and appropriately and, whenever possible, incinerated. If prompt disposal is not possible, deep-freezing is often an acceptable option for storage. Pathogenic waste should be sterilized and checked by an authorized doctor before conditioning.

h) Wet/moist solid waste should be collected in such a way as to avoid leakage of the contaminated liquids. Normally double packaging is used.

i) Standardized and approved containers should be used, where possible, for transportation.

j) Storage containers should be appropriately labelled with a radiation trefoil and a unique identification code.

B3.1.2.2 Landfill disposal of cleared or approved waste

Approval should be obtained from the Radiation Protection Inspectorate before radioactive waste is disposed of to a landfill site. All radiation labels (trefoils) should be removed before disposal. All the information concerning individual disposals should be recorded. Hazardous, infectious and biological waste should be treated before or excluded from landfill disposal.

B3.1.3 Management of Used-Up or Spent Sealed Radioactive Sources
Used-up or spent sealed sources should be returned to the supplier or manufacturer (see Reg. 70(1), Radiation Regulations, 2008). As a general principle, sealed sources should not be removed from their holders, or the holders physically modified.

B3.1.3.1 Used-up or spent sealed sources can be categorized as follows:

a) Sources with half-lives <100 days, with high activity content.

Radionuclides like Ir-I92 are currently used in medical applications and in pipe welds. For this type of sealed sources, decay storage at end user’s facilities is currently the preferred option as there is no national storage and conditioning facility in the country.

b) Sources with half-lives >100 days, with low or high activity.

The source-holder with the source inside should be kept intact during operational storage. Adequate security and radiological precautions should be adhered to during the handling and storage of these sources (e.g. additional shielding, strict access control, radiation monitoring, etc.).

c) Sources with a potential emanation and contamination hazard.

Adequate security and radiological precautions should also be taken during the handling and storage of spent radium sources and sources known to be leaking. Special attention should be given to the monitoring of surface and airborne contamination. These sources should be stored in a dedicated area with appropriate ventilation.

d) Consideration should be given to the possibility that sources containing primarily short-lived radionuclides may also contain smaller quantities of long-lived radionuclides.

e) Detailed records should be maintained for all spent sealed sources in storage.

f) The Radiation Protection Inspectorate should be informed when a sealed source is taken out of use, and becomes a used-up or spent source in storage.

g) Used-up or spent sealed sources should be segregated and collected separately because of their potentially high radiological hazard.

h) Used-up or spent sealed sources should not be removed from their associated shielding or source holders unless adequate precautions are taken to avoid exposure to radiation and contamination.

i) Peripheral components of large irradiation equipment (i.e. those not directly associated with the source) should be removed, monitored and disposed of appropriately as normal waste.

j) Sealed sources should not be subjected to compaction, shredding or incineration.

B3.1.4 End User Operational Storage Facilities

End user operational storage facilities for liquid or solid wastes may consist of metal cabinets, rooms or an entire building designated as storage. The essential design features of storage cabinets and rooms are discussed below.
B3.1.4.1 Waste storage in cabinets

Storage cabinets are primarily applicable to the temporary storage of small quantities of low-activity, low-hazard radioactive waste. Design features for storage cabinets (besides general features mentioned above) may include:

B3.1.4.2 Waste storage in rooms

Storage rooms are applicable to larger volumes of low activity, unconditioned radioactive waste. The most important design features of storage rooms are listed below:

a) Entrances should be suitable both for personnel and radioactive waste packages. Doors should be secured by a lock and access should be restricted to authorized persons;

b) Separate store areas should be provided for each packaged waste type, for different types of radionuclides (e.g. short-lived for decay), and for used-up or spent sealed sources;

c) For the storage of unconditioned radioactive waste, rooms should include adequate ventilation and a fire protection system. If a ventilation/filtration system is unavailable, natural ventilation should be considered.

d) Prefabricated corrosion-resistant steel storage units (e.g. ISO freight/transport containers) could be considered as a potential alternative to a storage room.

B3.1.5 Packaging and Transportation

a) Packaging and transportation should be carried out in accordance with the requirements of the Radiation Protection Regulations (2008) and IAEA Regulations for the Safe Transport of Radioactive Material. The package design should take into account subsequent transportation and storage requirements.

b) In the case of sealed sources, shielding is usually an integral part of the original storage/transport package. Hence, the dimensions and type of shielding depend on activity and radionuclides to be shipped. If possible, the original manufacturer's packaging should be used when transporting sealed sources. However, consideration should be given to, whether the design of the original packaging is in accordance with the requirements for the Radiation Protection Regulations (2008) and IAEA Regulations for the Safe Transport of Radioactive Material. If the original package is not available, the spent source should be repackaged in accordance with the transportation Regulations for radioactive material. The position of the on/off knob of the source holder should be verified and sealed (by welding) in the locked-off position.

B3.1.6 Criteria Used To Define and or Classify Radioactive Waste

Radioactive waste is defined under the Act as any material that contains or is contaminated with radionuclides at concentrations or radioactivity levels greater than the exempt quantities, or quantities prescribed by the Minister and for which no use is foreseen. While, the Radiation Protection Regulations, define radioactive waste as material, whatever its physical form, remaining from practices or interventions and for which no further use is foreseen, that contains or is contaminated with radioactive substances and has an activity or activity concentration
higher than the level for exemption or clearance from regulatory requirements, and exposure to which is not excluded from the Regulations.

Radioactive waste shall be classified in accordance with their activity and half-life, in order to determine the option for their further management, abiding by the provisions in the Radiation Protection Regulations of 2008, as outlined under Sixth schedule of the Regulations (Annex 1: Radioactive Waste Classification), as follows:

a) Cleared material/waste

Waste containing levels of radio-nuclides at concentrations less than the clearance levels established by the Radiation Protection Inspectorate;

b) Low level (short lived)/Decay waste

Low level radioactive waste containing short lived radio-nuclides only (e.g. with half-lives less than 10 days) that will decay to clearance levels within three years after the time of its generation;

c) Low and intermediate level short lived waste (LILW-SL)

Waste which will not decay to clearance levels within 3 years and contains beta/gamma emitting radio-nuclides with half-lives less than 30 years and/or alpha emitting radio-nuclides with an activity less than 400 Bq/g and a total activity less than 4000 Bq in each waste package;

d) Low and intermediate level long lived waste (LILW-LL)

Radioactive waste containing radio-nuclides with concentrations above those for LILW-SL, but which does not generate heat at above 2 kW/m³ of waste

Exemptions from the requirements of the Act with respect to exempt activity concentrations and exempt activities of radionuclides authorised is covered under Schedule 1 of the Radiation Protection Regulations, 2008.

Section C: Scope of Application

This section covers the obligations under Article 3 (Scope of application).

The report does not apply to the safety of spent fuel management since Botswana does not have nuclear power plants and nuclear reactors. Furthermore, Botswana has not declared radioactive waste that contains only naturally-occurring-radioactive-material (NORM) that does not originate from the nuclear fuel cycle, as radioactive waste for the purpose of the Convention, pursuant to Article 3(2).

Botswana does not have any military programmes that generate any spent fuel or radioactive waste within military or defence programmes for the purposes of the Convention, pursuant to Article 3(3).
Section D: Inventories and Lists

This section covers the obligations under Article 32 (Reporting), paragraph 2. Contracting Parties are encouraged to use clearly defined waste categories when reporting inventories

D1: List of spent fuel management facilities

As stated in Section A, above, Botswana is a non-nuclear country and does not have spent fuel facilities subject to the Convention.

D2: List of radioactive waste management facilities

Botswana does not have a national radioactive waste storage, conditioning and disposal facilities, subject to this Convention at present.

D3: Inventory of radioactive waste

Currently, spent sealed sources are either sent back to suppliers or temporarily stored on-site at end user’s temporary stores, under the regulation of the Radiation Protection Inspectorate (Regulatory body), until decayed or shipped back to supplier for further management. The Regulatory body takes care of confiscated, impounded or sources out of regulatory control and such sources are stored at a temporary steel cargo container donated by the USA government in 2011 (Annex 2: Inventory of Radioactive Waste).

All sealed sources are registered by the Radiation Protection Inspectorate (Regulatory body), in RAIS (Regulatory Authority Information System) and access to the system is controlled.

Section E: Legislative and Regulatory system

This section covers the obligations under the following articles:

- Article 18. Implementing measures
- Article 19 and 20. Legislative and regulatory framework (Regulatory body)

Each Contracting Party shall take, within the framework of its national law, the legislative, regulatory and administrative measures and other steps necessary for implementing its obligations under this Convention.

E1: Implementing measures

In conformance to Article 18 of the Joint Convention, the Botswana has undertaken the necessary legislative, regulatory and administrative measures to fulfil its obligations under the Joint Convention and these are reported in this report.

E2: Legislative and regulatory framework (Regulatory Body)

Botswana has the following legislative instruments in place:

- Radiation Protection Act, 2006 (CAP24:03)
- Radiation Protection Regulations, 2008

The above primary legislative instrument (Act) establishes the national independent regulatory system, i.e. the Radiation Protection Board and the Radiation Protection Inspectorate. The Act applies to any person or body of persons whose undertaking involves or includes generally the use of atomic energy and nuclear technology and, in particular, the production, processing,
handling, use, holding, possessing, storage, transport and disposal of natural and artificial radioactive materials and radiation devices in respect of any other activity which involves a risk or harm arising from radiation and binds the State. The Radiation Protection Act and Radiation Protection Regulations are being reviewed to align them to the prevailing International Atomic Energy Agency (IAEA) radiation safety regulatory requirements, covering spent fuel and radioactive waste management and also to address some of the identified regulatory gaps.

E2.1: Establishment of the Radiation Protection Board

Section 5 of the Act establishes the Radiation Protection Board (RPB) and performs such functions as may be conferred on it by this Act or any other enactment. It is vested by the Act with responsibilities, among others, for authorization, regulatory review and assessment, and enforcement, and for establishing safety principles, criteria, regulations and guides. The Board consist of a minimum of five and a maximum of seven members appointed by the Minister. The Minister by notice in the Gazette, notify the appointment, resignation or revocation of the appointment, of any Board member. A member shall hold office for such period, not exceeding five years, as may be specified in the legal instrument appointing him or her. The Radiation Protection Inspectorate (Inspectorate) is the secretariat to the Board. The Director or any member of staff designated by the Director shall attend the meetings of the Board, but shall have no right to vote. Subject to the provisions of the Act, the Board shall regulate its own procedure. The decisions of the Board are by a simple majority of votes of the members present and voting at a meeting for the Board, and, in the event of an equality of votes, the chairperson shall have a casting vote in addition to his or her deliberative vote. The decision or proceeding of the Board shall not be rendered invalid on account of the appointment of any member being defective or by reason of a vacancy in the membership of the Board, if the decision was done, or the decision was made, or the proceedings took place, in accordance with a majority vote of the persons who were at the time entitled to act as members. Minutes of each meeting of the Board is recorded and kept by the secretariat and confirmed by the Board at a subsequent meeting of the Board.

E2.1.2: Functions and powers of the Radiation Protection Board

The functions of the Board as conferred on it by the Act are to:

a) advise the Minister with regard to all matters concerning atomic energy, nuclear science and related technologies;

b) authorize the peaceful use of atomic energy and nuclear technology and in particular the production, processing, handling, import, export, possession, storage, use, transport and disposal of radioactive materials and related substances;

c) oversee the supervision of the carrying out of all requirements designed to ensure the safety and health of radiation workers, patients, the public and the environment;

d) maintain relations with the International Atomic Energy Agency and other similar international and national organizations, and to collaborate and liaise with these organizations on matters relating to the development of safe and secure application of atomic energy; and

e) promote collaboration between universities and research institutions in Botswana for the purposes of carrying out research into the peaceful use of nuclear energy and technology,

f) draft guidelines upon which its regulatory actions are based;

g) review and assess submissions on safety from the operators both prior to authorization and periodically during operation; and

h) issue, amend, suspend or revoke licences, subject to any necessary conditions, which may specify,
   i. the facilities, activities or inventories of sources covered by the authorization,
ii. the requirements for notifying the Board of any modifications to safety related aspects,
iii. the obligations of the operator in respect of its facility, equipment, radiation source and personnel,
iv. any limits on operation and use, such as dose or discharge limits, action levels or limits on the duration of the authorization,
v. **conditioning criteria for radioactive waste processing for existing or foreseen waste management facilities**, 
vi. any additional separate authorizations that the operator is required to obtain from the Board, 
vii. the requirements for reporting accidents, 
viii. the procedure for reporting to the Board by the operator, 
ix. the records that the operator is required to retain and the periods for which they must be retained, and 
x. the emergency preparedness arrangements

**E2.1.2.1: Application for licence**

No person shall:

a) acquire, own, possess, transfer, distribute, sell, use, manufacture, transport, import or export any radioactive material, radioactive substance or source;

b) administer any radioactive substance to any person for purposes of diagnosis, treatment or research;

c) add radioactive substances in the production and manufacture of foodstuffs, medicinal products, cosmetics and products for household use;

d) physically or chemically alter or modify part or all of any radioactive material, substance or source; or 

e) manage or dispose of any radioactive waste, 

f) unless such person has been granted a licence by the Board to do so, 

g) A person who wishes to apply for a licence to do anything referred to above, shall make a written application to the Board in such form as may be prescribed by the Minister,

**E2.2: Establishment of the Radiation Protection Inspectorate (Inspectorate)**

The Act establishes the Radiation Protection Inspectorate (referred to as "the Inspectorate") which consists of a Director, a Deputy Director and such other officers of the Inspectorate, as may be necessary for the proper performance of its functions. The Inspectorate is established as a public office, under the Ministry of Tertiary Education, Research, Science and Technology. Its mission is to provide effective and efficient regulatory services to protect the public and the environment against the effects of ionising radiation. The Inspectorate has four divisions that enable it to implement its mandate, namely: Environment monitoring & radioactive waste management; Licencing & Inspections; Standards & Instrumentation, and Corporate services. **Annex 3 shows services offered by the Inspectorate.**

**E2.2.1 Functions of the Inspectorate**

The functions of the Inspectorate as conferred on it by the Act are to implement the decisions of the Radiation Protection Board and, without prejudice to the generality of the foregoing, shall:

a) carry out regulatory inspections (announced, un-announced, follow-up, pre-authorisation);  
b) develop safety principles and criteria for approval by the Board; 
c) require any operator to conduct a safety assessment;
d) require any operator to provide it with any necessary information, including information from its suppliers, even if the information is confidential;
e) recommend to the Board the issue, amendment, suspension or revocation of licences and the setting of conditions to such licences;
f) require an operator to perform a systematic safety reassessment or a periodic safety review over the lifetime of its facilities;
g) enter a site or facility at any time to carry out an inspection;
h) enforce regulatory requirements;
i) obtain such documents and opinions from private or public organizations or persons as may be necessary and appropriate;
j) communicate its regulatory requirements, decisions and opinions and their basis to the public;
k) make available, to other governmental bodies, national and international organizations, and to the public, information on incidents and abnormal occurrences, and their effects to the public; and
l) liaise and coordinate with other governmental or non-governmental organizations having competence in such areas as health and safety, environmental protection, security, and transport of dangerous goods,

E2.2.1.1 Powers of entry and inspection

A Radiation Inspector may, at any time:
a) enter, inspect and examine or search any premises, vehicle, vessel, aircraft or any carriage where he or she has reasonable grounds to believe that radioactive material or any source of ionizing radiation is stored, used, transported or disposed of, in such premises, or vehicle, vessel, aircraft or carriage;
b) require the production of any licence or permit authorizing the use or import, as the case may be, of any radioactive material, radioactive substance or sources of ionizing radiation;
c) seize any substance or equipment or any book, record, or document found in respect of which any provisions of this Act appears to have been contravened;
d) by written notice to the person in control thereof prohibit the use, sale or removal of, or any other dealing whatsoever in connection with, any materials in respect of which any provision of this Act appears to have been contravened;
e) take as many samples as may be necessary of any substance as may be considered necessary for the purpose of testing, examination or analysis in terms of this Act; or
f) conduct or cause to be conducted any investigations, tests or examinations on any incident or situation considered to be appropriate in terms of the Act,

E2.3 Regulations Promulgated

The Act establishes a general framework on which specific regulations concerning radiation protection are based. Pursuant to the Act, the Radiation Protection Regulations were promulgated in 2008. The general obligation of the Regulations is that, no person shall engage in activities which involve practices or sources within practices unless the requirements of the Regulations, including the requirements for notification and authorisation, are met. Part XI of the Radiation Protection Regulations, 2008, covers the aspect of regulatory framework for the management of radioactive waste, including safety requirements, handling, treatment, transport (including trans-boundary transport of radioactive waste), storage and disposal of radioactive waste. However, the regulations do not cover spent fuel management and financial provisions for management of radioactive waste and spent fuel, but they require licensee to keep cost of waste generation to the minimum practicable.
E2.3.1: Radioactive Waste Management Requirements

No person or organisation shall generate, keep or manage radioactive waste except in accordance with a licence issued by the Board. Licensees are responsible for the safe management of the radioactive waste generated by the practices or sources for which they are authorised and shall take all necessary steps to this aim, including:

a) keeping the generation of, both, the activity and volume of radioactive waste to the minimum practicable by suitable design, operation and decommissioning of its facilities;

b) ensuring that radioactive waste is managed by appropriate classification, segregation, treatment, conditioning, storage and disposal, and maintain records of such activities;

c) ensuring that disposal of radioactive waste is not unnecessarily delayed; and

d) reporting to the Inspectorate required information at intervals as may be specified in the licence,

Licensees using radioactive material shall, not dismantle any sealed source and before declaring the radioactive material as waste, consider whether the licensee or any other organisation can make use of the material; and if appropriate, transfer the material after confirming with the Inspectorate that the organisation to which it is transferred has the necessary authorisation to hold that material.

E2.3.1.1: Quality assurance programmes

Licensees shall submit a Quality Assurance Programme to the Board for approval as part of the licence application covering all aspects of the radioactive waste management, especially those features important to safety such as facilities, activities and waste and be commensurate with the scale of operations. The effectiveness of the Quality Assurance Programme shall be verified by independent audits to ensure that radioactive waste management activities are carried out to meet the requirement to protect human health and the environment. Quality assurance documentation shall include:

a) an inventory of radioactive waste, including origin, location, physical and chemical characteristics, and, as appropriate, a record of radioactive waste removed or discharged from the facility;

b) site plans, engineering drawings, specifications and process descriptions;

c) data resulting from quality assurance and quality control procedures and from operating activities;

d) safety and environmental assessment methods and computer codes;

e) results of safety and environmental assessments;

f) effluent and environmental impact monitoring results;

g) radioactive waste package identification;

h) disposal facility or arrangements as outlined in the regulations; and

i) detailed facility closure plan

E2.3.1.2: Return of sealed sources to the manufacturer

The current regulatory requirement is that, when purchasing sealed sources, licensees shall make contractual arrangements for the return of the spent sealed sources to the manufacturer or supplier. Any person or organisation that intends to import a sealed source containing radioactive material which 10 years after receipt will have an activity greater than 100 MBq shall:

a) require the supplier, as a condition of any contract for purchase or as acceptance of any gift, to receive the source back after its useful lifetime within one year of the recipient requesting
such return, provided that the recipient seeks to return the source to the supplier not later than 15 years after purchase; and
b) submit to the Inspectorate a copy of relevant parts of the contract or acceptance document and obtain its written agreement prior to entering the contract or accepting the source,
c) Any person or organisation that intends to purchase, lease or rent generators of radionuclides, or if such generators are donated, must make arrangements with the supplier or donor, to return the waste resulting from the use of radionuclides, if such waste cannot be cleared after decay storage.

Several safety guidelines and procedures have been developed by the Regulatory Body to aid in enforcing the provisions of the Act and its regulations. **Annex 4 shows list of developed relevant guidelines and procedures.**

**Section F: Other General Safety Provisions**

**F1: Responsibilities of the licence holder (Article 21).**

| 1. Each Contracting Party shall ensure that prime responsibility for the safety of spent fuel or radioactive waste management rests with the holder of the relevant license and shall take the appropriate steps to ensure that each such license holder meets its responsibility. |
| 2. If there is no such license holder or other responsible party, the responsibility rests with the Contracting Party which has jurisdiction over the spent fuel or over the radioactive waste |

**F1.1: Licensees shall**

a) bear the responsibility for establishing and implementing the technical and organisational measures that are needed for ensuring protection and safety for the practices and sources for which they are authorised and for compliance with all applicable requirements of these Regulations;
b) notify the Regulatory Body of their intentions to introduce modifications to any practice or source for which they are licensed whenever the modifications could have significant implications for protection or safety, and shall not carry out any such modification unless specifically authorised by the Regulatory Body; and
c) ensure that only workers who are designated in the application by name or qualification credentials and authorised by reference in the licence, as having key assignments related to protection and safety, and other workers assigned tasks involving operation or handling of radiation sources which could substantially affect protection and safety are permitted to fulfil such required assignments and tasks

**F1.2: Safety culture**

Licensees shall establish a management system, commensurate with the size and nature of the authorised activity, which ensures that -
a) policies and procedures are established that identify protection and safety as being of the highest priority;
b) problems affecting protection and safety are promptly identified and corrected in a manner commensurate with their importance;
c) the responsibilities of each individual for protection and safety are clearly identified and each individual is suitably trained and qualified;
d) clear lines of authority for decisions on protection and safety are defined; and
e) organisational arrangements and lines of communications are established that result in an appropriate flow of information on protection and safety at and between the various levels in the entire organisation of the licensee
F1.3: Radioactive waste

A person who is licensed to generate, keep or manage radioactive waste shall-
(a) be responsible for the safe management of radioactive waste generated by the practice or
source for which he or she is authorized; and shall take all necessary steps to this aim, including keeping the generation of, both, the activity and volume of radioactive waste to the minimum practicable by suitable design, operation and decommissioning of its facilities; ensuring that radioactive waste is managed by appropriate classification, segregation, treatment, conditioning, storage and disposal, and maintain records of such activities; ensuring that disposal of radioactive waste is not unnecessarily delayed; and reporting to the Regulatory Body required information at intervals as may be specified in the licence.
(b) when purchasing a sealed source, make contractual arrangements for the return of the spent sealed source to the manufacturer; and
(c) appoint a technically competent person to be a Radiation Waste Management Officer in order to assist the licensee in the safe and efficient on-site management of radioactive waste.
(d) Subject to the approval of the Board, the Radiation Waste Management Officer and the Radiation Safety Officer may be the same person depending on the size and complexity of the waste management activities,

F2: Human and financial resources (Article 22)

Each Contracting Party shall take the appropriate steps to ensure that: (i) qualified staff is available as needed for safety-related activities during the operating lifetime of a spent fuel and a radioactive waste management facility; (ii) adequate financial resources are available to support the safety of facilities for spent fuel and radioactive waste management during their operating lifetime and for decommissioning; (iii) financial provision is made which will enable the appropriate institutional controls and monitoring arrangements to be continued for the period deemed necessary following the closure of a disposal facility.

The Radiation Protection Inspectorate (in the Act referred to as "the Inspectorate") currently has forty-seven (47) staff members, this include technical and support staff. It consist of a Director, a Deputy Director and such other officers of the Inspectorate, as may be necessary for the proper performance of its functions. The Inspectorate is a public office and accordingly, the provisions of the Public Service Act apply to the Director, Deputy Director and the officers thereof. Therefore, each year, the Inspectorate gets its funding from the Government to sustain its operations. All technical staff within the Inspectorate hold university qualifications and their work experience within the regulatory body ranges from five (5) months to fifteen (15) years.

F3: Quality Assurance (Article 23).

Each Contracting Party shall take the necessary steps to ensure that appropriate quality assurance programmes concerning the safety of spent fuel and radioactive waste management are established and implemented.

Regulation 71 of the Radiation Protection Regulations covers the general requirements on quality assurance and that any person who intends to generate, keep or manage radioactive waste shall submit a Quality Assurance Programme to the Radiation Protection Board for approval as part of the licence application covering all aspects of the radioactive waste management, especially those features important to safety such as facilities, activities and waste and be commensurate with the scale of operations.

Quality assurance documentation shall include-
(a) an inventory of radioactive waste, including origin, location, physical and chemical characteristics, and, as appropriate, a record of radioactive waste removed or discharged from the facility;
(b) site plans, engineering drawings, specifications and process descriptions;
(c) data resulting from quality assurance and quality control procedures and from operating activities;
(d) safety and environmental assessment methods and computer codes;
(e) results of safety and environmental assessments;
(f) effluent and environmental impact monitoring results;
(g) radioactive waste package identification;
(h) disposal facility and
(i) detailed facility closure plan

The Regulatory Body is in the process of obtaining certification from Botswana Bureau of Standards Institution for all its activities in accordance with ISO 9001:2015 Standard. However, one of its laboratory (National Dosimetry laboratory) is ISO17025 accredited. Efforts are being made to accredit its environmental monitoring test methods (gamma and alpha spectrometry test methods), in accordance with ISO17025 Standard.

**F4: Operational Radiation Protection (Article 24).**

| 1. Each Contracting Party shall take the appropriate steps to ensure that during the operating lifetime of a spent fuel or radioactive waste management facility: (i) the radiation exposure of the workers and the public caused by the facility shall be kept as low as reasonably achievable, economic and social factors being taken into account; (ii) no individual shall be exposed, in normal situations, to radiation doses which exceed national prescriptions for dose limitation which have due regard to internationally endorsed standards on radiation protection; and (iii) measures are taken to prevent unplanned and uncontrolled releases of radioactive materials into the environment. 2. Each Contracting Party shall take appropriate steps to ensure that discharges shall be limited: (i) to keep exposure to radiation as low as reasonably achievable, economic and social factors being taken into account; and (ii) so that no individual shall be exposed, in normal situations, to radiation doses which exceed national prescriptions for dose limitation which have due regard to internationally endorsed standards on radiation protection. 3. Each Contracting Party shall take appropriate steps to ensure that during the operating lifetime of a regulated nuclear facility, in the event that an unplanned or uncontrolled release of radioactive materials into the environment occurs, appropriate corrective measures are implemented to control the release and mitigate its effects. |

The Radiation Protection Regulations (regulation 17-21) adopted the IAEA basic concepts of justification, dose limitation and optimization through dose constraint and dose limits.

**F4.1 Regulation 17: Justification of practices**

No practice shall be authorised unless it:

a) produces sufficient benefit to the exposed individuals or to society to offset the radiation harm that it might cause, taking into account social, economic and other relevant factors; and
b) the applicant for an authorisation has provided to the Board sufficient information and evidence on the benefits and the harm to support the justification of the practice,

The following practices are deemed to be not justified whenever they would result in an increase, by deliberate addition of radioactive substances or by activation, in the activity of the associated commodities or products—
a) except for justified practices involving medical exposures, practices involving food, beverages, cosmetics or any other commodity or product intended for ingestion, inhalation or percutaneous intake by, or application to, a human being;
b) practices involving the unjustified use of radiation or radioactive substances in commodities or products such as toys and personal jewellery or adornments; and
c) any other practices determined by the Inspectorate as unjustified,

**F4.2 Regulation 18: Dose limitation**

The normal exposure of individuals shall be restricted so that neither the total effective dose nor the total equivalent dose to relevant organs or tissues, caused by the possible combination of exposures from authorised practices, exceeds any relevant dose limit specified in the Second Schedule, except in the special circumstances considered in regulation 40.

**F4.3 Regulation 19: Optimisation of protection and safety**

In relation to exposures from any particular source within a practice, radiation safety shall be optimised in order that the magnitude of individual doses, except-

a) for therapeutic medical exposures;
b) the number of people exposed;
c) and the likelihood of incurring exposures, are kept as low as is reasonably practicable, taking into account, economic and social factors, within the restriction that the dose to individuals delivered by the source shall be subject to dose constraints, as provided for in regulation 20(2).

The licensee shall use, to the extent practicable, procedures and engineering controls based upon sound radiation safety principles to achieve the objective intended in sub-regulation (1).

**F4.4 Regulation 20: Dose constraints**

Except for medical exposure, the optimisation of the radiation safety measures associated with a given practice shall satisfy the condition that the resulting doses to the individuals of the critical group do not exceed dose constraints which are equal to the dose limits specified in the Second Schedule or any lower values established by the Board.

In case of any source that can release radioactive substances to the environment, the dose constraints shall be established so that the prospective annual doses to members of the public, including people distant from the source and people of future generations, summed over all exposure pathways, including contributions by other practices and sources, are unlikely to exceed the dose limits specified in the Fifth Schedule or any lower values established by the Board.

**F4.3 Discharge or release of radioactive substances to the environment**

The current regulatory requirement is that, all licensed facilities, including radioactive waste management facilities, are to ensure that radioactive substances from their practices and sources are not discharged to the environment unless -

(a) such discharge is within the limits specified in the licence and is carried out in a
(b) controlled fashion using authorised methods; or
(c) the activity discharged is confirmed to be below clearance levels established by the Board as specified in regulation 13 of the Radiation Protection Regulations
The law further states that, Licensees shall, during the operational stages of sources under their responsibility -

a) Keep all radioactive discharges as far below the authorised limits as is reasonably achievable;

b) Monitor and record the discharges of radionuclides with sufficient detail and accuracy to demonstrate compliance with the authorised discharge limits and to permit estimation of the exposure of critical group of population;

d) Report discharges to the Inspectorate at such intervals as may be specified in the licence; and

(e) Report promptly to the Inspectorate any discharges exceeding the authorised limits.

F5: Emergency Preparedness (Article 25).

F5.1 National Radiological Emergency Response Provisions

The Radiation Protection Act of 2006 gives the primary responsibility for emergency responses to licensees. However, the Regulatory Body, together with other emergency response organizations have to take responsibility of emergency situations where a licensee is not directly involved, such as in situations of non-authorized activities, including activities relating to dangerous sources obtained illicitly and or orphaned sources. To this end, the Regulatory Body has developed a national Radiological Emergency Preparedness and Response Plan, whose aim and objective is to ensure that arrangements are in place for a timely, managed, controlled, coordinated and effective response at the scene and at local, national, regional and international level. The response plan is part of the existing structures of responding to disasters within the country.

To ensure that the emergency preparedness and response plan is consistent with the level of threat in the country reference was made to IAEA SAFETY STANDARD SERIES No. GS-R-2, (Preparedness and Response for a Nuclear or Radiological Emergency). According to the IAEA radiological threat categories, there are no facilities in category I, II, III and V in Botswana. All radiation facilities or practices in the country fall in threat category IV, which applies to all States and jurisdictions that do not have nuclear facilities. According to the country’s source inventory, most of the sources fall in source category 4 with a few in source categories 3 and 5. Sealed sources utilised at one private hospital are classified as category 2. Based on the country’s current inventory and threat category, conditions that can trigger an emergency response include the following: a discovered dangerous source, transport accident involving radioactive source, nuclear threats, facility emergencies, missing dangerous sources, elevated levels of unknown origin and space object re-entry. The severity of the radiological disasters will be measured using the International Nuclear and Radiological Event Scale (INES).

F5.2: Requirements for Emergency Intervention (regulations 95-98)

F5.2.1: Responsibilities of licensees

If an authorised practice or source within a practice has a potential for accidents which may provoke unplanned exposure of any person, the licensee shall ensure that an emergency plan appropriate for the source and its associated risks is prepared and is kept operational. If an
authorised source is involved in an accident or incident, the licensee is responsible for taking such protective actions as may be required for protection of occupationally exposed workers undertaking intervention and for protection of the public from exposure set forth in the licence application and emergency plans approved by the Inspectorate, or as might otherwise be required by the inspectorate to protect against, mitigate or remediate a hazardous situation involving the licensed sources.

F5.2.2: Licensee emergency response planning requirements

Licensee responsible for sources for which prompt intervention may be required shall ensure that there is an emergency plan which defines on-site responsibilities and takes account of off-site responsibilities of other intervening organisations appropriate for implementation of the emergency plan. The emergency plan referred to above shall:

a) characterise the content, features and extent of a potential emergency taking into account the results of any accident analysis and any lessons learned from operating experience and from accidents that have occurred with sources of a similar type;

b) identify the various operating and other conditions of the source which could lead to the need for intervention;

c) describe the methods and instruments for assessing the accident and its consequences on and off the site;

d) provide for protection and mitigation actions, and assignment of responsibilities for initiating and discharging such actions;

e) provide for rapid and continuous assessment of the accident as it proceeds and determining the need for protective actions;

f) allocate responsibilities for notifying the relevant authorities and for initiating intervention;

g) provide procedures, including communication arrangements, for contacting any relevant intervening organisation and for obtaining assistance from fire-fighting, medical, police and other relevant organisations;

h) provide for training personnel involved in implementing emergency plans to be rehearsed at suitable intervals in conjunction with designated authorities; and

i) provide for periodic review and updating of the plan

F5.2.3: Implementation of intervention

The licensee shall ensure that the protective actions or remedial actions aimed at reducing or averting accidental exposures are only undertaken when they are justified, taking into account health, social and economic factors. The form, scale and duration of any justified interventions shall be optimised so as to produce the maximum net benefit under the prevailing social and economic circumstances. Licensees shall promptly notify the Inspectorate when an accidental situation requiring intervention has arisen or is expected to arise and shall keep them informed of:

a) the current situation and its expected evolution;

b) the measures taken to terminate the accident and to protect workers and members of the public; and

(c) the exposures that have been incurred and that are expected to be incurred

F5.2.4: Intervention doses

No worker undertaking an intervention shall be exposed in excess of the maximum single year dose limit for occupational exposure specified in the Second Schedule:

a) for the purpose of saving life or preventing serious injury; or

b) if undertaking actions to prevent the development of catastrophic conditions
Workers who undertake actions in which the dose may exceed the maximum single year dose limit shall be volunteers and shall be clearly and comprehensively informed in advance of the associated health risk, and shall, to the extent feasible, be trained in the actions that may be required. Once the emergency phase of an intervention has ended, workers undertaking recovery operations, such as repairs to equipment and buildings, waste disposal or decontamination shall be subject to the full system of detailed requirements for occupational exposure specified in the Regulations. All reasonable steps shall be taken to provide appropriate protection during the emergency intervention and to assess and record the doses received by workers involved in emergency intervention. When the intervention has ended, the doses received and the consequent health risk shall be communicated to the workers involved. Workers shall not be precluded from incurring further occupational exposure because of doses received in an emergency exposure situation. Medical advice shall be obtained by the licensee before the exposure is incurred if a worker who has undergone an emergency exposure receives a dose exceeding 10 times the maximum single year dose limit, or at the worker’s request. **Annex 5 shows the Radiation Protection Inspectorate Radiological Emergency Response Flow Chart**

The regulatory body has nineteen (19) Thermo-luminescent dosimeter (TLD) stations installed at Meteorological weather stations across the country, to monitor ambient background radiation. The data from the TLD stations is combined with meteorological data to make an informed regulatory assessment. Furthermore, the Regulatory body also operates an automatic high-volume air sampling equipment, housed at the national environmental laboratory. Air aerosols are collected at set period of hours during night time to minimise the effect of car fumes, and the air filters are then sent to the Regulatory body Environmental Radio-analysis laboratory for analysis. The results are very useful for assessing possible effects of suspected radioactivity releases. The station is located in the capital city, within the industrial area. An accidental release of airborne radionuclides would be likely to be detected due to the high sensitivity of the station.

The Regulatory body also has a real-time search, surveillance and data recording mobile radiation Monitoring System mounted on a vehicle for radiation searches, lost sources, contamination, emergency response, security. The system has a high resolution (1024 channel) gamma spectrometer that makes the measurement of both the naturally occurring and man-made radioactive elements as transparent and automatic an operation as possible allowing the system to be operated by radiation non-specialists. The system consists of two NaI gamma detector and a He tube array for neutron detection packaged in a vehicle roof-top carrier. Each gamma detector has its own Advanced Digital Spectrometer (ADS) and spectral summation of multiple detectors is performed without degradation or distortion. The neutron detector utilizes techniques to eliminate ‘noise’ caused by vibration and high frequency EM interference.

**F6: Decommissioning (Article 26)**

> Each Contracting Party shall take the appropriate steps to ensure the safety of decommissioning of a nuclear facility. Such steps shall ensure that: (i) qualified staff and adequate financial resources are available; (ii) the provisions of Article 24 with respect to operational radiation protection, discharges and unplanned and uncontrolled releases are applied; (iii) the provisions of Article 25 with respect to emergency preparedness are applied; and (iv) records of information important to decommissioning are kept

Botswana does not have nuclear facilities as such this Article does not apply.
However, provisions for decommissioning of a radiation facility or radioactive facility are provided for in Regulations 60 and 71 of the Radiation Protection Regulations, 2008, and states that: Licensees shall be responsible for the safe management of the radioactive waste generated by the practices or sources for which they are authorised and shall take all necessary steps to this aim, including: keeping the generation of, both, the activity and volume of radioactive waste to the minimum practicable by suitable design, operation and decommissioning of its facilities, and that the quality assurance documentation shall include, detailed facility closure plan.

Section G. Safety of Spent fuel Management

Each Contracting Party shall take the appropriate steps to ensure that at all stages of spent fuel management, individuals, society and the environment are adequately protected against radiological hazards. In so doing, each Contracting Party shall take the appropriate steps to: (i) ensure that criticality and removal of residual heat generated during spent fuel management are adequately addressed; (ii) ensure that the generation of radioactive waste associated with spent fuel management is kept to the minimum practicable, consistent with the type of fuel cycle policy adopted; (iii) take into account interdependencies among the different steps in spent fuel management; (iv) provide for effective protection of individuals, society and the environment, by applying at the national level suitable protective methods as approved by the regulatory body, in the framework of its national legislation which has due regard to internationally endorsed criteria and standards; (v) take into account the biological, chemical and other hazards that may be associated with spent fuel management; (vi) strive to avoid actions that impose reasonably predictable impacts on future generations greater than those permitted for the current generation; (vii) aim to avoid imposing undue burdens on future generations.

This section regarding safety of spent fuel management (Articles 4 – 10) is not applicable to Botswana.

- Article 4. General safety requirements
- Article 5. Existing facilities
- Article 6. Siting of proposed facilities
- Article 7. Design and construction of facilities
- Article 8. Assessment of safety of facilities
- Article 9. Operation of facilities
- Article 10. Disposal of spent fuel

Section H. Safety of Radioactive Waste Management

Each Contracting Party shall take the appropriate steps to ensure that at all stages of radioactive waste management individuals, society and the environment are adequately protected against radiological and other hazards. In so doing, each Contracting Party shall take the appropriate steps to: (i) ensure that criticality and removal of residual heat generated during radioactive waste management are adequately addressed; (ii) ensure that the generation of radioactive waste is kept to the minimum practicable; (iii) take into account interdependencies among the different steps in radioactive waste management; (iv) provide for effective protection of individuals, society and the environment, by applying at the national level suitable protective methods as approved by the regulatory body, in the framework of its national legislation which has due regard to internationally endorsed criteria and standards; (v) take into account the biological, chemical and other hazards that may be associated with radioactive waste management; (vi) strive to avoid actions that impose reasonably predictable impacts on future generations greater than those permitted for the current generation; (vii) aim to avoid imposing undue burdens on future generations.
This section covers the obligations under the following articles:

Article 11. General safety requirements
Article 12. Existing facilities and past practices
Article 13. Siting of proposed facilities
Article 14. Design and construction of facilities
Article 15. Assessment of safety of facilities
Article 16. Operation of facilities
Article 17. Institutional measures after closure

**H1: General Safety Requirements (Article 11)**

**H1.1 Radioactive Waste Management**

The current regulatory requirement is that, no person or organisation shall generate, keep or manage radioactive waste except in accordance with a licence issued by the Board. Licensees are responsible for the safe management of the radioactive waste generated by the practices or sources for which they are authorised and shall take all necessary steps to this aim, including:

- e) keeping the generation of, both, the activity and volume of radioactive waste to the minimum practicable by suitable design, operation and decommissioning of its facilities;
- f) ensuring that radioactive waste is managed by appropriate classification, segregation, treatment, conditioning, storage and disposal, and maintain records of such activities;
- g) ensuring that disposal of radioactive waste is not unnecessarily delayed; and
- h) reporting to the Inspectorate required information at intervals as may be specified in the licence,

Licensees using radioactive material shall, not dismantle any sealed source and before declaring the radioactive material as waste, consider whether the licensee or any other organisation can make use of the material; and if appropriate, transfer the material after confirming with the Inspectorate that the organisation to which it is transferred has the necessary authorisation to hold that material.

**H1.2: Control of radioactive waste generation**

Licensees shall ensure that steps are taken to keep generation of radioactive waste and its environmental impact and cost to the minimum practicable by:

- (a) avoiding the use of unnecessarily hazardous or toxic materials;
- (b) minimising the activity of waste by using the minimum quantity of radioactive material needed;
- (c) using short-lived radionuclides where possible;
- (d) minimising the amount of waste by preventing unnecessary contamination of materials; and
- (e) maintaining consistency with the management strategy and systems

**H1.3: Segregation, collection and characterisation of radioactive waste**

Licensees shall ensure that waste is segregated at the point of origin in accordance with the national waste management strategy as may be directed by the Inspectorate.

**H1.4: Treatment and conditioning of radioactive waste**
Licensees shall ensure that the treatment and conditioning of radioactive waste is carried out in accordance with the national waste management strategy where appropriate, and, in particular, meet any waste acceptance criteria established by the Inspectorate.

H1.5: Discharge or release of radioactive substances to the environment
Licensees shall ensure that radioactive substances from their practices and sources are not discharged to the environment unless:
(a) such discharge is within the limits specified in the licence and is carried out in a controlled fashion using authorised methods; or
(b) the activity discharged is confirmed to be below clearance levels established by the Board.

Licensees, shall, during the operational stages of sources under their responsibility:
(a) keep all radioactive discharges as far below the authorised limits as is reasonably achievable;
(b) monitor and record the discharges of radionuclides with sufficient detail and accuracy to demonstrate compliance with the authorised discharge limits and to permit estimation of the exposure of critical group of population;
(c) report discharges to the Inspectorate at such intervals as may be specified in the licence; and
(d) report promptly to the Inspectorate any discharges exceeding the authorised limits.

Whether activity is released within the clearance levels established by the inspectorate or radioactive waste is discharged under licence, licensees shall consider the non-radiological hazards of the released waste and shall comply with the requirements of any other regulations concerning those hazards.

H1.6: Disposal of radioactive waste
When the radioactive waste is not suitable for discharge or release to the environment or for clearance within a reasonable time, the holder of the waste shall submit to the Inspectorate its proposals for disposal of the waste and ensure that the criteria set by the Inspectorate for acceptance of the waste at any repository or any national waste management organisation are met.

H1.7: Transport of radioactive waste
Licensees shall ensure that radioactive waste is prepared for transport to a storage or disposal site, and is regarded as a radioactive source for transport in accordance with the Regulations as well as the International Atomic Energy Agency Regulations for the Safe Transport of Radioactive Material.

H1.8: Waste storage
Radioactive waste shall be stored in such a way as to protect human health and the environment, and, in particular, shall not be stored in the vicinity of corrosive, explosive or easily flammable materials.

H1.9: Recycle and reuse of radioactive material
Licensees using radioactive material shall:
(a) not dismantle any sealed source;
(b) before declaring the radioactive material as waste, consider whether the licensee or any other organisation can make use of the material; and
(c) if appropriate, transfer the material after confirming with the Inspectorate that the organisation to which it is transferred has the necessary authorisation to hold that material

**H1.10: Return of sealed sources to the manufacturer**

When purchasing sealed sources, licensees shall make contractual arrangements for the return of the spent sealed sources to the manufacturer or supplier. Any person or organisation that intends to import a sealed source containing radioactive material which 10 years after receipt will have an activity greater than 100 MBq shall:

(a) require the supplier, as a condition of any contract for purchase or as acceptance of any gift, to receive the source back after its useful lifetime within one year of the recipient requesting such return, provided that the recipient seeks to return the source to the supplier not later than 15 years after purchase; and

(b) submit to the Inspectorate a copy of relevant parts of the contract or acceptance document and obtain its written agreement prior to entering the contract or accepting the source

Any person or organisation that intends to purchase, lease or rent generators of radionuclides, or if such generators are donated, must make arrangements with the supplier or donor, to return the waste resulting from the use of radionuclides, if such waste cannot be cleared after decay storage.

**H1.11: Quality assurance programmes**

Licensees shall submit a Quality Assurance Programme to the Board for approval as part of the licence application covering all aspects of the radioactive waste management, especially those features important to safety such as facilities, activities and waste and be commensurate with the scale of operations. The effectiveness of the Quality Assurance Programme shall be verified by independent audits to ensure that radioactive waste management activities are carried out to meet the requirement to protect human health and the environment. Quality assurance documentation shall include:

- an inventory of radioactive waste, including origin, location, physical and chemical characteristics, and, as appropriate, a record of radioactive waste removed or discharged from the facility;
- site plans, engineering drawings, specifications and process descriptions;
- data resulting from quality assurance and quality control procedures and from operating activities;
- safety and environmental assessment methods and computer codes;
- results of safety and environmental assessments;
- effluent and environmental impact monitoring results;
- radioactive waste package identification;
- disposal facility and
detailed facility closure plan

**H1.12: Physical protection**

The licensee shall ensure that all necessary means are taken to prevent unauthorised persons gaining access to the waste.

**H1.13: Records and reports**

Licensees shall report to the Inspectorate an up-to-date inventory record of radioactive waste in their possession. The inventory shall be in such form and contain such details as the Inspectorate
may require. Licensees shall send to the Inspectorate before 15th of January, every year a copy of their waste inventory and a report for the previous year giving types, quantities and destinations of:

(a) cleared materials released to the environment;
(b) waste discharged to the environment;
(c) spent radiation sources returned to suppliers; and
(d) such other details as the Inspectorate may require.

The Inspectorate has the right to inspect and review the records of a licensee at any time. If any radioactive waste has been lost, stolen or is missing, the licensee shall inform the Inspectorate not later than 24 hours of the occurrence or discovery. If radioactive material has been released to the environment above the clearance criteria established by the Board or if waste has been discharged above the limits of licence issued by the Board, the licensee shall inform the inspectorate not later than 24 hours of the occurrence or discovery. The reports shall be followed by written reports submitted to the Inspectorate within 21 days concerning the matter and the actions which have been taken.

H2: Existing Facilities and Past Practices (Article 12)

Currently there is no national storage facility in the country to store and manage spent sealed sources. The regulatory requirement is that all spent sources must be returned to supplier by the licensee. However, the Regulatory body, with the assistance of the USA-Department of Energy, did construct a temporary storage facility, using a steel transport cargo container and the facility is currently being used to store confiscated or impounded sealed sources by the radiation Inspectors and security organs (Police, Customs) while investigations are being made regarding the impounded source. Efforts are being made by the government to construct a national storage and conditioning facility for spent sealed sources during National Development Plan 11 (2017 – 2023). However, end users are required to construct storage facilities, within their facilities to store their sealed sources, while awaiting to be sent back to supplier.

H3: Siting of Proposed Facilities, Design and construction of facilities, Assessment of safety of facilities, Operation of facilities and Institutional measures after closure (Article 13 to Article 17)

Efforts are being made by the government to construct a national storage and conditioning facility for spent sealed sources during National Development Plan 11 (2017 – 2023). To this end, siting for the suitable location to construct the facility is on-going. The Regulatory body will ensure that all necessary regulatory steps, including, siting, suitable design, construction, operation and decommissioning of the proposed national storage facility are abide by, in line with the Joint Convention provisions and applicable national legislations and regulations.
Section I: Trans-boundary Movement

1. Each Contracting Party involved in transboundary movement shall take the appropriate steps to ensure that such movement is undertaken in a manner consistent with the provisions of this Convention and relevant binding international instruments. In so doing: (i) a Contracting Party which is a State of origin shall take the appropriate steps to ensure that transboundary movement is authorized and takes place only with the prior notification and consent of the State of destination; (ii) transboundary movement through States of transit shall be subject to those international obligations which are relevant to the particular modes of transport utilized; (iii) a Contracting Party which is a State of destination shall consent to a transboundary movement only if it has the administrative and technical capacity, as well as the regulatory structure, needed to manage the spent fuel or the radioactive waste in a manner consistent with this Convention; (iv) a Contracting Party which is a State of origin shall authorize a transboundary movement only if it can satisfy itself in accordance with the consent of the State of destination that the requirements of subparagraph (iii) are met prior to transboundary movement; (v) a Contracting Party which is a State of origin shall take the appropriate steps to permit re-entry into its territory, if a transboundary movement is not or cannot be completed in conformity with this Article, unless an alternative safe arrangement can be made. 2. A Contracting Party shall not license the shipment of its spent fuel or radioactive waste to a destination south of latitude 60 degrees South for storage or disposal. 3. Nothing in this Convention prejudices or affects: (i) the exercise, by ships and aircraft of all States, of maritime, river and air navigation rights and freedoms, as provided for in international law; (ii) rights of a Contracting Party to which radioactive waste is exported for processing to return, or provide for the return of, the radioactive waste and other products after treatment to the State of origin; (iii) the right of a Contracting Party to export its spent fuel for reprocessing; (iv) rights of a Contracting Party to which spent fuel is exported for reprocessing to return, or provide for the return of, radioactive waste and other products resulting from reprocessing operations to the State of origin.

The shipment of radiation material in and outside Botswana is subject to the international requirements regarding transportation of radioactive material. The provisions of the Radiation Protection Regulations, 2008 govern the domestic and international transportation of radioactive material, as defined in regulation 74 to 94. The current regulatory requirement is that Licensees are required to apply for a permit to import/export and transport radioactive material inland (Annex 6: Template for an Import/Export Permit). Furthermore, the Regulatory Body requires Licensees to ensure that radioactive material, including radioactive waste, is prepared for transport to a storage or disposal site, and is regarded as a radioactive source for transport in accordance with the Regulations as well as the International Atomic Energy Agency Regulations for the Safe Transport of Radioactive Material (TS-R-2).

Radioactive material are mainly transported by road and air in and outside the country. According to the Radiation Protection Act and Radiation Protection Regulations, source owners’ needs to have approval from the Regulatory Body to import, export and transport such source. Transport couriers from other countries are subject to international regulations on the shipment of dangerous goods, including radioactive material. Therefore, all transport couriers are required at ports of entry to show proof that sources being transported has been authorised from country of origin to be transported. If such, documents are not availed at port of entry, such consignment is denied entry into the country. As a strategy to control illicit trafficking of sealed sources, the Regulatory body has signed a Memorandum of Understanding with the Botswana Unified Revenue Services (Customs), to work together to intensify control of importation and exportation of radioactive material in the country. To this end, the Regulatory body has trained several Customs officials on how to detect and identify radioactive material and also the required transport documentations.

Furthermore, licensees are required by law to make contractual arrangements for the return of the spent sealed sources to the manufacturer or supplier when purchasing such sources and to also submit to the Inspectorate a copy of relevant parts of the contract or acceptance document.
and obtain its written agreement prior to entering the contract or accepting the source. There has never been a shipment of radioactive waste from Botswana to a destination south of latitude 60 degrees south and no such shipment would be allowed.

**Section J: Disused Sealed Sources (Article 28)**

1. Each Contracting Party shall, in the framework of its national law, take the appropriate steps to ensure that the possession, remanufacturing or disposal of disused sealed sources takes place in a safe manner. 2. A Contracting Party shall allow for re-entry into its territory of disused sealed sources if, in the framework of its national law, it has accepted that they be returned to a manufacturer qualified to receive and possess the disused sealed sources.

Sealed sources in Botswana are used mainly in health, agriculture, mining, research, manufacturing and construction industries. Currently the total number of registered and licensed facilities stands at two-hundred-and-thirty-one (231). While that of registered sealed sources stands at six-hundred-and-fifteen.

The Radiation Protection Act and Radiation Protection Regulations, implement the obligations under Article 28 of the Joint Convention ensuring that possession, storage and disposal of disused sealed sources take place in a safe manner. Because the country does not have a condition and disposal facility for sealed sources, the current regulatory requirement is that, when purchasing sealed sources, Licensees shall make contractual arrangements for the return of the spent sealed sources to the manufacturer or supplier. Any person or organisation that intends to import a sealed source containing radioactive material which 10 years after receipt will have an activity greater than 100 MBq shall:

a) require the supplier, as a condition of any contract for purchase or as acceptance of any gift, to receive the source back after its useful lifetime within one year of the recipient requesting such return, provided that the recipient seeks to return the source to the supplier not later than 15 years after purchase; and

b) submit to the Inspectorate a copy of relevant parts of the contract or acceptance document and obtain its written agreement prior to entering the contract or accepting the source.

Any person or organisation that intends to purchase, lease or rent generators of radionuclides, or if such generators are donated, must make arrangements with the supplier or donor, to return the waste resulting from the use of radionuclides, if such waste cannot be cleared after decay storage. However, long term storage and disposal of old disused radioactive sources have been a challenge in the country due to unavailability of a national storage and conditioning facility for spent sources. Those facilities that could not return their old spent sealed sources are currently being advised to store their spent sources at their facility temporary source stores for accountability. However, there is a likelihood of such sources to be stolen as such facility stores are only meant to store sources temporarily not long term. Nonetheless, efforts are being made by government to construct a national storage and conditioning facility for spent sealed sources during National Development Plan 11 (2017 – 2023). To this end, siting for the suitable location to construct the facility is on-going.

Furthermore, Licensees are required by law to report to the Regulatory body an up-to-date inventory record of spent or disused sealed sources in their possession. Licensees shall send to the Regulatory body, every year, a copy of their waste inventory and a report for the previous year giving types, quantities and destinations of:

a) cleared materials released to the environment;

b) waste discharged to the environment;
c) spent radiation sources returned to suppliers; and
d) such other details as the Inspectorate may require

As part of its enforcement activities, the Regulatory body do audit all facilities where sealed sources are used or stored in order to ensure that the usage and storage of such sources is in line with the prevailing regulatory requirements and conditions in the licenses.

Botswana does not have manufacturing plants for sealed sources, as such, all sealed sources are imported into the country. As for orphan sources, the regulatory requirement is that such sources shall be recovered from public domain and taken under the custody of the Regulatory body for proper storage, while investigations are being made to establish the source owner. However, it has been established that orphan sources are rarely identified in Botswana. There have only been one case where a sealed source (troxler gauge) was found at a local scrap metal after the owner actioned scrap metals to the scrap yard. Due to good relationship between the Regulatory body and the scrap metal dealers, the scrap metal owner notified the Regulatory of such incident and the source was recovered and sent back to the owner, who, then sent it back to the supplier.

As a strategy to aid in the recovery of orphan sources, the Regulatory body has procured a real-time search, surveillance and data recording mobile radiation Monitoring System mounted. The system has a high resolution (1024 channel) gamma spectrometer that makes the measurement of both the naturally occurring and man-made radioactive elements as transparent and automatic an operation as possible allowing the system to be operated by radiation non-specialists. The system consists of two NaI gamma detector and a He tube array for neutron detection packaged in a vehicle roof-top carrier. Each gamma detector has its' own Advanced Digital Spectrometer (ADS) and spectral summation of multiple detectors is performed without degradation or distortion. The neutron detector utilizes techniques to eliminate 'noise' caused by vibration and high frequency EM interference. **Annex 2: Inventory of Spent/ Disused sealed sources in Botswana**

### Section K: General Efforts to Improve Safety

This section provides an opportunity to give a summary of safety issues of concern identified earlier and of planned future actions to address those issues

This is the first national report submitted by the Republic of Botswana on the implementation of its obligations under the Joint Convention on “the safety of spent fuel management and on the safety of radioactive waste management” and reaffirms its commitment in the management of radioactive waste and spent sources and that additional safety measures on the management of radioactive waste will be needed over the coming years when more radiation facilities emerges. The Radiation Protection Inspectorate and other relevant stakeholders within the country are fully committed to meeting the obligations of the Joint Convention. To this end, Licensees continue to return their spent sealed sources to the manufacturer or supplier as required by law. Furthermore, the Regulatory body has signed a Memorandum of Understanding with the Botswana Unified Revenue Services (Customs), to work together to intensify control of importation and exportation of radioactive material in the country.

Long term storage and disposal of old spent radioactive sources, that were procured before the Radiation Act was promulgated, have been a challenge in the country due to unavailability of a national storage and conditioning facility for spent sources. Some radiation facilities have encountered challenges when returning their spent sources if the source supplier is no longer in business. As such, if a cost effective way of disposal is not found by the end users, there is a risk
that such sources are going to be kept indefinitely at the facility temporary source stores without a defined procedure for final disposal. Nonetheless, efforts are being made by government to construct a national storage and conditioning facility for spent sealed sources during National Development Plan 11 (2017 – 2023). To this end, siting for the suitable location to construct the facility is on-going. Alternatively, the Regulatory body, with the assistance of the USA-Department of Energy, did construct a temporary storage facility in 2012, using a steel transport cargo container, to temporarily store confiscated or impounded sealed sources by the radiation Inspectors and security organs (Police, Customs) while investigations are being made regarding the impounded source.

In Botswana, spent sources have the same legal status as sources in active use as they are all subject to the same regulatory requirements and are to be kept safe and secure and are subject to regular inspections. Additionally, once sources are taken out of active use the licensee is required by law to notify the Regulatory body. The Regulatory body is empowered to demand the disposal of a radioactive source that is no longer in use and is not properly secure.

Planned efforts to strengthened regulatory framework to enhance safety of radioactive waste management will include:

- Revising the current Radiation Protection Act, 2006 and Radiation Protection Regulations, 2008 to align them to the prevailing IAEA safety requirements and all principles and requirements specified in the Joint Convention. The plan is to review the laws during 2017/18 financial year and presented in Parliament in 2018/19 financial year.

- Construction of a national storage and conditioning facility for spent sealed sources during National Development Plan 11 (2017 – 2023). To this end, siting for the suitable location to construct the facility is on-going. The Regulatory body will ensure that all regulatory steps, including, siting, suitable design, construction, operation and decommissioning of the proposed national storage facility are abide by, in line with the Joint Convention provisions and applicable International safety requirements and national legislations and regulations.

- Installation of portal monitors at six commercial ports of entry during National Development Plan 11 (2017 – 2023) to intensify control of importation and exportation of radioactive material in the country, including spent sources returned to suppliers.

- At the request of the Government of Botswana, an international team of eleven experts and an observer in radiation safety and security will be visiting the Radiation Protection Inspectorate (RPI), an executive arm of the Radiation Protection Board (RPB), from 15 to 24 October 2017 to conduct an Integrated Regulatory Review Service (IRRS) mission to review the country’s regulatory framework and the effectiveness of the RPI, as the body responsible for discharging day-to-day regulatory functions for radiation protection and safety in relation to activities involving radiation sources and radiation facilities in Botswana.
Section L: Annexes (Article 38)

ANNEX 1:
RADIOACTIVE WASTE CLASSIFICATION

<table>
<thead>
<tr>
<th>Class</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cleared material/waste</td>
<td>Materials containing levels of radionuclides at concentrations less than the clearance levels established by the Radiation Protection Inspectorate</td>
</tr>
<tr>
<td>Low level (short-lived)/</td>
<td>Low level radioactive waste containing short-lived radionuclides only (e.g. with half-lives less than 10 days) that will decay to clearance levels within three years after the time of its generation</td>
</tr>
<tr>
<td>Decay waste</td>
<td></td>
</tr>
<tr>
<td>Low and intermediate level</td>
<td>Waste which will not decay to clearance levels within three years and contains beta/gamma emitting radionuclides with half-lives less than 30 years and/or alpha emitting radionuclides with an activity less than 400 Bq/g and a total activity less than 4000 Bq in each waste package</td>
</tr>
<tr>
<td>short-lived waste (LILW-SL)</td>
<td></td>
</tr>
<tr>
<td>Low and intermediate level</td>
<td>Radioactive waste containing radionuclides with concentrations above those for LBLW-SL, but which does not generate heat at above 2 kW/m² of waste.</td>
</tr>
<tr>
<td>long-lived waste (LILW-LL)</td>
<td></td>
</tr>
</tbody>
</table>

Annex 2:

Inventory of Spent Sealed Radioactive Sources as of 20th October 2017

The number of registered sealed sources in use in Botswana continues to increase, and the number stands at six-hundred-and-fifteen (615) as of 20th October 2017. While the number of disused/ spent sealed sources stored at end user’s facilities is somewhat decreasing, albeit at slow rate, as end-users continue to make efforts to return their disused/ spent sealed sources to the manufacturer or supplier as required by law.

The inventory shared below reflect the current number of disused/ spent sealed sources kept at end-users temporary source stores, which are subjected to regular inspections by the Regulatory Body.
Table 1: Short Lived (Half-Life < 100 Days) Sealed Source

<table>
<thead>
<tr>
<th>Item</th>
<th>Isotope</th>
<th>Activity</th>
<th>Source Category</th>
<th>Source Location</th>
<th>Quantity</th>
<th>Planned Method of Disposal</th>
</tr>
</thead>
</table>
| 1    | Ir-192  | exemptio n levels | 2 | source storage | 1 | • Decay and store  
• The source is exchanged every 3 months and the old source is sent back to supplier |

Table 2: Spent Sources at the Department of Geological Survey

<table>
<thead>
<tr>
<th>Item</th>
<th>Nuclide</th>
<th>Activity (Bq)</th>
<th>Source Location</th>
<th>Quantity</th>
<th>Practice</th>
<th>Planned Method of Disposal</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Am-241/Be</td>
<td>3Ci</td>
<td>source storage</td>
<td>1</td>
<td>exploration</td>
<td>long term store</td>
</tr>
<tr>
<td>2</td>
<td>Cs-137</td>
<td>125mCi</td>
<td>source storage</td>
<td>1</td>
<td>exploration</td>
<td>long term store</td>
</tr>
<tr>
<td>3</td>
<td>not identified</td>
<td>corroded</td>
<td>source storage</td>
<td>1</td>
<td>exploration</td>
<td>long term store</td>
</tr>
<tr>
<td>4</td>
<td>not identified</td>
<td>corroded</td>
<td>source storage</td>
<td>1</td>
<td>exploration</td>
<td>long term store</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Total 4</td>
</tr>
</tbody>
</table>

Table 3: Spent Sources at BCL Mine

<table>
<thead>
<tr>
<th>Item</th>
<th>Nuclide</th>
<th>Activity (Bq)</th>
<th>Source Location</th>
<th>Quantity</th>
<th>Practice</th>
<th>Planned Method of Disposal</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Cs-137</td>
<td>1.07GBq</td>
<td>source storage</td>
<td>1</td>
<td>level gauge</td>
<td>send back to supplier</td>
</tr>
<tr>
<td>2</td>
<td>Cs-137</td>
<td>corroded</td>
<td>source storage</td>
<td>3</td>
<td>level gauge</td>
<td>send back to supplier</td>
</tr>
<tr>
<td>3</td>
<td>Cs-137</td>
<td>1.9GBq</td>
<td>source storage</td>
<td>5</td>
<td>level gauge</td>
<td>send back to supplier</td>
</tr>
<tr>
<td>4</td>
<td>Cs-137</td>
<td>1.85GBq</td>
<td>source storage</td>
<td>8</td>
<td>level gauge</td>
<td>send back to supplier</td>
</tr>
<tr>
<td>5</td>
<td>Cs-137</td>
<td>1.1GBq</td>
<td>source storage</td>
<td>1</td>
<td>level gauge</td>
<td>send back to supplier</td>
</tr>
<tr>
<td>6</td>
<td>Cs-137</td>
<td>0.925GBq</td>
<td>source storage</td>
<td>1</td>
<td>density gauge</td>
<td>send back to supplier</td>
</tr>
<tr>
<td>7</td>
<td>Cs-137</td>
<td>3.7GBq</td>
<td>source storage</td>
<td>1</td>
<td>level gauge</td>
<td>send back to supplier</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Total 20</td>
</tr>
</tbody>
</table>
Table 4: *Spent Sources at Tati Nickel Mine*

<table>
<thead>
<tr>
<th>Item</th>
<th>Nuclide</th>
<th>Activity (Bq)</th>
<th>Source location</th>
<th>Quantity</th>
<th>Practice</th>
<th>Planned Method of Disposal</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Cs-137</td>
<td>20mCi</td>
<td>source storage</td>
<td>1</td>
<td>density gauge</td>
<td>send back to supplier</td>
</tr>
<tr>
<td>2</td>
<td>Cs-137</td>
<td>150mCi</td>
<td>source storage</td>
<td>1</td>
<td>density gauge</td>
<td>send back to supplier</td>
</tr>
<tr>
<td>3</td>
<td>Cs-137</td>
<td>217MBq</td>
<td>source storage</td>
<td>1</td>
<td>density gauge</td>
<td>send back to supplier</td>
</tr>
<tr>
<td>4</td>
<td>Cs-137</td>
<td>199MBq</td>
<td>source storage</td>
<td>1</td>
<td>density gauge</td>
<td>send back to supplier</td>
</tr>
<tr>
<td>5</td>
<td>Cs-137</td>
<td>100mCi</td>
<td>source storage</td>
<td>4</td>
<td>density gauge</td>
<td>send back to supplier</td>
</tr>
<tr>
<td>6</td>
<td>Cs-137</td>
<td>1.85MBq</td>
<td>source storage</td>
<td>2</td>
<td>density gauge</td>
<td>send back to supplier</td>
</tr>
<tr>
<td>7</td>
<td>Cs-137</td>
<td>3.7MBq</td>
<td>source storage</td>
<td>4</td>
<td>density gauge</td>
<td>send back to supplier</td>
</tr>
<tr>
<td>8</td>
<td>Cs-137</td>
<td>372MBq</td>
<td>source storage</td>
<td>1</td>
<td>density gauge</td>
<td>send back to supplier</td>
</tr>
<tr>
<td>9</td>
<td>Cs-137</td>
<td>377MBq</td>
<td>source storage</td>
<td>1</td>
<td>density gauge</td>
<td>send back to supplier</td>
</tr>
<tr>
<td></td>
<td><strong>Total</strong></td>
<td></td>
<td></td>
<td><strong>16</strong></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Table 5: *Spent Source at Princess Marina Hospital - Eye Clinic*

<table>
<thead>
<tr>
<th>Item</th>
<th>Nuclide</th>
<th>Activity (Bq)</th>
<th>Source location</th>
<th>Quantity</th>
<th>Practice</th>
<th>Method of Disposal</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Sr-90</td>
<td>55mCi</td>
<td>source storage</td>
<td>1</td>
<td>therapy</td>
<td>long term store</td>
</tr>
<tr>
<td></td>
<td><strong>Total</strong></td>
<td></td>
<td></td>
<td><strong>1</strong></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Table 6: *Disused Low Activity Sources at the University Of Botswana*

<table>
<thead>
<tr>
<th>Item</th>
<th>Nuclide</th>
<th>Activity</th>
<th>Source location</th>
<th>Quantity</th>
<th>Practice</th>
<th>Planned method of Disposal</th>
</tr>
</thead>
<tbody>
<tr>
<td>Am-241</td>
<td>1 μCi</td>
<td>source storage</td>
<td>1</td>
<td>Not being used</td>
<td>long term store</td>
<td></td>
</tr>
<tr>
<td>Am-241</td>
<td>5 μCi</td>
<td>source storage</td>
<td>1</td>
<td>Not being used</td>
<td>long term store</td>
<td></td>
</tr>
<tr>
<td>Y-88</td>
<td>1 μCi</td>
<td>source storage</td>
<td>1</td>
<td>Not being used</td>
<td>long term store</td>
<td></td>
</tr>
<tr>
<td>Na-22</td>
<td>1 μCi</td>
<td>source storage</td>
<td>1</td>
<td>Not being used</td>
<td>long term store</td>
<td></td>
</tr>
<tr>
<td>Co-60</td>
<td>1 μCi</td>
<td>source storage</td>
<td>1</td>
<td>Not being used</td>
<td>long term store</td>
<td></td>
</tr>
<tr>
<td>Sn-113</td>
<td>1 μCi</td>
<td>source storage</td>
<td>1</td>
<td>Not being used</td>
<td>long term store</td>
<td></td>
</tr>
<tr>
<td>Co-57</td>
<td>1 μCi</td>
<td>source storage</td>
<td>1</td>
<td>Not being used</td>
<td>long term store</td>
<td></td>
</tr>
</tbody>
</table>
Table 7: **Disused Low Activity sources at Various Government Senior Secondary Schools**

<table>
<thead>
<tr>
<th>Item</th>
<th>Nuclide</th>
<th>Activity (Bq)</th>
<th>Source Location</th>
<th>Quantity</th>
<th>Practice</th>
<th>Method of Disposal</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Sr-90</td>
<td>1μCi</td>
<td>Physics laboratory Store room</td>
<td>24</td>
<td>Educational (Demonstration)</td>
<td>long term store</td>
</tr>
<tr>
<td>2</td>
<td>Am-241</td>
<td>5μCi</td>
<td>Physics laboratory Store room</td>
<td>11</td>
<td>Educational (Demonstration)</td>
<td>long term store</td>
</tr>
<tr>
<td>3</td>
<td>Ra-226</td>
<td>5μCi</td>
<td>Physics laboratory Store room</td>
<td>10</td>
<td>Educational (Demonstration)</td>
<td>long term store</td>
</tr>
<tr>
<td>4</td>
<td>Co-60</td>
<td>1μCi</td>
<td>Physics laboratory Store room</td>
<td>25</td>
<td>Educational (Demonstration)</td>
<td>long term store</td>
</tr>
<tr>
<td>5</td>
<td>Pb-210</td>
<td>0.1μCi</td>
<td>Physics laboratory Store room</td>
<td>28</td>
<td>Educational (Demonstration)</td>
<td>long term store</td>
</tr>
<tr>
<td>6</td>
<td>Natural radioactive rocks</td>
<td>5μCi</td>
<td>Physics laboratory Store room</td>
<td>4</td>
<td>Educational (Demonstration)</td>
<td>long term store</td>
</tr>
<tr>
<td>Total</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>102</td>
</tr>
</tbody>
</table>
Table 8: Other Radioactive Waste Packages at Mine Exploration Site

<table>
<thead>
<tr>
<th>Isotope</th>
<th>Dose rate on surface</th>
<th>Category</th>
<th>Number of Waste packages</th>
<th>Method of Disposal</th>
</tr>
</thead>
<tbody>
<tr>
<td>Contaminated soil with Cs-137</td>
<td>115µSv/hr</td>
<td>5</td>
<td>27 drums of Cs-137 contaminated soil (5.4m³)</td>
<td>long term storage at end user facility</td>
</tr>
</tbody>
</table>

Total number of waste packages 27 drums of Cs-137 contaminated soil (5.4m³)

ANNEX 3:

SERVICES OFFERED BY THE INSPECTORATE

Radiation Protection Inspectorate core mandate is to Enhance safe use of Radiation Technologies. To implement its mandate, the following services are offered:

<table>
<thead>
<tr>
<th>ITEM</th>
<th>TYPE OF SERVICE</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Regulatory framework</td>
<td>Issue licenses to possess, use or sell radiation sources (Radiation Protection Board – statutory Body)</td>
</tr>
<tr>
<td></td>
<td>Issue import/export permits</td>
</tr>
<tr>
<td></td>
<td>Issue permits to transport radiation sources</td>
</tr>
<tr>
<td></td>
<td>Conduct statutory inspections of facilities using radiation sources</td>
</tr>
<tr>
<td></td>
<td>▪ Pre-authorisation inspection</td>
</tr>
<tr>
<td></td>
<td>▪ Routine inspections,</td>
</tr>
<tr>
<td></td>
<td>▪ Unannounced inspections,</td>
</tr>
<tr>
<td></td>
<td>▪ Follow-up inspections</td>
</tr>
<tr>
<td></td>
<td>▪ Ad hoc Safety Assessment</td>
</tr>
<tr>
<td>2. Occupational Exposure Control</td>
<td>National Dosimetry laboratory Services</td>
</tr>
<tr>
<td></td>
<td>▪ Personal dosimetry services</td>
</tr>
<tr>
<td></td>
<td>▪ Environment dosimetry services</td>
</tr>
<tr>
<td></td>
<td>▪ Workplace monitoring services</td>
</tr>
<tr>
<td>3. Medical exposure control</td>
<td>Conducts quality control tests on radiation equipment in medical practices</td>
</tr>
<tr>
<td>4. Public Exposure Control</td>
<td>Environment Monitoring</td>
</tr>
<tr>
<td></td>
<td>▪ Surveillance measurements of natural background radiation levels</td>
</tr>
<tr>
<td></td>
<td>▪ Assessments of Radon levels indoor/ outdoor;</td>
</tr>
<tr>
<td></td>
<td>▪ Radio-analysis service (measure radioactivity in soil, vegetation and foodstuff (water, vegetables, milk etc.)</td>
</tr>
<tr>
<td>5. Emergency preparedness and response capabilities</td>
<td>Response to radiological emergencies the competent authority in the country is the Radiation Protection Inspectorate.</td>
</tr>
</tbody>
</table>
ANNEX 4:

THE RADIATION PROTECTION INSPECTORATE RADIOTHERMAL EMERGENCY RESPONSE FLOW CHART

NATIONAL RADIOTHERMAL EMERGENCY RESPONSE

1. Licensed/Facility owner reports incident to NWP/NCA (D)
   - Verification and classification on event scale
   - Notify National Disaster Management Office (NDMO)
   - Inform Police and Local authorities to secure location
   - Dispatch reconnaissance team to the site for preliminary assessment

2. Event Scale
   - Less than 3: Reassess levels, implement recovery measures and monitor progress.
     - Conduct investigations and recommend preventive measures.
   - Greater than 3: Inform OP, IEC, and Neighbouring Member States.

3. Event Scale: Equal to 3
   - Brief local authorities about seriousness of event.
   - Notify IEC.
   - Situation upgrading to high event scale: Interim decommissioning of facility.
   - Implement recovery and mitigation measures.
   - Situation contained: Recovery and decontamination completed.

4. Recovery and decontamination completed: Re-occupation/Resettlement
   - Recommissioning of facility

Estimated Total Duration: 48 hours minimum
ANNEX 5:

TEMPLATE FOR AN IMPORT/ EXPORT PERMIT

PERMIT No. / / 

Authority is hereby granted to:
Name of Licensee: Address:

Physical Address of Premises:
Name of Responsible Person:

to import/export ionizing radiation generator(s) as listed below:

<table>
<thead>
<tr>
<th>Manufacturer</th>
<th>Model</th>
<th>Ser. No.</th>
<th>Max kVp</th>
<th>Max mA</th>
<th>Use</th>
<th>Location on Premises</th>
<th>Date Installed</th>
</tr>
</thead>
<tbody>
<tr>
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</tbody>
</table>

RADIOACTIVE SOURCE(S)

<table>
<thead>
<tr>
<th>Nuclide</th>
<th>Activity Category eg.</th>
<th>Package Type</th>
<th>Radiation Level at 10cm</th>
<th>IF SOURCE IS ENCLOSED IN A DEVICE</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Manufacturer</td>
</tr>
<tr>
<td></td>
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<td></td>
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</tr>
</tbody>
</table>

Date of Issue: Place of Issue:

Date of Expiry:

Director – Radiation Protection

Official Stamp
ANNEX 6:

LIST OF RELEVANT ACTS, REGULATIONS & GUIDES

a) ACTS:
   (i) Radiation Protection Act, of 2006, Government of Botswana
       An Act to provide for the safe uses of atomic energy and nuclear technology
       and for matters incidental thereto

b) REGULATIONS:
   (i) Radiation Protection Regulations, of 2008, Government of Botswana
       Radiation Protection: Subsidiary Legislation

c) RELEVANT RADIATION PROTECTION GUIDELINES DEVELOPED
   (i) Radiation Protection Inspectorate Enforcement Policy, dated 1st September 2016;
   (ii) Guideline for Import and Export of Sources and X-ray Generators, dated February 2008,
   (iii) Draft Inspection Guideline Procedure for Medical Diagnostic x-ray facilities in Botswana,
   (iv) Guideline for Radiation Protection in Well Logging and Analytical Devices, dated 24/10/2013
   (v) Guideline for developing Radiation Protection and Safety Programme in Industrial Radiography, dated 28/06/2016;
   (vi) Guideline: Radiation Protection Inspectorate Radiological Emergency Preparedness and Response Plan;
   (vii) Guidelines for the Management OF SPENT and DISUSED SEALED SOURCES, dated March 2009
   (viii) Radiation Safety Guides For The Design Of The On-Site Temporary Storage Facility For Spent Or Disused Radiation Sources; dated March 2009
   (ix) PROCEDURE_03_CONDUCTING AN INSPECTION (Issue 2.0), dated
   (x) Procedure: Issuance of Licenses, dated 23/08/2016;
   (xi) Procedure: Issuance of Permits, dated 23/08/2016;
   (xii) PROCEDURE_02_RADIOACTIVE WASTE MANAGEMENT (Issue 1.0); dated 26/02/2015;
   (xiii) PROCEDURE_03_CONDUCTING AN INSPECTION (Issue 2.0), dated 23/08/2016;
   (xiv) PROCEDURE_05_MANAGEMENT REVIEW (Issue 1.0); dated 26/02/2015
   (xv) PROCEDURE_07_INTERNAL AUDITS (Issue 1.0), dated 26/02/2016;
   (xvi) FORM - Storage Facility Radiation Area Survey (issue No 2), dated 26/02/2016
   (xvii) FORM - Storage Facility Radiological Movement (issue No 2), dated 26/02/2016
(xviii) PROCEDURE_01_RESOURCE MANAGEMENT (Issue 1.0), dated 23/08/2016;
(xix) PROCEDURE_04_COMMUNICATION (Issue 1.0), dated 26/02/2015;