



JOINT CONVENTION ON THE SAFETY OF SPENT FUEL MANAGEMENT AND ON THE SAFETY OF RADIOACTIVE WASTE MANAGEMENT

SECOND NATIONAL REPORT BY THE REPUBLIC OF BOTSWANA

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Section A: Introduction

The description in the report submitted to the 6th review meeting is still valid and most of it is repeated here to give a consistent and comprehensive country overview. This report has been prepared taking into account comments and questions on Botswana's previous report submitted to the 6th review meeting of 2018. 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 became a Contracting Party on 12 Nov 2015. In November 2018 the Government of Botswana also acceded to the IAEA supplementary guidelines on the "*Management of Disused Radioactive Sources*", which were published in 2018 as supplementary guidance to the IAEA Code of Conduct on the Safety and Security of Radioactive Sources, to fulfil its international obligation. There were no declarations or reservations attached to the instrument of accession.

This is Botswana's Second National Report to the 7th Joint Convention Review Meeting. Botswana is a country that has no nuclear industry, no research reactor or other facility manufacturing radioactive substances. There is no nuclear fuel or spent fuel liquid waste on Botswana territory. Therefore, many of the requirements of the Joint Convention under Section G, 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. The two laws are currently being amended by the government, through the Attorney General's Chamber, to close the identified regulatory gaps and to also align them to prevailing international instruments that have been ratified or are going to be ratified, including the Joint Convention. The amended legislations will cover all relevant radiological safety issues, including provisions for safe decommissioning of facilities and remediation of contaminated areas, in line with prevailing IAEA safety standards. With the amended Radiation Protection Act and the Regulations in place, the foundation will be fully established for proper monitoring and supervision of safe management of radioactive waste in the country.

At the request of the Republic of Botswana, an international team of senior nuclear and radiation safety experts conducted an Integrated Regulatory Review Service (IRRS) mission from 15 to 24 October 2017. The purpose of the IRRS mission was to perform a peer review of Botswana's national regulatory framework for nuclear and radiation safety against IAEA safety standards as the international benchmark for safety. The IRRS team concluded that Botswana has made significant progress since the first IRRS mission they hosted in 2008 as the country has a regulatory framework for radiation safety in place as demonstrated during the mission. Nonetheless, there are still challenges to be resolved related to the consistent and effective regulation of the use of ionizing radiation sources in the country.

The total amount of radioactive waste generated and/or stored in Botswana is very low because most spent sealed sources are returned to their suppliers and/or manufacturer for disposal or proper management, in line with the current regulatory requirement. Botswana does not have a final radioactive waste disposal nor centralised storage and conditioning facility. Hence, spent sources are either stored at end-user locations or sent back to suppliers for disposal. As a result, the very low activity and volume of radioactive waste generated in Botswana does not justify for the development of a national final waste disposal or depository facility. However, efforts are being made by the Government to construct a centralised national storage and conditioning facility

during the remaining period of the national development plan 11 (2020 to 2023). The facility will aid in the proper management of the current inventory of spent sources that are stored at licensees' on-site source stores. The project implementation programme was hindered by absence of land.

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 27th October 2020 there were 376 registered facilities (licensees) in the inventory of regulated facilities that use radiation sources in Botswana.

This report is Botswana's second national report and is presented to the 7th Joint Convention Review Meeting to be held on 24th May 2021 in Austria, 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. 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.

Summary of the Main Developments to improve safety during the Reporting Period

The main developments made to improve safety, since the last national report include:

- Commencement for the comprehensive review of the Radiation Protection Act, 2006 and the Radiation Protection Regulations, 2008, which started in November 2018. The review process is at advanced stage as the draft Bill (zero draft) had been compiled by the Attorney General's Chambers as at August 2020. The draft Bill is undergoing government stakeholder review and validation process.
- Government efforts to construct a centralised national storage and conditioning facility for spent sealed sources during the National Development Plan 11 (2017 –2023) are still on-going. To this end, the Botswana International University of Science and Technology has shown interest to absorb the project as part of their strategies to expand their "Nuclear Science and Technology Education Programmes" and the discussions between the Ministry of Tertiary Education are on-going.
- Project implementation for the Installation of portal monitors at six commercial ports of entry to strengthen control of import/export of radioactive material in the country is at advanced stage. To this end, installation of portal monitors at Kazungula border is on-going and the anticipated completion date is March 2021. While implementation for other ports of entry is at design stage as it involves other stakeholders, like customs officials.
- Implementation of the outcomes from the IAEA IRRS mission of October 2017 is on-going and various initiatives are at different stages of implementation. For instance, the comprehensive review process for the Radiation Protection Act, 2006 and its Regulations started in November 2018 and a draft Bill has been compiled. The development of the national policy and strategy for radioactive waste management and that of the national emergency plan is at advanced stages, as drafts for the two documents are in place and are undergoing government validation and approval process. In addition, the regulatory body has embraced graded approach in implementing its regulatory programmes in order to optimise its resources through task prioritisation as recommended by the IRRS mission.

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 specifies the criteria used to define and categorize radioactive waste in the country

B1: Spent fuel management policy and practices

No changes were made to the framework described in the previous report and the conditions and most of the text remain unchanged. There are no nuclear reactors or nuclear fuel facilities on Botswana territory, as such there is nothing to report in relation to spent fuel management (Article 32.1 (i) and (ii)).

B2: Radioactive waste management policy

No significant changes have been made to the legal framework described in the previous report, as the Government is still reviewing the Radiation Protection Act 2006 and Regulations of 2008. In addition, the Government is also finalising a draft national policy and strategy for the *Management of Radioactive Waste and spent sources*, to further demonstrate its commitment in addressing the recommendations made during the IRRS mission to the Republic of Botswana from 15 to 24 October 2017.

The management of radioactive waste in the country is regulated by the Radiation Protection Act, of 2006 and the Radiation Protection Regulations, of 2008, which are consistent with the relevant international principles in the management of radioactive waste. As such, 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 current regulatory requirement is that Licensees are required by the Radiation Protection Act, of 2006 and the Radiation Protection Regulations, of 2008 to return their spent sealed sources to suppliers and/or manufacturer for disposal or proper management, because the country does not

have a centralised national radioactive waste storage and management facility and a disposal facility. Hence, when purchasing a sealed source, Licensees are required by law to make contractual arrangements for the return of the spent sealed source to the supplier/ manufacturer. The Regulations require the Licensees to securely store their sources if they cannot send them back to suppliers, where suppliers are no longer in business.

In the absence of a centralised national storage and conditioning facility for spent/disused sealed sources, the country refurbished a temporary steel cargo container in 2011, with the assistance of the USA-Department of Energy under their global threat reduction initiative, to temporarily store impounded and confiscated sealed sources by front-line officers, while investigations are on-going. The facility is fully operational.

Nonetheless, efforts are still being made by the Government to construct a centralised national storage and conditioning facility for spent sources during National Development Plan 11 (i.e. 2017-2023 financial years), even though the current efforts are being thwarted by lack of land as communities are not willing to host the facility in their villages. Alternatively, the Government is currently consulting other potential stakeholders, like research and academic institutions, to host the facility.

B3. Radioactive waste management practices

Radioactive waste management framework is based on the practical needs of the country. As such, the low activity and volume of radioactive waste generated in the country does not warrant development of a national final waste disposal facility for now. Nonetheless, plans are on-going to construct a centralised national storage and conditioning facility for spent sources, during National Development Plan 11 (i.e. 2017-2023). The current regulatory requirement is that spent and/or disused sealed sources must be returned to the suppliers or manufacturers by Licensees, unless such sources can be stored by Licensees under secure conditions until decayed.

In addition, implementation of the outcomes from the IAEA IRRS mission of October 2017 is on-going. To this end, the comprehensive review process for the Radiation Protection Act, 2006 and its Regulations of 2008 is on-going. The review of the two laws will ensure that provisions for the safe decommissioning of facilities, the safe management and disposal of radioactive waste arising from facilities and issues associated with uranium mining and milling (as mining licence has been granted), are incorporated as recommended by IRRS mission. Furthermore, the development of the national policy and strategy for radioactive waste management is at an advanced stage as the developed draft document is undergoing final government validation and approval process.

B3.1 Management of Different Types of Radioactive Waste

B3.1.1 Liquid Waste

The current regulatory requirement is that, 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.

Currently there are fewer facilities that utilise open sources and generate radioactive liquid waste in the country. Hence, the use of open sources is mainly in the medical sector, albeit at limited quantities. A few laboratories outside the medical sector use very limited amounts of open sources (radionuclides) for research. Currently, there is only one private hospital operating a nuclear medicine clinic in the country and it has been authorised to only use Technitium-99m radionuclide

for diagnostic purposes. The radioactive waste generated by the nuclear medicine clinic is being managed on-site through long term storage and decay method, commonly termed 'delay and decay'.

The conditions for handling of open sources, including releases, are outlined in the nuclear medicine clinic users' license. The conditions, among others, involves holding the Technitium-99m liquid and solid waste in delay tanks and storeroom, respectively, until the desired reduction in activity has occurred through radioactive decay of the radionuclide contained in the waste. Approval should be obtained from the Radiation Protection Inspectorate (Regulatory body) before radioactive effluent is discharged to the environment to ensure that the radioactivity levels are within authorized limits. The records of the discharged waste are kept by the licensee.

B3.1.2 Solid Wastes

The regulatory requirement is that, solid radioactive waste from registered facilities must be characterized, collected and segregated as far as possible at the point of origin according to its physical, chemical, special hazard and radiological properties. Waste containing radionuclides with relatively short half-lives (e.g. <100 days) should be segregated at source to facilitate decay storage and disposal. Therefore, the solid waste generated by the nuclear medicine clinic is managed on-site through decay method, commonly termed 'delay and decay'.

The solid waste generated by the only nuclear medicine clinic is collected in simple containers lined inside with a durable plastic bag, which can be tied with adhesive tape and transferred to a larger container (also lined) when necessary. While, sharp wastes from the nuclear medicine clinic is collected separately and stored in rigid, puncture-resistant containers, which have been clearly labelled "sharps". The regulatory requirement is that the solid waste must be discharged to the environment (landfill) once the radioactivity levels are within authorized limits and records of discharged waste are kept.

In addition, there are 27 drums of Cs-137 contaminated soil ($\approx 5.4\text{m}^3$), ((arising from an accident with a stuck Cs-137 source (*with initial activity of 3971MBq as of 11/2005*) in a coal exploration borehole)), currently stored at end-user temporary storage facility. Dose rate on the surface of waste packages @ 10cm (as of 15/10/2020) ranges from $0.55\mu\text{Sv/hr}$ to $53\mu\text{Sv/hr}$. Efforts were made by the licensee to separate the Cs-137 from the soil, but it was not possible due to the method used to manufacture the Cs-137 source. The manufacture informed the licensee that the Cs-137 was infused in Ceramic beads to make the source stable (**refer to Annex 1, table 11, for data of the crushed source**).

B3.1.3 Management of Spent Sealed Radioactive Sources

The current regulatory requirement under the Radiation Protection Regulations, 2008 (Reg. 70 (1)), is that spent and/or disused sealed sources must be returned to the suppliers or manufacturers for disposal. If such sources cannot be returned back, the Licensee is required to ensure that the spent sources/disused sealed sources are stored under secure conditions, while making alternative source disposal or management options.

Sealed sources with half-lives <100 days, like Ir-192 are currently being used in the medical sector and in pipe welds within the country. The preferred option for this type of sealed sources is decay storage at end user's facility, as the country does not have a centralised national storage and conditioning facility for spent sources. The current regulatory practice is that the spent Ir-192 sources are returned back to the supplier by the licensees, after every three months, once the radionuclide activity has decayed to exemption levels. Licensees are required by the Radiation

Protection Regulations, 2008 to keep detailed records for all spent sealed sources sent back or in storage. Since the last review, twenty (20) spent sealed sources were returned/ sent back to suppliers by end-users. While, one-hundred-and-thirty-nine (139) spent/ disused sealed sources are still stored at end-user's onsite storage facilities as licensee's are not able to return the spent sources back to suppliers. The absence of a centralised national storage and conditioning facility in the country, exacerbate the situation, as spent sources stored at licensee's on-site stores cannot be collected and managed at a centralised area.

Since the last review, there has been no reported cases of orphan sources in the country, this could be due to the orphan source surveillance strategies introduced by the regulatory body, whereby scrap metal yards are audited annually.

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. Currently, three troxler gauges, that were impounded by the regulatory body from one local authority (municipality), are stored at the regulatory body temporary steel cargo container storage, while the owners are processing the license to possess and own the sources.

B3.1.4 Packaging and Transportation of radioactive material

The current regulatory requirement is that packaging and transportation of radioactive materials within the country must be carried out in accordance with the requirements of the Radiation Protection Regulations, 2008 and prevailing IAEA safety standards for the Safe Transport of Radioactive Material. In the case of sealed sources, where possible, the original manufacturer's packaging is used when transporting spent sealed sources back to suppliers.

However, consideration is given to whether the design of the original packaging is in accordance with the requirements for the Radiation Protection Regulations of 2008 and/or IAEA safety standards for the Safe Transport of Radioactive Material. Therefore, if the original package is not suitable, the spent source is repackaged in accordance with the current IAEA safety standards for the Safe Transport of Radioactive Material.

B3.1.5 Criteria Used to Define and or Classify Radioactive Waste

Radioactive waste is defined under the Radiation Protection Act, 2006 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.

The Radiation Protection Regulations of, 2008, classify radioactive waste in accordance with their activity and half-life, as follows: (i) Cleared material/waste; (ii) Low level (short lived)/Decay waste; (iii) Low and intermediate level short lived waste (LILW-SL) and (iv) Low and intermediate level long lived waste (LILW-LL). Table 1 below illustrate national radioactive waste management policy.

Table 1: National Waste Management Policy

Type of Liability	Long Term Management Policy	Funding of Liabilities	Current Practice / Facilities	Planned Facilities
Spent Fuel	N/A	N/A	N/A	N/A
Nuclear Fuel Cycle Waste	N/A	N/A	N/A	N/A
Application Wastes	Decay	<ul style="list-style-type: none"> ▪ Licensee ▪ State budget 	<ul style="list-style-type: none"> ▪ Decay ▪ Temporary storage 	Centralised national storage and conditioning facility
Decommissioning	N/A	N/A	N/A	N/A
Disused/ Spent Sealed Sources	Return to supplier	Part of contractual arrangements	<ul style="list-style-type: none"> ▪ Return to supplier ▪ Storage at end-user on-site source stores ▪ Storage in a steel cargo container (ISO transport container) for impounded sources 	Disused Sealed Sources

Section C: Scope of Application

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

There are no changes from the previous report in this section. The report does not apply to the safety of spent fuel management, because the Republic of 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, as such does not have spent fuel facilities subject to the Convention.

D2: List of radioactive waste management facilities

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

D3: Inventory of radioactive waste

All sealed radioactive sources and x-ray generators are registered by the Radiation Protection Inspectorate (Regulatory body), in the Regulatory Authority Information System (RAIS) and access to the RAIS database/ system is controlled.

Currently spent sealed radioactive sources are either sent back to suppliers or temporarily stored on-site at end-user's temporary source 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.

Since last review, three troxler gauges were impounded from the local authorities (municipality) due to failure to renew license to possess and own the sources and the sources are temporarily stored at the regulatory body temporary steel cargo container storage, while the owners are renewing the license. While, one hundred and thirty-nine (139) spent/disused sources stored still stored at end-user's on-site temporary storage facilities (**Annex 1: Inventory of Spent Sources and other Solid Radioactive Waste**).

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 (Article 18)

In conformance to Article 18 of the Joint Convention, the Republic of 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. The responsibility to provide regulatory oversight for the safe uses of atomic energy and nuclear technology and for matters incidental thereto at national level is vested in the Ministry of Tertiary Education, Research, Science and Technology.

The Republic of Botswana currently has the following legislative instruments in place, that is, Radiation Protection Act, 2006 and the Radiation Protection Regulations, 2008, to fully establish the foundation for proper monitoring and supervision of safe use of radioactive materials and proper management of radioactive waste that result from the use of nuclear/radioactive material in the country.

The Act and the Regulations establish the regulatory body, specify the types of regulated facilities and activities, empower the regulatory body for development and promulgation of regulatory requirements, require authorization for the operation of facilities and for the conduct of activities,

and provide for the inspection and enforcement. The Act apply 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.

The Integrated Regulatory Review Service IRRS team concluded that Botswana has made significant progress since the first IRRS mission they hosted in 2008 and it has a regulatory framework for safety in place and a strong commitment to nuclear and radiation safety as demonstrated during the mission.

However, it was noted that there is a need for the Government to ensure that the legal and regulatory framework for safety clearly allocates the responsibilities to all involved, in line with the recommendations made by the reviewers during the Integrated Regulatory Review Service (IRRS) Mission to Republic of Botswana from 15 to 24 October 2017. As such, the current legislative instruments (Act and Regulations) are currently being reviewed by the Government to align them to the prevailing International Atomic Energy Agency (IAEA) general safety requirements and to also address the recommendations made expert reviewers during the Integrated Regulatory Review Service (IRRS) Mission in October 2017.

E2: Legislative and regulatory framework (Article 19)

There are no changes from the previous report in this section. Botswana has the following legislative instruments in place, which are currently being reviewed by the Government:

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

The above legislative instruments (i.e. Act and the Regulations) establish the regulatory body, specify the types of regulated facilities and activities, empower the regulatory body for development and promulgation of regulatory requirements, require authorization for the operation of facilities and for the conduct of activities, and provide for the inspection and enforcement.

The current 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.

However, the Radiation Protection Act, 2006 and Radiation Protection Regulations, 2008 are being reviewed by the Attorney General's Chambers to align them to the prevailing International Atomic Energy Agency (IAEA) general safety requirements, covering spent fuel and radioactive waste management and to also address the recommendations made by expert reviewers during the IRRS Mission in October 2017. The review process for the Act started in 2018/19 financial year and it is still on-going. To this end, a draft Bill is in place and it is going through the Government validation and approval process. It is anticipated that the review process for the Act will be completed during 2021-2022 financial year.

The IRRS review team recommended that, while amending the Act, the Government should ensure that: (1) the types type of authorizations that are required for the operation of facilities and for the conduct of activities, in accordance with a graded approach, are clearly stated, (2) the regulatory body is enabled to perform its functions more effectively by allowing the Board to delegate certain powers to RPI, (3) all organizations or individuals, natural or legal, who may be

authorized to operate a facility or conduct an activity are covered, (4) the criteria for release from regulatory control are established, and that (5) the provisions for the safe decommissioning of facilities, the safe management and disposal of radioactive waste arising from facilities and activities are included, and responsibility for the remediation of contaminated areas.

E2.1: Establishment of the Radiation Protection Inspectorate (regulatory body) (Article 20)

The Act establish the regulatory body (Radiation Protection Inspectorate), specify the types of regulated facilities and activities, empower the regulatory body for development and promulgation of regulatory requirements, require authorization for the operation of facilities and for the conduct of activities, and provide for the inspection and enforcement.

The Act also establishes the Radiation Protection Inspectorate (as the regulatory body) which consists of a Director, a Deputy Director and such other officers as may be necessary for the proper performance of its functions. The Radiation Protection Inspectorate is established as a public office, under the Ministry of Tertiary Education, Research, Science and Technology.

The regulatory body has an establishment of fifty-two (52) staff members, this include technical and support staff. All technical staff within the regulatory body hold university qualifications (i.e. Diploma, Master and PhD certificates) and their work experience ranges from four to fourteen (14) years. The regulatory body is mandated to regulate safe use of nuclear technology in the country and matters incidental thereto, which include enforcing radioactive waste management Regulations.

The Radiation Protection Inspectorate has also been designated the national competent authority for the purposes of the IAEA Convention on Assistance in the Case of a Nuclear Accident or Radiological Emergency and the Convention on Early Notification of a Nuclear Accident and is the National Authority responsible for the physical protection of nuclear material.

The Radiation Protection Inspectorate has four divisions that enable it to implement its mandate, namely: Environment monitoring & radioactive waste management; Licencing & Inspections; Standards & Instrumentation, and Corporate services. The regulatory body gets its financial support from the Government regular budget and also from donors/ partners, like IAEA to implement its annual regulatory activities.

However, the IRRS review team in October 2017 noted that the Director for the regulatory body reports to the Board and also to the Ministry Permanent Secretary, as a result, the Director may get conflicting instructions, and that the dual reporting role may impede on the effective independence of the Regulatory body, as there is the possibility for senior members of Government (not directly in charge of regulatory activities) to influence the regulatory decision for the organisation, which does not comply with international standards.

The IRRS team recommended that, while amending the Act, the Government should ensure that the legal and regulatory framework enables the effective independence of the regulatory body and that it is not subjected to pressures associated with political circumstances. As such, the on-going exercise to review the Act will ensure that the legal and regulatory framework enables the effective independence of regulatory body and that it is not subjected to pressures associated with political circumstances, to address the cited IRRS recommendations above.

E2.1.1 Functions of the Radiation Protection Inspectorate (regulatory body)

The functions of the Radiation Protection Inspectorate (regulatory body) as conferred on it by the Radiation Protection Act, of 2006 are to:

- a) carry out regulatory inspections (announced, un-announced, follow-up, pre-authorisation);
- b) develop safety principles and criteria for approval by the Regulatory body;
- 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 Regulatory body 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: Application for licence

The current regulatory requirement under the Act and Regulations is that, 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 regulatory body to do so,

A person who wishes to apply for a licence to do any of the activities referred to above, shall make a written application to the Regulatory body in such form as may be prescribed by the Minister,

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 or organisation shall generate, keep or manage radioactive waste except in accordance with a licence issued by the Regulatory body. Part XI of the Radiation Protection Regulations, 2008, covers the aspect of regulatory framework for the management of radioactive waste.

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

However, the current Regulations do not cover spent fuel management and lack financial provisions for management of radioactive waste and spent fuel, but they require licensee to keep cost of waste generation to the minimum practicable. To this end, the Government is reviewing the Act and the Regulations to align them to prevailing IAEA general safety requirements and to also address the recommendations made during IRRS mission of October 2017.

E2.3.2: Return of sealed sources to the manufacturer or supplier

The current regulatory requirement is that, when purchasing sealed sources, licensees are required to make contractual arrangements for the return of the spent sealed sources to the manufacturer or supplier.

The Regulations require that, 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 100MBq 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.

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 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*

There is no spent fuel in Botswana in terms of the Joint Convention, hence the following responsibilities applies to licencing for the handling of radioactive substances and management of waste in general.

The current Radiation Protection Regulations of 2008 clearly assign the prime responsibility to the Licensee (authorised license holder) to establish and implement organizational measures that are needed for ensuring protection and safety for the practices and sources for which they are authorized and for compliance with all applicable requirements of the Regulations.

F1.1: Licencing and enforcement system

The requirement under the Radiation Protection Act, 2006 (section 23) is that, no person shall: acquire, own, possess, transfer, distribute, sell, use, manufacture, transport, import or export any radioactive material, radioactive substance or source and manage or dispose of any radioactive waste, unless such person has been granted a licence by the regulatory body to do so. Hence, the duties and responsibilities of licence holders in Botswana are described in the licence conditions.

There are currently 376 active/ approved licences covering a broad range of activities, including radiotherapy, research, non-destructive testing, diagnostic, industrial (mining, construction, canning, etc.). All sealed and unsealed radioactive sources are registered by the Radiation Protection Inspectorate (Regulatory body), in the Regulatory Authority Information System (RAIS) and access to the RAIS database is controlled.

The RAIS database provides a useful tool in the “cradle to grave” management of sources in the country. However, the IRRS review team in October 2017 noted that the regulatory body was not conducting un-announced inspections, even though they are provided for in the Act, and they recommended the Regulatory body to carry out unannounced inspections and include them in its inspection programme. To this end, the regulatory body has amended its inspection procedure to allow for unannounced inspections in its itinerary programme to fulfil the requirements of the Act.

The current Act gives a Radiation Inspector powers of entry and inspection at any time, to 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.

F1.2: Management of radioactive waste:

The current regulatory requirement is 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) when purchasing a sealed source, make contractual arrangements for the return of the spent sealed source to the manufacturer.

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 (regulatory body) currently has an establishment of fifty-two (52) staff members, this include technical and support staff. It consists of a Director, a Deputy Director and such other officers, as may be necessary for the proper performance of its regulatory

functions. The Radiation Protection 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, the regulatory body gets its funding from the regular Government budget to sustain its annual operations. The IRRS review team in October 2017 noted the Government has made provisions in regard to building and maintaining the necessary level of competence for persons with responsibilities for safety in facilities and activities through the Regulations.

All technical staff within the regulatory body hold university qualifications (Diploma to Master’s certificate) and their work experience ranges from four (4) to fourteen (14) years. Furthermore, the Government has proactively engaged with Universities to encourage establishing courses in ‘Radiation Science and Health Physics’ to ensure the necessary competences are available within the country.

The current organisational structure for the Radiation Protection Inspectorate is shown in Figure 1 below.

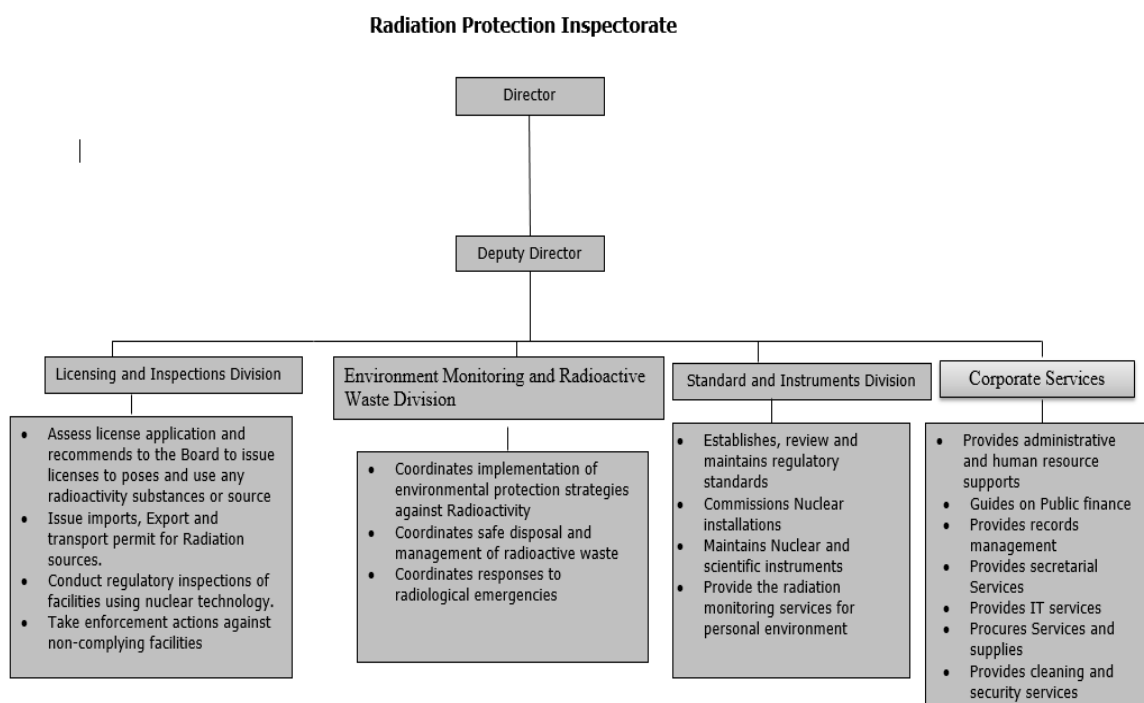


Figure 1: Organizational Structure for the Radiation Protection Inspectorate (Regulatory body)

The IRRS review team in October 2017 noted that although the Regulatory body may confiscate sources for safety reasons, and a fine may be levied to the licensee for breaches of their authorization, there was no charges indicated in the Act nor Regulations for storing sources after being confiscated and that the Act does not require for a decommissioning fund to be established.

Therefore, the review exercise for the Act or Regulations will include provisions for levying fees for storing confiscated sources and also establishment of waste and decommissioning fund, to expresses long term commitment to safety.

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

There are no changes from the previous report in this section, because the Regulatory Body is still in the process of obtaining ISO 9001:2017 certification from the Botswana Bureau of Standards for all its activities. The IRRS review team in October 2017 noted that the Regulatory Body has established a new Management System according to the international standard for “Quality management systems (ISO 9001:2015)” and the requirements of GSR Part 2.

The documents for the newly developed Integrated Management System (IMS) are prepared, reviewed, revised and approved in a controlled manner following the procedure for *Document Control*.

Furthermore, the regulatory body dosimetry laboratory activities are accredited against the standard “General” requirements for the competence of testing and calibration laboratories (ISO/IEC 17025:2005) by the Southern African Development Community Accreditation Service (SADCAS). Government efforts are on-going to accredit the environmental monitoring test methods (i.e. gamma and alpha spectrometry techniques) in accordance with ISO 17025 Standard.

So far a team of internal auditors has conducted two internal audits to verify if the operations for the Regulatory Body comply with the newly developed Integrated Management System (IMS) documentation, against the requirements of the ISO9001 and IAEA GSR-Part 2 standards. The team made some recommendations to improve areas of the processes audited.

The regulatory body has developed an overall process map consisting of six management processes, seven core processes; Authorization and Notification; Inspections; Review and Assessment of Facilities and Activities; Enforcement of Regulatory Requirements; Emergency Preparedness and Response; Monitoring; Preparation of Legislation and Guides as well as six supporting processes.

In addition, the regulations require that, any person who intends to generate, keep or manage radioactive waste shall submit a Quality Assurance Programme to the Radiation Protection Regulatory body 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.

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 current Radiation Protection Regulations of 2008 (i.e. Regulation 17 - 21) adopted the IAEA basic concepts of justification, dose limitation and optimization through dose constraint and dose limits.

F4.1: Responsibilities of licensees (Article 21)

The principle of prime responsibility of the licence holder is met by a sum of regulatory requirements including justification and adherence to specific licence conditions set down by the Regulatory body. Duties and responsibilities of licensee and staff are set out in section 29 of the Act.

The current regulatory requirements are that, 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 the 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.

F4.2: Justification of practices

The current regulatory requirement is that; 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 Regulatory Body sufficient information and evidence on the benefits and the harm to support the justification of the practice.

F4.3: Optimisation of protection and safety

In relation to exposures from any particular source within a practice, the current regulatory requirement is that, 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 Regulations require the licensee to use, to the extent practicable, procedures and engineering controls based upon sound radiation safety principles to achieve the intended radiation safety objective.

F4.4: Discharge or release of radioactive substances to the environment

The current regulatory requirement is that, licence holders 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 Regulatory body at such intervals as may be specified in the licence; and
- d) report promptly to the Regulatory Body any discharges exceeding the authorised limits

F5: Emergency Preparedness (Article 25).

1. Each Contracting Party shall ensure that before and during operation of a spent fuel or radioactive waste management facility there are appropriate on-site and, if necessary, off-site emergency plans. Such emergency plans should be tested at an appropriate frequency. 2. Each Contracting Party shall take the appropriate steps for the preparation and testing of emergency plans for its territory insofar as it is likely to be affected in the event of a radiological emergency at a spent fuel or radioactive waste management facility in the vicinity of its territory.

F5.1 National Radiological Emergency preparedness and Response framework

The Act and the Regulations set out the basis for regulating Emergency preparedness and Response (EPR) of licensees. The Act includes requirements for the licensee to develop and maintain emergency preparedness arrangements and an onsite response plan, which has to be approved by Regulatory body.

The Act also specifies the responsibilities of the licensee including developing emergency preparedness arrangements, submitting an incident response plan when applying for a licence and reporting to Regulatory body any case of overexposure, loss, theft or diversion of radioactive material within 12 hours. Although the Act gives the primary responsibility for emergency responses to licensees, other emergency response organizations do also 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.

The Regulatory body is the competent authority when it comes to response to radiological emergencies within the country. While, at the national level, the National Disaster Management Office (NDMO) leads and coordinates all the national emergency responses in the country.

Botswana has ratified the Convention on Early Notification of a Nuclear Accident and Convention on Assistance in the Case of a Nuclear Accident or Radiological Emergency. Hence, there is an effective and fast exchange of information between the national competent authority and the International Atomic Energy Agency, with regards to radiological incidents and emergencies under the State's jurisdiction and to also request for international assistance through the IAEA emergency centre. In addition, the country continues to benefit knowledge transfer and capacity building through IAEA regional and international training courses and workshops that are organised by the IAEA under the auspices of the NOT and Early conventions.

However, the IRRS review team in October 2017 noted that the current national response framework, including Regulatory body responsibilities, lack the governmental basis. The mission recommended that the Government of Botswana should develop a national emergency plan that addresses nuclear and radiological emergencies, in a coordinated and integrated manner with other relevant national plans. To address the IRRS recommendation, the Regulatory body has started drafting the National Radiological Emergency Preparedness and Response Plan (NREP), in consultation with other national emergency response organizations. The draft National Radiological Emergency Preparedness and Response Plan has been developed and is going through stakeholder validation and approval process. The objective of the draft National Radiological Emergency Plan 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 developed National Emergency Response Plan will be part of the existing structures for responding to emergencies or disasters within the country.

The Regulatory body has nineteen (19) Thermo-luminescent dosimeter (TLD) stations installed at Meteorological weather stations across the country, to monitor ambient gamma background radiation. The data from the TLD stations is combined with meteorological data to make an informed regulatory decision.

In addition, the Regulatory body also operates an automatic high-volume air sampling equipment housed at the National Environmental Laboratory to collect air aerosols. The air filters from the air sampler are then collected and analysed at the Radio Analysis Laboratory (housed within the Regulatory body) and the results are very useful for assessing possible or suspected radioactivity releases from within the country and/or from neighbouring countries.

The regulatory body has also procured a vehicle mounted Spectrometry System which could be deployed by the Regulatory body to support other emergency response organisation during a radiological emergency. Currently the mobile spectrometry system is being used to map ambient background gamma radiation for selected cities and towns.

Maintaining competence in emergency preparedness and response is a challenge for a small non-nuclear country such as Botswana. The solution adopted is to be actively involved in IAEA Convention Exercises. Hence, Botswana regularly participates in international exercises i.e. ConvEx exercises organized by the IAEA to build competence among Inspectors. However, plans are on-going to conduct a second national radiological emergency exercise that will involve other emergency response organisations, after the first ever national exercise was conducted in December 2015 under the auspices of the IAEA regional project.

Nonetheless, licensees are required by the Regulations to conduct periodic exercises to rehearse their approved on-site/ facility emergency plans.

F5.2: Responsibilities of licensees

The current regulatory requirement is that, each 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 facility emergency plan 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.

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.

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 containing articles 4 - 10 is not applicable to Botswana, because the country does not have nuclear facilities.

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 - 12)

The Act establishes a general framework on which specific regulations concerning radiation protection are based. The Regulations cover the aspects related to the regulatory control in the management of radioactive waste. However, the regulations do not cover financial provisions for management of radioactive waste, but they require licensees to keep waste generation to the minimum practicable. The Regulations establish that waste is to be stored under conditions that ensure the protection of human health and the environment avoiding risks associated with degradation of waste integrity. However, provisions for decommissioning of radioactive waste facilities are not included in the current legal and regulatory framework, and the identified regulatory gap will be rectified during the review of the current Radiation Protection Regulations of 2008.

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 Regulatory body.

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;
- d) 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 maintaining consistency with the management strategy and systems and
- e) reporting to the Inspectorate required information at intervals as may be specified in the licence conditions.

Licensees using radioactive material are required by law, not to 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 (Regulatory body) that the organisation to which it is transferred has the necessary authorisation to hold that material.

However, the IRRS review team in October 2017 observed that, the current regulations do not address the following: Protection of future generation; development of plans for design and operation, and the development of the safety case for operational safety; waste packages and unpackaged accepted for processing, storage and/or disposal and recommended to the Government to ensure that all regulations related to radiation safety are updated to be consistent with the latest IAEA safety standards. The government has started the process to review the current Radiation Act of 2006 and Regulations of 2008, as of November 2018 and a draft Bill (zero draft) has been compiled by the Attorney General's Chambers as at August 2020.

H1.2: Return of sealed sources to the manufacturer

The 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.

In addition, 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.

H1.3: Quality assurance programmes

The regulatory requirement is that licensee shall ensure that radioactive waste management activities are carried out to meet the requirement to protect human health and the environment, and that a quality assurance programme that 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.

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 17)

Efforts are being made by the Government to construct a centralised 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 still on-going, after the community rejected the initial site that was identified by the Government in 2015 to construct the national storage facility.

As an alternative or temporary safety measure, the Regulatory body, with the assistance of the USA-Department of Energy, constructed a temporary storage facility, using a steel ISO transport cargo container to store sealed sources confiscated or impounded by the radiation Inspectors and/or State security agencies (Police, Customs), while investigations are being made regarding the impounded source.

Nonetheless, the Regulatory body will ensure that all necessary regulatory steps, including, siting, suitable design, construction, operation and decommissioning of the proposed national storage and conditioning facility for spent sealed sources are abided 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

The shipment of radiation material in and outside Botswana is subject to the international requirements regarding transportation of radioactive material. Radioactive material is mainly transported by road and air in and outside the country. The provisions of the Radiation Protection Regulations, 2008 govern the domestic and international transportation of radioactive material.

The Radiation Protection Act and Regulations, requires that source owners acquire an import/export and transport permit to move such radioactive material in and outside the country. 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.

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.

Furthermore, the government is currently implementing a national project for the installation of radiation detection portal monitors at five commercial ports of entry during National Development Plan 11 (2017 – 2023) to intensify control of importation and exportation of radioactive material and/or illicit trafficking of spent sealed sources into the country. To this end, installation of portal monitors at Kazungula one-stop border is on-going and completion is anticipated to be March 2021.

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. As of 27th October 2020 there were **three-hundred and seventy-six (376)** approved facilities (licensees) in the inventory of regulated facilities that use radiation sources in Botswana. While that of registered sealed sources stands at **six-hundred-and-fifty (650)**.

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. Since, the country does not have a conditioning and disposal facility for spent sealed sources, the current regulatory requirement is that, when purchasing sealed sources, Licensees are required to make contractual arrangements for the return of the spent sealed sources to the manufacturer or supplier (*Section 31 of Act and Regulation 70*).

Furthermore, the Regulations requires that, 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 management of spent and disused sealed sources is a challenge in the country, due to unavailability of a centralised National Storage and Conditioning Facility to manage spent or disused sealed sources. Licensees that could not return their old spent sealed sources are currently being advised to store their spent sources at their on-site temporary source stores for source security and accountability. However, there is a danger or likelihood of such sources to be stolen because end-user source stores were not designed or meant to store spent sources for extended periods (**Annex 1: Inventory of Spent sealed sources in Botswana**).

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.

However, as part of its enforcement activities, the Regulatory body do audit all facilities where sealed sources are used and stored 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, because the Regulatory body annually audit scrap metal yards across the country, as a national strategy to recovery orphan sources or sources outside regulatory control. It is worth reporting that; no orphan sources were discovered from scrap yards since the last reporting period.

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 second 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 in the coming years when more radiation facilities emerge.

The IRRS mission in October 2017, identified 4 good practices and also made recommendations and suggestions to indicate where improvements are necessary or desirable to further enhance and more closely align the regulatory framework with IAEA safety standards. The IRRS mission noted that some of the identified regulatory gaps/ shortfalls had been identified by the regulatory body through the SARIS (self-assessment exercise) and the shortfalls are being addressed by the government through the review of national laws regulating safe use of nuclear technology in the country.

Some of the good practices identified by the IRRS mission include:

- Safety culture is an integrated part of the management system and Regulatory body has recently assessed the technical staff’s experience on the safety culture aspects including leadership for safety.
- Through participation in a wide range of international instruments and bilateral and multilateral arrangements, as well as International Peer Reviews Botswana strongly recognizes the importance of International cooperation in relation to safety in contributing to the development of a global safety regime.
- Regulatory body has established goals and strategies that are consistent with overall safety policy and the Strategic Plan of the Ministry.
- Regulatory body has a system for providing information on transport operations by the shippers which improves knowledge of facilities and activities that should be regulated and as a result enables effective management of resources.

However, the IRRS mission made some observations that warrant additional emphasis. Specifically, that the Government should: (i) establish and implement national policies and strategies for safety and for waste management, which achieve the fundamental safety objective and includes decommissioning, remediation and disposal and expresses long-term commitment to safety; (ii) ensure the legal and regulatory framework enables the effective independence of the Regulatory body and it is not subjected to pressures associated with political circumstances, (iii) initiate a process for reviewing and updating the Regulations and guides to achieve consistency with the latest version of IAEA safety standards, and (iv) develop an emergency plan at the national level to address nuclear and radiological emergencies, in a coordinated and integrated manner with other relevant national plans.

The above cited observations made by the IRRS mission are currently being addressed by the government, through the Radiation Protection Inspectorate, under the Ministry of Tertiary Education, Research, Science and Technology. To this end, the government has started the process to comprehensively review the current Radiation Protection Act of 2006 and Regulations of 2008, as at November 2018, to align the regulatory framework with IAEA safety standards and the Joint Convention provisions, and also address the IRRS mission recommendations. The draft Bill (zero

draft) has been compiled by the Attorney General's Chambers as at August 2020 and it is going through the government appraisal and validation process.

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 spent radioactive sources, is still a challenge in the country due to unavailability of a centralised National Storage and Conditioning Facility for spent sources. Some Licensees have encountered challenges when returning their spent sources if the source supplier is no longer in business. As such, there is a risk that spent sources are going to be kept indefinitely at the licensee's on-site temporary source stores without a defined procedure for final disposal.

Nonetheless, the Government is trying by all means to construct a centralised National Storage and Conditioning Facility for spent sealed sources during National Development Plan 11 (2017-2023). Siting for the suitable location to construct the facility is still on-going, after the initial site was abandoned in May 2015, due to community objection of hosting the storage facility in their village. To this end, the government is negotiating with the Botswana International University of Science and Technology (BIUST) to absorb the project as part of their strategies to expand their "Nuclear Science and Technology Education Programmes" in line with the recommendations made by the IAEA "Business Plan for Establishing Nuclear Science and Technology Education Programmes in Botswana Report of November 2018".

Alternatively, the Regulatory body is using a steel transport cargo container to temporarily store sealed sources confiscated or impounded 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.

Planned Measures to Strengthened Regulatory Framework to Enhance Safety of Radioactive Waste Management in the Country, will include:

- Amending the current Radiation Protection Act, 2006 and Radiation Protection Regulations, 2008 to align them to prevailing IAEA safety requirements and all principles and requirements specified in the Joint Convention. The government has started the process to review the current Radiation Act and Regulations, as of November 2018 and a draft Bill (zero draft) has been compiled by the Attorney General's Chambers as at August 2020.
- Secure land for the construction of a centralised national storage and conditioning facility for spent sealed sources during National Development Plan 11 (2017 – 2023). Siting for the suitable location to construct the facility is still on-going and potential stakeholders are being consulted.
- Installation of radiation detection portal monitors at five commercial ports of entry during National Development Plan 11 (2017-2023) to intensify control of importation and exportation of radioactive material and/or illicit trafficking of spent sealed sources. To this end, installation of portal monitors at one port of entry (i.e. Kazungula border) is on-going.

- Commitment to address all the outcomes and recommendations made by the IAEA IRRS mission of October 2017. The government is currently addressing the recommendations made by the IRRS mission. Review of Radiation Act and Regulations has been initiated as of November 2018.

Section L: Annexes (Article 38)

The following may be included as annexes to the National Reports:

- (a) List of spent fuel management facilities;*
- (b) List of radioactive waste management facilities;*
- (c) List of nuclear facilities in the process of being decommissioned;*
- (d) Inventory of spent fuel;*
- (e) Inventory of radioactive waste;*
- (f) References to national laws, Regulations, requirements, guides, etc.;*
- (g) References to official national and international reports related to safety;*
- (h) References to reports on international review missions performed at the request of a Contracting Party; and*
- (i) Other relevant material.*

Annex 1:

Inventory of Disused/ Spent Sealed Radioactive Sources in Botswana as of 27th October 2020

The number of registered sealed sources in use in Botswana continues to increase, and the number stands at **six-hundred-and-fifty (650)** as of 27th October 2020. 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. To date, there are at least hundred and thirty-nine (139) spent sources and 5.4m³ of Cs-137 contaminated soil waste stored at Licensees on-site source stores.

The inventory shared below reflect the current number of disused/ spent sealed sources kept at end-user's temporary source stores, which are subjected to regular inspections by the Regulatory Body.

Table 1: Short Lived (Half-Life < 100 Days) Sealed Source

Item	Isotope	Activity	Source Category	Source location	Quantity	Planned Method of Disposal
1	Ir-192	exemption levels	2	On-site source storage	1	<ul style="list-style-type: none"> • 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

Item	Nuclide	Activity (Bq)	Status	source location	Quantity	Practice	Planned Method of Disposal
1	Am-241/Be	3Ci	Spent source	On-site source storage	1	exploration	long term store
2	Cs-137	125mCi	Spent source	On-site source storage	1	exploration	long term store
3	Am-241/Be	1000mCi	Spent source	On-site source storage	1	exploration	long term store
4	Cs-137	125mCi	Spent source	On-site source storage	1	exploration	long term store
5	not identified	corroded	Spent source	On-site source storage	1	exploration	long term store
6	not identified	corroded	Spent source	On-site source storage	1	exploration	long term store
Total					6		

Table 3: Spent Sources at BCL Mine

Item	Nuclide	Activity (Bq)	Status	source location	Quantity	Practice	Planned Method of Disposal
1	Unknown	Unknown	Spent source	On-site source storage	8	level gauge	send back to supplier
2	Co-60	18MBq	Spent source	On-site source storage	1	level gauge	send back to supplier
Total					9		

Table 4: Spent Sources at Tati Nickel Mine

Item	Nuclide	Activity (Bq)	Status	source location	Quantity	Practice	Planned Method of Disposal
1	Cs-137	217MBq	Spent source	On-site source storage	1	density gauge	send back to supplier
2	Cs-137	199MBq	Spent source	On-site source storage	1	density gauge	send back to supplier
3	Cs-137	1.85MBq	Spent source	On-site source storage	2	density gauge	send back to supplier
4	Cs-137	3.7MBq	Spent source	On-site source storage	4	density gauge	send back to supplier
Total					8		

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

Item	Nuclide	Activity (Bq)	Status	source location	Quantity	Practice	Method of Disposal
1	Sr-90	55mCi	Spent source	On-site source storage	1	therapy	long term store
Total					1		

Table 6: Spent Source at Scottish Livingstone Hospital - Eye Clinic

Item	Nuclide	Activity (Bq)	Status	source location	Quantity	Practice	Method of Disposal
1	Sr-90	55mCi	Spent source	On-site source storage	1	therapy	long term store
Total					1		

Table 7: Spent Source at Scottish Livingstone Hospital

Item	Nuclide	Activity (Bq)	Status	Source location	Quantity	Practice	Method of Disposal
1	Sr-90	55mCi	Spent source	On-site source storage	1	therapy	long term store
Total					1		

Table 8: Disused Low Activity Sources at the University of Botswana

Item	Nuclide	Activity	Source location	Quantity	Practice	Planned method of Disposal
	Am-241	1 µCi	On-site source storage	1	Not being used	long term store
	Am-241	5 µCi	On-site source storage	1	Not being used	long term store
	Y-88	1 µCi	On-site source storage	1	Not being used	long term store
	Na-22	1 µCi	On-site source storage	1	Not being used	long term store
	Co-60	1 µCi	On-site source storage	1	Not being used	long term store
	Sn-113	1 µCi	On-site source storage	1	Not being used	long term store
	Co-57	1 µCi	On-site source storage	1	Not being used	long term store
	Cs-137	1 µCi	On-site source storage	1	Not being used	long term store
	Fe-55	1 µCi	On-site source storage	1	Not being used	long term store
	Th-228	0.5 µCi	On-site source storage	1	Not being used	long term store

	Co-60	5 μ Ci	On-site source storage	1	Not being used	long term store
	Co-57	0.3 μ Ci	On-site source storage	1	Not being used	long term store
	Co-57	1 mCi	On-site source storage	1	Not being used	long term store
	Am-241	0.1 μ Ci	On-site source storage	1	Not being used	long term store
	Po-210	0.1 μ Ci	On-site source storage	1	Not being used	long term store
	Bi-207	1 μ Ci	On-site source storage	1	Not being used	long term store
	Tl-204	1 μ Ci	On-site source storage	1	Not being used	long term store
Total				17		

Table 9: Disused Low Activity sources at Various Government Senior Secondary Schools

Item	Nuclide	Activity (Bq)	Source Location	Quantity	Practice	Method of Disposal
1	Sr-90	1 μ Ci	Physics laboratory Store room	24	Educational (Demonstration)	long term store
2	Am-241	5 μ Ci	Physics laboratory Store room	11	Educational (Demonstration)	long term store
3	Ra-226	5 μ Ci	Physics laboratory Store room	10	Educational (Demonstration)	long term store
4	Co-60	1 μ Ci	Physics laboratory Store room	25	Educational (Demonstration)	long term store
5	Pb-210	0.1 μ Ci	Physics laboratory Store room	28	Educational (Demonstration)	long term store
6	Natural radioactive rocks	5 μ Ci	Physics laboratory Store room	4	Educational (Demonstration)	long term store
Total				102		

Table 10: Spent Sources at Material Testing Services (Pty)

Item	Nuclide	Activity (Bq)	Serial No.	Manufacturer	source location	Practice	Quantity	Method of Disposal
1	Am-241/Be	40 mCi	798	Humboldt Scientific	On-site source storage	Density	1	send back to supplier
2	Am-241/Be	40 mCi	1376	VIATEC 405 Ltd	On-site source storage	density	1	send back to supplier
3	Am-241/Be	40 mCi	1335	VIATEC 405 Ltd	On-site source storage	Density	1	send back to supplier
4	Am-241/Be	40 mCi	1422	VIATEC 405 Ltd	On-site source storage	Density	1	send back to supplier
Total							4	

Table 11: Other Radioactive Waste Packages at Coal Mine Exploration Site

a) Cs-137 Contaminated Soil Waste Packages (arising from an accident with a stuck source in a coal exploration borehole) *

Waste type (Solid)	Dose rate on surface of waste packages @ 10cm (as of 15/10/2020)	Background dose rate	Number of Waste packages	Method of Disposal
Cs-137 Contaminated Soil (initial source activity was 3971MBq in 11/2005)	It ranges from 0.55µSv/hr to 53µSv/hr	0.19µSv/hr	27 drums of Cs-137 contaminated soil (5.4m ³)	long term storage at end user facility
Total number of waste packages			27 drums of Cs-137 contaminated soil (5.4m³)	

*refer to the below table on the data for the crushed Cs-137 well-logging source (Date of accident/incident: 10/10/2008)

Radionuclide	Activity content	Initial activity (as at 2005/11/01)	Date of initial activity measurement	Source serial no.	Source manufacturer	Recommended working life	Application
Cs-137	Ceramic bead	3971MBq	2005/11/01	M5087	NTP radioisotopes	15 years	Well-logging

Annex 2:

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

<http://www.elaws.gov.bw/default.php?UID=602> (search using Cap No: 24:03)

b) REGULATIONS:

(i) **Radiation Protection Regulations, of 2008, Government of Botswana**

Radiation Protection: Subsidiary Legislation

<http://www.elaws.gov.bw/displaysubsidiary.php?cid=24:03&id=397>

c) **REPORT ON THE INTEGRATED REGULATORY REVIEW SERVICE (IRRS) MISSION TO THE REPUBLIC OF BOTSWANA, Gaborone, 15 to 24 October 2017**

https://www.iaea.org/sites/default/files/documents/review-missions/irrs_botswan.pdf

d) **RELEVANT RADIATION PROTECTION GUIDELINES DEVELOPED**

- (i) Radiation Protection Inspectorate Enforcement Policy, dated 1st September 2016;
- (ii) Procedure: Issuance of Licenses, dated 23/08/2016;
- (iii) Procedure: Issuance of Permits, dated 23/08/2016;
- (iv) Procedure_02_Radioactive Waste Management (Issue 1.0); dated 26/02/2015;
- (v) Procedure_03_Conducting an Inspection (Issue 2.0), dated 23/08/2016;
- (vi) FORM - Storage Facility Radiation Area Survey (issue No 2), dated 26/02/2016
- (vii) FORM - Storage Facility Radiological Movement (issue No 2), dated 26/02/2016
- (viii) Procedure_04_Communication (Issue 1.0), dated 26/02/2015;
- (ix) National Radiation Emergency Plan (Draft), dated 25 July 2020;