

Challenges in securing vulnerable radioactive sources in Senegal

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Abstract

The national inventory of radioactive sources developed by the Senegalese regulatory authority effectively created in 2011 shows that most of them are vulnerable.

The aim of this work is to highlight the challenges posed by these radioactive sources and to show the initiatives that can be taken to improve their security in a context of limited resources.

1. INTRODUCTION

A vulnerable source is a radioactive source for which the control is inadequate to provide assurance of long term safety and security, such that it could relatively easily be acquired by unauthorized persons [1].

The security of radioactive material began to become a concern for the Regulatory Authority of Senegal, following the various discoveries of sources that were used and stored at sites during visits made as part of our inspection program. Radiation measurements at some medical, industrial and research facilities have uncovered radioactive sources such as Ra-226 needles, Cs137, Am241-Be and Sr-90 sources that have been formerly used and abandoned in places reserved for any type of equipment out of order or stored with very low safety measures and no security measures.

Among radioactive sources found during inventory few of them had been authorized by two ministries which had no means of control over the installations concerned.

In several facilities visited, radioactive sources and nuclear materials were stored without the knowledge of their managers.

Laws [7-8] relating only to radiation protection and nuclear safety were promulgated more than forty years after independence in 1960, but a regulatory authority in charge of their implementation has only been in place since 2011.

However, decree 2010-893 [9] developed after the IAEA Advisory Mission in Senegal in 2009 took some steps to fill this gap and give the regulatory means to take initiatives in securing vulnerable radioactive sources.

The challenges of managing the security of these vulnerable and all-used sources have led Senegal, with assistance from the International Atomic Energy Agency, to develop its Integrated Nuclear Security Support Plan (INSSP) in 2014.

Several accidents linked to these vulnerable radioactive sources have caused the international community's concern over the possibility that they may be seized and used for malicious purposes. These concerns have led many States to address issues relating to the control of radioactive sources and the International Atomic Energy Agency (IAEA) to initiate a programme of work on the safety and security of radioactive sources [2]. Progress on these efforts can be traced through the proceedings of a series of IAEA international conferences on the subject [366].

The purpose of this article is to show how the Regulatory Authority has managed to first inventory a number of used and abandoned sources, to characterize and condition them with the help of the IAEA in order to ensure

regulatory control and securing. Support from other partners for inventory and training on nuclear security will also be shown.

2. NATIONAL INVENTORY

2.1 Inventory of radioactive sources and assessment of existence of qualified experts

The ARSN has launched in 2011 the first national inventory of sources of ionizing radiation in Senegal. The aim of the investigations conducted by the ARSN was to identify the sources of ionizing radiation and nuclear materials along with laws and regulations applicable to them and to assess availability of qualified expert for the management of those sources and nuclear materials.

Inventories carried out in the region of Dakar and in part of the region of Thies have led to the identification of many radioactive sources used in the country. Nuclear material (depleted uranium) used for shielding of some category 1 and 2 radioactive sources and in one research facility (uranium and thorium) has been found, identified and reported to IAEA. The distribution in number of the radioisotopes found is given in the FIG.1 and FIG.2. shows how the number of these radioactive sources has increased over the years.

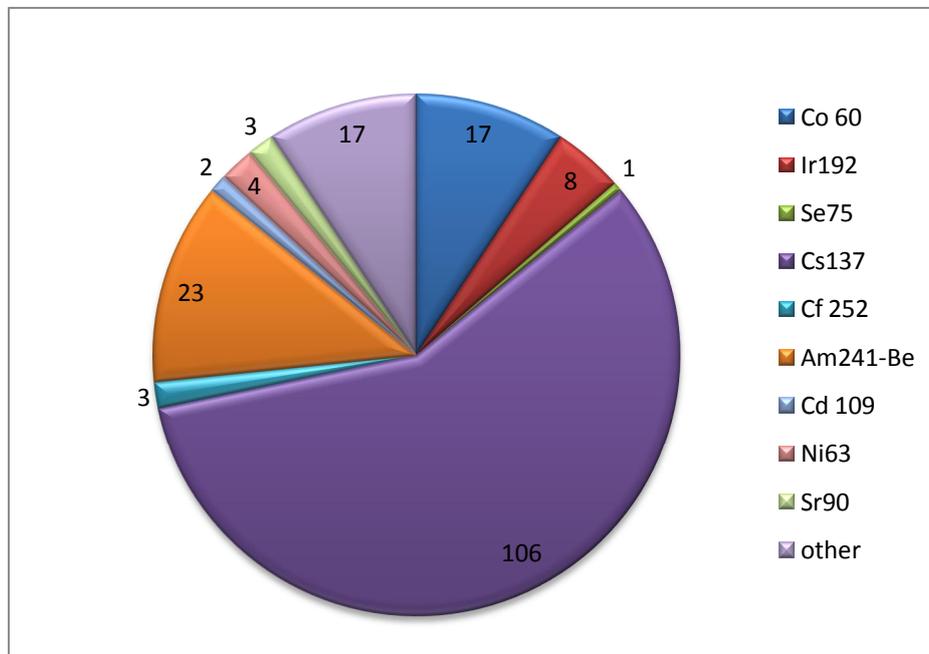


FIG.1. Distribution of radioactive sources by number of radioisotopes

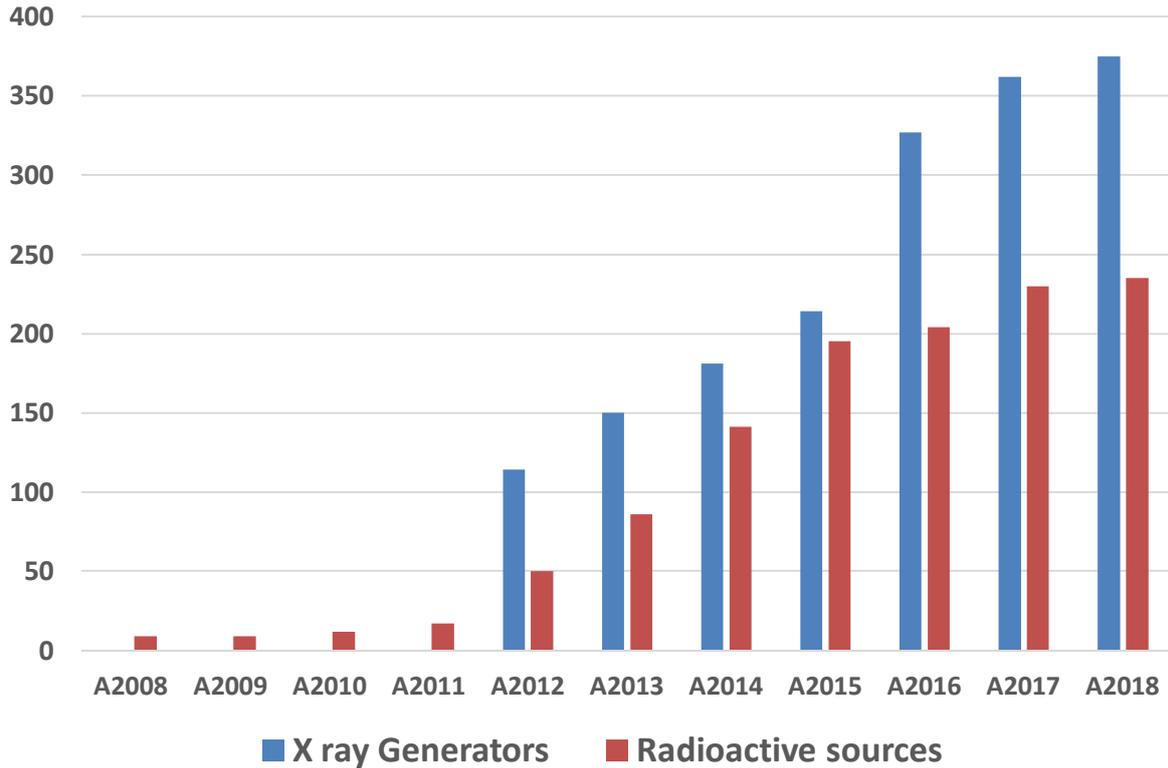


FIG.2. Evolution of national inventory in number of radioisotopes per year

Most of these sources were used in medicine, industry and research before the actual establishment of the regulatory authority.

In most of the facilities visited there was no qualified expert in radiation protection and nuclear safety and security. The safety and security culture was nonexistent. No specific measures were taken for the security of the sources and the perception of a threat did not exist. The monitoring of radioactive sources was not the subject of any particular measure in the security program of installations such as hospitals and industries. Few facilities had detection equipment, most of which did not work or was not calibrated.

It is clear that most of these sources were vulnerable because they could relatively easily be seized and used for malicious purposes.

It follows from the ARSN's investigations that the root of the problem is the lack of a suitable legal and regulatory framework and put into effect by an authority endowed with adequate expertise and means.

Indeed, it was emphasized during the conference on Safety and Security of Radioactive Sources "Towards a Global System for the Continuous Control of Sources throughout their Life Cycle [6]" that in developing countries, source inventory is not high, as it is in the USA and the EU, but the risk that these sources become orphaned is greater owing to weak national regulatory infrastructures.

ARSN took measures in 2012 to improve the security of vulnerable radioactive sources. It involved national stakeholders through protocols with, in particular, the defense and security forces. It has also seized the opportunities offered by multilateral and bilateral cooperation to secure the most dangerous radioactive sources, provide training for its inspectors and other national stakeholders and put in place an integrated national plan to support nuclear security. ARSN also established national storage facility to secure those vulnerable radioactive sources that cannot be returned yet to suppliers. Finally, it drew up a draft law on nuclear safety, security and safeguards as well as its implementing decree in accordance with international standards.

3. IMPROVING SECURITY OF VULNERABLE RADIOACTIVE SOURCES

3.1 Securing dangerous and vulnerable radioactive sources

In 2012, a year after its creation, ARSN authorized a Cobalt 60 radioactive source of Category 1 used in external radiotherapy. Such a source was already in use when there was not yet a regulatory authority in the country. Through the Global Threat Reduction Initiative (GTRI) of the United States Department of Energy, an A security level system has been established for this dangerous vulnerable source.



FIG.3. GTRI site visit

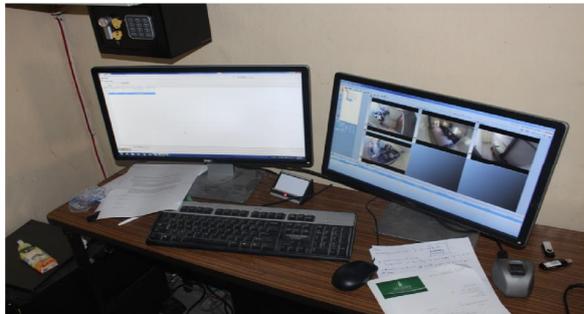


FIG.4. Part of GTRI site security system

Several legacy radioactive sources have been discovered in sites without any provision being made to ensure their security. The managers of these legacy sites generally do not have the technical and financial capacity to declare these sources and ensure their security.

To reduce the vulnerability of these sources, ARSN benefited in 2017 from the IAEA's RAF9054 technical cooperation project to identify and characterize them. As part of this project, ARSN built a temporary storage site equipped by the IAEA. Some of the inherited, orphaned and vulnerable radioactive sources could be seized and stored on this site in 2018. Some of these sources were properly conditioned.

The source aggregate category is being established. Ultimately, a security level A will be assigned to the installation to cover any eventuality.



FIG.5. Vulnerable radioactive sources removal from facility



FIG.6. Vulnerable radioactive sources conditioning at the Interim Storage Facility

3.2 National and international cooperation

The problem of the security of vulnerable radioactive sources is a national problem which requires the participation of all structures which can play a relevant role. In Senegal, the defense and security forces enjoy a remarkable security culture on many issues. ARSN has therefore taken initiatives within the framework of bilateral cooperation (United States, European Union, Mauritania) and with the International Atomic Energy Agency (IAEA) to strengthen the nuclear security culture of these forces.

Memorandums of understanding have thus been signed with the Customs, the Gendarmerie and the Armed Forces. Such protocols are being prepared for civil protection, intelligence services and the bodies responsible for coordinating the fight against terrorism.

Several national training courses have been organized involving these forces in the area of nuclear security and safeguards.

ARSN inspectors already trained on nuclear safety by the IAEA as part of the Post Graduate Educational Course (PGEC) also benefited from these training courses.

ARSN has organized in 2013 with USDOE a GTRI Training Course on Physical protection and Security of Radioactive Sources Management, 24 - 27 September 2013, Dakar Senegal. In 2014 during a GTRI Basic Search and Secure Training Workshop (Dakar, Senegal April 14th ó 18th, 2014) US DOE has given to ARSN a number of detection equipment.

The cooperation initiated within the framework of the GTRI continued with the Office of Radiological Security on the response to nuclear security events (ORS International Response Training course Dakar (January 10-13, 2017)) and on the development of security plans for sites hosting radioactive sources (ORS International Workshop on developing site security plans for radioactive sources (May 22-24, 2017)).

Cooperation between Senegal and the IAEA in the field of nuclear security was formalized through the INSSP which was adopted in 2014 by the Prime Minister and revised in 2017.

In addition to the detection equipment made available to the country by the Agency, several training activities for the defense and security forces and ARSN inspectors were organized, in particular the following:

IAEA Workshop on Design, Strategy and Planning for Nuclear Security Detection Architecture (NSDA), Dakar, Senegal, November 11 to 15, 2019,

IAEA National Workshop on Drafting Transport Security Regulations, Dakar, Senegal, 22 ó 25 October 2019,

IAEA Sub-regional tabletop exercise on the security of radioactive materials during transport in West Africa: Organization of national authorities during a transport of radioactive materials Dakar, Senegal, 11-14 June 2019,

IAEA Regional Training Course on Introduction to Nuclear Forensics, Mbour, Senegal 10-13 November 2018,

IAEA Meeting on Development of Training Guidelines for National Training Courses on Safe Transport of Radioactive Material, Dakar, Senegal, from 19 to 23 November 2018,

IAEA National Design Basis Threat Training Workshop held 5-8 August 2014.

3.3 Regulatory control

To reduce the vulnerability of radioactive sources, ARSN has set up a system for authorization and inspection in accordance with laws 2004-17 and 2009-14 relating to radiation protection and nuclear safety and decree 2010-893 in its article 6.

A process for bringing laws and regulations into force, although not yet fully formalized, is applied. Thus, a source whose detention had not been authorized was seized and secured by the ARSN.

In addition to the penal provisions contained in the current laws and regulations, the ARSN worked for the introduction of penal provisions relating to the terrorist acts concerning the radioactive sources and the nuclear materials in the new penal code [10]. It also contributed to the preparation of the process of ratifying the amendment to the Convention on the Physical Protection of Nuclear Material [11].

In addition, the national legal and regulatory framework has been the subject of an in-depth review with the help of the IAEA Office of Legal affairs to draw up a draft law on nuclear safety, security and safeguards in accordance with international standards.

A national register of sources of ionizing radiation containing all the information supplied from the authorization and inspection system has been put in place.

4. CONCLUSION

The establishment of a regulatory authority for the implementation of the national legal and regulatory framework relating to nuclear safety, security and safeguards in Senegal has made it possible to inventory vulnerable radioactive sources in the country.

To reduce the vulnerability of these sources, the most dangerous have been secured at an appropriate level thanks to international cooperation. The national inventory is not yet completed but is being continued with help of US NRC [12]

A systematic approach to taking charge of nuclear security in the country has been adopted through the development of an INSSP plan. All national stakeholders have been trained as part of cooperation between Senegal and the IAEA and US DOE. A new legal and regulatory framework developed with the Office of Legal Affairs of the IAEA has been proposed to the competent authorities. The authorization and inspection process put in place makes it possible to control the implementation of the security requirements recently attached to the new authorizations.

Many remains to be done to reduce the vulnerability of radioactive sources in the country, but the dynamics initiated will ultimately achieve this objective.

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- [7] Law No. 2004-17 of 15 June 2004 on the Protection against Ionizing Radiation.
- [8] Law No 2009-14 on nuclear Security and Radiation protection.
- [9] Decree No. 2010-893 of 30 June 2010 on the organization and functioning of the Radiation Protection and Nuclear Safety.
- [10] Law amending the law No 65-60 of 21 July 1965 on the Penal Code.
- [11] Law 2017-21 of 5 April 2017 authorizing the President of the Republic to ratify the Amendment to the CPPNM.
- [12] Protocol with US NRC.