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Case Report

Nuclear Security Measures Implemented at the 2023 African Cup of Nations in Côte d'Ivoire: The Case of the Alassane Ouattara Olympic Stadium in Abidjan

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Abstract

The security context in the West African sub-region has been deteriorated significantly in recent years due to the Jihadist threat. This has prompted the Government of Côte d'Ivoire to integrate nuclear security measures into the overall security of the 2023 African Cup of Nations as this Major Public Event where a large number of people were expected to gather, could be a great attraction for terrorist groups. This Event took place in five (05) major cities of Côte d'Ivoire and nuclear security concerned all the competition stadiums and the other strategic locations such as airports, Fan zones, car parks, VIP hotels, training stadiums, etc. However, for the purposes of this report, we are only interested in the nuclear security system deployed at the Alassane Ouattrara Olympic Stadium in Ebimpé where 10 competition matches were played, including the opening and the final matches of the tournament. We first highlight the importance of the International Atomic Energy Agency training program (Train-the-Trainers courses) for national stakeholders which has enabled us to achieve our objectives. We Then present the different component of nuclear security that have been taken into account, the good practices applied and the weaknesses or the unexpected problems identified. Finally, the lessons learned and the prospects for a sustainable implementation of nuclear security during all major public events that will take place in Côte d'Ivoire are presented. It should be noted that all detection devices operated correctly and no nuclear security events were reported.

Keywords

Major Public Event, Jihadist Threat, Nuclear Security Measures, Train-the-Trainers Courses

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1. Background

The organization of the 2023 African Cup of Nations (2023 AFCON), which have been postponed to 2024 (i.e. from January 13 to February 11, 2024) took place in five big cities of Côte d'Ivoire (Abidjan, Yamoussoukro, Bouaké, Korhogo and San-Pedro) and was the opportunity for this country to integrate, for the very first time, the nuclear security component into the overall security plan for a Major Public Event (MPE). The stated objective of the Ivorian authorities was to prevent terrorists or malicious individuals from entering competition stadiums and other strategic venues of the 2023 AFCON (Airports, Fan zones, VIP hotels, training stadiums, etc.) with radioactive sources or material to commit malicious or terrorist acts.

1.1. Jihadist Threat

Indeed, in recent years, Côte d'Ivoire, due to its historical relations with France and its ideological proximity to Western countries, has become a target for terrorist and jihadist organizations. These malicious organizations are already very active in the Sahel region near Côte d'Ivoire, where they recruit, attack, or plan attacks.

In reality, Côte d'Ivoire shares hundreds of kilometers of common border with Mali and Burkina Faso in its northern part. Both countries have been prey to the jihadists for several years. Their security systems are undermined and cohesion between local communities is disrupted by planned terrorist acts that lead to mass population displacements.

Today, everything suggests that these various jihadist groups are developing an "expansion project" towards the Gulf of Guinea and are trying to create corridors to reach port areas, particularly those of Côte d'Ivoire, Ghana, Togo, and Benin [1].

This threat finally materialized and became a reality in Côte d'Ivoire with the successive attacks on the seaside resort of Grand-Bassam in southern Côte d'Ivoire on March 13, 2016, on the Ivorian army position in Kafolo on the northern border with Burkina Faso, twice, on the nights of June 10 to 11, 2020, and March 28 to 29, 2021, and finally on the Kolobougou gendarmerie post, a small town in the north also on the border with Burkina Faso, on the night of March 28 to 29, 2021 [2-4]. These four attacks, which were successfully repelled, still resulted in the deaths of civilians, soldiers, and terrorists.

Since then, according to Ivorian and French security sources, several attempted attacks have been thwarted thanks to collaboration between the Ivorian, Malian, Burkinabe and French intelligence services.

To date, all terrorist attacks in this area have been carried out using conventional weapons (explosives and firearms). However, Côte d'Ivoire, countries in the sub-region and even the international community fear that these jihadists may acquire radioactive sources and use them as unconventional weapons by manufacturing Radiological Dispersion Devices (RDD) or Radiological Exposure Devices (RED).

Truly, radioactive material is "available" in this area because peaceful applications of nuclear techniques based on the use of ionizing radiation sources were promoted by the IAEA and are now widely used in Côte d'Ivoire and most countries in the West African sub-region. They are found in sectors as diverse as health (Radiotherapy), industry and mining (industrial gauges), agriculture (humidity/density gauges), livestock farming, education, and research.

Although, Mali, Burkina Faso and Côte d'Ivoire have, with the help of the IAEA, adequate regulatory infrastructure to regulate and control the use of radioactive sources on their territory (regulatory authority, laws and regulations, etc.) [5], the risk of seeing these radioactive sources diverted from their peaceful use and social welfare function, by terrorists to commit odious acts for ideological or political criminal purposes, cannot be ruled out.

Moreover, knowing the porosity of land borders in this area, which facilitates all kinds of illicit trafficking, and knowing the attractiveness of MPEs for terrorist groups, the Ivorian Authorities understood that 2023 AFCON could represent a prime target for terrorists and they decided to include nuclear security in the global security plan of this event.

1.2. Nuclear Security Regulatory Infrastructure

As indicated above, with the help of the IAEA and under the combined effects of national concerns linked to the increase and the diversification of the Ivorian stock of radioactive sources and the international security concerns following September 11, 2001 with the terrorist attacks, the State of the Côte d'Ivoire has gradually set up an institutional and legal framework for nuclear safety and security.

1.2.1. Domestic Infrastructure

An independent Nuclear and Radiological Regulatory Body called Radiation protection, Nuclear Safety and Security Authority (in French ARSN) was created the by the law No. 2013-701 of October 10, 2013 on Nuclear Safety and Security and protection against the dangers of ionizing radiation to regulate activities involving ionizing radiation sources [6]. Two implementing decrees of this law were also promulgated: The Decree No. 2014-361 of June 12, 2014 on the organization and operation of the regulatory body (ARSN) [7] and the Decree No. 2014-362 of June 12, 2014 implementing Law No. 2013-701 of October 10, 2013 [8]. Also, as part of the fight against terrorism, Côte d'Ivoire also adopted the Law No. 2015-493 of July 7, 2015 on the repression of terrorism [9] which was amended by the Law No. 2018-864 of November 19, 2018 [10]. This system was reinforced by the Law No. 2016-992 of November 14, 2016 on the fight against money laundering and the financing of terrorism [11].

1.2.2. International Agreements

In addition to national regulations, Côte d'Ivoire is party to many international agreements relating to nuclear security, such as those issued by the IAEA or by the United Nations (UN) like the Treaty on the Nuclear-Weapon-Free Zone in Africa (PELINDABA TREATY) [12], the Convention on the Physical Protection of Nuclear Material (CPPNM) and its Amendment (CPPNM/A) [13], the Convention on Early Notification of a Nuclear Accident (NOT) [14], the Convention on Assistance in the Case of a Nuclear Accident or Radiological Emergency (ASSIST) [15], the Code of conduct on the Safety and Security of Radioactive Sources and its Supplement on the Import and Export of Radioactive Sources [16], the Treaty of Non-Proliferation of Nuclear Weapons (NPT) [17], the International Convention for the Suppression of the Acts of Nuclear Terrorism (ICSANT) [18] and the United Nation Security Council Resolutions 1373 and 1540 [19, 20].

Côte d'Ivoire, also voluntary shares incidents involving radioactive material on the IAEA's Incident and Trafficking Database (ITDB). Furthermore, there is an Integrated Nuclear Security Support Plan (INSSP), implemented by the ARSN, that was developed and adopted in 2014 with the support of the IAEA [21]. The INSSP was revised in October 2017 in Abidjan and then in October 2021. It is precisely within the framework of this INSSP that the Ivorian government, through the regulatory body for nuclear safety and security (ARSN), requested and received, during the 2023 AFCON, a technical support from the IAEA (Côte d'Ivoire is a member since 1963). This technical assistance included the free loan of radiological detection equipment, an updated analysis report of the IAEA's incident and trafficking database (ITDB), the dispatch of an expert observation mission and, above all, the strengthening of the capacities of ARSN personnel and the training of the National Defense and Security Forces (FNDS i.e. NRBC units, UIGN units, Army, Police, Gendarmerie) in nuclear security [22].

1.3. Training of the National Actors by IAEA Experts and ARSN Specialist

For several years now, Côte d'Ivoire, through the ARSN, has benefited from numerous nuclear security training offered by the IAEA, that have enabled its staff members to acquire the skills necessary to regulate activities involving radioactive materials in the country. However, the specific aspect of nuclear security for MPEs had never been considered by the ARSN, much less by the FNDS. This attitude was no longer tenable knowing the attractiveness of MPEs for terrorist groups. The only solution was the implementation of nuclear security measures during the 2023 AFCON with the support of the IAEA.

So, as part of the 2023 AFCON, the ARSN set up a training program prepared with the assistance of the IAEA and consisting of technical visits or internships abroad, national workshops and full-scale exercises to test the nuclear security system held in Côte d'Ivoire. The IAEA had organized three (03) national workshops in Côte d'Ivoire and three (03) Technical Visits or Internships abroad to train the trainers.

The ARSN, for its part, organized two (02) national workshops and participated in two (02) full-scale exercises or tests. Regarding the two full-scale tests (Exercise during the qualifying match for the 2023 AFCON between Côte d'Ivoire and Lesotho in September 9, 2023 at San Pedro stadium and Exercise during the friendly match between Côte d'Ivoire and Mali at the Olympic Stadium September 12, 2023), many difficulties arose on the ground, mainly due to the fact that we were not truly ready at that time. Indeed, these exercises took place a little bit too early, in September 2023, i.e. well before all the trainings had been provided and even before the equipment loaned by the IAEA arrived in Côte d'Ivoire.

Figure 1. *Participants from ARSN and from FNDS (CBRN unit, UIGN, Army, Police) at the national workshop on the development and implementation of nuclear security measures for MPE organized by the IAEA from July 3 to 7, 2023 in Abidjan.*

Eighty (18) specialists from the ARSN had their capacities strengthened and sixty 60 senior officers and officers from the FNDS benefited directly from these training courses. The participants in those Train-the-Trainers courses were supposed to share their knowledges with their brothers in arms upon their return to their respective units or corps (UIGN, Police, Gendarmerie and the CBRN unit of GSPM). Figure 1 illustrates the participation of the ARSN's specialists and the FNDS's officers in a practical exercise of a national workshop on the "Development and implementation of nuclear security measures for EPM" organized by the IAEA at the Olympic stadium.

1.4. Composition of Nuclear Security Team at the Alassane Ouattara Olympic Stadium

The Security subcommittee of the local Organizing Committee for the 2023 AFCON designated the National Gendarmerie Intervention Unit (in French UIGN) specialized in Counterterrorism and Hostage Rescue and the Chemical, Biological, Radiological and Nuclear Unit (in French CBRN) of the Military Firefighters Group (in French GSPM) as the ARSN's main operational partners in Abidjan. It was therefore in collaboration with these two elite units of the FNDS that the ARSN performed, in Abidjan, the nuclear security measures, including background radiation mapping and monitoring of all the major locations of the 2023 AFCON. Figure 2 below shows an operation carried out jointly by ARSN's specialists responsible for detecting radioactive materials and the UIGN's deminers responsible for detecting explosives.

Figure 2. *ARSN's specialists (in black with portable radiation scanner backpacks) and UIGN's deminers (with explosives-sniffing dogs) together in search operations.*

This report focuses solely the nuclear security measures implemented for matches taking place at the Alassane Ouattara Olympic Stadium. Located in the suburbs of Abidjan (Ebimpé), the economic capital of Côte d'Ivoire, this stadium is the country's largest stadium (60,000 seats) and notably hosted the opening ceremony and the final match of the 2023 AFCON.

2. Nuclear Security Measures Implemented at the Olympic Stadium

It should be emphasized that the fundamental objective of the technical assistance requested from IAEA, through these various training courses, was to provide the participants (ARSN specialists and FDS officers) with the necessary skills to develop, but above all, to implement in a coordinated manner, operational procedures for deployment on the ground. Thus, the concepts of operation, the deployment of radiation detection instruments, etc., applied on the day of each match at the Olympic Stadium are presented in detail below. It should also be noted that in addition to the training courses, the ARSN relied on IAEA publications to draft all of these operational procedures [23].

2.1. Preparatory Meetings and Equipment Check at ARSN Headquarter

On the eve of each day of competition at the Olympic Stadium, the ARSN team held its preparatory meeting. The aim was to agree on the composition of the team (05 or 06 staff members), to check the batteries and equipment (PRD, RID and Backpacks) and to prepare the release sheets for the equipment that would be provided to the FNDS (UIGN, Police, Gendarmerie and the CBRN unit of GSPM).

After that, the ARSN team leader contacted the Stadium Security Coordinator (a senior police officer in charge of the Olympic Stadium operational security) either by a message or by telephone to inform him that, the day after, ARSN will participate in background noise mapping operations with the UIGN team and in entrances monitoring with the Police, Gendarmerie and the CBRN unit of GSPM.

2.2. The Departure of the ARSN Team to the Olympic Stadium

The departure for the Olympic stadium was made after a call or a message of the UIGN team leader, generally 12 hours before the start of the first match of the day, therefore around 1 a.m. local time. Once arrived at the stadium, the ARSN team checked again the operating status of the equipment (batteries and calibration) as shown in Figure 3.

Figure 3. *Arrival of the ARSN's specialists at the Olympic stadium in the early morning, approximately 12 hours before the start of the matches to prepare the equipment.*

This was followed first by the step of the sweep and the dose rates mapping of the stadium and all its strategic locations conducted jointly with the UIGN deminers (and sometimes with the NRBC unit of the GSPM), which took place approximately ten hours before the stadium opened to the public. Then, approximately one to two hours before the stadium opened to the public, the continuous radiological monitoring system was set up, which included:

1) The first-line detection teams (Gendarmerie, Police and NRBC unit of the GSPM)
2) The second-line detection teams (ARSN experts and Gendarmerie, Police and NRBC unit of the GSPM)
3) The third-line detection team (ARSN experts only)

2.3. Sweep and Dose Rate Mapping of the Stadium by ARSN's Specialists and UIGN's Deminers

The purpose of this control was to ensure the absence of radioactive materials in all areas not continuously monitored, including: The presidential box, the VIP area, the grandstands, the locker rooms, the offices, the lawn and the parking lots. This operation was carried out by the ARSN specialist accompanied by a team of (10 to 20) UIGN deminers.

The ARSN team leader began each time with a briefing of the UIGN unit on the role of radiological detection, the use of PRDs and the procedures to be implemented during this operation, particularly in the event of alarms being triggered. Subsequently, each member of the UIGN unit received a PDR against a discharge. A total of 10 to 20 PRDs were thus distributed. Under the supervision of the ARSN team leader, ARSN specialist and UIGN deminers began by sweeping all the above-mentioned locations, equipped with Backpacks, PRDs and RIDs, as shown in Figure 4. Only innocent alarms due to the high background noise from the construction materials at the Presidential box, the VIP area and locker rooms were noticed.

Finally, these teams crisscrossed the stadium pitch with backpack detectors which are equipped with GPS and which allowed them to generate a map of the area with the distribution of ambient radiation dose rates. Once this work was completed, both ARSN and UIGN teams informed the Stadium Security Coordinator of the Olympic Stadium.

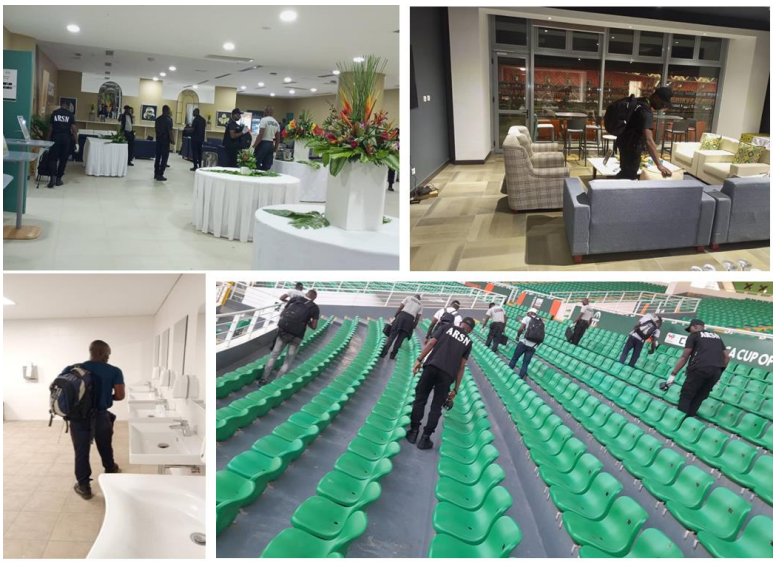

Figure 4. *Sweep of the VIP rooms, the VIP seating areas, the public seating areas and the player toilet by the ARSN, UIGN and GSPM teams before the start of the matches.*

2.4. Continuous Detection by Front-Line Officers at Pedestrian and Vehicle Access Checkpoints (First-Line Detection Teams)

Figure 5. *Portable radiation scanner backpacks used by the CBRN unit of GSPM at the unique vehicles entrance.*

The set up of a continuous radiological monitoring system for all the access routes to the stadium was intended to ensure that no one could enter the stadium perimeter with radioactive materials, notably through the two pedestrian entrances and the sole vehicle entrance. These entrances were under the control of first-line officers from conventional units of the Gendarmerie and the Police at pedestrian entrances No 1 et No 2 and from CBRN unit of GSPM at the unique vehicles entrance. The front-line officers were also in charge of the physical screening of vehicles and pedestrians using search procedures and metal detection equipment. One portable radiation scanner backpack was given to the CBRN responsible for the continuous radiological monitoring of the unique vehicles entrance as it is illustrated in Figure 5.

And about thirty (30) PRDs to be worn at belt level were distributed to the Gendarmerie officers after signing a discharge as shown in Figure 6 and to the police officers as shown in Figure 7. No alarm signal from the frontline officers was noted.

Figure 6. *Belt-worn PRDs used by Gendarmerie officers at the pedestrian entrance No 1.*

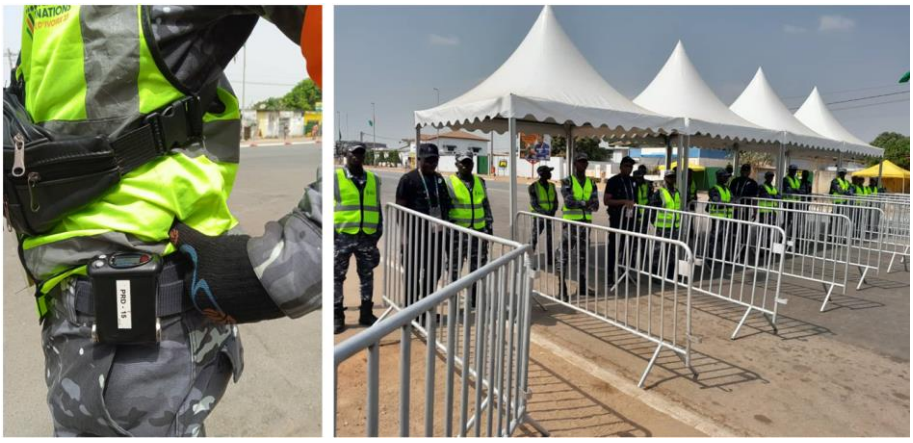

Figure 7. *Belt-worn PRDs used by Police officers at the pedestrian entrance No 2.*

2.5. Second Assessment of the Alarm by the ARSN Team (Second-Line Detection Teams)

After handing over the PRDs to the Police and Gendarmerie units, the ARSN team remained on standby to await any alarm signals from the frontline officers. If a vehicle or a pedestrian triggered an alarm on the PRDs, the vehicle and its occupants, or the pedestrian, would be escorted by the frontline officers to a secure location for a secondary assessment of the alarm by the ARSN team. There the radiation protection specialists equipped with RID had to verify and to clear False alarm or Innocent alarm or to confirm non-innocent alarm.

2.6. Third Assessment of the Alarm by the ARSN Team (Third-Line Detection Teams)

The third detection line is a mobile expert support team, located at the ARSN headquarters, that could be activated and deployed to investigate into the origin of the proven alarms following the research conducted by the second line. This team was equipped with RID and Back pack and had sources recovery and securing equipment (container, clamps, gloves, disposable suits, etc.).

2.7. End of Operations and Writing of the Day's Report

At the end of a day of deployment, the ARSN team collected the equipment unloaded by the police and gendarmerie officers and ensured that it was in good working order. The discharge forms were countersigned by the ARSN inspectors and the police and gendarmerie officers. After a day's deployment, a report describing all the day's activities and highlighting the results in terms of events that occurred was written by the ARSN team and forwarded to the Deputy Director of Nuclear Safety and Security.

3. Results and Discussions

The ARSN has supervised the setup of nuclear security measures at the Olympic stadium during the ten (10) matches scheduled there. The six (06) ARSN's specialists assigned there participated fully, first in the step of the sweeping and the dose rates mapping of the stadium and all its strategic locations with the UIGN deminers and sometimes with the NRBC unit of the GSPM (several hours before the stadium opened to the public). Then in the step of setting up a continuous radiological monitoring of the stadium accesses (around one to two hours before its opening to the public).

It should be noted that globally, the training courses received by the FDS's officers have fully achieved their objectives, namely, to enable the various officers to understand the basic principles of radiation protection, to acquire the skills necessary to use radiological detection equipment (e.g. personal radiation detectors (PDRs), radionuclide identification devices (RIDs), portable radiation scanner backpacks), and become familiar with nuclear security operational concepts and standard operating procedures. This has enabled effective collaboration in the field with the ARSN's specialists and would have even made it possible to provide a rapid and coordinated response in the event of a radiological threat or attack by terrorists.

It should also be noted that only innocent alarms were reported at the Presidential box, the VIP area and locker rooms during the sweep and the dose rate mapping. After investigations, it appeared that these alarms were due to the high background noise at this location from the construction materials (Presence of naturally occurring radioactive material).

At the end of the competition, we identified the best practices implemented, the weaknesses or unexpected problems identified by the IAEA observation mission, the lessons learned, as well as the challenges and opportunities. All of this is summarized and discussed in the table below.

Table 1. *Good practices, weaknesses or unexpected issues, Lessons learned and challenges or prospects.*

Good practices	Weaknesses / unexpected issues	Lessons learned	Prospects / challenges
1. Accreditations obtained for all areas of the stadium for ARSN specialists. 2. Good visibility of ARSN specialists through their flocked uniform (ARSN stamped) which allowed them to stand out in the field among other actors. 3. Taking into account most of the nuclear security measures: a. Dose rate mapping of venues before the competition b. Background survey and sweeps of venues before each match c. Continuous control at the 02 pedestrian entrances and at the unique vehicle entrance d. Presence of the ARSN at briefings and debriefings security meetings each match days 4. Training of all ARSN specialists in the use of detection equipment. 5. Training of many FNDS units for nuclear security measures: a. UIGN b. National Police c. Army d. National Gendarmerie e. Military Firefighters Group f. Scientific police 6. Codification and traceability of all the detection equipment. 7. Provision of daily and final report templates to nuclear safety team leaders at different stages. 8. Awareness-raising by ARSN of senior civil and FNDS authorities regarding the implementation of nuclear security measures.	1. It was not always that the FNDS agents previously trained by the IAEA and the ARSN who were present during the checks at the stadium entrances on match days. 2. ARSN could not install detection equipment at the Presidential and VIP pedestrian entrances. 3. None among private security companies used for VIP pedestrian entrances was equipped with radiation detection equipment. 4. No radio communication means from the FNDS with ARSN.	1. Cooperation with the IAEA who provide training to the trainers (ARSN specialists FNDS units) is essential. 2. Loan (free of charge) from IAEA of sufficient radiological detection instruments is essential. 3. Early awareness of nuclear security culture among all stakeholders is necessary to fully integrated nuclear security into the overall security plan notably at the level of the President's security (continuous control at the presidential and VIP pedestrian entrances has been refused). 4. it is important to ensure that only the FNDS agents previously trained by the IAEA and the ARSN are present during the checks at the stadium entrances on match days. 5. It is important to implement a program of Exercises or full-scale tests so as to ensure that all the stakeholders responsible for nuclear security are familiar with the nuclear security practices and procedures that are necessary when hosting an MPE	1. Continue to raise awareness among senior security officials. 2. Integrate systematically nuclear security into the security of all MPE taking place in Côte d'Ivoire. 3. Continue to strengthen the capacities of ARSN experts in nuclear security for MPE. 4. Request the government of Côte d'Ivoire to provide additional financial resources to ARSN to acquire the detection equipment necessary to deal with future MPEs. 5. Implement a nuclear security training and education module in the training curriculum of FNDS schools and training centers. 6. Establish MoUs with the FNDS. 7. Strengthening response capabilities to nuclear security events. 8. Establish and implement a national detection architecture. 9. Provide sufficient financial, material and human resources to ARSN by the Government of Côte d'Ivoire.

4. Conclusion

The integration of nuclear security into the traditional security framework for MPEs is an international standard that Côte d'Ivoire successfully implemented for the very first time during the organization of the 2023 African Cup of Nations. This was possible thanks to the strong commitment of the Ivorian government and the valuable technical assistance of the IAEA.

At the Alassane Ouattrara Olympic Stadium in which thousands of people congregate during the 10 competitive matches, all the components of the nuclear security were taken into account and no nuclear security incidents were reported. This resounding success is attributable to the relevance of the training provided by the IAEA, the quality of the

equipment loaned by the IAEA, and the seamless collaboration between the ARSN and the various stakeholders (UIGN and GSPM units, the Police and Gendarmerie).

Today, the challenge for Côte d'Ivoire is to sustain nuclear security for MPEs by ensuring that all major sporting, cultural, and political gatherings are covered by the ARSN specialists and the first responders of FNDS who were trained during the 2023 AFCON.

Abbreviations

AFCON	African Cup of Nations
ARSN	Radiation protection, Nuclear Safety and Security
ASSIST	Convention on Assistance in the Case of a Nuclear Accident or Radiological Emergency
CBRN	Chemical, Biological, Radiological and Nuclear
CPPNM	Convention on the Physical Protection of Nuclear Material
FNDS	National Defense and Security Forces
GSPM	Military Firefighters Group
IAEA	International Atomic Energy Agency
ICSANT	International Convention for the Suppression of the Acts of Nuclear Terrorism
INSSP	Integrated Nuclear Security Support Plan
ITDB	Incident and Trafficking Database
MPE	Major Public Event
NOT	Convention on Early Notification of a Nuclear Accident
NPT	Treaty of Non-Proliferation of Nuclear Weapons
PRD	Personal Radiation Detector
UIGN	National Gendarmerie Intervention Unit
RDD	Radiological Dispersion Device
RED	Radiological Exposure Device.
RID	Radionuclide Identification Device

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Conflicts of Interest

The authors declare no conflicts of interest.

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Biography

N'Guessan Guy Leopold Oka is a nuclear physicist and a Qualified Expert in Radiation Protection. He is currently the Deputy Director of Nuclear Safety and Security at the ARSN, the Regulatory Body for Nuclear Safety and Security of Côte d'Ivoire and a sworn Inspector of ARSN. He is also a Researcher at the Laboratory of Nuclear Energy and Radiation Protection of the Institute for Research on New Energies of the University of Nangui-Abrogoua. He was Head of Radiation Protection Services at the Sub-Directorate of Protection against Ionizing Radiation (SDPRI) of the National Public Health Laboratory (LNSP) from 2002 to 2008 and then Manager of the "Radiation Protection and Environment Consulting" consultancy from 2009 to 2013.

Bogbe Douo Louis Huberson Gogon is a lecturer (Associate Professor) at the Felix HOUPHOUT-BOIGNY University of Abidjan, at the Sciences of Structure of Matter and Technology (SSMT) Training and Research Unit. He is a permanent member of the Physics Nuclear and Radiation Protection team which is under the Laboratory of Sciences of Matter, Environment and Solar Energy. He got his Doctorate in Nuclear techniques and Physics from the Caddi Ayad University at the Semlalia Faculty of Sciences in Marrakech (Morocco) in 2010. As an Associate Professor since 2022, I supervised several master thesis of Nuclear Sciences and Techniques. He got a AIEA Post Graduate Educational Course in radiation protection and the Safety of Radiation Sources (PGEC) in mars 2014. He is also a Deputy Director of Authorization of the Côte d'Ivoire's Regulatory Body for Nuclear Safety and Security (ARSN) and the sworn inspector of this regulator.

Gnionnihindjoue Romaric Nonka is a nuclear physicist and specialist in the implementation of nuclear security measures during MPEs. He works as an inspector at the Sub-Directorate of Nuclear Safety and Security of the ARSN, the Regulatory Body for Nuclear Safety and Security of Côte d'Ivoire. He is currently preparing a doctorate at the Laboratory of Material Sciences, Environment and Solar Energy (LASMES) at the Félix Houphouët-Boigny University (UFHB) in Abidjan, Côte d'Ivoire.

Bi Gore Descar Tchan is a Nuclear Physicist who works at the Regulatory Body for Nuclear Safety and Security of Côte d'Ivoire as Deputy Director of training and Dosimetry. Currently, he is a PhD Student at the Laboratory of Material, Environmental, and Solar Energy Sciences (LASMES) at the University of Félix Houphouët-Boigny (UFHB) Abidjan-Cocody, Côte d'Ivoire.

Research Field

N'Guessan Guy Leopold Oka: Evaluation of the Radiological quality of some foods and drinking waters consumed in Côte d'Ivoire, Study of optimization of doses, Optimization of nuclear security measures for Major Public Events.

Bogbe Douo Louis Huberson Gogon: Radioecology or environment, Radiological physics, Modulization and simulation, Radiation Protection, Nuclear safety and security.

Gnionnihindjoue Romaric Nonka: Study of radon concentrations in the air of dwellings, Radioecology, Optimization of nuclear security measures for Major Public Events.

Bi Gore Descar Tchan: Assessment of radon and thoron in drinking waters, Radioecology, Optimization of nuclear security measures for Major Public Events.