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*Atoms for Peace and Development*

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**Senegal's initiatives, efforts and  
perspectives in capacity building.**

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# Capacity building :outcomes of the Regcon2023



## Regcon2023 recalled :

✓ The key elements of Capacity Building (CB), which are education and training, human resources development, knowledge management and knowledge networking, and the need for a systematic and integrated approach (“umbrella approach”):



✓ That CB requires a multidisciplinary and multi-institutional approach as well as appropriate resources to ensure that key stakeholders (Government, Regulators, Operators, TSOs, Educational institutions, others..) are able to attract and retain sufficient human resources in the short, medium and long term.

✓ The necessary collaboration and cooperation among all stakeholders to develop the national CB strategy to ensure it meets their needs, and to provide feedback when gaps and/or new or emerging needs are identified.

## Highlights from the topical session dedicated to Capacity Building for the Future – Holistic Approaches for Nuclear and Radiation Safety and Security :

- The importance of **systematic, harmonized, and globalized approaches to human resources and education and training in nuclear sciences and technology**;
- The challenges regulators face in the current environment, including financial constraints, an ageing workforce, and the **need for new competencies** in areas such as cybersecurity and digitalization;
- The importance of **leadership** for safety and security culture as essential components in driving capacity building, along with greater diversity and inclusion;
- The necessity of developing durable capacity building programmes, **transferring knowledge to the next generation**, and cultivating a global workforce of regulatory practitioners.





**Some key messages to consider in CB programmes and strategies are:**

- ✓ **Regulators need to build resilience and agility** to respond to new and emerging challenges in a rapidly changing environment. In particular, they
- ✓ **The need to strengthen international cooperation**, knowledge transfer, mutual learning and **efficient networking**, in particular through regional networks and **to leverage regional cooperation** for training, technical assistance and knowledge transfer among Member States to build regulatory competence and stakeholder confidence;
- ✓ **The need for diversity and gender balance in the regulatory workforce;**
- ✓ **The need to fully prepare and empower a new generation of leader**

**Some key Challenges to CB programmes :**

- Shortage of expert staff;
- Digital Transformation;
- Employee market;
- New family/ life models, Mobility ;
- Ageing society;
- Large scale retirements of qualified staff;
- Preparing for the Gen Z workforce

## Capacity building : Senegal's efforts, initiatives and perspectives for regulatory effectiveness



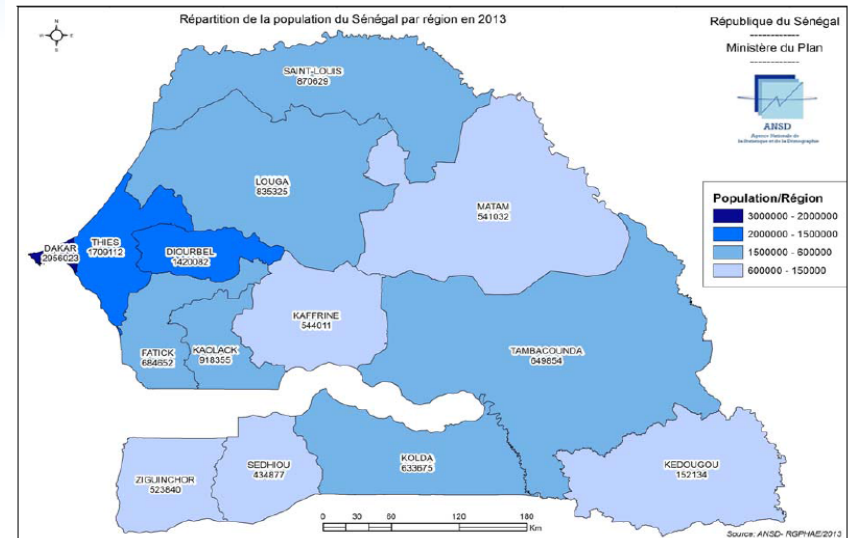


# 1. Background information

**PAST:** The use of nuclear techniques started in Senegal (AOF) in the 1950s :

- ❖ Radium needles were used in 1950's in medical facilities
- ❖ The first carbon-14 laboratory on the African continent in 1963
- ❖ Cobaltotherapy from 1990 to 2017

The nuclear regulatory authority was effectively established in 2011 (60 years later).



**NOW:** Ionizing radiation are being used in medicine (radiotherapy, nuclear medicine, conventional and interventional radiology), industry (NDT, well logging and drill, oil and gas exploration, nuclear gauges, cement production, etc.), education and research.

**FUTURE:** The presence of ionizing radiation will likely increase

- ❖ In medicine with the expansion of radiotherapy and nuclear medicine facilities;
- ❖ In industry with oil and gas exploitation, uranium exploitation (exploration began in 2022);
- ❖ In education and research with the research reactor project

And in other sectors



## 2. Introduction



In 2011, beginning of the national inventory of the sources of ionizing radiation and the associated practices.

Since 2011, radioactive sources used in past activities and disused ones are gradually being brought under regulatory control and the regulatory infrastructure being established for an effective control over current activities.

For this, the Senegalese Authority for Radiation Protection, Nuclear Safety and Security (The ARSN) has established strong cooperation with:

- ✓ relevant national stakeholders;
- ✓ international partners (IAEA, USNRC, ORS, PNNL, Vertic, etc..);
- ✓ regulatory authorities of partner countries;
- ✓ regional partners (FNRBA, FASSN).

In 2021, promulgation of a new and comprehensive nuclear law (Law 2021-44 of 31 of December 2021)







## Capacity building for the RB

- **Identify capacity-building needs and set up strategic planning (three-year plans).**
- **Management approach:**
  - Progressive integration of the three mission areas (safety, security, safeguards)
  - Process approach
  - Graded approach

**Security has been introduced into capacity-building programs in the 2014-2016 three-year plan.**

**Strategy: Develop a three-year strategic planning framework**

**For the first three-year plan (2011- 2013)**

**Main objectives:**

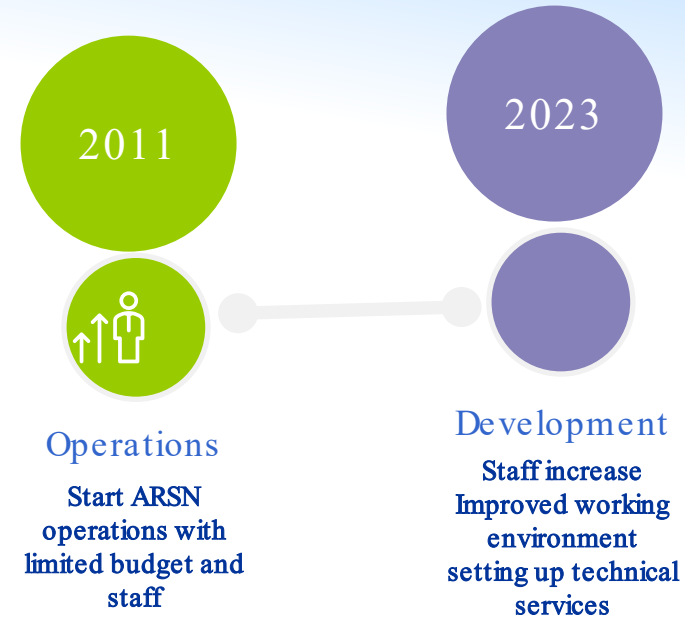
- **Operational implementation of ARSN;**
- **Prioritize control of facilities with high-category sources;**
- **Undertake a review of existing laws and regulations to identify gaps;**
- **Identify the training needed to acquire knowledge and skills in protection and radiation safety and in safeguards;**
- **Identify external support required**



## Capacity building for the RB

❖ In 2011, start recruiting technical staff using ITNA's existing human resources:

- 3 students with a master's degree in nuclear physics were recruited as potential inspectors (one attended the 2012 PGEC in Alger, two the 2013 PGEC in Morocco)
- 3 teachers with PhDs in nuclear physics were appointed heads of technical departments and trained in protection and radiation safety as part of national and regional IAEA projects and training programs run by other partners.



❖ In 2014 one more student recruited and attended the PGEC in Alger. Since then, 4 more attended the PGEC and two more will attend the next starting in November 2023;

❖ From 2011 to 2023, CB programmes (Licensing & Inspection Trainings, specific training courses, etc.) have been planned, implemented and funded by national budget and international cooperation.



## Capacity building for the RB

### Example of specific trainings for some of our inspectors:

- **Licensing and authorization of linacs**
- **Grammagraphy**
- **Search and secure of rad sources**
- **Several thematic training courses through regional and international networks (FNRBA, FASSN, NSSCs)**

### Perspectives:

- **Two newly recruited staff will attend the Master « Ingénierie de la santé » which will take place from August 21, 2023 to August 20, 2024 at Grenoble Alpes University;**
- **Recruitment of new inspectors and other specialized staff in line with the three-year plan**

- **Building nuclear competency with respect to research reactors.**

- **17th EERRI (Eastern European Research Reactor Initiative) Research Reactor Group Fellowship Training Course in Vienna, Austria, Ljubljana, Slovenia and Prague, Czech Republic from **26 September to 4 November 2022.****
- **IAEA-KINS Workshop on Safety Evaluation of Research Reactor Daejeon, Korea **July 2019****
- **Workshop on Regulatory Inspection Programmes for Research Reactors for Forum of Nuclear Regulatory Bodies in Africa (FNRBA) Morocco, **November 2018.****



## Capacity building for the RB



### Licensing and authorization of Linacs

Senegal hosted several (more than 20 regional trainings organized by the IAEA) and by other partners (USNRC, ORS, PNNL)  
Next: Regional Training Course on the Security of Radioactive Material in Use and Storage to be held 16-20 Oct 2023 in Dakar, Senegal



### Practical recovery, conditioning and packaging the legacy sources



### Search and secure of rad sources





# Initiatives and Efforts in Capacity Building

## Capacity building for the RB

As a result,





## Capacity building for the RB

### Achievements for an effective RB

- **Effective authorization and inspection processes and programmes;**
- **Competent and well trained technical staff**
- **Completion of the national inventory with the help of USNRC and with equipment procured by IAEA and USDOE;**
- **Establishment of an interim storage facility with capabilities and equipment for conditioning disused radioactive sources;**
- **Establishment of an Dosimetry laboratory (OSL);**

### Perspectives:

- **Establishment of an environmental monitoring laboratory and a program on public and environmental radiation Protection;**
- **Recruitment of new competences and continuing CB program to respond to new challenges (acquisition of irradiation facilities, introduction of advanced technologies in medicine : PET/CT, SPECT/CT, proton therapy, cyclotron, research reactors, Oil and gas exploration and exploitation)**



## Capacity building for medical practitioners

### Efforts for equipment and training in radiotherapy

#### Current status of radiotherapy

Region	Hospital	Linac	HDR Brachy.
Dakar	Dalal Jamm	2	1
	Dantec (Rebuilding in progress)	1	1
	Military	1	
Diamniadio	National Oncology Centre	2	1
Touba	K. Rassoul Hos.	1	

#### Planning new radiotherapy facilities up to 2026

- North : Saint Louis, 2 Linacs – HDR Brachytherapy
- South : Ziguinchor  
1 Linac – HDR Brachytherapy
- Center : Kaolack ?  
( under discussion)

#### Specialist Training

- Training of 13 Radiation Oncologists (local funds)
- Training of 10 Radiation Technologists RTT'S (Bilateral cooperation with Belgium)



## Capacity building for medical practitioners

### Trainings of Medical physicists (IAEA )

- Two of them holds a PHD in Nuclear physics;
- Three of them completed the Advanced Master Studies (and Residency) in Medical Physics, International Centre for Theoretical Physics (ICTP) & University Hospital of Trieste, Italy, 2018 – 2019, 2019-2021
- One the PGEC, Algeria, 2017
- Two the Joint IAEA- ICTP, International school on Nuclear Security ICTP, Trieste (Italy), April, 2016

#### ❖ Medical physicists benefitted from recent regional trainings

- AFRA Regional meeting on optimization of radiation protection of patients in computed tomography, Kampala, March 2023;
- Regional (AFRA) Training Course on Internal dosimetry, Algiers, July 2023;
- Training Course to Train the Trainers on Implementation of the Harmonized Quality Control Programme in Nuclear Medicine and Diagnostic Radiology, Sousse, Tunisia, August 29 to September 02, 2022;
- Regional (AFRA) Technical Group fellowship on Nuclear Medicine for French speaking Technologists, Algiers, September 18 to November 17, 2022;



.....;





## Capacity building for medical practitioners

### Educational programmes:

**Senegal has created 3 Diplomas of Specialized Studies (DES) in Radiology, Nuclear Medicine and Radiotherapy at UCAD**

- ❖ Sub-regional **Diploma of Specialized Studies in Nuclear Medicine** validated and harmonized for the CAMES zone

**Graduated students:** Benin:1, Burkina: 5, Cameroon:1, Senegal: 4, Togo: 1

**Others enrolled in different levels:** Benin: 1, Burkina Faso: 4, Gabon: 1  
Niger:1, Senegal: 3, Chad: 1

### Perspectives:

- **Master's degree in medical physics planned for next academic year;**
- **Project to create a Franco-Senegalese professional degree in dosimetry and radiation protection (LP DORA);**
- **Recognition of accredited training centers in nuclear medicine and radiotherapy in Senegal**





## Capacity building for users and practionners in medecine

**Perspectives : training under SEN 9065 and RAF9067 (RAYS OF HOPE :**

	Current	Needs to 2026	Under training	IAEA Fellowship
Radiation oncologists	14	20	6	
Medical physicist	4	20	2	8
Radiation oncology nurses	4	12	-	-
Radiation therapy technologists	14	32	-	8
Radiopharmacist's	2	10	-	8
Nuclear Medecine Specialist	6	12	4	4



# Initiatives and Efforts in Capacity Building



## Capacity building for education and research In progress

	Degree	University/Country
1 Male	PHD Thesis in Nondestructive testing	Harbin University of Science and Technology/ China
1 Male	PHD Thesis in Nuclear Power Engineering and Thermal Physics	Harbin University of Science and Technology /China
1 Male	PHD Thesis in Chemical Engineering for Nuclear fuel Cycle	Harbin University of Science and Technology /China

	Training Programme	University/Country
1Female+1 Male	Nuclear Power Engineering and Thermal Physics	Nizhny Novgorod State Technical/Russia
1 Female	Nuclear Medecine	Tomsk polytechnic
1 Male	Nuclear Power Engineering and Thermal Physics	National Research University



## Capacity building for education and research

Training programmes for students from the Institut de Technologie nucléaire appliquée (ITNA). Funding mechanism: bilateral cooperation between UCAD and Universities or Institutes in China, Russia and US

### Already achieved

1 Female	Degree	University/Institute/ Country
	Master in Nuclear Power Engineering and Thermal Physics	Nizhny Novgorod State Technical University/China
1 Female	Master in Safeguards	
	Master in Materials science for nuclear applications	Moscou Engineering Physical Institute /Russia
1 Female + 1 Male	Training program	University/Institute/Country
	External particle track detector at ATLAS	Brookhaven National Laboratory in New York

### Perspectives:

- Senegal plans to accelerate its digital transformation with the creation of the Université Numérique Cheikh Hamidou Kane (formerly UVS);
- On September 14, 2023 the Senegalese government, launched the national strategy on artificial intelligence (AI);





## Capacity building for other stakeholders

### Security forces

### Ex. of National trainings

- Civil nuclear issues and challenges, Conference for the academic year 2022-2023, Cours d'Application des Officiers de Gendarmerie (CAOG), March 2023;
- Virtual Meeting Meeting on Capacity Building on Nuclear Forensics and RCSM, December 2022
- Nuclear Security Awareness Workshop for Gendarmerie, Customs, Army and Fire Brigade, September 2022;
- National seminar on "Assessment of nuclear security culture", November 2022;
- Creation in 2018 of the national cybersecurity school as part of Senegal's national cybersecurity strategy (SNC2022);



### IAEA regional trainings

- Introductory webinar on the Crime Scene and Nuclear Forensics Unit (new IAEA technical document in the area of nuclear forensics), July 2023;
- Webinar on « Nuclear Security Detection Architecture - Planning, Implementing, and Evaluating Detection Operations », March 2023.





# Challenges



## **Enhance the effectiveness of ARSN**

- **Maintain and develop the technical and regulatory skills of new and existing staff (align skills and qualifications with new challenges);**
- **Strengthen organizational capabilities, including adequate financial resources;**
- **Attract and retain highly qualified human resources.**

**Enhance nuclear safety and security culture and the knowledge of relevant stakeholders**



## CONCLUSION

**Capacity building programmes for an effective regulatory body have been implemented through education and training, human resources development, knowledge management and knowledge networking.**

**International cooperation and regional networking have played a key role in supporting our CB priorities and objectives**

**For continuous improvement in building and maintaining nuclear science skills, the identification of training and capacity-building needs in all areas will soon be carried out by the Knowledge Management Assistance Mission (KMAV) within the framework of AFRA-NEST.**





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NUCLÉAIRES**

*Thank you!*