

Education in the nuclear Field

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Introduction

- The nuclear regulation efficiency and effectiveness **depends** on that the nuclear regulatory body **establishes a consistent and rigorous regulatory position** on safety matter
- These positions should be based on **high technical expertise** and relevant **ordinances, standards** and **guidelines** reflecting policy changes governing nuclear regulations
- In this sense, the access and preservation of information is **strategic** for a better execution of the tasks in the nuclear area
- This presentation shows the necessity of construction of a Capability Building and shows some actions of Knowledge Management in Brazil

Capacity Building

CB is a **systematic** and **integrated** approach that includes **education & training, human resource development, knowledge management** and **knowledge networks** to develop and **continuously improve** governmental, organizational and **individual competences** and **capabilities** necessary for achieving safe, secure and sustainable nuclear power programme

Capacity Building

1. **Education and training:** Education and training infrastructures and processes are fundamental to the capacity building strategy
2. **Human resource development:** Development of an effective workforce at organizational level, by providing a structured approach to estimate the human resource needs for the program
3. **Knowledge management:** The knowledge that individuals need as part of the competence requirements for assigned tasks and the additional knowledge they acquire in carrying out those tasks needs to be preserved and shared widely
4. **Knowledge networks:** Knowledge networks are established to promote the combine, analysis and sharing of nuclear technical, safety and security knowledge and experiences at national, regional and international levels

Capacity Building

- Includes **education** at the national, regional and international levels
- To cover all the nuclear safety related areas, including safe operation, emergency preparedness & response and regulatory effectiveness
- Uses **existing capacity** to build additional knowledge
- The expected outcome of this approach is to continuously ensure **sufficient** and **competent human resources** necessary to deliver their responsibilities

Knowledge

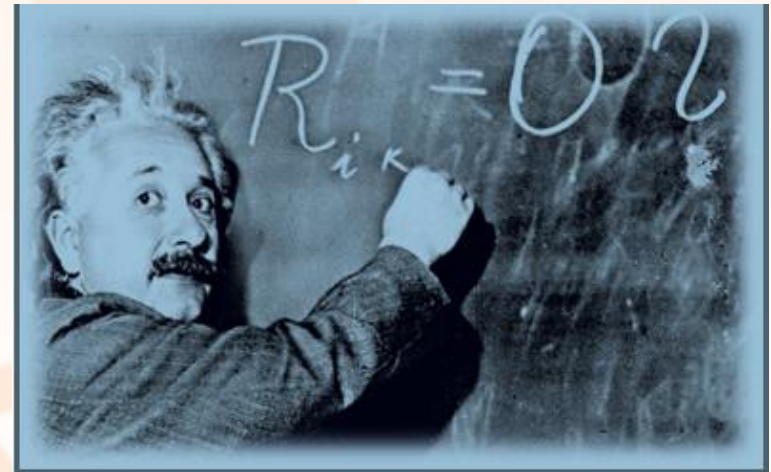


Knowledge is power

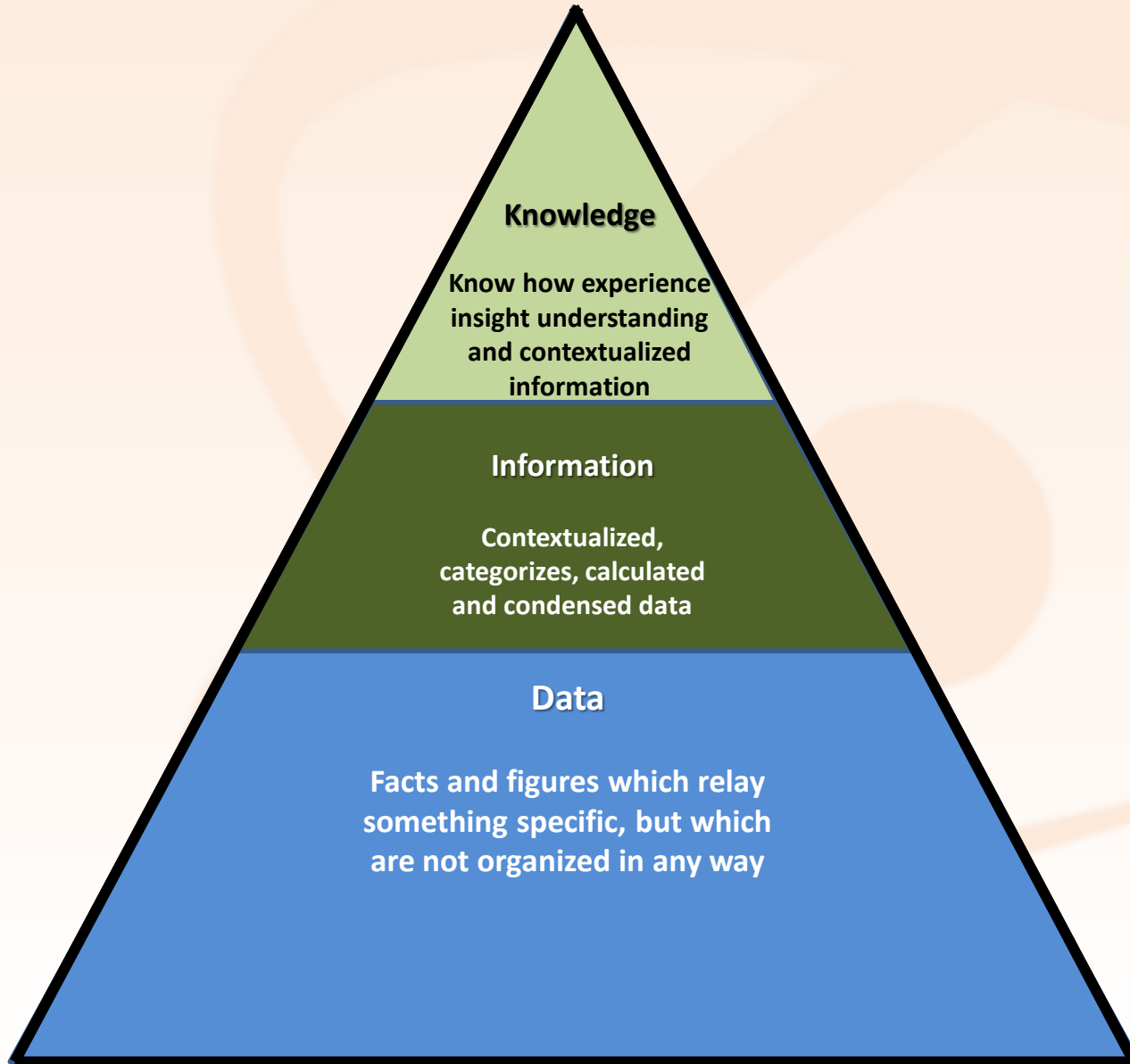
Francis Bacon, 1561 – 1626

*Knowledge is experience,
everything else is information*

Albert Einstein, 1879 – 1955



Knowledge

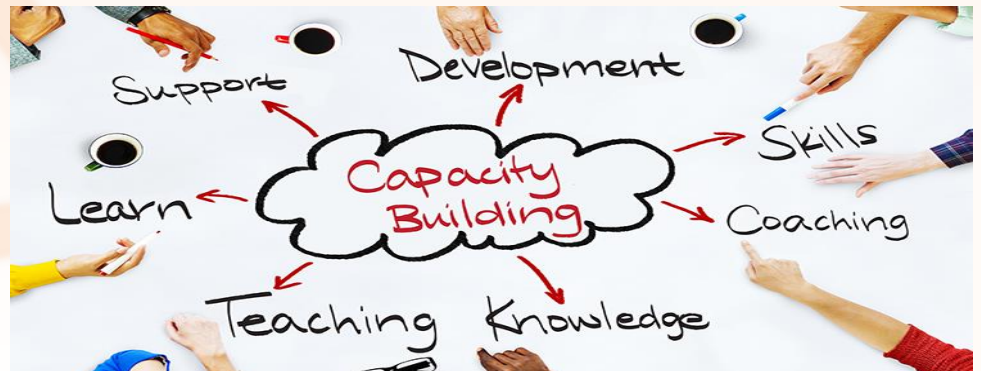


Kinds of Knowledge

1. **Combination:** involves the combination of different sets of explicit knowledge
2. **Internalization:** is the process of incorporating explicit knowledge into tacit knowledge
3. **Socialization:** sharing of experiences and, from there, to the creation of tacit knowledge, such as mental models or shared technical skills
4. **Externalization:** expressed in the form of analogies, hypotheses or models

Knowledge Management Benefits

- ✓ Enables acceleration of learning, knowledge and innovation processes
- ✓ Increases the value of the organization in relation to individual interests
- ✓ Decrease in costs through increased productivity
- ✓ Adopts a proactive decision-making culture
- ✓ Intellectual Capital (Human Capital + Structural Capital)
- ✓ Strategic Positioning



Nuclear Knowledge Management

Main Objectives

- **Safety** – achieve *safe* operation and maintenance of all nuclear facilities by sharing operational experience
- **Benefit** – achieve gains in economics and operational performance through effective management of the resource – nuclear knowledge
- **Security and non-proliferation** – achieve *responsible use* by properly identifying and protect nuclear knowledge from improper use
- **Innovation** – facilitate *innovation* to achieve significant improvements in the safe, economical operation of all new nuclear projects
- **Sustainability** – maximize the *flow of nuclear knowledge from one generation to the next*

Actions of CNEN

- CNEN maintains activities of research, orientation, planning, regulation and inspection, acting in several sectors that maintain interaction with the nuclear area:
 - Generation of electrical energy
 - Applications in Medicine
 - Applications in Industry, Agriculture and the Environment
 - Exploitation and research in processing of nuclear mineral reserves
 - Defense, especially related to nuclear propulsion
 - Treatment and storage of radioactive waste
 - Radiological safety and protection of the population
 - Research and teaching related to applied technologies
- The organization of the nuclear area in Brazil involves responsibilities shared by a large number of entities, requiring coordination between different agencies and ministries

Specialized Education for Nuclear Field 2017

- **Objective:** To develop science and nuclear technologies and applications to attend several society uses
- **CNEN investment in 2017:** near US\$ 1 million
- **Finality:** To **promote** and encourage the adequate specialization at the **postgraduate level**, of technical and scientific personnel, aiming at their **capacity to meet** the demands in the Nuclear Sector

Specialized Education for Nuclear Field

- Description: The promotion of the training of specialized personnel to meet the needs of the Nuclear Sector
 - The specialized technical training for the Brazilian nuclear sector includes postgraduate, master's and doctoral courses offered by CNEN's Technical and Scientific Units (TSU) and a program for granting masters and doctoral fellowships offered through **Public Edict**
- This segment is made up of:
 - a small number of universities that offer courses in the nuclear area
 - the postgraduate courses offered by CNEN's TSU

Specialized Education for Nuclear Field

➤ Knowledge areas of Interest:

- Public acceptance of nuclear technology
- Analysis and evaluation of safety and environmental impact of nuclear and radiative facilities
- Applications and effects of ionizing radiation in agriculture, food, industry, health, environment, art and culture
- Nuclear fuel cycle
- Nuclear instrumentation, control, interface man/nuclear systems
- Material and chemical process of nuclear interest
- Nuclear fusion
- Radioactive waste
- Regulatory research for the nuclear sector
- **Ionizing radiation Metrology**
- **Ionizing radiation Dosimetry**
- **Radiation Protection**

Covered by IRD



CNEN Post Graduation Fellowship in 2017

- Students competing for CNEN post graduation fellowship public edict: **79**
- Total CNEN fellowships in 2017:

Students Origin	Degree	
	Master	Doctor
Public edict	10	5
CNEN Technical Scientific Units	16	13
Pre 2017	21	33
Total 2017	47	51

CNEN Post Graduation Fellowship in 2017

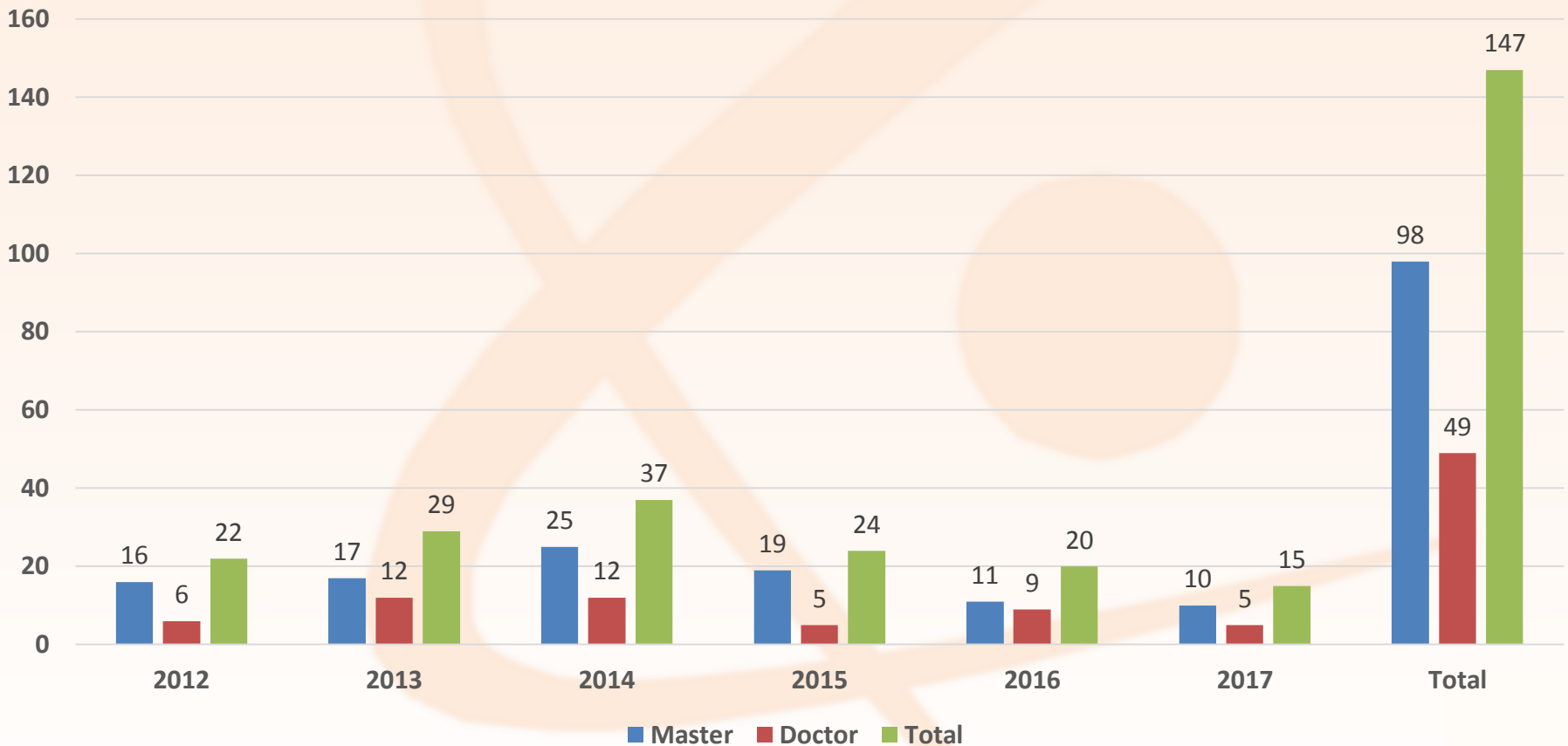
Institutions

1. **CDTN – Centro de Desenvolvimento da Tecnologia Nuclear**
2. **IEN – Instituto de Engenharia Nuclear**
3. **IPEN – Instituto de Pesquisas Energéticas e Nucleares**
4. **IRD – Instituto de Radioproteção e Dosimetria**
5. **CRCN-NE – Centro Regional de Ciências Nucleares do Nordeste**
UFPE – Universidade Federal de Pernambuco
6. **FPP – Faculdade Pequeno Príncipe**
7. **PUC-GO – Universidade Católica de Goiás**
8. **UERJ – Universidade do Estado do Rio de Janeiro**
9. **UFF – Universidade Federal Fluminense**
10. **UFMG – Universidade Federal de Minas Gerais**
11. **UFRGS – Universidade Federal do Rio Grande do Sul**
12. **UFRJ – Universidade Federal do Rio de Janeiro**
13. **UFS – Universidade Federal de Sergipe**
14. **UNIFAL – Universidade Federal de Alfenas**
15. **USP – Universidade de São Paulo**

CNEN
Technical
Scientific
Unit

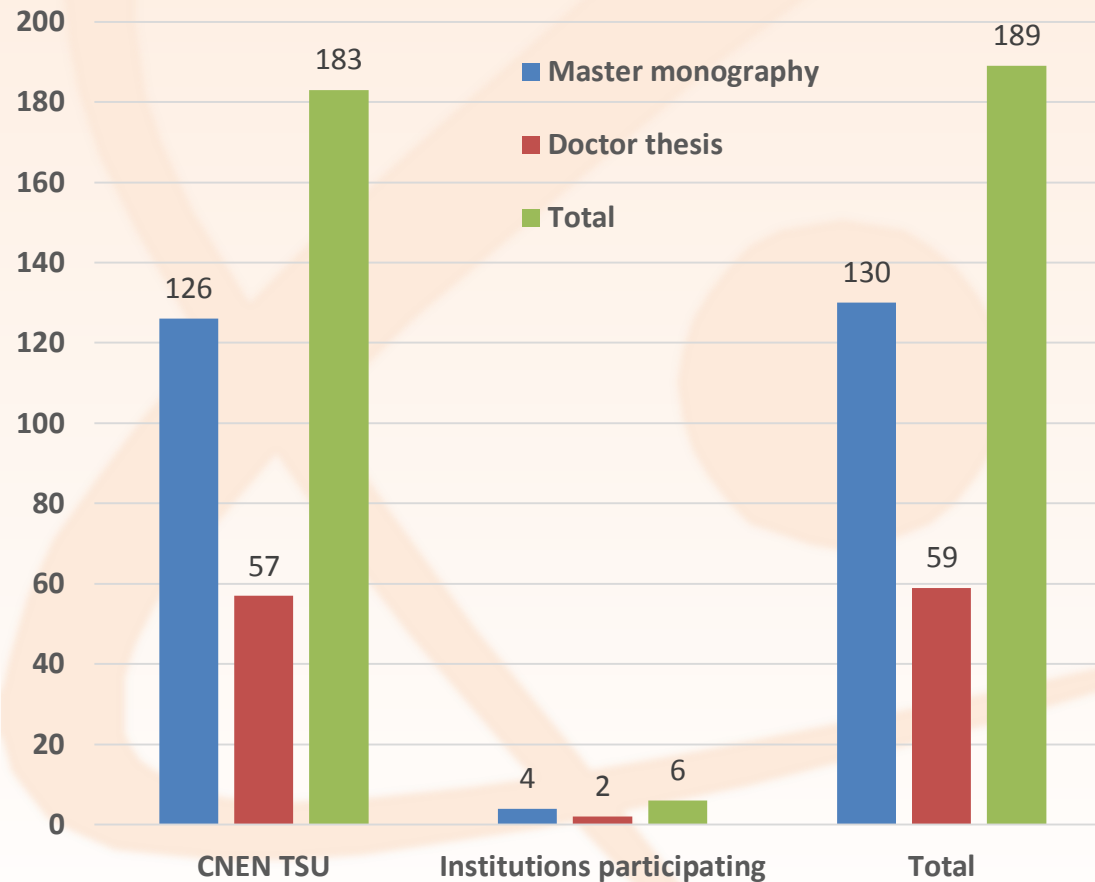
CNEN Post Graduation Fellowship

CNEN fellowship granted



CNEN Post Graduation Fellowship

Professional formed in 2017



CNEN Scientific Initiation Fellowship in 2017

- CNEN had resources to grant **60** undergraduate fellowships
- The resource was passed on to National Council of Research (CNPq), through a specific Decentralized Execution Term, which manages it
- The CNPq itself granted the technical and scientific units of CNEN another **150** scientific initiation fellowships

CNEN Postdoctoral Fellowship in 2017

- CNEN stated a **postdoctoral fellowships** program to strength the lines of research of its TSU
- In 2017 CNEN started the program to consolidate and promote a **greater specialization of professionals in the areas** of CNEN's activities
- Through a public announcement, was granted **20** postdoctoral fellowships
- Since October 2017, the professionals are working on projects supervised by CNEN researchers

Actual Human Resource

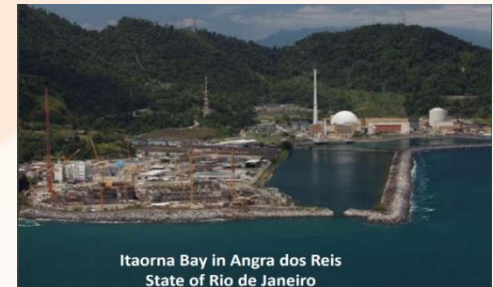
- Over the last few decades, the Brazilian Nuclear Program (BNP) has been running at a **very slow pace**, and institutions in this area have **stopped hiring qualified professionals** (or hired in a small number)
- This has **alienated** the new generations from the nuclear area and resulted in a **lack of qualified professionals** in CNEN unities
- Although **CNEN has an experienced set of professionals**, with solid training in the nuclear area, this group **is not dimensioned** to meet the needs of implementation of BNP
- Also, many professionals have an **average age close to retirement** and, recent years, many professionals have retired

Actual Human Resource

- It should be noted that, due to its **multifaceted characteristic**, the **training time of professionals is long**, which is true for the industrial segment and the areas of licensing and inspection, development, innovation and research
- So, there is an **important demand for specialized human resources** that needs to be met for the current activities. The **success** of the country in the implementation of its BNP depends very much on the incorporation of the **new generations** into the national institutions of the nuclear sector.
- A Specialized Training Budget Action for the Nuclear Sector can contribute to meeting this demand

Conclusion

- Capacity Building and Knowledge Management are **essential** for the **preservation of knowledge** as well as the prospect of knowledge
Also, they serve as **essential tools for the safety and security of nuclear activities**
- **CNEN has a relevant role** in the construction of a Knowledge Network in the nuclear area in Brazil
- It is estimated that in the ^{very} near future there will be a need to expand capacity building, given the size of the new BNP:
 - construction of the Angra 3 Plant
 - expansion of uranium production capacity and fuel elements by INB
 - implementation of the Brazilian nuclear fusion program
 - construction of the nuclear submarine
 - increased production of radiopharmaceuticals
 - expansion of the Brazilian population's access to the benefits of Nuclear Medicine
 - construction of the Brazilian Multipurpose Reactor and its associated units
 - construction of the Repository for Low and Medium Level Rejects
 - the need for licensing and inspection of nuclear and radioactive facilities





Conclusion

- With the expected growth and specialization, the country will also need to invest in non-academic training programs in this specialized area, with a view to the rapid incorporation of new professionals in the area and to the absorption of technologies made available by the maturation of new enterprises

...Thank you for your attention

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