Education in the nuclear Field

Dr. Renato Di Prinzio
Institute of Radiation Protection and Dosimetry
IRD/CNEN
renato@ird.gov.br
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.
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 program.
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 is power
Francis Bacon, 1561 – 1626

Knowledge is experience, everything else is information
Albert Einstein, 1879 – 1955
Knowledge

Know how experience insight understanding and contextualized information

Information

Contextualized, categorizes, calculated and condensed data

Data

Facts and figures which relay something specific, but which are not organized in any way
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:

<table>
<thead>
<tr>
<th>Students Origin</th>
<th>Master</th>
<th>Doctor</th>
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<tbody>
<tr>
<td>Public edict</td>
<td>10</td>
<td>5</td>
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<tr>
<td>CNEN Technical Scientific Units</td>
<td>16</td>
<td>13</td>
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<tr>
<td>Pre 2017</td>
<td>21</td>
<td>33</td>
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<td><strong>Total 2017</strong></td>
<td><strong>47</strong></td>
<td><strong>51</strong></td>
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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 Post Graduation Fellowship

CNEN fellowship granted

<table>
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<th>Year</th>
<th>Master</th>
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<td>2014</td>
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<td>2016</td>
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<td>Total</td>
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</table>
CNEN Post Graduation Fellowship

Professional formed in 2017

- CNEN TSU:
  - Master monography: 126
  - Doctor thesis: 57
  - Total: 183

- Institutions participating:
  - Master monography: 4
  - Doctor thesis: 2
  - Total: 6

- Total:
  - Master monography: 130
  - Doctor thesis: 59
  - Total: 189
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 area 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.

• CNEN has a relevant role in the construction of a Knowledge Network in the nuclear area in Brazil.

• It is estimated that in the 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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