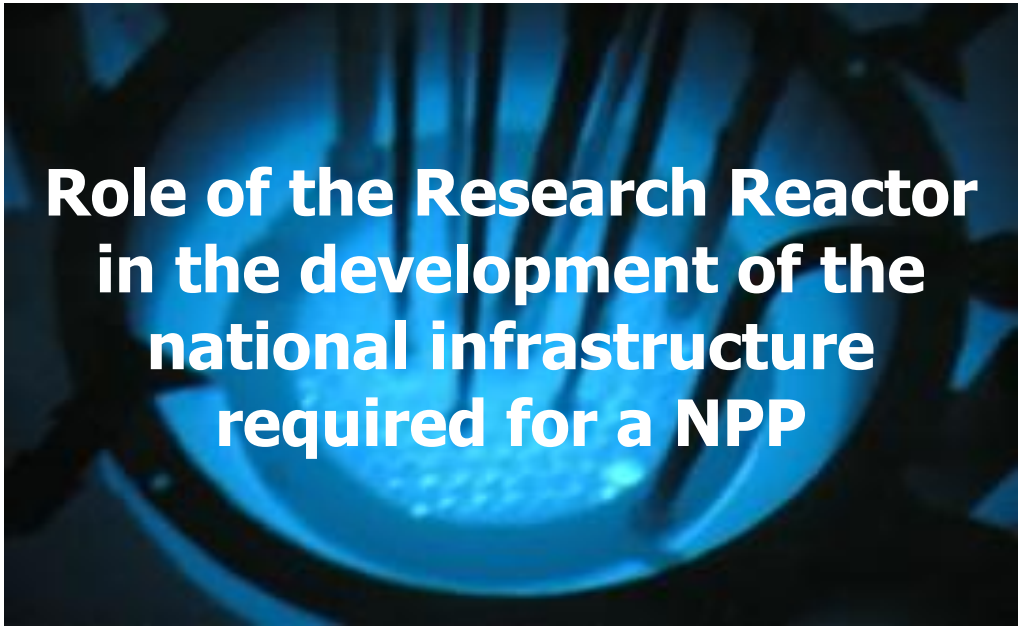
International Conference on Research Reactors: Safe Management and Effective Utilization

14-18 November 2011
Rabat, Morocco



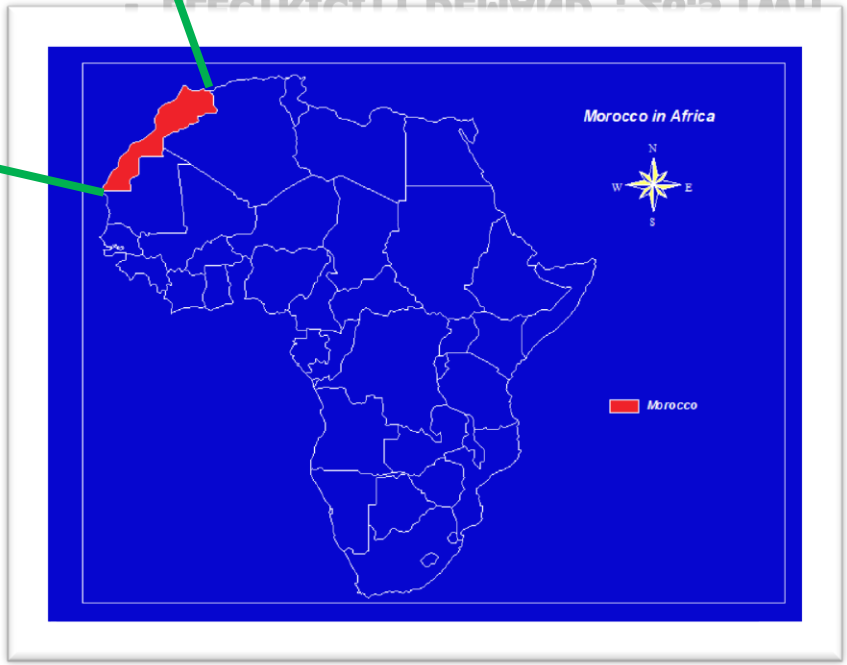
By
Khalid EL MEDIOURI
Director General of CNESTEN

Outline

- Overview on the Maamora Nuclear Research Center (NRC)
- TRIGA Research Reactor utilization program
- Role of the research reactor in the development of national infrastructure for the Nuclear Power Program

General information

- **AREA : 710 850 KM²**
- **DEMOGRAPHY: 31.5 MILLIONS INHABITANTS**
- **URBAN POPULATION : 55%**
- **GDP – PER CAPITA (PPP): 4800 USD**
- **GDP COMPOSITION BY SECTORS (2009) : SERVICES (55%), AGRICULTURE (16%), INDUSTRY (29%)**
- **ENERGY CONSUMPTION : 16.15 MTOE**
- **ELECTRICITY DEMAND : 26.5 TWH**



Nuclear enegy applications in Morocco

- **Utilization of nuclear techniques in socio-economic fields since 1960's**
- **Nuclear power as open long term option**
  - ✓ **Establishment of the feasibility study and the selection of the Sidi boulebra Site for the first nuclear power plant, 1980's**
  - ✓ **Considered as alternative option in the new energy strategy for the period of 2020 – 2030**
- **Institutional and legal framework**
  - ✓ **National Council of Nuclear Energy (CNEN)**
  - ✓ **Creation of CNESTEN**
  - ✓ **Establishment of the National center of Radiation protection**
  - ✓ **Two regulatory bodies for nuclear and radiation safety activities (Ministry of energy and Ministry of health)**
  - ✓ **Development of legislative framework (law of 1971 and law on civil liability of 2005)**
  - ✓ **Development of regulatory framework (regulation, licensing process, …)**
- **Accession to international instruments**
- **Development of international cooperation**

OVERVIEW ON THE MAAMORA NUCLEAR RESEARCH CENTER

National Center for Nuclear Energy, Sciences and Techniques (CNESTEN)

Missions

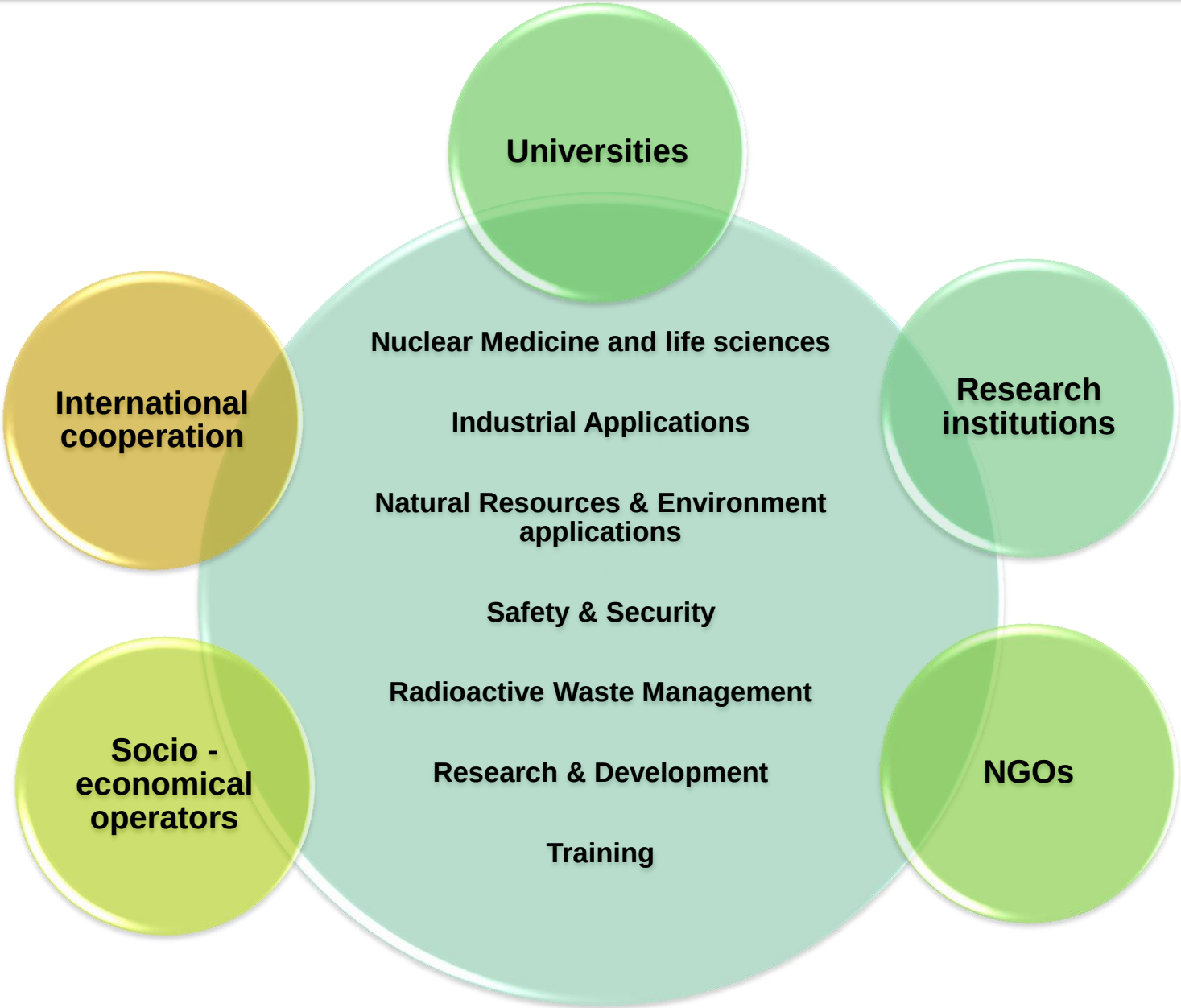
- Promoting nuclear scientific research and applications in socio-economic sectors

- Contributing to the development of infrastructure for a national nuclear power program

- Technical support organization (TSO) for authorities in the fields of nuclear and radiation safety and security, Emergency preparedness and response and Safeguards

- Radioactive waste management at national level

CNESTEN
Fields of activities and partnership



Nuclear Research Center of Maamora

Research Reactor

Waste Management

Life science

Industrial Applications

Earth Sciences

Safety & Security

Major programs

- **Health and life Sciences :**

Production of radiopharmaceuticals, Medical and Nutrition Research

- **Earth Sciences applications**

Hydrological studies , Climate change, Sol erosion and desertification phenomena, Agriculture, Impact studies (air, water and soil pollution)

- **Industrial applications :**

Industrial Control Services, Training & Certification in NDT, Instrumentation

Major programs (Cont'd)

- **Radioactive waste management :**

Management at national level (Medical and industrial sectors), Research in cooperation with universities

- **Safety&Security:**

Nuclear safety, Radiation protection, Environment survey, Radiological emergency preparedness and response, Physical Protection, Safeguards

TRIGA RESEARCH REACTOR UTILIZATION PROGRAM

TRIGA research reactor

- **2MW TRIGA MARK II research reactor**
- **Achieved in full compliance with international standards**
  - *IAEA INSARR Review missions*
- **Technical assistance of IAEA, USA and France**
- **Licensing process :**
  - *Construction licence (decree of 26 February 1999);*
  - *Release of radioactive liquid and gaseous effluents (Ordinance of 23 December 2005);*
  - *Commissioning tests (Ordinance of 13 March 2006);*
  - *Operation licence (Ordinance, February 2009)*
  - *Decommissioning*
- **First criticality in 2007**
- **Operating licence 2009**

Strategic objectives for the reactor utilization

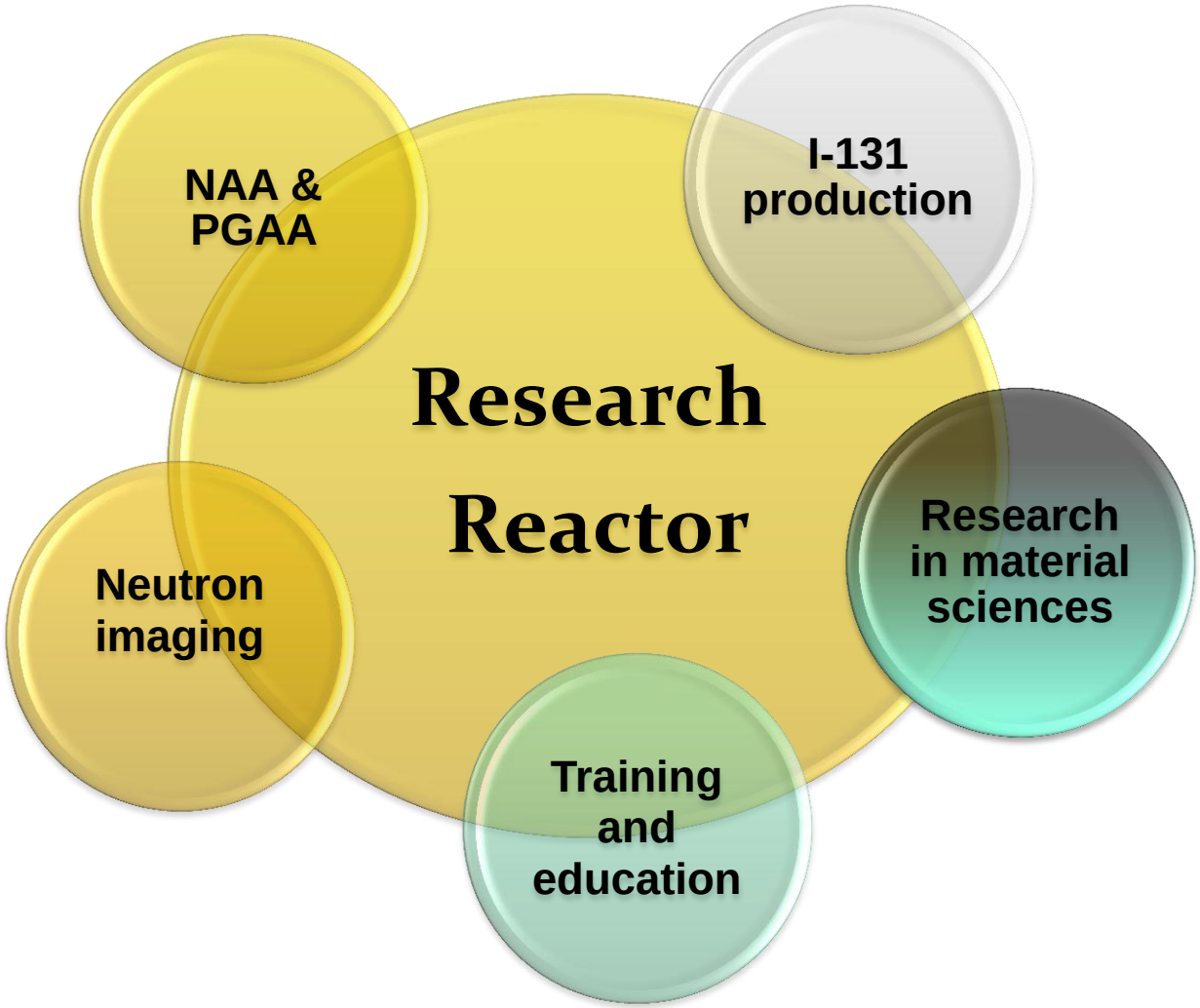
- **Enhancement of scientific production in accordance with national scientific research orientations**

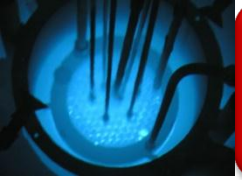
- **Development of services and products for self-reliance based on an established business plan**

- **Development of training and education activities at national and regional level**

- **Strengthening of CNESTEN capabilities to serve as TSO for a NPP**

Utilization program of the Research Reactor





Utilization of the Research Reactor

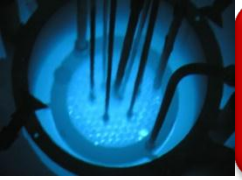
- **Radioisotopes production :**

  - **Medical applications: Iodine-131, Samarium-153, Rhenium-186, Ytrium-90**
  - **Industrial applications: Bromine-82, Iridium-192, Argon-41**
  - **Status : Commercial phase**

    - I-131 scheduled for 2012

    - Others medical RI scheduled for 2013

    - Industrial RI scheduled for 2012
  - **National Partners : public and private hospitals, industrial operators, …**
  - **International Partners : IAEA, Belgium, South Africa, Germany, …**



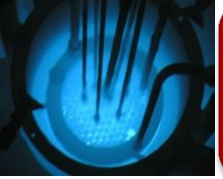
Utilization of the Research Reactor

Neutron & Prompt Gamma activation analysis

- **Status :**
  - ✓ **INAA (Instrumental Neutron Activation Analysis):** operational
  - ✓ **PGAA (prompt gamma activation analysis):** design in progress
- **Application areas :** Air pollution monitoring, Medicinal plants, Geochemistry of basins, Environment, Geology and mining, Cultural heritage, ….
- **Partners :** Moroccan Universities, Mining, Geology and Environment Departments, IAEA, Slovenia, France, USA

Utilization of the Research Reactor

- **Neutron scattering**
  - **Status :**
    - ✓ **Powder diffraction :** under construction
    - ✓ **SANS :** Feasibility study underway
  - **Partners :** IAEA , LLB-CEA-Saclay, KFKI Budapest, National School for Mineral Industry, Ministry of Higher Education and Scientific Research, …
  - **End users :** Networks of Material Sciences, Condensed matter and modeling in material science, Moroccan society of Polymers and Soft matter
- **Neutron radiography**
  - **Status :** Feasibility study underway
  - **Partners :** IAEA, Antares RFMII (Gemany), Atominstitute (Vienna), Paul scherrer Institut (Suisse), Universities
  - **Applications :** Quality control of products, Training , R&D, Aeronautic industry, archeology, Geology

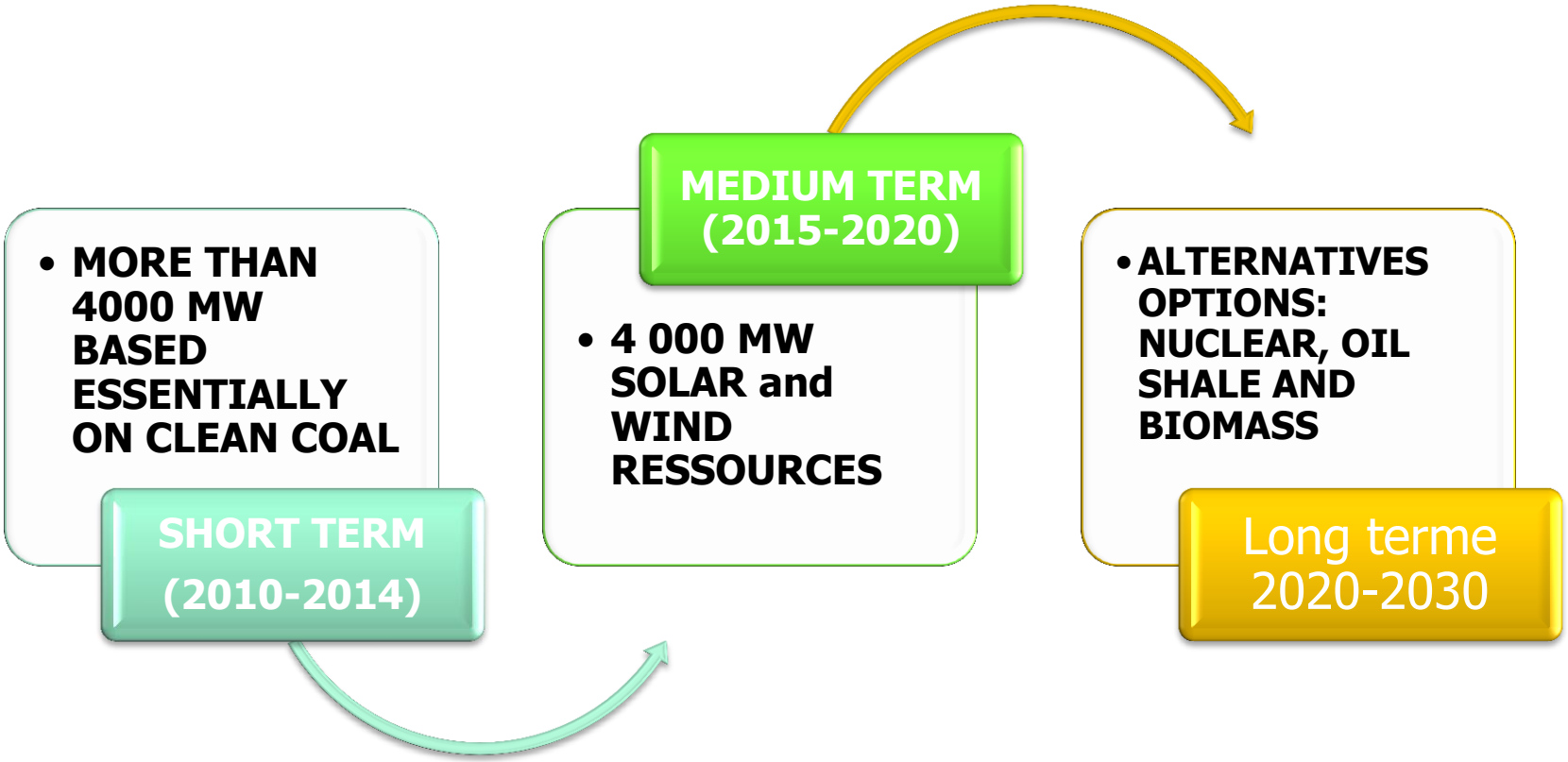


Utilization of the Research Reactor

- **Training & Education**
  - **Utilization of the reactor for education programs (master, PhD) with universities**
  - **Utilization of the reactor for regional and international cooperative activities**

ROLE OF THE RESEARCH REACTOR IN THE DEVELOPMENT OF NATIONAL INFRASTRUCTURE FOR THE NUCLEAR POWER PROGRAM

National Energy strategy
Electrical energy program



Nuclear power program
Nuclear Power and Desalination Committee (CRED)

- **CREATION:**
  - **Established on January 2009 by the Ministry of Energy, Mines, Water and environment**
  - **Members from Departments of Energy, Water and environment, ONE, ONEP, OCP, CNESTEN, University of Fez, AIGAM**

- **OBJECTIVES :**
  - **Evaluation of national infrastructure required for a NPP**
  - **Proposal of elements of strategy**

19 issues to consider in infrastructure building for a NPP and potential areas of RR contribution

Issues	Potential role
1. National position	X
2. Nuclear safety	X
3. Management	
4. Funding and financing	
5. Legislative framework	X
6. Safeguards	X
7. Regulatory framework	X
8. Radiation protection	X
9. Electrical grid	
10. Human resource development	X
11. Stakeholder involvement	X
12. Site and supporting activities	X
13. Environmental Protection	X
14. Emergency planning	X
15. Security and physical protection	X
16. Nuclear fuel cycle	X
17. Radioactive waste	X
18. Industrial involvement	
19. Procurement	

National position

- **Contribution to the national infrastructure self evaluation process**

- **Experience gained through the implementation of the research reactor project is helping in fully understanding the long term commitments required for a NPP. This includes :**
  - **Guaranteeing safety, security and non-proliferation of nuclear material;**
  - **Acceding to appropriate international legal treaties and conventions;**
  - **Developing a comprehensive legal framework covering safety, security, nuclear liability;**
  - **etc.**

Legal and regulatory framework

- **All relevant nuclear international instruments that are adopted for the research reactor are also necessary for NPP**

- **The NRC implementation and operation have enabled the development of the legal and regulatory framework. The major components are :**

  - **Decree on the licensing and inspection of nuclear facilities**
  - **Law and decree on nuclear civil liability**
  - **Nuclear Safety authority**
  - **Advisory Commission on nuclear safety matters**
  - **Draft law on radiological and nuclear safety and security**
  - **Establishment of unique and independant regulatory body planned**

Security and emergency preparedness

- **Strengthening National Emergency preparedness and response capabilities**
  - ✓ **Nuclear security and emergency response exercises involving all stakeholders**
  - ✓ **Establishment of technical emergency operation center in support of authorities**
- **Contribution in the development of a national nuclear Security regime**
- **Establishment of national support Center in nuclear security in collaboration with IAEA**
- **Platform of training for national stakeholders (Civil protection, Customs, National police, …)**

Nuclear safety

- Implementation of NRC in compliance with IAEA fundamental safety principles and other internationally recognized safety standards

- Contribution to the global nuclear safety regime :
  - ✓ Part of International Legal Instruments (Conventions and Codes of Conduct)
  - ✓ NRC infrastructure involved in the international efforts to continuously improve nuclear safety and security

- Experience with fostering and maintaining a nuclear safety culture by involvement of stakeholder

Radioactive waste management

- Radioactive waste management at national level and up to date infrastructure for low and Intermediate activity
- Capacity building in the field RWM
- Ratification of all relevant international conventions
- Implementation of joint Convention on safety of spent fuel management and on safety of radioactive waste management
- Contribution to the awareness on the importance of the national RWM policy and strategy

Environment protection

- Experience in the environmental impact study of the NRC site
- Experience in environment survey in conformity with regulatory requirements
- Availability in NRC of fully equipped laboratories

Human ressources development (1/2)

- National Centre for NDT training and certification
- Regional Training Center in the fields of radiation protection, Isotope hydrology and Nutrition (IAEA-AFRA)
- National support Center in nuclear security

Human ressources development (2/2)

- Integration of the Research Reactor in the university education programs (Bachelor, Master and PhD)

- Developing training capabilities for future NPP (operating organization, Regulatory body, and other involved organizations)

Conclusion

- The construction and operation of the Research Reactor and associated laboratories constitute an important step toward a future power program
- The Research reactor is vital to create training and educational programs in support of human resource development for a NPP
- The NRC is the main technological platform to transfer safety and security culture to all stakeholders
- The NRC continuously improves its capabilities to play the role of a technical support organization
- The NRC is open to regional and international cooperation including support to the IAEA Research Reactors coalition and network initiatives (Africa, Mediterranean region, …)

Thank You For Your Attention