THE NIGERIA RESEARCH REACTOR-2 (NIRR-2) PROJECT: PERSPECTIVES ON PROLIFERATION RESISTANT

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OVERVIEW OF PRESENTATION

- INTRODUCTION/BACKGROUND
- STATUS OF THE MPRR PROJECT
- STAKEHOLDERS' ENGAGEMENTS
- PERSPECTIVES ON PROFLIFERATION RESISTANCE
- SUMMARY
- CONCLUDING REMARKS

INTRODUCTION/BACKGROUND

- Population: >200m as at 2021 with over 200 Universities
- Nigeria joined IAEA in 1964 for peaceful applications of NE
- Signed NPT in 1968
- Established NAEC via the Act of 1976
- Established Regulatory Body (NNRA) via the Act of 1995
- Commissioned NIRR-1 as 1st RR in 2004 with HEU core
- NIRR-1 was converted to LEU (13%) in 2018
- Irradiated HEU fuel returned to China in 2018
- RRs in the African Region are HEU-free

INTRODUCTION/BACKGROUND

- Why New MPRR? NIRR-1 shortcoming
- Little or no RI production, suitable for shortlived RIs
- Cannot be used for medical RIs e.g. 99m-Tc
- Compact nature- little or no flexibility for multipurpose applications (i.e. Beam port physics expt.)
- Max operable time @ full power is 2.5 hrs for the fresh core (i.e. low flux 1x 10^{12} n/cm^2.s)
- Increasing high demand for R & D with RRs (over 200m people, Universities, industries. Hospitals)
- No high flux RRs in W/Africa so no RI production, no beam port for physics expts., E & T, etc.
- MPRR will be high-flux RR to serve W/African region

THE MPRR AS NIRR-2

- MPRR Project was initiated in 2014 as part of a National Nuclear Energy programme – IAEA miletones' documents
- Country's nuclear programme was launched in 2006 by NAEC
- Nigeria planned to deploy NPPs as part of its energy-mix
- For the MPRR, a National TC Project NIR/1011 was initiated in 2014.
- NAEC developed documents under NIR/1011:
  - Strategic Plan (SP) Document
  - Feasibilty Search Report (FSR)
  - Self Evaluation Report (SER)

PROGRESS OF NIR/1011 PROJECT

- Feasibility study for a new multipurpose research reactor.
  - Indicator: Preliminary feasibility report justifying development of new research reactor has been completed
  - Draft submitted to IAEA & review comments received.
  - Draft undergoing revision to accommodate review comments.
- Bid specification for a new multipurpose research reactor.
  - Bidding process to be initiated (PHASE II)
  - Bidder to be determined? (discussion ongoing with Vendors)
  - Proposed Reactor Technical Specifications (10 MW and Above)

PROGRESS OF NIR/1011 PROJECT

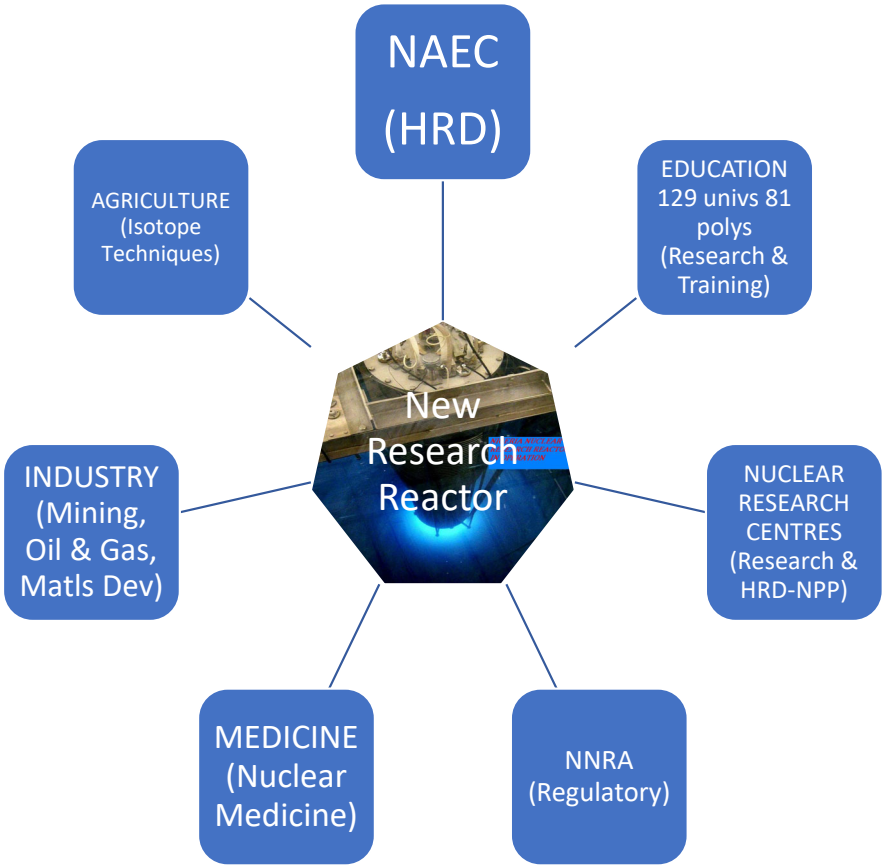
- Expert Mission (EM): EM to review Site has taken place
- IAEA Fellowship (FE); Partially implemented. Placement could not be made for some nominees.
- Scientific Visits (SV): SV for regulatory staff implemented.
- Recommendations: For the site, there is a need for a Meteorological Station at the proposed site.
- 1st ever INIR-RR Mission was to Nigeria in 2018

- **NIRR-2: MULTIPURPOSE RESEARCH REACTOR (MPRR)**

TECHNICAL DATA (proposal to incorporate PR)

Parameter	Value
Reactor type	Swimming pool type
Power	~ 10 MW
Max. thermal flux	> $1x10^{14}$ n's cm^{-2} s^{-1}
Fuel	LEU
Reflector	Beryllium
Cooling	H_2O, forced convection
Operation	~ 300 days per year
Availability of Neutron Beams	TBD

STAKEHOLDER IDENTIFICATION: MAIN BENEFICIARIES AND USERS



SERVICES ENVISAGED FOR MPRR

- EDUCATION & TRAINING (E & T)
- RADIOISOTOPE PRODUCTION (RI)
- NEUTRON ACTIVATION ANALYSIS (NAA)
- NEUTRON TRANSMISSION DOPING (NTD)
- PROMPT GAMMA NEUTRON ACTIVATION ANALYSIS
- BORON NEUTRON CAPTURE THERAPY (BNCT)
- NEUTRON BEAM ANALYSIS (NBA)
- MATERIAL & FUEL IRRADIATION (MFI)
- GEMSTONE COLOUR ENHANCEMENT (GCE)
- NEUTRON RADIOGRAPHY

PROPOSALS FOR PROFILERATION RESISTANCE

- What is **Proliferation Resistance**? – Characteristic of a nuclear system that impedes diversion or undeclared production of nuclear material, or misuse of technology, by States in order to acquire nuclear weapons or other nuclear explosive devices (IAEA INPRO)
- It means inclusion of PR in Reactor Systems to stem Proliferation:
  - PR taken into account as early as possible in the design & development of MPRR in collaboration with Manufacturer/Vendor
  - Consideration of incorporating into design of MPRR, intrinsic & extrinsic measures required to provide or improve PR at minimal cost

PROPOSALS FOR PROFILERATION RESISTANCE

- A joint collaboration of NAEC-CERT & US DOE-NNSA M3's Office of RR Conversion collaboration on PR for MPRR is underway
- To take advantage of NNSA's approach to integration of PR into the design of MPRR
- Take advantage of Lab Spaces/Offices built for Neutronics Analyses at CERT, that can be devoted to PR Activities
- Exist a pool of young graduates that can be deployed
- Needs: PCs, Codes, Training opportunities (Scientific Visits), Expert Missions
- Can be designated as a Regional Training Centre in future
- Many African countries are embarking on RR projects (Senegal, Kenya, Uganda, Niger, etc.)

SUMMARY

- The IAEA TC project is being used to drive new RR Project in Nigeria
- Stakeholders have been identified & Meetings held
- Physical infrastructure & Human resources are available @ NAEC Centres (6 of them; one CERT currently operates NIRR-1; Universities
- To be sited @ NTC, Sheda-Abuja, a central location
- Regulatory infrastructures to be provided by NNRA, has 18 years experience vis-a-vis NIRR-1 since 2004
- To be implemented as a PSA (tripartite project with Nigeria, IAEA & vendor)
- Preparation for followup INIR-RR Mission 4th-Q2022
- Use the benefits of joint NAEC-CERT/DOE-NNSA being proposed to incorporate PR into the design of MPRR (i.e Core & Auxiliary Systems)

CONCLUDING REMARKS

- NIRR-2, will be 2nd nuclear reactor in Nigeria
- Need to re-launch a new Project with the IAEA since 1011 has closed
- It will also serve as a major facility for HRD training towards the acquisition of NPPs in Nigeria
- As part of NIRR-2 Project, we will integrate proliferation resistance into the design of the reactor & auxiliary systems.
- To do this, we leverage on experience garnered during neutronics & T-H calculations codes used in the conversion of NIRR-1
- A Proposal for PR Activities is to be initiated at CERT under the aegis of NAEC-CERT/DOE-NNSA collaboration in M3's Office of RR Conversion

Thank you for listening