

## REGULATORY CONTROL OF THE NIGERIAN RESEARCH REACTOR (NIRR-1)

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**Abstract.** The Nuclear Safety and Radiation Protection Act 1995 (Act) established the Nigerian Nuclear Regulatory Authority (NNRA) and charged it with regulatory oversight of **nuclear research reactors and also** with responsibility to ensure Nigerian compliance with international safety, security and safeguards legal framework. Under Technical Cooperation with the Agency, Nigeria installed and commissioned **NIRR-1**, which was licensed by the NNRA. The NNRA has since exercised regular oversight on the facility, ensuring its safe operation.

### 1. Introduction - Legal and Regulatory Infrastructure

The Nuclear Safety and Radiation Protection Act 1995 (Act), established the NNRA, with responsibility for nuclear safety and radiological protection regulation in Nigeria. Amongst others, NNRA shall:

- i regulate the possession and application of radioactive substances and devices emitting ionizing radiation
- ii ensure protection of life, health, property and the environment from the harmful effects of ionizing radiation, while allowing beneficial practices involving exposure to ionizing radiation
- iii regulate the safe promotion of nuclear research and development, and the application of nuclear energy for peaceful purposes
- iv perform all necessary functions to enable Nigeria meet its national and international safeguards and safety obligations in the application of nuclear energy and ionizing radiation
- v Advise the Federal Government on nuclear security, safety and radiation protection matters
- vi liaise with and foster co-operation with international and other organisations or bodies concerned having similar objectives, and
- vii regulate as appropriate, the exploration, mining and milling of radioactive ores and other ores associated with the presence of radioactive substances

The NNRA has powers to:

- i categorize and license activities involving exposure to ionizing radiation, in particular, the possession, production, processing, manufacture, purchase, sale, import, export, handling, use, transformation, transfer, trading, assignment, transport, storage and disposal of any radioactive material, nuclear material, radioactive waste, prescribed substances and any apparatus emitting ionizing radiation
- ii establish appropriate register for each category of sources or practices involving ionizing radiation
- iii license operators of **nuclear research reactors and critical assemblies, nuclear power reactors, mining and milling of radioactive ores and other facilities of the nuclear fuel cycle**
- iv issue codes of practice which shall be binding on all users of radioactive and prescribed substances, and of sources of ionizing radiation
- v review and approve safety standards and documentation
- vi protect the health of all users, handlers and the public from the harmful effects of ionizing radiation
- vii provide training, information and guidance on nuclear safety and radiation protection
- viii establish in co-operation with other competent national authorities, plans and procedures which shall be periodically tested and assessed for coping with any radiation emergency and abnormal occurrence involving nuclear materials and radiation sources
- ix undertake investigations and research into ionizing radiation sources and practices: and
- x do everything necessary to ensure that all concerned persons and bodies comply with laid down regulations under this Act.

### 1.1 Nigeria's International Obligations

- i Nigeria signed the **Nuclear Non Proliferation Treaty (NPT)** in 1968 and voted for its indefinite extension in 1995
- ii Nigeria also signed the **Comprehensive Safeguards Agreement** in 1988 and the **Protocol Additional to the Application of the Safeguards Agreement (Additional Protocol)** in 2001
- iii Nigeria ratified the **Convention on Early Notification of a Nuclear Accident** and the **Convention on Assistance in the Case of Nuclear Accident or Radiological Emergency** in 1988
- iv Nigeria in April 2007 signed the instruments ratifying the:
  - a. **Protocol Additional to the Agreement between the Federal Republic of Nigeria and the Agency for the Application of Safeguards**
  - b. **Agreement on the Privileges and Immunities of the Agency**
  - c. **Convention on Nuclear Safety**
  - d. **Joint Convention on the Safety of Spent Fuel Management and on the Safety of Radioactive Waste Management**
  - e. **Convention on the Physical Protection of Nuclear Material**
  - f. **Amendment to the Convention on the Physical Protection of Nuclear Material**
  - g. **Vienna convention on Civil Liability for Nuclear Damage**

Furthermore, an Agency **International Nuclear Security Service (INSServ)** mission was conducted in 2004, which concluded amongst others that Nigeria should consider a review of the 1995 Act to ensure that it adequately covers nuclear security. Consequently an Inter-Ministerial Committee reviewed the Act and strengthened it with provisions that:

- i established and empowered the National Nuclear Security Committee (NSC)
- ii broadened NNRA's scope to include the regulation of nuclear installations
- iii imposed strict liability for nuclear damage on a nuclear installation licensee
- iv specified duties regarding nuclear accidents and incidents, and
- v provided for emergency planning for nuclear accidents or incidents

The revised Act is awaiting passage by the Federal Parliament.

### 2. NIRR-1

Nigeria's compliance with international conventions, the promulgation of the Act and the establishment of the NNRA in 2001 facilitated the installation and commissioning of the 30 KW **Nigeria Research Reactor-1** (or **NIRR-1**), covered by INFCIRC/526 - Project and Supply Agreement signed at the Agency in 1996, between the Agency, the Governments of Nigeria and China. **NIRR-1** is located at the Centre for Energy Research and Training (CERT), Ahmadu Bello University, Zaria. It is designed for teaching, research and for use in Neutron Activation Analysis (NAA) and limited radioisotope production. It is a tank-in-pool type reactor with 90% HEU (U-Al alloy) as fuel, light water as moderator and coolant, and metallic beryllium as reflector. It has a built-in clean cold core excess reactivity of 3.77 mk. It can operate for a maximum of 4.5 hours at full power (i.e. equivalent to a thermal neutron flux of  $1 \times 10^{12} \text{ n.cm}^{-2}.\text{s}^{-1}$  in the inner irradiation channels).

## 2.1 Authorization of NIRR-1

The authorization of the **Nigeria Research Reactor-1** (or **NIRR-1**) was initiated by a formal application by CERT for a retroactive authorization of the Siting and the Design and Construction of the **NIRR-1**. Consequently, the NNRA in August 2001 inaugurated the **Technical Advisory Committee (TAC) for the Establishment of Licensing Procedure for Nuclear Research Reactors** and for the **Licensing of Reactor Operators in Nigeria**. The TAC developed and submitted the **Guide to Licensing Nuclear Research Reactors in Nigeria** and the **Guide to Licensing Nuclear Research Reactor Operators in Nigeria**. The TAC reviewed the "whole life cycle" of the reactor and established criteria for the authorization of each of the distinct "stages" namely, Siting, Design and Construction, Fuel Importation, Commissioning and Operation and, Decommissioning. It also witnessed the fuel importation, installation, criticality experiments, commissioning tests, other initial operations and submitted its report in July 2002.

During the fuel importation the activities were greatly influenced by the heightened international concern for nuclear safety and security arising from the September-11 incident. Thus, in addition to the requirements of INFCIRC 225 (rev. 4), INFCIRC 274 (Rev. 1) and TS-R-1 as they relate to Category II Nuclear Materials, the NNRA reviewed and upgraded the submissions by CERT with regards to all security arrangements to forestall even the remotest possibility of undesired occurrences including sabotage and theft. Furthermore, stringent conditions were also imposed such that the fuel must be evacuated from the port of entry within six (6) hours of its arrival and must be loaded into the reactor core within the shortest possible time. Furthermore, transportation and the security of the fuel between the port of entry and the reactor site was solely the responsibility of the Federal Government of Nigeria.

CERT applied for authorization to operate NIRR-1 early in 2004 with the completion of Commissioning Tests and submission of a Commissioning Tests Report. NNRA's first reactor safety inspection in May 2004 assessed the Programmes for **Physical Security, Emergency, Access Control, Maintenance, Quality Control** and **Radiation Protection** of NIRR-1. The NNRA also observed the Reactor Operators run the NIRR-1 for the first time without Chinese assistance. The NNRA further successfully licensed the NIRR-1 for operation as well as the first set of Nigerian Nuclear Reactor Operators by issuing **Reactor Operation Licence** and **Reactor Operators Licence** for **Categories A, B and C Operators** later in June 2004.

## 2.2 Inspection, Enforcement and Safety of NIRR-1

NNRA commenced its regular schedule of inspection in September 2004. These included compliance and quarterly safety inspections to assess CERT's compliance with the terms and conditions of the Reactor Operations Licence. By May 2005, some inspection findings identified the necessity for closer monitoring, which compelled the NNRA to institute a regular monthly safety inspection schedule. Further need to ensure skill acquisition, confidence building and sustainability compelled the NNRA in August 2005 to direct CERT to stop the operation of the reactor until proper measures were emplaced to ensure overall reactor safety. Further NNRA interventions ensured improvement of QA, QC and ultimately helped the renewal of CERT's Licences. The Agency has also conducted regular annual Safeguards Inspections since 2003 and in May 2005, sent an **International Nuclear Security Advisory Service (INNServ) Mission** to Nigeria. Additionally, the Agency also sent an **Incident Reporting for Research Reactor Mission** in February 2005.

The NNRA through its regular inspection and enforcement activities and indeed its general oversight activities over **NIRR-1** has ensured that it is been safely operated. In this regard, three types of Inspections are being conducted comprising Preauthorization, Compliance and Routine Reactor Safety inspections. These have helped CERT to focus on enhancement of the safety aspects for reactor operation and on improvement of the safety culture.

### **ACKNOWLEDGEMENTS**

I am grateful to the Agency and the Nigerian Nuclear Regulatory Authority for providing the opportunity and the sponsorship of my participation.

### **REFERENCES**

- [1] Nuclear Safety and Radiation Protection Act 1995