

FEDERAL REPUBLIC OF NIGERIA



## NIGERIAN NUCLEAR REGULATORY AUTHORITY

DRAFT NIGERIAN SAFETY REGULATIONS ON  
COMMISSIONING OF NUCLEAR POWER PLANT, **JUNE**  
**20172020** (Revision 1a)

## Table of Contents

PART – 1 General.....	3
Regulation 1 – Interpretations.....	3
Regulation 2 - Objectives.....	4
Regulation 3 – Scope .....	4
Regulation 4 - Application.....	4
PART – 2 Management and Organizational Structure of the Operating Organization .....	5
Regulation 6 – General Responsibilities.....	5
Regulation 7 - Management System for Commissioning .....	7
Regulation 8 – Organizational Arrangement for Commissioning .....	8
PART - 3 Commissioning and Testing Plans .....	9
Regulation 9 .....	9
Regulation 10.....	9
Regulation 11 .....	9
Regulation 12.....	10
PART - 4 Requirements for the Commissioning and Testing Programmes.....	11
Regulation 14 – Commissioning Programmes .....	11
Regulation 16 - System performance tests prior to fuel loading .....	13
Regulation 17 - Fuel Loading and Pre-Criticality Tests of the Reactor Systems .....	14
Regulation 18 - Making the reactor critical and low-power tests.....	15
Regulation 19 - Power tests .....	15
PART – 5 Requirements for the Reviewing, Evaluating and Reporting Test Results .....	16
Regulation 20.....	16
PART – 6 NNRA’s Oversight Function in the Commissioning and Testing Phases .....	18
Regulation 22 - Commissioning .....	18
Regulation 23 - System Performance Tests Prior to Fuel Loading .....	18
Regulation 24 - Fuel loading and pre-criticality tests of the reactor systems.....	19
Regulation 25 - Making the reactor critical, low-power tests and power tests.....	19
Regulation 26 - Documentation of the test results.....	19
PART - 7 Offences and Penalties .....	20
Regulation 27 - Offences .....	20
Regulation 28 - Penalties .....	20
Regulation 29 - Appeal .....	20

# NUCLEAR SAFETY AND RADIATION PROTECTION ACT NO.19 OF 1995

## DRAFT NIGERIAN COMMISSIONING OF NUCLEAR POWER PLANT REGULATIONS, 2017

[Day, Month, Year]      Commencement

In exercise of the powers conferred on it by Section 47 of the Nuclear Safety and Radiation Protection Act No.19 of 1995 and of all other powers enabling it in that behalf, THE NIGERIAN NUCLEAR REGULATORY AUTHORITY, with the approval of the President; hereby makes the following Regulations.

### PART – 1 General

#### Regulation 1 – Interpretations

- “Act”** means the Nuclear Safety and Radiation Protection Act 19 of 1995, including any amendment thereto.
- “Authority”** means Nigerian Nuclear Regulatory Authority (NNRA) established under Section 1 of the Nuclear Safety and Radiation Protection Act 19 of 1995.
- “Authorization”** means the granting by the Authority of written permission for an operator to perform specified activities. Authorization could include, for example, licensing, certification, registration, etc.
- “Commissioning”** means the process, by means of which systems and components of facilities and activities, having been constructed, are made operational and verified to be in accordance with the design and to have met the required performance criteria.
- “Licence”** means a legal document issued by the Authority granting authorization to perform specified activities related to a facility or activity. The holder of a current licence is termed a licensee.
- “Operating Organization”** means any *person or organization* applying for *authorization* or *authorized* to operate an *authorized facility* and be responsible for its *safety*.
- “Quality Management”** means the function of a *management system* that provides confidence that specified *requirements* will be fulfilled. Planned and systematic actions are necessary to provide adequate confidence that an item, *process* or service will satisfy given *requirements* for quality.

## **Regulation 2 - Objectives**

- i. The objectives of these Regulations shall be to establish the requirements which must be satisfied to ensure the safe commissioning of nuclear power plants. These Regulations are governed by the safety objective and safety principles that are established in the IAEA Fundamental Safety Principles.
- ii. The Regulations is also intended to form part of the licensing basis for a regulated facility or activity. It is intended for inclusion in licences as either part of the conditions and safety and control measures in a licence, or as part of the safety and control measures to be described in a licence application and the documents needed to support that application.
- iii. This Regulations also applies to commissioning related to the modifications made to nuclear power plants that are being operated or when a nuclear power plant is to be restarted after an extended shutdown period.

## **Regulation 3 – Scope**

- i. The scope of these regulations shall set out requirements for the commissioning and testing of a nuclear power plant and the regulatory control by the Authority in the commissioning and testing phases.
- ii. Where applicable, these Regulations also apply to commissioning related to the modifications made to nuclear power plants that are being operated.
- iii. Where applicable, these Regulations also concern regulatory control of the commissioning of high power nuclear research reactors.

## **Regulation 4 - Application**

The application of these Regulations shall be in addition to the Radiation Protection Regulations, any other existing ionizing radiation and nuclear Regulations, as well as relevant Guidance documents.

## **Regulation 5 – Objective of Commissioning Programme**

Commissioning has the objective of demonstrating that the nuclear power plant as constructed meets the design requirements and the safety requirements as specified in the safety analysis report and in the licence conditions. For the achievement of this objective and to ensure safe and reliable operation of the plant in the future, the commissioning process shall include activities for the following purposes:

- i. To verify that structures, systems and components fulfil the design safety objectives through the corresponding acceptance criteria;
- ii. To collect baseline data for equipment and systems for future reference;
- iii. To validate those operating procedures and surveillance procedures for which the commissioning tests provide representative activities and conditions, and to validate by trial use, to the extent practicable, that the facility's operating procedures, surveillance procedures and emergency procedures are adequate;

- iv. To familiarize the operating, maintenance and technical personnel, in terms of number and competence, of the nuclear power plant with the operation of the plant.
- v. During the commissioning, it shall be verified that the structure, functions and duties of the operating organization as well as the number and competence of necessary personnel are sufficient to ensure the safe operation of the nuclear power plant. Furthermore, modifications made during the construction shall be inspected and recorded in documents during the commissioning.
- vi. The commissioning plan of a nuclear power plant shall be so extensive and specified that appropriate design and construction as well as safe operation of the plant can be verified on its basis.
- vii. The commissioning shall be planned and implemented in such a manner that the operating personnel can get acquainted with operation of the plant during commissioning and, at the same time, it shall be verified that the training of the operating personnel is sufficient.
- viii. During commissioning, it shall be verified that the documents concerning the operation and periodic tests of the plant systems, structures and equipment are appropriate. To this end, it shall be verified in particular that the documents do not contain any error that would jeopardize the safety. Furthermore, the clarity, unambiguity and applicability of the instructions and documents shall be verified.

## **PART – 2 Management and Organizational Structure of the Operating Organization**

### **Regulation 6 – General Responsibilities**

- i. The operating organization shall have primary responsibility for nuclear and radiation safety as well as for protection of workers and the environment, and shall ensure the correct and satisfactory organization, planning, execution and assessment of the commissioning process.
- ii. Appropriate organizational arrangements shall be established to ensure that the operating organization can properly and effectively discharge its responsibilities with regard to the commissioning programme. When commissioning activities are conducted by contractors, the operating organization shall make the necessary arrangements to review and approve these activities at all stages, and it shall establish appropriate hold points and milestones.
- iii. The operating organization shall develop a commissioning plan for the nuclear power plant as part of the application for the construction licence.
- iv. During construction and commissioning, the operating organization shall monitor, preserve, and maintain the plant so as to protect plant equipment, to support the testing stage and to maintain consistency with the safety analysis report.
- v. During construction and commissioning, the operating organization shall carry out a comparison between the as built plant and its design parameters. A comprehensive

process shall be established to address non-conformances in design, manufacturing, construction and operation. Resolutions to correct differences from the initial design and non-conformances shall be documented.

- vi. The -Authority shall review the commissioning plan of a nuclear power plant as part of handling the construction licence. The commissioning and related start-up tests shall begin even before the plant is granted an operating licence and continue at different power levels under -Authority's control.
- vii. All the functions of the operating organization shall be performed at the appropriate stages during commissioning. These functions shall include discharging responsibilities for management, training of personnel, the radiation protection programme, waste management, managements of records, fire safety, physical protection and the emergency plan.
- viii. The operating organization shall take appropriate actions during the commissioning stage to ensure that the operating personnel are involved in the commissioning activities as early as possible. Attributes of safety culture such as personal dedication, safety consciousness and a questioning attitude shall be fostered in the pre-operational stages so as to become instinctive for the subsequent operational stage.
- ix. The operating organization shall ensure that the interfaces and the communication lines between different groups (i.e. groups for design, groups for construction, contractors, groups for commissioning and groups for operations) shall be clearly specified and controlled.
- x. The operating organization shall be responsible for ensuring that construction activities are of appropriate quality and that completion data on commissioning activities and comprehensive baseline data, documentation or information are provided.
- xi. The operating organization shall also be responsible for ensuring that the equipment supplied is manufactured under a quality assurance programme that includes inspection for proper fabrication, cleanliness, calibration and verification of operability.
- xii. The operating organization shall be responsible for demonstrating that the plant has been constructed and the equipment installed in accordance with the plans and that the facility fulfils the requirements set by the authorities.
- xiii. The operating organization shall establish liaison with the Authority and other relevant authorities to ensure a compliance with, safety requirements and their interface with other requirements, such as those of security, protection of health or protection of environment.

## Regulation 7 - Management System for Commissioning

- i. For the commissioning stage, the operating organization shall establish, implement, assess and continually improve an integrated management system.
- ii. The management system shall ensure that nuclear safety matters are not dealt with in isolation during commissioning but are considered in the context of all commissioning activities.
- iii. The operating organization shall develop and implement a management system that describes the overall arrangements for the management, performance and assessment of activities at the nuclear power plant during commissioning. The management system shall cover all the activities that are carried out in, or are necessary for, the commissioning stage.
- iv. The management system for commissioning shall be established early on, before the start of commissioning. The system shall cover all items, services and processes relating to commissioning, including those important to safety. In establishing and implementing the management system for commissioning, a graded approach based on the relative importance to safety of each item or process shall be used.
- v. The structure, content, extent and means of control of commissioning documents, including their verification and approval, shall be described in the management system of the operating organization.
- vi. The management system shall support the development and enhancement of a safety culture in all commissioning activities, including among members of the construction, commissioning and operating groups as well as other participants. This safety culture and safety awareness shall be ensured through appropriate training, highlighting the role and the safety significance of the components concerned.
- vii. The operating organization shall implement adequate arrangements in a management system to ensure safety and quality for a commissioning programme that is effective and is in accordance with national and international standards. Provision shall be made to ensure that the safety, health, environmental, security, quality and economic requirements for commissioning are met by all organizations participating in commissioning activities, including contractors.
- viii. The operating organization shall ensure that appropriate procedures are established for the control of commissioning activities on the site, to ensure that the commissioning of the plant fulfils the requirements of the commissioning programme.

~~Operating procedures and test procedures shall be verified and validated to ensure their technical accuracy and usability with the installed equipment and control systems. Verification and validation of procedures shall be performed to confirm their applicability and quality, and to the extent possible shall be performed prior to fuel handling operations on the site. This process shall continue during the commissioning phase.~~

- ~~ix.~~ From the commencement of commissioning, the operating organization shall ensure that review and approval arrangements for work control, modification control and plant configuration control are in place to meet the conditions of the commissioning tests.

~~xi.~~x. Arrangements shall be made for adequate and, where necessary, independent oversight and control of the quality of ongoing work.

~~xii.~~xi. The management system shall integrate all the elements of the management so that processes and activities that may affect safety are established and conducted coherently with other requirements, including requirements in respect to leadership, protection of health, human performance, protection of the environment, security and quality, and so that safety is not compromised by other requirements or demands.

## **Regulation 8 – Organizational Arrangement for Commissioning**

- i. Organizational arrangements shall be put in place to achieve the safety objectives of commissioning in accordance with the commissioning programme. These organizational arrangements shall represent a convenient and practical working scheme that allows the optimum use of the available personnel, resources and methods, and that provides assurances on safety.
- ii. The operating organization shall plan and establish, well in advance, commissioning groups that has the necessary expertise and experience to control the commissioning and to ensure the safety in all phases of the commissioning.
- iii. The working arrangements shall, as far as practicable, make use of the operating personnel so that they become familiar with the plant and the facilities during commissioning. In addition, the operating group shall participate in the commissioning activities from the start of the commissioning process, to ensure that as many operating personnel as possible gain field experience and to establish an ‘institutional memory’ for the plant.
- iv. The management system shall ensure that the responsibilities remain clear at all times, even if construction, commissioning and operating activities overlap.
- v. The operating organization shall be responsible for:
  - a. Steering, assessing and coordinating the operations of the group established for the commissioning programme and shall state clearly the tasks and the responsibility of these group;
  - b. Verifying that persons who have the necessary expertise and experience prepare, assess and approve the operating instructions and the test programmes, as well as documentation of the test results;
  - c. Planning the procedures to be followed in coordinating the commissioning;
  - d. Ensuring that a sufficient number of personnel who have been trained, qualified and authorized for their jobs are available for the commissioning operations;
  - e. Submitting the documents pertaining to the commissioning to the Authority.
- vi. The design organizations of the plant and systems, the equipment manufacturers and the quality control personnel shall co-operate closely with the organizations that shall carry out the testing. In particular, the operating organization shall verify that the plant supplier’s design engineers and equipment manufacturers supply the organizations to carry out the testing with all information necessary for the commissioning. In addition, the operating organization shall ensure that the design engineers examine the test results of the plant and verify that they are in accordance with the design and the set target values.



- vii. The responsibilities of the different organizations shall be defined clearly and unambiguously such that no unclear or unsettled matters remain between the different organizations.

## **PART - 3 Commissioning and Testing Plans**

### **Regulation 9**

The commissioning plan shall contain a description of how the plant commissioning is organized. The plan shall describe how and in which stage of the commissioning the functions important for nuclear power plant safety and other operations are performed.

### **Regulation 10**

The commissioning plan of the plant shall be presented in the preliminary safety analysis report or in a document supplied as a part of it. The testing plan shall contain at least the following:

- i. The scope of the testing, including the main stages, and the areas of responsibility assigned to those organizations that are involved in planning the testing programmes necessary for the different stages and in implementing the tests;
- ii. Instructions and procedures to be followed in planning the testing;
- iii. Utilization of the experience gained with similar plants in planning the testing;
- iv. Identification of the items that require special attention, and separate summaries of the tests to be carried out on these items;
- v. A preliminary estimate of the testing schedule;
- vi. The role of the testing in validating the plant operating instructions;
- vii. An estimate of the number of personnel required in the different organizations during testing.

### **Regulation 11**

A testing plan shall be submitted to the Authority for information well in advance before starting the system performance tests. This plan shall contain information on the following:

- i. Principal stages of the testing and the objectives set for each stage;
- ii. Organizations involved in the testing, including their areas of responsibility, and definition of the duties of the most important persons;
- iii. Instructions and procedures to be followed in drawing up the testing programme;

- iv. Delineation of authority during the testing, the principles that ensure compliance with the testing programme, and the procedure for modifying the testing programme, if necessary, during its implementation;
- v. Utilization of the experience gained with similar plants in drawing up the testing programme;
- vi. A schedule for drawing up the plant operating instructions and a plan specifying the role of the testing in ensuring the correctness and adequacy of these instructions;
- vii. A testing schedule, which specifies the planned durations and mutual chronological order of the different sub-tests, and deadlines for completion of the detailed test programmes;
- viii. Procedures to be followed in fuel loading and in achieving the criticality, including the safety measures and precautions;
- ix. A summary plan for the system performance tests and the pre-criticality tests of the reactor systems, including the name of the detailed test programme drawn up for each test, any preliminary requirements for conducting the test, the purpose of the test, and a description of the test scope and acceptance criteria;
- x. A summary plan for the low-power and power tests, including the name of the detailed test programme drawn up for each test, the purpose of the test, a description of the test scope and acceptance criteria, and a description of the power levels at which the tests are planned to be conducted;
- xi. The procedure for assessing the test results, including the division of duties, and measures to be taken in the event that some test results fail to meet the acceptance criteria;
- xii. The method for recording the results.

### **Regulation 12**

The final safety analysis report shall contain a summary of the testing plan and other matters and descriptions connected with the testing stated above. A summary of the test results shall be attached to the final safety analysis report when they become available.

### **Regulation 13 - Acceptance criteria**

- i. Acceptance criteria for the commissioning tests, against which the acceptability of the test results will be evaluated, shall be defined by the test procedures.
- ii. The technical basis of the acceptance criteria, which is consistent with the safety, design and performance requirements, shall be documented in preparation for and prior to conducting the tests.

## **PART - 4 Requirements for the Commissioning and Testing Programmes**

### **Regulation 14 – Commissioning Programmes**

- i. The commissioning programme for the plant shall cover the full range of plant conditions required in the design and the safety case. The results shall be used to demonstrate that the behaviour of the plant as built is in compliance with the design assumptions and the licence conditions. Special attention shall be paid to ensuring that no commissioning tests are performed that might place the plant in an unanalysed condition. Commissioning stages, test objectives and acceptance criteria shall be specified in such a way that the programme is auditable.
- ii. The commissioning programme shall provide the operating organization and the Authority with the means of identifying the hold points in the commissioning process at which approval may be required prior to continuing to the next stage.
- iii. The commissioning programme shall be divided into stages. A review of the test results for each stage shall be completed before commissioning is continued to the next stage. On the basis of the review, a judgment shall be made on whether the commissioning programme can proceed to the next stage. Judgements shall also be made on the basis of the review on whether the succeeding stages will be modified as a consequence of the test results, or because some tests in the stage had not been undertaken, or some tests had been undertaken but had not been completed. The results for some stages may be subject to approval by the Authority before commissioning can proceed to the next stage.
- iv. The commissioning programme shall include all the tests necessary to demonstrate that the plant as built and as installed meets the requirements of the safety analysis report and satisfies the design intent and, consequently, that the plant can be safely operated in accordance with the operational limits and conditions.
- v. Operating and maintenance procedures shall be validated to the extent practicable as part of the commissioning programme, with the participation of future operating personnel.
- vi. Suitably qualified operations personnel shall be directly involved in the commissioning process. Operating personnel and plant technical staff shall be involved in the commissioning process to the extent necessary to ensure proper preparation for the operational phase.
- vii. The commissioning programme shall be sufficiently comprehensive as to provide reference data to characterize structures, systems and components. Such reference data shall be retained as they are important for ensuring the safety of the plant and for subsequent safety reviews.
- viii. All the functions of the operating organization shall be performed at the appropriate stages during commissioning. These functions shall include discharging responsibilities for management, training of personnel, the radiation protection programme, waste management, managements of records, fire safety, physical protection and the emergency plan.

- ix. Operating procedures and test procedures shall be verified to ensure their technical accuracy and shall be validated to ensure their usability with the installed equipment and control systems. Verification and validation of procedures shall be performed to confirm their applicability and quality, and to the extent possible shall be performed prior to fuel handling operations on the site. This process shall continue during the commissioning phase. Verification and validation shall also be carried out for procedures for overall operation.
- x. From the commencement of commissioning, reviewed and approved arrangements for work control, modification control and plant configuration control shall be in place to meet the conditions of the commissioning tests.
- xi. Initial fuel loading shall not be authorized until all relevant pre-operational tests have been performed and the results have been accepted by the operating organization and the Authority. Reactor criticality and initial power increase shall not be authorized until all necessary tests have been performed and the results have been accepted by the operating organization and the Authority, as appropriate. The tests of the commissioning programme shall be successfully completed as a necessary condition for authorization, as appropriate, for normal operation of the plant to be commenced.
- xii. The operating organization shall ensure that the interfaces and the communication lines between different groups design groups, construction groups, contractors, commissioning groups and operations groups shall be clearly specified and controlled.
- xiii. The authorities and responsibilities shall be clearly specified and shall be delegated to the individuals and groups performing the commissioning activities. The operating organization shall be responsible for ensuring that construction activities are of appropriate quality and that completion data on commissioning activities and comprehensive baseline data, documentation or information are provided. The operating organization shall also be responsible for ensuring that the equipment supplied is manufactured under a quality assurance programme that includes inspection for proper fabrication, cleanliness, calibration and verification of operability.
- xiv. During construction and commissioning, the plant shall be monitored, preserved and maintained so as to protect plant equipment, to support the testing stage and to maintain consistency with the safety analysis report.
- xv. During construction and commissioning, a comparison shall be carried out between the as built plant and its design parameters. A comprehensive process shall be established to address non-conformances in design, manufacturing, construction and operation. Resolutions to correct differences from the initial design and non-conformances shall be documented.

### **Regulation 15 - Testing Phases**

- i. Tests shall be performed in phases and in a logical progressive sequence. There shall be a minimum of four phases:
  - a. Phase A: System performance tests prior to fuel loading
  - b. Phase B: Fuel Loading and Pre-Criticality Tests of the Reactor Systems
  - c. Phase C: Making the reactor critical and low-power tests

d. Phase D: Power tests

- ii. Before proceeding to the next phase, it shall be confirmed that all prerequisites established between the Operating organization and the Authority necessary for proceeding beyond the current phase are met.
- iii. Before transitioning from one phase of the commissioning process to the subsequent phase, the operating organization shall assure that SSCs credited in the safety case for that phase have been installed and confirmed to the extent practicable to meet their designed safety function.
- iv. The Authority shall witness some commissioning tests. In such cases, the operating organization shall inform the Authority so that staff can attend.

**Regulation 16 - System performance tests prior to fuel loading**

- i. System performance tests shall be conducted to demonstrate that every system important to safety and every individual part thereof is capable of fulfilling its designed function. It shall be further demonstrated that the systems are capable of functioning together as designed. The tests shall ensure the operability under normal operating conditions and, as far as possible, under the transient and accident conditions in which the systems are required to function.
- ii. If it has been planned to conduct a system performance test after the beginning of fuel loading, this shall be justified test by test.
- iii. A detailed test programme shall be drawn up for each test in advance. The main sections of the programme shall contain the following:
  - a. An introduction;
  - b. A description of the test sequence, if necessary owing to the nature, scope or clarity of the test;
  - c. Purpose of the test and test methods;
  - d. Acceptance criteria;
  - e. Limits on plant operation and other conditions for the test performance;
  - f. Initial state of the systems;
  - g. Prerequisites for performing the test;
  - h. Test conditions and instructions for the test performance;
  - i. A description of the provision made for malfunctions during the test performance;
  - j. Instruments to be employed and other testing equipment required;
  - k. The number of personnel involved in the test, requirements for the personnel and delineation of their responsibilities;
  - l. Specific instructions concerning occupational safety and component shielding; completion of the test;
  - m. Recording of the data to be monitored during the test;
  - n. Documentation of the test results.
- iv. In addition to **Regulation 14 (iii)** above, the programme shall contain, as a separate entry, a description of the measuring instruments or systems that may be required and that are not included in the plant fixed equipment.

- v. The tests shall be carried out as closely in accordance with the established programmes as possible; all non-conformances and their causes shall be documented. All arrangements for the measurement and output shall be checked before conducting the test, and the test results shall be documented in a way agreed on in advance.
- vi. The test programmes of the system performance tests shall be submitted to the NNRA for approval in accordance with the **Regulation 23** stated below.

### **Regulation 17 - Fuel Loading and Pre-Criticality Tests of the Reactor Systems**

- i. Initial fuel loading shall not be authorized until all relevant pre-operational tests have been performed and the results have been accepted by the operating organization and the Authority. Reactor criticality and initial power increase shall not be authorized until all necessary tests have been performed and the results have been accepted by the operating organization and the Authority,. The tests of the commissioning programme shall be successfully completed as a necessary condition for authorization, as appropriate, for normal operation of the plant to be commenced.
- ii. During this phase:
  - a. the reactivity control mechanism shall be available and in service and the reactor shall be maintained subcritical at all times
  - b. availability of the automatic shutdown systems shall be confirmed
  - c. the availability of the reactor trip system against neutronic and process-related upsets shall be confirmed
  - d. subcriticality checks shall be performed at regular steps during fuel loading to determine safe loading increments for subsequent loading
  - e. predictions of the behaviour of the core in terms of its reactivity shall be available for the evaluation of subcriticality margin
  - f. acceptance criteria for the maximum permissible deviation of predicted values from measurements shall be defined
  - g. tests on coolant flow, pressure, temperature and the performance of associated instrumentation and control mechanisms shall be conducted
  - h. fuel loading shall be supervised by certified personnel from the operating organization
- iii. A loading plan shall be drawn up, containing at least the following information:
  - a. A summary of the neutron flux and gamma radiation monitoring equipment required during loading and any other special measuring instruments;
  - b. The organization responsible for the loading, and the number, training and duties of the personnel required during loading;
  - c. The status of the reactor containment building and the systems contained in it during loading;
  - d. Detailed loading instructions;
  - e. Special safety instructions to be observed and precautions to be taken during loading.
- iv. The requirements for system performance tests presented in **Regulation 16** of this document shall also apply to the pre-criticality test programmes, performance of the tests and documentation of the test results.

- v. The fuel loading plan and the pre-criticality test programmes of the reactor systems shall be submitted to the Authority for approval.

### **Regulation 18 - Making the reactor critical and low-power tests**

- i. When making the reactor critical, the procedure shall be described in a detailed programme, which fulfils the requirements set for the system performance test programmes, where applicable.
- ii. The requirements for system performance tests presented in **Regulation 16** of this document shall also apply to the low-power test programmes, performance of the tests and documentation of the test results.
- iii. A test programme shall be drawn up to determine the neutron and gamma radiation. Radiation levels, particularly in the vicinity of the reactor, primary circuit and other principal radiation sources shall be examined in accordance with this programme.
- iv. During this phase:
  - a. trip set points shall be verified to ensure that they are compatible with the demands of the tests scheduled in this phase;
  - b. the availability of the automatic shutdown systems shall be confirmed for low-power shutdown
  - c. radiological surveys and functional tests of radiation protection equipment shall be made;
  - d. changes in reactivity shall be continuously monitored and evaluated so that the prediction of the point of criticality is continually checked;
  - e. the sequence and magnitude of the reactivity changes shall be performed in accordance with defined procedures;
  - f. the performance of the reactor core shall be commensurate with design assumptions and predictions, and comply fully with the safety analysis report;
  - g. it shall be confirmed that the reactor core is in proper condition to operate at higher power levels;
  - h. characteristics of the reactivity control systems and shielding shall be commensurate with design assumptions and predictions, and shall comply fully with the safety analysis report;
  - i. integrated system validation shall be completed if it has not been conducted during earlier phases of commissioning;
- v. The programme concerning the making of the reactor critical and the low-power test programmes shall be submitted to the Authority for approval.

### **Regulation 19 - Power tests**

- i. The requirements for system performance tests presented in **Regulation 16** of this document shall also apply to the power test programmes, performance of the tests and documentation of the test results. Furthermore, the required power level shall be stated in each test programme.
- ii. Radiation level measurements shall be conducted extensively at different power levels to ensure that the area classification and markings related to the working are correct.
- iii. During this phase:

- a. high-power tests shall be performed at various bulk power intervals, and these intervals shall be approved by the Authority
- b. in accordance with the design, tests shall be made to demonstrate that the reactor facility is able to:
  - ✓ safely operate at steady state under normal operating conditions
  - ✓ mitigate or prevent [Anticipating Operating Occurences](#) escalating to more severe events
  - ✓ safely cope with [Design Basis Accidents](#) (note that the facility need not be put into a DBA condition, but rather the function of mitigating systems verified)

iv. The power test programmes shall be submitted to the Authority for approval.

## **PART – 5 Requirements for the Reviewing, Evaluating and Reporting Test Results**

### **Regulation 20**

- i. Test results shall be reviewed by the commissioning organization to ensure that all deviations are resolved and that operating constraints, if any, are identified and documented.
- ii. Interpretation of test data shall be reviewed by persons who have the technical expertise to determine that the operational characteristics of the structure, system or component and/or process are captured.
- iii. A report shall be drawn up on the results of all tests included in the testing programme. In addition to the final test results, the report shall contain information on the non-conformances and their causes and on the repair and improvement measures taken during the testing that have been necessary to achieve acceptable test results.
- iv. Furthermore, a summary report shall be drawn up on each stage of the testing. Besides essential results of the test stage concerned, the report shall contain a summary of the observations made during the testing as well as an assessment of the appropriateness of the testing performed in the stage concerned and of any necessary changes to the testing programme or the plant use.
- v. The reactor facility design, operational and safety documentation shall be updated to reflect test results and resolution of deviations.
- vi. The commissioning organization shall report the test results to the operating organization and to other participants in the commissioning program, as required.
- vii. On completion of the testing, the operating organization shall assess the results of testing as a whole. If test results indicate that a change to the scope of subsequent tests is required, a documented assessment shall be performed prior to proceeding with the remaining tests to ensure that:
  - a. the proposed changes do not fall outside the range of assumptions made in the safety analysis and do not invalidate the licensing basis
  - b. the proposed changes do not invalidate the results of the previous tests
  - c. the proposed changes do not adversely impact future tests in terms of scope, objectives and sequence
  - d. the commissioning documents are updated with the nature of, and justification for, the proposed changes as per management system requirements



## **Regulation 21 - Modifications**

- i. Modifications to test procedures and other related documents shall be authorized by means of a formal licensee-approved process to control changes in documentation.
- ii. For modifications to the sequence of a test within a hold point or across hold points, reviews shall be performed and approvals obtained from the appropriate organizations. The reviews shall ensure that prerequisites for the out-of-sequence test are met in order to ensure the test is performed safely.
- iii. Temporary modifications to an approved design configuration for the purposes of commissioning testing shall be controlled by the commissioning organization, with licensee oversight. A review shall be performed to ensure that safety implications are considered.

## **PART – 6 NNRA’s Oversight Function in the Commissioning and Testing Phases**

### **Regulation 22 - Commissioning**

- i. The NNRA shall ensure that the plant is constructed in accordance with the design intent and its licensing base, and that the systems and equipment are installed as designed, and to ensure that their functionality, as well as the behaviour of the plant as a whole, demonstrates compliance with the design intent and the safety requirements, and demonstrates that the power plant can be operated safely.
- ii. The NNRA shall approve the commissioning programme and establishes the hold points for inspections, reviews and assessments of the testing results in accordance with the acceptance criteria.
- iii. The Authority shall review the commissioning plan of the nuclear power plant as part of the preliminary safety analysis report.
- iv. In addition, the NNRA shall inspect the operating organization’s functions during the construction and commissioning to ensure the safe commissioning of the plant.
- v. The NNRA and the operating organization should liaise closely throughout the implementation of the entire commissioning programme.

### **Regulation 23 - System Performance Tests Prior to Fuel Loading**

- i. The operating organization shall request the Authority approval for all test programmes that involve systems belonging to safety classes 1, 2 and 3. Of the systems belonging to safety class 4, the NNRA shall determine, on the basis of the plant testing programme, those system tests whose programmes the operating organization shall submit to the Authority for approval. Other test programmes of the systems belonging to safety class 4 shall be submitted to the Authority for information. The test programmes of compatibility tests of the main and auxiliary systems shall also be submitted to the Authority for approval.
- ii. If a test programme is subject to approval of the Authority, the test shall be begun only upon receipt of the approval.
- iii. The Authority shall supervise system performance tests at the power plant, as it deems necessary. It shall oversee the tests of systems belonging to safety classes 1 and 2 and some of the tests of systems belonging to safety classes 3 and 4. For the purpose of overseeing the tests, the Authority shall be provided with testing schedules well in advance. The Authority shall be informed of any changes in the schedules without delay.
- iv. The Authority shall be informed of the tests early enough, but the presence of Authority representative is not a precondition for conducting the test, unless Authority has required this in its decision of approval on the testing programme concerned. Performance tests of the auxiliary equipment of the pressure system shall form part of the commissioning inspection. Preliminary documents of the system performance test results, which have been inspected by the testing organization, shall be submitted of all tests whose

programmes are subject to approval of the Authority as part of the application concerning fuel loading.

#### **Regulation 24 - Fuel loading and pre-criticality tests of the reactor systems**

- i. To ensure that the plant fulfils the requirements set for it, the Authority shall carry out an inspection in accordance with Section 39 of the Act before fuel loading. When results that meet the acceptance criteria have been achieved in the pre-criticality tests of the reactor systems, the Authority permission shall be requested to make the reactor critical and to perform the low-power tests at the power specified in the application. Preliminary results of the preceding tests, which have been inspected by the testing organization, shall be submitted as part of the application within the scope necessary to prove that the acceptance criteria have been met.

#### **Regulation 25 - Making the reactor critical, low-power tests and power tests**

- i. Making the reactor critical shall begin after the Authority has taken a decision to approve the programme that describes the measures concerned. The same decision shall also apply to low-power tests provided that the related programmes have been approved.
- ii. The Authority shall supervise the making of the reactor critical, low-power tests and power tests.
- iii. When results that meet the acceptance criteria have been achieved in the low-power tests, the Authority permission shall be requested to perform the power tests at a certain power specified in the application. Preliminary results of the preceding tests, which have been inspected by the testing organization, shall be submitted as part of the application within the scope necessary to prove that the acceptance criteria have been met.
- iv. When results that meet the acceptance criteria have been achieved at the specified power level, the NNRA's approval shall be requested for the use of a higher power. The application shall contain preliminary results of the tests conducted at the previous power, which have been inspected by the testing organization, within the scope necessary to prove that the acceptance criteria have been met. The power can be raised to a new, higher level after the Authority has preliminarily inspected the results of the tests conducted at the previous power level and taken a decision to approve the programmes of the tests to be carried out at the new power level.

#### **Regulation 26 - Documentation of the test results**

Final documentation of the results of all tests whose test programmes are subject to the approval of the Authority shall be submitted to the Authority for approval within two months of the completion of the tests.

## **PART - 7 Offences and Penalties**

### **Regulation 27 - Offences**

- i. Any person who contravenes any of the provisions of these regulations commits an offence.
- ii. Any person who commits an offence under these regulations shall be liable to the penalties as established in the enforcement policy issued by the Authority and other applicable extant laws.

### **Regulation 28 - Penalties**

- i. The Authority shall impose penalties such as suspension, revocation of authorization, imposing administrative fine, closure of facility or any combination of these.
- ii. Any person or body corporate who, being a holder of authorization under these regulations, commits an offence shall be liable to prosecution in the court of law and upon conviction be liable to pay fines not exceeding N5, 000, 000 for an individual and not exceeding N50, 000, 000 for a corporate body or be given a jail term not exceeding ten years or both. These fines may be revised by the Authority as necessary.

### **Regulation 29 - Appeal**

Any person to whom these regulations apply may appeal to the Board of the Authority if he/she is not satisfied with the decision made against him/her.

Made in Abuja this .....day of .....2017

**PROFESSOR LAWRENCE ANIKWE DIM**  
**Director General/CEO**

