

# **NIGERIA NUCLEAR ENERGY PROGRAMME: SOME BASIC CONSIDERATIONS**

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# 1.0 COUNTRY OVERVIEW

- ◆ AREA: 923,766 KM<sup>2</sup>
- ◆ POPULATION: 178.52 MILLION (NBS, 2014)
  - 47% OF WEST AFRICA'S
- ◆ ECONOMY: AFRICA'S LARGEST ECONOMY
- ◆ GDP PER CAPITA (2014): 1091.64 USD WITH 9.19% GROWTH RATE
- ◆ POWER SECTOR:
  - 🇳🇮 MAINLY HYDRO (27.2%) & GAS (71.5%)
  - 🇳🇮 DEMAND: 28,360 MWE ; SUPPLY: 6,500 MWE
  - 🇳🇮 PER CAPITA ELECTRICITY: LESS THAN 37 W
  - 🇳🇮 POWER SECTOR REFORM: ELECTRICITY SUPPLY INDUSTRY (ESI)
  - 🇳🇮 ELIMINATE GOVERNMENT'S INVOLVEMENT IN UTILITY MANAGEMENT
  - 🇳🇮 PROMOTE PRIVATE SECTOR PARTICIPATION AND ATTRACT INVESTORS
  - 🇳🇮 CREATE EFFICIENT AND REGULATED MARKET STRUCTURES FOR THE ESI



## 2.0 NUCLEAR POWER PROGRAMME BACKGROUND

- ❑ ENACTMENT OF ACT 46 OF 1976, FOR THE CREATION OF NAEC AS THE NATIONAL FOCAL AGENCY FOR THE DEVELOPMENT OF PEACEFUL USE OF ATOMIC ENERGY.
- ❑ IN 1978, 2 UNIVERSITY-BASED NUCLEAR ENERGY RESEARCH CENTRES WERE ESTABLISHED AS THE BASIC KERNEL FOR NATIONAL MANPOWER AND CAPACITY DEVELOPMENT.
  - ✓ THE CENTRE FOR ENERGY RESEARCH AND TRAINING (CERT) AT THE AHMADU BELLO UNIVERSITY (ABU) WAS INSTALLED WITH A 31.1KW MINIATURE NEUTRON SOURCE REACTOR (MNSR).
  - ✓ THE CENTRE FOR ENERGY RESEARCH AND DEVELOPMENT (CERD) AT THE OBAFEMI AWOLOWO UNIVERSITY (OAU) HAS A 1.7MV PELLETRON TANDEM ACCELERATOR.
- ❑ IN 1979, URANIUM EXPLORATION ACTIVITIES WERE INITIATED BY NUMCO(DEFUNCT) WHICH WAS ESTABLISHED THROUGH NIGERIA-FRANCE COLLABORATION .
- ❑ WITHIN THIS PERIOD, PROJECT FEASIBILITY AND NPP SITING ACTIVITIES WERE CARRIED OUT

# NUCLEAR POWER PROGRAMME BACKGROUND 2

- ❑ IMPLEMENTATION OF PROJECT ELEMENTS IN THE AREAS OF HRD, URANIUM EXPLORATION AND NPP SITING, WERE DONE IN COLLABORATION WITH FRANCE MINING COMPANY (BRGM), SWISS-BASED ENGINEERING CONSULTANT (MOTOR COLUMBUS) AND OTHER FOREIGN TECHNICAL PARTNERS.
- ❑ NP DEVELOPMENT PROCESS WAS HAMPERED BECAUSE PROGRAMME EXECUTION DID NOT FOLLOW ANY CLEARLY DEFINED ROADMAP. HENCE IMPLEMENTATION OF VARIOUS ASPECTS OF THE DEVELOPMENT OF THE NATIONAL NUCLEAR POWER PROGRAMME BY THE VARIOUS GOVERNMENT AGENCIES WERE NOT PROPERLY COORDINATED.

## **3.0 NEED TO INCLUDE NUCLEAR IN ENERGY MIX**

- **AFTER AN EXTENSIVE STUDY MADE BY THE ENERGY COMMISSION OF NIGERIA ON THE ENERGY PORTFOLIO IN 2005, IT WAS RECOMMENDED THAT NUCLEAR AND RENEWABLES SHOULD BE INTRODUCED.**
- **GOVERNMENT THEN SET UP INTER-MINISTERIAL COMMITTEE TO REVIEW THE REPORT. THE COMMITTEE UPHELD THE RECOMMENDATION.**
- **THE NIGERIA ATOMIC ENERGY COMMISSION WHICH WAS CREATED BY LAW IN 1975 WAS ACTIVATED IN 2006 AND GIVEN MANDATE TO DEVELOP ROADMAP FOR THE IMPLEMENTATION.**
- **MOST OF THE ON-GOING NEW POWER PROJECTS ARE GAS-FIRED PLANTS, AND WOULD PROVIDE THE ADDITIONAL CAPACITY IN THE COMING YEARS.**
- **HYDRO POTENTIAL IS LIMITED; ONLY 14 GWE CAN BE HARNESSSED FROM ALL AVAILABLE HYDROPOWER SOURCES**

## 4.0 LEGISLATIVE FRAMEWORK

### INTERNATIONAL LEGAL INSTRUMENTS

Nigeria has long been Party to the following international legal instruments governing the peaceful uses of nuclear energy:

Treaty on the Non-proliferation of Nuclear Weapons(NPT) signed on 1 <sup>st</sup> July, 1968	Convention on Early Notification of a Nuclear Accident ratified on 10 <sup>th</sup> August 1990;	Convention on Assistance in the Case of a Nuclear Accident or Radiological Emergency ratified on 10 <sup>th</sup> August, 1990;	The Treaty of Pelindaba on the African Nuclear-Weapon- Free Zone, ratified 20 April, 2000;	1963 Vienna Convention on Civil Liability for Nuclear Damage acceded to on 4 <sup>th</sup> April 2007;	Convention on the Physical Protection of Nuclear Material acceded to on 4 <sup>th</sup> April 2007;	Amendment to the Convention on the Physical Protection of Nuclear Material ratified on 4 <sup>th</sup> May, 2007;	Convention on Nuclear Safety ratified on 4 <sup>th</sup> April, 2007;	Joint Convention on the Safety of Spent Fuel Management and on the Safety of Radioactive Waste Management, acceded to on 4 <sup>th</sup> April, 2007;	Application of safeguards in connection with the Treaty on Non-Proliferation of Nuclear Weapons (with Protocol) signed February 29, 1988;	Protocol Additional to the Agreement between the Federal Republic of Nigeria and the International Atomic Energy Agency for the Application of Safeguards in connection with the Treaty on the Non-Proliferation of Nuclear Weapons, signed on 20 <sup>th</sup> September, 2001;	Revised Supplementary Agreement Concerning the Provision of Technical Assistance by the IAEA (RSA), signed 13 <sup>th</sup> March, 1989;	Agreement on the Privileges and Immunities of the IAEA, accepted 4 <sup>th</sup> April, 2007;	African Regional Co-operative Agreement for Research, Development and Training Related to Nuclear Science and Technology (AFRA) – Third Extension accepted May 6, 2005.
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## 4.0 LEGISLATIVE FRAMEWORK

### DOMESTIC LEGISLATIONS:

Two major legislations governing nuclear energy

The 1976 Nigeria Atomic Energy Act – *"An Act to establish the Nigeria Atomic Energy Commission for the development of atomic energy and all matters relating to the peaceful use of atomic energy."*

The 1995 Nuclear Safety and Radiation Protection Act.



## 5.0 NATIONAL POLICY ON CIVIL LIABILITY FOR NUCLEAR DAMAGE

- ❖ THESE PROVISIONS DO NOT ADDRESS THE GENERAL NUCLEAR LIABILITY PRINCIPLES, AS SUCH NOT IN CONFORMITY WITH ACCEPTABLE INTERNATIONAL STANDARDS.
- ❖ NUCLEAR LIABILITY PRINCIPLES HAVE BEEN ADDRESSED IN THE DRAFT COMPREHENSIVE LEGISLATION.
- ❖ A DRAFT NATIONAL POLICY ON CIVIL LIABILITY FOR NUCLEAR DAMAGE HAS BEEN DEVELOPED BY NAEC IN COLLABORATION WITH OTHER RELEVANT STAKEHOLDER AGENCIES .
- ❖ THE DOCUMENT ONCE APPROVED BY THE EXECUTIVE COUNCIL WILL BE REFLECTED IN THE DRAFT LEGISLATION, AS APPROPRIATE.

# **6.0 CREATING AN ENABLING ENVIRONMENT FOR THE INTRODUCTION OF NUCLEAR POWER: THE GREATEST CHALLENGE FACED**

**THE NUCLEAR ROADMAP HAS SOME STRINGENT TIMELINES FOR ITS SUSTAINABLE AND SUCCESSFUL IMPLEMENTATION. THE IMPLEMENTATION OF THE NUCLEAR POWER PROGRAMME IN NIGERIA IS NOT MOVING AS FAST AS DESIRED DUE TO SOME FACTORS WHICH INCLUDE:**

- FUNDING LIMITATIONS DUE TO ANNUAL BUDGETARY ALLOCATION SYSTEM**
- SLOW PROCESS OF REQUISITE LEGAL FRAMEWORK DEVELOPMENT**
- INADEQUATE SYNERGY WITH PARTNERING INSTITUTIONS FOR HUMAN RESOURCES DEVELOPMENT PROGRAMMES**
- SLOW IMPLEMENTATION OF HUMAN RESOURCES CAPACITY DEVELOPMENT**
- DEVELOPMENT OF SYNERGY IN STAKEHOLDER'S INVOLVEMENT**
- DEVELOPMENT OF PUBLIC AWARENESS INITIATIVES**

# 7.0 ASSISTANCE FROM THE IAEA

- **SOME OF THESE TEETHING PROBLEMS WE ENCOUNTERED WERE EVENTUALLY RESOLVED WITH THE ASSISTANCE OF THE IAEA**
- **THE COUNTRY RECEIVED A LOT OF ASSISTANCE FROM THE IAEA IN FORM OF:**
  - **FELLOWSHIP**
  - **EXPERT MISSION**
  - **SCIENTIFIC VISITS**
  - **TECHNICAL COOPERATION PROGRAMMES**
  - **HUMAN RESOURCE DEVELOPMENT (EDUCATION AND TRAINING)**
- **THESE ASSISTANCE HELPED US TO DEVELOP A GOOD NUCLEAR INFRASTRUCTURE PROGRAMME**

## **8.0 SAFETY AND SECURITY CONSIDERATIONS**

- **SAFETY IS AIMED AT PREVENTING ACCIDENTS; WHILE SECURITY IS AIMED AT PREVENTING INTENTIONAL ACTS THAT MIGHT HARM THE NUCLEAR FACILITY OR RESULT IN THE THEFT OF NUCLEAR MATERIALS.**
- **BOTH DISCIPLINES HOWEVER, SHARE A COMMON OBJECTIVE OF LIMITING THE RISKS OF OPERATING A NUCLEAR FACILITY TO A SATISFACTORY LEVEL WITH THE ULTIMATE AIM OF PROTECTING PEOPLE, SOCIETY, AND THE ENVIRONMENT.**
- **SOME ELEMENTS OR ACTIONS SERVE TO ENHANCE BOTH SAFETY AND SECURITY SIMULTANEOUSLY (FOR EXAMPLE, THE CONTAINMENT STRUCTURE AT A NUCLEAR POWER PLANTS ARE CONSTRUCTED WITH PROTECTIVE BARRIERS OF STEEL AND REINFORCED CONCRETE THAT SERVE BOTH A SECURITY AND A SAFETY FUNCTION) WHILE IN SOME CIRCUMSTANCES ACTIONS WHICH SERVE ONE OBJECTIVE CAN BE ANTAGONISTIC TO THE ACHIEVEMENT OF THE OTHER (FOR EXAMPLE, THE INTRODUCTION OF DELAY BARRIERS FOR SECURITY REASONS CAN LIMIT RAPID ACCESS TO RESPOND TO A SAFETY EVENT OR CAN LIMIT EMERGENCY EGRESS BY PLANT PERSONNEL).**
- **AS AN OPERATOR, BOTH SAFETY AND SECURITY REQUIREMENTS ARE WEIGHED AND TREATED EQUALLY TO MINIMISE THE OBSTRUCTION OF ONE AGAINST THE OTHER.**

## **8.1 ADOPTION OF CPPNM AND ITS AMENDMENT AND IAEA SECURITY GUIDANCE AND RECOMMENDATIONS**

- **NIGERIA IS ADOPTING THE PROVISIONS OF THE CPPNM, ITS AMENDMENT AND THE IAEA NUCLEAR SECURITY RECOMMENDATIONS AND GUIDANCE.**
- **THE DRAFT NIGERIAN REGULATIONS ON THE PHYSICAL PROTECTION OF NUCLEAR MATERIAL AND NUCLEAR FACILITIES IS ENTIRELY BASED ON IAEA GUIDANCE INFCIRC 225 REV. 5, TITLED NUCLEAR SECURITY RECOMMENDATIONS ON PHYSICAL PROTECTION OF NUCLEAR MATERIAL AND NUCLEAR FACILITIES OR NSS 13.**
- **OTHER NIGERIAN REGULATIONS ON SECURITY IN STORAGE, USE AND TRANSPORT ARE BASED ON THE RELEVANT NSS SERIES DOCUMENTS**

## **8.2 SUPPORT RECEIVED FROM THE IAEA FOR PHYSICAL SECURITY UPGRADES**

- **IAEA ASSISTED NIGERIA IN THE PHYSICAL SECURITY UPGRADES AT THE NRR1 AT ZARIA**
- **IAEA ASSISTED IN THE PROVISION OF HOMELAND SECURITY SURVEILLANCE SYSTEM HS3**
- **FURTHERMORE IAEA ASSISTED IN THE PHYSICAL SECURITY UPGRADE OF OUR GAMMA IRRADIATION FACILITY AT SHEDA, NEAR ABUJA**
- **IN ADDITION IAEA ASSISTED IN THE HRD OF OUR EXPERTS IN NUCLEAR SECURITY**

## **8.3 CHALLENGES FACED IN INTEGRATING SECURITY FEATURES INTO NUCLEAR FACILITIES AT THE DESIGN STAGE**

- **HIGH LEVEL CLASSIFICATION OF DESIGN BASIS THREAT (DBT) SUCH THAT DESIGNERS ARE NOT ABLE TO ACCESS IT AS WELL AS UNDERSTAND SECURITY REQUIREMENTS.**
- **LOW PERCEPTION OF THREAT AMONG DESIGNERS: SECURITY HAS OFTEN HAD A LOW PROFILE AMONG DESIGNERS BECAUSE THEY DO NOT PERCEIVE THREATS AS BEING REAL. ALSO, SECURITY BEING TRADITIONALLY PERCEIVED AS THE SOLE RESPONSIBILITY OF SECURITY MANAGERS MEANS THAT FEW STAKEHOLDERS LEARNED ABOUT THEM WHEN SECURITY INCIDENTS HAVE ALREADY TAKEN PLACE.**
- **DESIGN ENGINEERS, NUCLEAR SAFETY SPECIALISTS AND OPERATORS HAVE NOT PERCEIVED THE NEED TO KNOW; THEY HAVE OFTEN FAILED TO APPRECIATE THE ROLE THEY WOULD BE PLAYING IN MAKING A FACILITY MORE SECURE.**
- **SECURITY MANAGERS INADVERTENTLY BLOCK DEVELOPMENT OF THE HOLISTIC, FLEXIBLE DESIGNS THAT ARE MOST EFFECTIVE DUE TO THEIR CONCERNS THAT AN ADVERSARY MIGHT LEARN THE DETAILS OF A FACILITY'S PROTECTION PLANS.**
- **MANAGEMENT OFTEN RELEGATES TO THE BACKGROUND THE ISSUES OF SECURITY WHILE PROMOTING SAFETY.**
- **ADDITIONALLY, AVAILABILITY OF RELEVANT LOCAL EXPERTS WITH REQUISITE NUCLEAR SECURITY EXPERIENCE WITH REGARD TO NUCLEAR INSTALLATIONS IS ALSO A CONCERN**

**THUS THE MAJOR CHALLENGE IN INTEGRATING SECURITY FEATURES AT THE DESIGN STAGE IS IN GETTING THE TRUST OF THE DESIGN OWNER TO ALLOW PARTICIPATION OF NIGERIANS BEARING IN MIND THAT RESPONSIBILITY FOR NUCLEAR SECURITY IS THAT OF THE FEDERAL REPUBLIC OF NIGERIA**

## **8.4 CHALLENGES FACED IN INTEGRATING SECURITY FOR THE FACILITIES INTO THE OVERALL SECURITY PLAN OF THE COUNTRY?**

- **UNAVAILABILITY OF NECESSARY POLICIES AND CHARTERS.**
- **NO DESIGN TRAINING COURSES THAT ENABLE EACH MEMBER OF THE TEAM TO UNDERSTAND THE NEEDS AND CONCERNS OF THE OTHERS.**
- **INABILITY TO VIEW, BY ALL STAKEHOLDERS, SECURITY AS AN INTEGRAL PART OF THE ORGANISATION.**
- **BY INTEGRATING NUCLEAR SECURITY OF OUR FACILITIES INTO THE OVERALL SECURITY PLAN OF THE COUNTRY, IT WILL BECOME A NATIONAL ISSUE RATHER THAN BEING AN ORGANIZATIONAL ISSUE. THIS MEANS THAT ANY SECURITY BREACH OF OUR NUCLEAR FACILITY IS SEEN AS A NATIONAL SECURITY THREAT WITH ITS ATTENDANT NATIONAL CONSEQUENCES.**



# 8.5 HOW TO ADDRESS SAFETY AND SECURITY INTERFACE AS AN OPERATOR

**IN ADDRESSING SAFETY AND SECURITY INTERFACE, THE OPERATORS MUST:**

- ❖ **DESIGN, IMPLEMENT AND MAINTAIN TECHNICAL SOLUTIONS AND OTHER ARRANGEMENTS TO SATISFY REGULATORY REQUIREMENTS RELATED TO BOTH SAFETY AND SECURITY;**
- ❖ **VERIFY THE SKILLS AND APPROPRIATE TRAINING OF PERSONNEL;**
- ❖ **INFORM THE REGULATORY AUTHORITIES OF ANY EVENT LIKELY TO AFFECT THE SAFETY OR SECURITY OF THE NUCLEAR FACILITY AND, AS APPROPRIATE, REQUEST SUPPORT;**
- ❖ **MAINTAIN COORDINATION WITH STATE ORGANIZATIONS THAT ARE INVOLVED IN SAFETY OR SECURITY;**
- ❖ **IMPLEMENT A QUALITY ASSURANCE SYSTEM IN BOTH THE SAFETY AND SECURITY FIELDS.**
- ❖ **HAVE A CENTRALIZED INFORMATION SYSTEM AND A CENTRALIZED COMMAND CENTRE FOR DIRECTING OPERATIONS DURING A SAFETY OR SECURITY EVENT.**

**NOTE: BOTH SAFETY AND SECURITY TYPICALLY FOLLOW THE STRATEGY OF DEFENCE IN DEPTH — THAT IS, THE EMPLOYMENT OF LAYERS OF PROTECTION. THE FUNDAMENTAL NATURE OF THE LAYERS IS SIMILAR. PRIORITY IS GIVEN TO PREVENTION. SECOND, ABNORMAL SITUATIONS NEED TO BE DETECTED EARLY AND ACTED ON PROMPTLY TO AVOID CONSEQUENT DAMAGE. MITIGATION IS THE THIRD PART OF AN EFFECTIVE STRATEGY. FINALLY, EXTENSIVE EMERGENCY PLANNING SHOULD BE IN PLACE IN THE EVENT OF THE FAILURE OF PREVENTION, PROTECTION AND MITIGATION SYSTEMS.**

**THUS, THIS CAN BE ADDRESSED BY ENSURING THE PROVISION OF COMMON TRAINING FOR BOTH SAFETY AND SECURITY EXPERTS; ENSURING REGULAR INTERACTION FOR BOTH SIDES TO APPRECIATE THE IMPORTANCE OF THE OTHER**

## **8.6 REQUIREMENTS FOR DEVELOPING NUCLEAR SECURITY CULTURE IN A NUCLEAR POWER PLANT**

- **ENACTMENT OF COMPREHENSIVE LEGISLATION ON NUCLEAR SECURITY**
- **IDENTIFYING AND RATIFYING RELEVANT INTERNATIONAL TREATIES AND CONVENTIONS.**
- **ADHERENCE TO HIGH STANDARD OF PROFESSIONALISM WITH RESPECT TO NUCLEAR SECURITY BY THE WORKFORCE.**
- **IMPLEMENTATION OF SECURITY AWARENESS PROGRAMMES**
- **ESTABLISHMENT OF EFFECTIVE MANAGEMENT SYSTEM ON NUCLEAR SECURITY**
- **ORGANIZING AND CONDUCTING NUCLEAR SECURITY CULTURE ASSESSMENT**
- **ESTABLISHING A VISIBLE SECURITY POLICY ACCOMPANIED BY ROLES AND RESPONSIBILITIES FOR NUCLEAR SECURITY AS WELL AS THE PROVISION OF PHYSICAL PROTECTION SYSTEM**
- **TRAINING AND REWARDING PERSONNEL FOR THE GOOD WORK THEY PERFORM AS WELL AS FINDING AND HIRING TALENTED PEOPLE**

## **8.7 REQUIREMENTS FOR SUSTAINABILITY OF SECURITY SYSTEMS IN A NUCLEAR FACILITY**

- **SECURITY SYSTEMS SHOULD BE CONSTANTLY EVALUATED AND IMPROVED TO CONTINUOUSLY OUTPACE THE INGENUITY OF THE INTELLIGENT ADVERSARY.**
- **INSTITUTIONALIZATION OF AN EFFECTIVE AND FACILITY-WIDE NUCLEAR SECURITY CULTURE.**
- **PROVISION OF ADEQUATE AND EFFECTIVE REGULATORY CONTROL.**
- **ALWAYS CARRY OUT HUMAN RELIABILITY CHECK**

## **8.8 LESSONS LEARNED IN INTEGRATING SECURITY FEATURES INTO NUCLEAR FACILITIES AT THE DESIGN STAGE.**

- **BETTER SECURITY IS ACHIEVED BY PAYING MORE ATTENTION TO SECURITY DURING THE DESIGN STAGE.**
- **IT IS IMPERATIVE THAT SECURITY MANAGERS BE COMMITTED TO AND MUST BE WILLING TO WORK CLOSELY WITH OTHER DISCIPLINES AND TO SHARE DETAILS OF THREATS AND INCIDENTS OPENLY WITH THOSE WHO NEED TO KNOW.**
- **IT IS COST EFFECTIVE TO INTEGRATE SECURITY FEATURES AT THE DESIGN STAGE RATHER THAN AT A LATER DATE.**

# 9.0 CONCLUSION

- **NUCLEAR ENERGY IS A CLEAN AND FORMIDABLE SOURCE OF ENERGY TO MANKIND**
- **IT IS SAFE AND SECURE IF PROPERLY IMPLEMENTED**
- **IAEA IS ALWAYS AVAILABLE AND READY TO ASSIST ANY MEMBER STATE THAT REQUEST FOR ASSISTANCE**
- **FOR EFFECTIVE EXPLOITATION OF NPP, SAFETY AND SECURITY MUST BE CONSIDERED AND IMPLEMENTED FROM THE DESIGN STAGE**

**THANK FOR YOUR KIND ATTENTION**