Bello Luqman. A. (Nigeria)
Tomsk Polytechnic University, Tomsk
Scientific adviser: Stepanov B. P

REVIEW OF PREPAREDNESS AS NIGERIA MATCH TOWARDS NUCLEAR POWER PLANT AS PART OF ITS ENERGY MIX

Abstract

Nigeria is a newcomer country in the activities and development of nuclear technologies for peaceful purposes such as nuclear power plants. As a member of the global community, Nigeria has it fair share of the global unrest which is posing various security concerns in the country. Nigeria is home to one of the deadliest terrorist organization in the world ranked the third only after the ISIS and Al-Qaida. Boko-Haram operates across the northeastern region of Nigeria and other ethno centric militias operating in the country. The study reviewed Nigerian preparedness toward the acquisition of nuclear power plants amidst other security concerns. It was shown that Nigeria is committed its nuclear technology road map through cooperation and partnership with relevant organizations locally and internationally such as International Atomic Energy Agency (IAEA), World Institute for Nuclear Security (WINS) and others. Nigeria is also in collaborations with states own enterprise such as ROSATOM, US-PNS, KEPCO and has signed various forms of memorandum of understanding with countries such as Russia, China, South Korea and the US in areas of training and manpower development.

Introduction

Nuclear threats are on the increase and the threats from terrorist are also not diminishing. Nuclear security regimes across every Nuclear Material Own States are constantly on the alert for any eventuality. Nigeria, as a responsible member of the global community is heavily in support of an effective nuclear security regime. Nigeria match towards a cleaner source of energy is an act of responsibility to the reality of climate change mostly in the Sub-Saharan Africa. The major sources of energy in the country are hydro and fossil fuel power plants, while the citizens supplement their energy need with personal gasoline generator, solar, bio-fuel and the rest which are not environmentally compatible and sustainable.

Nigeria is a developing country with a galloping population growth and a booming economy needs to diverse its energy source to a stable, cleaner and ever evolving energy source. However, Nigeria as a member of the global community has it fair share of the global unrests, extremism, militancy, banditry insurgency and the rest.

Map of Nigeria and it Neighbours.

This study attempts to look into preparedness Nigeria on its journey to joining club of countries with functional nuclear power plants as another source of energy.

ENERGY CRISES IN NIGERIA

Nigeria is a country in West Africa bordering Niger in the north, Chad in the northeast, Cameroon in the east, and Benin in the west. Its southern coast is on the Gulf of Guinea in the Atlantic Ocean. It has a surface of nearly 1 million km2 and a population of about 206 million people growing at an average of 2% annually 7th in the world. It has the largest economy in Africa which heavily depends on the export of oil products and grows at an average of 6% annually. It has rich cultural diverse of ethnic nationalities.

However, due to so many factors, Nigeria is still unable to power its economy efficiently. Nigerians consume 144 kwh per capita annually, only 3.5% as much as South Africans. With only 12 GW installed, and typically just one-third of that delivered, Nigerian power production falls far short of demand, which is a primary constraint on economic growth. Self-generation using dirty diesel generators is exceedingly common in Nigeria, and bear a significant economic and environmental cost.

NUCLEAR ENERGY MIX

In the 1960s, Nigeria has tried to develop its nuclear sectors for energy production. In 1976 It established the Nigeria Atomic Energy Commission (NAEC) and two other nuclear energy centers: Center for Energy Research and Training (CERT) in Zaria and Center for Energy Research and Development (CERD) in Ife. The centers are to facilitate the rapid development and deployment of nuclear technologies in the country. However, due to change in government policies the drive for nuclear energy production was abandoned not until 2004, when sought the support of the IAEA to develop plans for up to 4,000 MW of nuclear capacity by 2027.

Nigeria has signed a deal with Russia's state-owned Rosatom to collaborate on the design, construction and operation of four nuclear power plants by 2035, the first of which will be in operation by 2025.

NIGERIA ATOMIC ENERGY COMMISSION (NAEC)

The Nigeria Atomic Energy Commission (NAEC), created by Act 46 of 1976, is the national focal agency charged with the responsibility for the promotion of the development of atomic energy and for all matters relating to the peaceful uses of atomic energy2. However, it was only activated to become fully operational in July 2006, under the aegis of the Federal Ministry of Science and Technology, when its Governing Board was inaugurated by the President and Commander-in-Chief, who is also the Chairman of the Board.

NAEC has five full scale nuclear energy centers strategically placed across the country.

Centre for Energy Research and Development, OAU, Ile-Ife

Centre for Energy Research and Training, ABU, Zaria

Nuclear Technology Centre, Sheda, Abuja.

Centre for Nuclear Energy Studies, UPH, Port Harcourt.

Centre for Nuclear Energy Research and Development, UM, Maiduguri

SECURITY CONCERNS: Challenges

Nigeria has its own share of Global Unrests, Extremism, Militancy, Terrorism and Insurgency. There is increasing presence of global terrorist cells across the sub-Saharan of Africa. These include but not limited to Boko-Haram, Bandits, and Aswad in the northern region and ethno centric militias in the southern region of Nigeria respectively. Boko-Haram is a typical example of extreme terrorism. This is notwithstanding the fact that it has international support and sponsorship; its activities are centered within the Nigeria State and her neighbors. However, Nigeria which has nuclear materials, has not recorded a bridge in any of its nuclear facilities.

SECURITY CONCERNS: Way forward

Nigerian success in nuclear sector has been its strong nuclear security culture and its technical expertise which is on the increase. Nigeria has a strong regulatory body. Nigeria Nuclear Regulatory Authority (NNRA) which regulate the nuclear activities in the country. Nigeria has being receiving technical support and expertise from IAEA and other member state such as US, Russia, China and South Korea. DBT incorporated in Nigeria licensing process for relevant stake holders to comply within building appropriate physical protection system for radiological materials and nuclear facilities to ensure security of the facilities1. Developed with the assistance of some stakeholders. Collaboration is ongoing effectively with the relevant bodies /stake holders in Nigeria to ensure safety, security and safeguard of radiolog-

ical material sand nuclear facilities in the country. Convention on Physical Protection for Nuclear Material and its amendment Nigeria has signed an agreement of cooperation with the United States Department of Energy (US-DOE) Office of Radiological Security (ORS).The objectives is to reduce and protect vulnerable nuclear and other radioactive material and to prevent theft or sabotage. The cooperation included Physical Security upgrades of some high risk radiological facilities. Nigeria is partner with the International Organizations for capacity building particularly in the development of the Nigerian Nuclear Security Support Centre, Physical security upgrades and HRP The physical security system in CERT facilities was first access in 2004 by NNRA and subsequently by expert from IAEA4.

Collaboration and Partnership

Nigeria enjoys support and cooperation from various nuclear related organizations such IAEA, WINS, US-DOE, ROSATOM, CIAE, KAREI. In 2007, Nigeria ratified the Convention on the Physical Protection of Nuclear Material and Amendment to the Convention on the Physical Protection of Nuclear Material. Nigeria has established a National Nuclear Security Centre (NNSC) in Abuja managed by the Office of National Security Adviser (ONSA)

Conclusions

The significance of security to mankind cannot be over-emphasized as the socio-economic structure of any society or organization depends on the security system available in such society or organization [2]. Nigeria as a state with nuclear materials and nuclear ambition for peaceful use recognized the relevance of the security of radioactive materials. It is constantly strengthening its partnerships with relevant international organizations to promote security capacities. It has first installed Radiation Portal Monitor (RPM) in all its major International Airports since 2008.

REFERENCE

1. Onoja, R.A, Physical protection of nuclear material and nuclear facilities: nigeria nuclear research reactor core conversion project. Available online:https://www.iaea.org/sites/default/files/17/11/cn-254-onoja-presentation.pdf Accessed 23/03/2021)
2. National Atomic Energy Commission, Director-General’s brief on the activities of the commission to the new permanent secretary federal ministry of science and technology, Abuja. 2010.
3. O. D. Oyeyinka, L. A. Dim, M. C. Echeta, A. O. Kuye, Determination of system effectiveness for physical protection systems of a nuclear en-

ergy centre// Science and Technology 2014, 4(2): 9-16 DOI: 0.5923/j.scit.20140402.01
4. IAEA, 1994. Convention on Nuclear Safety,

Fidel Castro Parimala Rangan (India)
Tomsk Polytechnic University, Tomsk
Scientific adviser: Dr. Alexander G. Korotkikh,

CALCULATION AND COMPARISON OF HEAT TRANSFER COEFFICIENT & HEAT FLUX BY VARYING THE PARAMETERS FOR SCWR THROUGH CFD SIMULATIONS

Abstract

In the present study, CFD simulation was conducted for 2×2 rod bare bundle using water at supercritical pressures. Main objective of the simulation was to compare working of different turbulence models. K-epsilon, K-omega and Spalart-Allmaras turbulence models were chosen for our study. K-epsilon and K-omega turbulence models are two equation models and are widely used for industrial research. Whereas Spalart-Allmaras is one equation model which is least computationally expensive of all the models. All three turbulence models come under the Reynolds Average Navier Strokes model (RANS). CFD results were found to be sensitive with the appropriate turbulence model and this variation is documented through various plots.

Introduction

CFD simulation was performed to replicate the results from the experiment of heat transfer to supercritical water in 2 × 2 rod bundle conducted at Shanghai Jiao Tong University. This report presents the results to assess capability of the commercial CFD software Ansys fluent in simulating the convective heat transfer of water at supercritical pressures in nuclear fuel rod. Sensitivity studies were performed for three turbulence models, K-epsilon, K-omega and Spalart-Allmaras. Results from all the turbulence models will be closely monitored to compare them with the experimental data. Different mesh configuration will be decided for each turbulence model. K-omega turbulence model will require prism layers closer to the wall in order to fully resolve the fluid flow. Experiments used for the assessment of the current simulations are presented in next section.

A series of experiments were performed at Shanghai Jiao Tong University [1]. It consists of the main test loop, cooling water loop and I&C system Fig 1. shows water temperature in the two channels with different fluid inlet