Book Review: 'The Quest for Nuclear Power in Ghana'
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This book is the forerunner of an emerging discussion of the future deployment of Small Modular Reactors (SMRs) in Ghana, the rest of Africa and, indeed, in other developed and developing countries around the globe. This is because Nuclear Power Plants (NPPs) are now being reassessed as necessary part of the solution for the decarbonisation effort, such that we could safely produce the needed power for industrial and domestic use, while at the same time helping to fight the catastrophic effects of Climate Change.

An attempt has been made to write the book in a non-technical manner while still appealing to the more technical reader; to meet this objective, a section on definitions has been included. If a reader comes across something that has not been explained in the body of the section, chapter, or in a footnote, he or she may more than likely find further explanation about the word in the definition section. The authors hope that this method helps to achieve the purpose of appealing to both audiences.

The Quest for Nuclear Power in Ghana is embedded in the grand vision of Osagyefo Dr. Kwame Nkrumah for the development of Ghana, and to the larger extent, Africa.

He best crystallized the nuclear energy vision in his remarks at the ceremony inaugurating the Atomic Energy Research Reactor Project on 25 November 1964, as follows: 'In the age of Science & Technology, in this age of Atomic Revolution, neither Ghana nor Africa can afford to lag behind other nations, or to ignore the scientific development of our time. Indeed, we start with certain definitive advantages over many nations, which have preceded us in the scientific revolution. We have not had to prove for ourselves that the atom can be split. We have not had to discover that steam can produce energy or that water power can be used to generate electricity. Indeed, we begin where many ended. We make our start from the great body of scientific and technological attainment, which is the common heritage of mankind. Beginning as loftily as we do, there is no reason for us to be timid in joining the forward march of knowledge'; his full speech has been reproduced in the book.

**The Ghana Atomic Energy Commission (GAEC):**

The authors have detailed a comprehensive history of GAEC, its mission and its impact so far on the peaceful applications of nuclear techniques in Ghana. The initial objective was to use the Kwabenya project to build a research reactor of 2MW capacity – to serve as a training and research centre - for the use of atomic or nuclear energy in health, industry, agriculture and environmental studies. Also, the atomic energy programme was to serve as the training centre for a future nuclear power programme for Ghana.

Since its commissioning in 1964, the GAEC has undergone several topsy-turvy changes in governments, administrations, amid reviews and advances in its activities; a Chinese Miniature Neutron Source Reactor (MNSR) was initiated and completed through an IAEA Technical Cooperation programme; the commissioning of the 30kW reactor, named as Ghana Research Reactor-1 (GHARR-1), was performed on 8th March, 1995.

The following is the current progress of activities at the GAEC:

Establishment in 2006 of the Graduate School of Nuclear and Allied Sciences (SNAS), UG, in collaboration with GAEC and IAEA for preservation, maintenance & enhancement of nuclear knowledge in Ghana and Africa

Establishment of Radiological and Medical Sciences Research Institute (RAMSRI)

Gas chromatograph (GC), Atomic Absorption Spectrometer (AAS), Isotope Hydrology laboratory acquired to upgrade Nuclear and Environmental Research Centre.

Establishment of the Accelerator Research Centre.

Establishment of the Nuclear Security Support Centre

National Data Centre of CTBTO

National Centre for Radioactive Waste Management Centre (for conditioning and storage of radioactive waste)

Establishment of the Ghana Space Sciences Technology Institute (GSSTI)

Establishment of the Nuclear Regulatory Authority (NRA)

Establishment of the Nuclear Power Institute (NPI), to fulfil Dr. Nkrumah's vision of introducing nuclear power for electricity generation in Ghana's socio economic development.

**Nuclear Power Plant (NPPs) – as part of the solution to fight climate change:**

The book has also attempted to explain nuclear reactor engineering in a layman's language, such that the average reader could comprehend how a nuclear reactor works – the structure and functions of the various buildings comprising a reactor, the controls, the fuel assemblies and how the reactor goes critical for power to be produced and harnessed in the form of steam, that is used to turn turbines to produce electricity. The evolution of NPPs is

discussed, according to the different generations in their development. The solution to the climate change events that are bringing disasters to most parts of the earth is hinging on the need to decrease our reliance on carbon-based energy polluting power plants to the new and renewable energy sources, including nuclear power – as these produce no carbon into the atmosphere, and hence do not exacerbate the greenhouse effect.

**The three major nuclear accidents:**

It should be noted that the overall record of safety in the nuclear industry is enviable; but people tend to remember and focus on lapses and accidents. The Three Mile Island, Chernobyl and Fukushima accidents have been discussed comprehensively in the book; the discussion of the nuclear accidents enables us to provide the way forward, especially in developing countries like Ghana and others in Africa, where we would be hard pressed to deal with such accidents, should they occur.

The book further discusses issues of nuclear reactor safety, management and the eventual safe return of the spent nuclear fuel and the waste generated to the supplier country.

**The SMRs – the reactors that will not explode or undergo a core meltdown:**

Most importantly, the authors have described a new reactor concept - the Small Modular Reactors (SMRs). The criteria for the development of SMRs require that they are designed with a high level of inherent safety features. Passive methods are used to implement such safety features; passive safety means that the reactor is able to passively cool itself without operator intervention or the need for external power supply to shut down the reactor and maintain cooling to remove the core's residual heat in the event of a power loss to the plant. SMRs have greater simplicity of design, economy of series production largely in factories, short construction times, and reduced siting costs. SMRs are proliferation resistant, affordable, mobile, may be built independently or as modules in a larger complex, with capacity added incrementally as more financing is secured. Furthermore, they can be designed to be placed below ground level, giving a high resistance to terrorist threats.

**Why not solar?**

Solar energy was extensively discussed; whereas solar is plentiful, causes no pollution, and is becoming increasingly cheaper, the primary disadvantage is that solar energy, like other renewables (wind, water) is considered an intermittent or variable source of power. The sun, for example, does not shine at night, so solar power is usually designed with

backup power such as batteries as part of the overall solar power plant. For grid power level of several hundred megawatts, the cost of such a solar power plant becomes very significant. So we need solar energy as a complement to a nuclear plant – which can supply baseload for 24 hours per day.

**Conclusion:**

The brief discussions and comparisons of the various reactor types and technologies in this book have led us to the conclusion that an SMR with inherently safe features is the best choice for a developing country like Ghana, and by extension for Africa.

The authors are thus recommending these modern nuclear power plants for consideration by Ghana and other African countries. Hence, Osagyefo Dr. Kwame Nkrumah's vision of utilising nuclear power in our energy mix, to consolidate our industrial take-off will finally be realised.