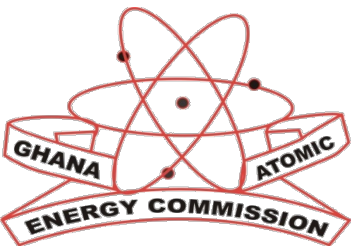
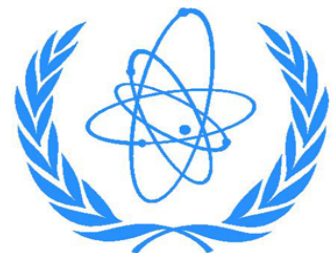


# NUCLEAR POWER FOR ELECTRICITY GENERATION IN GHANA: ISSUES AND CHALLENGES

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# PRESENTATION OUTLINE

- Introduction
- Historical Perspective
- Electricity Supply Options in Ghana
- Comparative Cost of possible Power Generation Sources in Ghana
- Key Issues and Challenges
  - National Position
  - Human Resource Development
  - Other Issues and Challenges
- Conclusion

# INTRODUCTION

- Ghana's Growth and Poverty Reduction Strategy (GPRS) is focus on the transformation of the Ghanaian economy from its current low income status into a middle income with a per capita income of about US\$ 1,000 by 2015.
- This requires cost competitive, environmentally friendly and reliable source of grid electricity.
- Energy consumption in Ghana (2005) was made up of wood fuel (60%), electricity (7%) and petroleum fuel (33%).
- Should the GPRS targets be realised, demand for energy is expected to rise steadily.

- Fuel including coal for thermal power generation in Ghana has climate change implications and Ghana has no coal reserves.
- The single source of natural gas supply through the West African Gas Pipeline (WAGP) is not reliable since the source and the pipeline system have suffered disruptions in the immediate past either through marine accidents or sabotage
- In the midst of these uncertainties, nuclear power could provide at least 10 % of the installed capacity by 2020.
- The electricity supply options available to the country and the nuclear power option are the main issues confronting the nation in the energy sector.

# Historical Perspective

- In 1961, the government of the 1st Republic of Ghana initiated the Kwabinya Nuclear Reactor Project (KNPP)
  - A 2 MW Soviet Reactor was to be acquired and used for research, training and production of radioisotopes
- The objectives of KNPP initiative of 1961 were to:
- A. introduce nuclear science and technology into Ghana

B. develop the infrastructure for nuclear power programme

C. acquire nuclear technology to provide sufficient electricity for industrialization

➤ The Nuclear Reactor Project was cancelled in 1966 after military coup - *John Cockcroft's recommendation*

10/27/2009

## OLD REACTOR BUILDING (1964)



## OLD REACTOR COOLING TOWERS

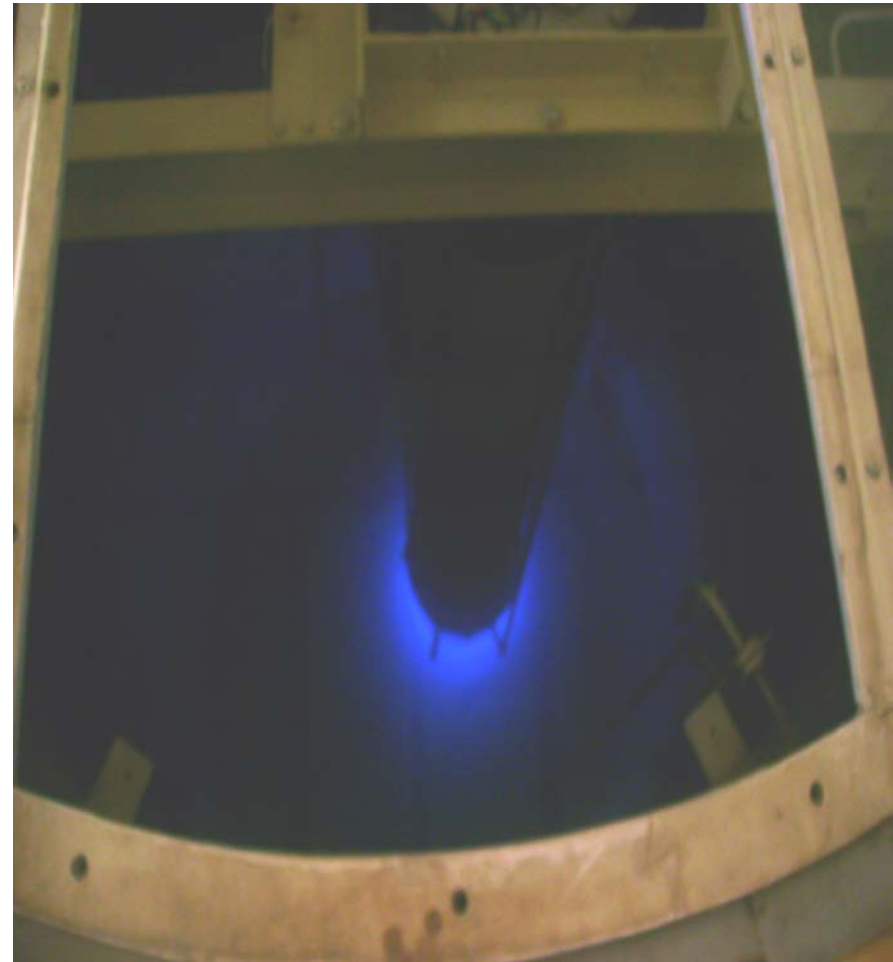
- The factors that prompted NPP initiative of 2007 are:
  - A severe drought in the sub-region between 2003 and 2006 led to about 44% decrease in water inflow into the Volta Lake in 2006
  - This situation led to a 30% shortfall in hydropower electricity generation in 2007 compared to 2004



- The situation was compounded by 50% decrease in electricity imports from Cote d'Ivoire in 2007 compare to 2004
- In order to address the shortfall in hydropower generation, thermal electricity generation increased by 300% in 2007 compared to 2004 and the electricity demand was curtailed by shedding the electricity load
- The price of Light Crude oil, the fuel for electricity generation increased by 88% in 2007 compared to 2004.



## THE 30KW RESEARCH REACTOR



- Government's response to 2006/2007 electricity crisis a National distribution exercise to reduce the peak load was established
- Presidential Committee was set up in May 2007 to:
  - advise government on potential use of nuclear energy
  - develop a Roadmap for implementation of a NPP

- Presidential Committee's recommendations:
- Nuclear can provide cost competitive electricity
  - A Roadmap was developed for 400 MW NPP to be installed by 2018
  - A cabinet decision was taken towards the end of 2008 to proceed with implementation of the recommendations of the Roadmap
  - Implementation of the recommendation of the Roadmap was however stalled due to change of government at the end of 2008

# ELECTRICITY SUPPLY OPTIONS IN GHANA

- Ghana's peak demand is projected to exceed the generating capacity of 3,000 MW in 2015 with corresponding energy demand estimated at 26,600 GWh and 4,400 MW in 2020 and with 33,000 GWh.
- Development of the Bui dam to form cascade with the Akosombo and Kpong dams will increase capacity to 1,600 MW.
- Medium hydropower projects at Pwalugu on White Volta, Juale on Oti River, Hemang on Pra River and those on Ankobra and Tano can only provide a total of 425 MW.

Contributions from renewable energy sources such as solar, wind, biomass will produce 380-500 MW, which cannot exceed 10% of the required total demand.

### ***AKOSOMBO DAM***



### ***ABOADZE THERMAL PLANTS***



# Comparative cost of Possible Power Generation Sources in Ghana

TYPE OF POWER PLANT		CAPACITY (MW)	GENERATION COST (CENTS/KWH)
Bui	Hydro	400	6.9
Juale	Hydro	87	8.1
Pwalugu	Hydro	48	9.3
Awisam	Hydro	50	12.6
Hemang	Hydro	80	11.4
Takoradi Gas Combined Cycle		300	5.0– 5.5
AP 600 – Nuclear		600	4.0 – 6.0

# KEY ISSUES AND CHALLENGES

1. National Position
2. Human resource development
3. Management
4. Nuclear Safety
5. Funding and financing
6. Legislative framework
7. Safeguards
8. Regulatory framework
9. Radiation protection
10. Electrical grid
11. Stakeholder involvement
12. Sites and supporting facilities
13. Environmental protection
14. Emergency planning
15. Security and physical protection
16. Nuclear fuel cycle
17. Radioactive waste
18. Industrial involvement
19. Procurement

# NATIONAL POSITION

- Nuclear Power Planning Committee (NPPC) involving Stakeholder Institutions was established by the President of Ghana in 2008 for the formulation of the Nuclear Power Policy and development of the basic elements of nuclear infrastructure
- The Committee made recommendations to the Government on the following
  - Position of nuclear power in the electricity market and generation mix
  - Economics of nuclear power
  - Legal, regulatory and legislative aspects on nuclear power

- ✓ Environmental and siting aspects of nuclear Power
- ✓ Selection of type of reactor
- ✓ Nuclear fuel cycle including waste management
- ✓ Role of government and private sector in the development of the programme
- ✓ Availability of the industrial base
- ✓ Human resource needs
- ✓ Extent of the uranium resources in the country and impact on the fuel policy and
- ✓ Public acceptance
- Based on the report submitted by NPPC, the Government took a Cabinet decision in 2008 to implement a nuclear power programme in Ghana



# HUMAN RESOURCE DEVELOPMENT

- *The main infrastructure development in place at the moment is human resource capacity building*
- *The Training can be categorized into two main areas:*
  - *Degree awarding*
  - *Non Degree awarding*



# DEGREE PROGRAMMES

- The first batch of 37 masters students were admitted in 2006/7 academic year into 6 programmes at the school of Nuclear and Allied Sciences, University of Ghana
- The school currently has 5 departments offering 10 accredited programmes



➤ Programmes related to the nuclear power programme are:

- ❑ Nuclear Engineering
- ❑ Applied Nuclear Physics
- ❑ Nuclear and Environmental protection
- ❑ Nuclear and Radiochemistry
- ❑ Nuclear Security and Safety
- ❑ Radiation Protection

➤ Some courses in Nuclear Engineering include:

- ✓ Basic Reactor Physics
- ✓ Nuclear Fuel Management
- ✓ Control and Instrumentation
- ✓ Thermal-hydraulics
- ✓ Radiation Shielding
- ✓ Two-phase Flows and Heat Transfer
- ✓ Reactor Materials and radiation damage
- ✓ Types of Reactors *etc.*

# NON DEGREE PROGRAMMES

- Training in Research Reactor Operation, Maintenance, Reactor Physics & Engineering
- IAEA Technical Cooperation Projects (TC)
  1. Planning for sustainable Energy Development GHA0008
  2. Human Resource Development and Nuclear Technology Support GHA0009
  3. Evaluating the Role of Nuclear Power in Future Options for Electricity Generation GHA0010

- Participation in IAEA Workshops on Nuclear Power, Regulatory Framework, Safety and Security etc.
- Common User Considerations
- Workshops for NPP Newcomers
- Training Courses and Workshops on Simulators
- Research Contracts on Core Conversion and Benchmarking for safety etc

# OTHER ISSUES AND CHALLENGES

- **Nuclear Safety** – Ghana has experience in operating a research reactor for almost 15 years with good safety record
- **Funding and financing** – Financing of 1<sup>st</sup> NPP could be by Governments, private or through bilateral negotiation
- **Legislative framework** – Conventions and treaties are being processed for parliamentary approval
- **Safeguards** – Ghana is signatory to NPT and Additional Protocol
- **Regulatory framework** – Ghana's regulatory body is currently part of the promoting body. A bill has been formulated for parliamentary approval to establish an independent regulatory body

- **Radiation protection** – Ghana has well established Radiation Protection Infrastructure that can be upgraded to deal with all emerging radiations
- **Electrical grid** – Ghana's grid size limits power level to about 1,000 MW
- **Stakeholder involvement** – All Stakeholders in the energy sector are currently involve in the NPP planning
- **Sites and supporting facilities** – The coastal belt of Ghana being Gulf of Guinea and many river bodies makes Water Cooled NPPs an ideal plant for electricity generation in Ghana

# CONCLUSION

- Ghana will require a secure electric power supply to meet expected future demand which is an essential requirement for economic development as envisaged under the government's growth and poverty reduction strategy.
- The existing installed capacity of almost 2000 MW inclusive of the emergency power plants will have to more than double in order to meet the peak power demand in 2020
- But the existing fuel mix for grid power generation in Ghana will not be able to securely meet the future supply requirements for transforming the Ghanaian economy into a middle income status.



- The only alternative to avert supply disruptions is to explore other energy sources such as nuclear energy for electricity generation.
- Nuclear energy is a mature technology which is expected to play an expanded role in meeting the growing demand for electricity in a safe and secure manner without contributing to global warming.
- Water cooled reactors will be ideal for Ghana due to its vast water resources
- Ghana has to accelerate its infrastructure development if the 2018 target set for the inclusion of nuclear power in its energy mix is to be met.

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- *I hope you enjoyed the Presentation*

- ***THANK YOU***