

MAJOR FACTORS AFFECTING ELECTRICITY GENERATION, TRANSMISSION AND DISTRIBUTION IN NIGERIA

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ABSTRACT

Electricity generation, transmission and distribution are three stages of delivering electricity to consumers. The delivery of electricity to consumers in Nigeria has multidimensional problems. This paper focused on capacity of electricity generation in Nigeria and the major factors affecting electricity generation, transmission and distribution in the country. The factors are none diversification of sources of energy used in electricity generation, poor maintenance culture, electrical power transmission line losses due to long distance between generating stations and load centers etc. Restructuring the Nigerian radial interconnected electricity generation station grid system which has National Control Centre at Oshogbo and replace it with a regional interconnected grid system in order to reduce transmission line losses and improve reliability of the Nigerian grid system among others was recommended.

Keywords: *Power installed capacity, Transmission, Distribution, Megawatt (Mw), National Independent Power Projects (NIPP)*

INTRODUCTION

Electrical power generation, transmission and distribution are the three stages of delivering electricity to consumers at residential, industry, commercial, and administrative areas. The supply of adequate and stable electricity to consumers is the back born of socioeconomic development of any nation. While inadequate and unstable supply of electricity to consumers in any nation would definitely lead that nation backward in terms its socio-economic growth. Like any other economic sector in Nigeria, the power sector has its peculiar problems. In fact the sector has multidimensional problems. This paper aims at discussing the major factors affecting electricity generation, transmission and distribution in Nigeria. For convenience the factors are group into two, namely factors affecting electricity generation and factors affecting electricity transmission and distribution. Some of these factors are insecurity, overloading of distribution transformers, non-diversification of sources of energy (fuels) used to drive the electricity generating stations, bribery, corruption and mismanagement of public funds in the execution and running of electricity power projects. The objective of this paper is to sensitize the Government, the governed and the organized private sector in order to solve the major problems affecting electricity delivery to Nigerian consumers.

ELECTRICITY GENERATION IN NIGERIA

The first electricity generating plant in Nigeria was installed in Lagos in 1896. The Plants were installed at isolated units owned and operated by either Native Authorities as in Ibadan and Kano, or by the public works departments as in Warri and Port-Harcourt. The isolated units were merged together when Nigerian Colonial Government passed the ordinance No.15 of 1950 which set up the Electricity Corporation of Nigeria (Uwaifo, 1994). The Corporation and the Niger dams Authority set up by an Act of Parliament in 1962 to exploit the water resources of the River Niger were unified into the National Electric Power Authority in 1973 through the Federal Military Government Decree No. 24 of June 27, 1972 (Uwaifo, 1994). The first electricity generating plant to be commissioned in Nigeria was Ijora 'B' Power station (Lagos) in 1956 by the head of British Common Wealth and the Queen Elizabeth.

A grid power transmission system that evolved connecting large power stations in Kainji, Jebba, Shiroro, Afam, Delta (Ughelli), Sapele (Ogorode) and Egbin (Lagos) came into being in the first half of the 1960s. That grid system served every state capital in Nigeria. By 1992, the total installed generation plant capacity was about 5,900 Mw. The total electricity available was 3,000 Mw and the coincident maximum demand had reached 2,400Mw (Uwaifo, 1994). In 2009, the electricity generating station installed capacity in Nigeria was 5000Mw, but only 2900Mw was generated as at November, 2009 (Babalola, 2009). Electricity can be generated at Hydro, Thermal, Wind, and Solar generating stations. Electricity is generated at thermal generating stations where fossil fuels such as crude oil, natural gas, coal are burnt to produce high pressure (typically 2400 to 3500/1b/in²) and high temperature (1000°F) steam, which is used to drive turbines at 3600 rev/min which in turn drive electrical generators to produce electricity (Donald, Beaty, Miley and Clapp, 2000). The concentrated solar power generating stations use mirrors or lenses to concentrate sunlight into a relatively small area and then use the resulting heat to raise steam to drive steam turbines and generators to produce Alternative Current (AC) power.

There are two methods of generating electricity namely; conventional method and non conventional method. The conventional method makes use of prime movers such as petrol engine, diesel engine, steam turbine, while non conventional method do not use prime movers. This includes Magneto Hydro Dynamic (MHD) generators, solar cells, fuel cells, wind, thermoelectric generators etc. Most of electricity generators are three phase-ac generators known as synchronous generators or alternators. They use rotating rectifiers called brushless excitation systems to maintain the generator voltage and control the reactive power flow at 30KV, 50Mw to 1500 Mw capacities (Hadi, 2004).

The availability of natural fuels such as coal, crude oil, natural gas of 180 trillion cubic feet (Amotsuka, 2008) and Rivers in Nigeria lead it to utilize hydro plants and steam gas turbines for electricity generation at Afam, Delta, Egbin, Sapele,

Kainji, Shiroro, Jebba and the proposed Monbila electricity generating stations. Another source of fuel for generating electricity at very small scale in Nigeria is Uranium use at National Nuclear Research Centre Zaria.

CAPACITY OF ELECTRICITY GENERATION STATIONS IN NIGERIA

Nigeria uses three types of electricity generation stations namely Hydro-generating stations, Steam turbine generating stations and gas turbine generating stations. Table 1 shown below gives the locations and the ratings of electricity generating stations use in Nigeria.

Table 1: Electricity generating stations, ratings and their locations in Nigeria

Station	Type	No. of Units	Installed Capacity	
			KVout	MWout
Kainji	Hydro	8	16.0	760
Afam I-III	Gas Turbine	12	10.5	260
Afam IV	Gas Turbine	6	11.5	450
Afam V	Gas Turbine	5	11.5	760
Egbin	Steam Turbine	6	16.0	1320
Egbin	Gas Turbine	9	11.5	270
Jebba	Hydro	6	16.0	570
Sapele	Steam Turbine	6	16.0	720
Sapele	Gas Turbine	4	10.5	300
Shiroro	Hydro	4	16.0	400
Delta II	Gas Turbine	6	11.5	120
Delta III	Gas Turbine	6	11.5	120
Delta IV	Gas Turbine	6	11.5	600

Source: (Nigeria Society of Engineers Technical Transactions, 2007, Vol. 42, No. 1, p27).

In Nigeria the electricity generating stations are interconnected in radial form with a single National Control Centre (NCC) in Oshogbo. This has lead to low reliability index of the Nigerian National grid (Yusuf, Boyi and Muazu, 2007). The Nigerian government has awarded contract for generation, transmission and distribution of 6000Mw with completion date on December 2010. This seem impossible, if you look at electric power score card of the government that is the installed capacity of electricity generating stations in Nigeria is 5000Mw, but only 2,900 Mw is generated as at November, 2009 due to major factors affecting electricity generation, transmission and distribution in Nigeria to be mention in this paper.

MAJOR FACTORS AFFECTING ELECTRICITY GENERATION, TRANSMISSION AND DISTRIBUTION IN NIGERIA

There are many factors that affect electricity generation in Nigeria, the major ones include but not limited to:

- (i) The Niger Delta crisis which leads to the vandalization of oil and gas pipe lines, oil gas exploration and exploitation facilities.
- (ii) The kidnapping of foreign and indigeneous professionals that manned oil and gas facilities in Nigeria resulting into abandoning of oil and gas exploration.
- (iii) The inability of Nigeria government in collaboration with oil multinational

companies to utilize fully the gas, due to gas flaring. The gas is a good source of energy for the generation of electricity

- (iv) Low level of annual rainfall in Nigeria due to global warming which leads to global climate change that affects water level at hydro generation stations. Reliance on Hydro can be constrained by the volume of water available during the period of draught and during the months of March to June when water level goes down (Sada, 2007).
- (v) Lack of water management in Nigeria is affecting water level at the hydro generation stations.
- (vi) Bribery, Corruption and Mismanagement in the power sector.
- (vii) The absence of research and development in Nigeria which focuses on investigating the different types of electricity generating potentials in Nigeria and how to utilize them. The research and development in the area of electricity generation, transmission and distribution can help in collecting data and offer services to government and private investors in the power sector.
- (viii) Non diversification of existing electricity generating potentials in Nigeria. Nigeria only utilizes oil, gas and dams for electricity generation. There are other alternative potentials existing such as renewable sources of energy (solar, wind, biomass) and nuclear which can supplement the existing hydro, oil and gas generating potentials. According to the Katsina State Government, it has started investing in the electricity generation using wind and Bio-mass sources.
- (ix) There is poor planned maintenance culture, in which fixed-time maintenance is not carried out regularly. Good maintenance culture lead to availability of electricity utilities in which electricity power is made available to consumers almost all the time (Oroge, 1991).
The sector cannot be maintained if they do not have enough funds to buy the needed spare parts and pay for their running cost. Good maintenance culture is very essential in keeping any physical systems, such as electricity generation, transmission and distribution networks in operational readiness. Maintenance of electricity utilities is a combination of any action carried out to retain the utilities in or restore them to normal operational standard. Basically, maintenance can be classified into two categories, namely; planned maintenance and unplanned maintenance. In Nigeria electricity power sector, unplanned maintenance are normally carried out after systems failure and is normally carried out without any forethought, control and records.
- (x) The electricity consumers in Nigeria are highly indebted to the Power Holding Company of Nigeria (PHCN) due to poor electricity delivery, none settlement of electricity bills, corruption by bill collectors. Illegal connections and high maintenance cost of equipment due to vandalization by thieves, wind also lead to low revenue generation by Power Holdings Company of Nigeria.
- (xi) Failing down of electricity transmission and distribution lines by winds as well as vandalization of these lines by thieves, construction works, fluid, soil erosion.

- (xii) The transmission line losses due to long distances between generating stations and load centers. The electrical power losses of the 330KV transmission lines, in Nigeria with and without compensation is given on table 2 (Yusuf, Boyi and Muazu, 2007).

Power transmission is the process in which large block of electricity is carried from the generating stations to distribution stations using 330KV EHV transmission lines; 132KV transmission lines and 33KV sub transmission lines either at 50KHz or 60KHz transmission frequency. After transmission process the distribution process follows immediately. At distribution stations, the line voltage is step down from 11KV to 0.415KV using three phase secondary distribution transformer or 0.22KV using single phase primary distribution transformer. In Nigeria the transmission and distribution of electricity are affected as per factors (vi), (ix), (x) as outlined above. Uwaifo (1994) reveals that in Nigeria the power distribution efficiency has plummeted to 74 percent while since 1969 the USA power distribution efficiency was 95 percent. (vi) The overloading of distribution transformers in Nigeria is seriously affecting the distribution of electricity to consumers. Also Uwaifo (1994) states that "since 1991, in Nigeria the average number of consumers for each distribution transformer had increased to 220 compare to 10 in the USA".

Table 2: Statistics for the Analysis of 330KV transmission line losses.

	Parameters	330KV Network with Compensation	330KV Network without Compensation
Input	Pin (Mw)	3040.80	3045.80
	Qin, (MVar)	181.40	465.02
Output	Ploss (Mw)	40.80	45.80
	Qloss (MVar)	1498.60	1394.20

Source: (NSE Technical Transactions, 2007).

CONCLUSION AND RECOMMENDATIONS

The supply of adequate and stable electricity to consumers is the back born of socio-economic growth of any nation and Nigeria is not an exception. The Power Sector in Nigeria has multidimensional problems such as bribery, corruption and mismanagement of funds for execution of electricity power projects. The overloading of transmission and distribution transformers, vandalization of power lines by thieves, winds, construction projects, soil erosion etc. are not unconnected with power problems faced in Nigeria. These factors are seriously affecting the performance indices of electricity utilities in the country. The performance indices are efficiency, number of consumers connected to distribution line per transformer, high maintenance cost, and transmission line losses (Copper losses). To improve the delivery of electricity to consumers in Nigeria the civil liberty organizations, the Non-governmental organizations and ordinary citizens have to cooperate and work together for good maintenance culture, good governance since the government is not delivering well the dividends of democracy. To maintain adequate power supply to the consumers in any part of the globe is a very challenging task, which require dedication, political will, political stability and above all faithfulness to God. For Nigerians to have adequate electricity supply this study recommends the followings:

- (i) The restructuring of the Nigerian radial interconnected electricity generation station grid system which has National Control Centre at Oshogbo and replace it with a regional interconnected grid system in order to reduce transmission line losses and improve reliability of the Nigerian grid system.
- (ii) The Government should diversify the sources of fuel for electricity generating stations. Nigeria has abundance coal reserve, Uranium, bio-mass, wind potentials, which can be used for generating electricity instead of relying only on gas, oil and hydro potentials.
- (iii) The loading of transmission and distribution transformers should be reduced. This is in order to trim down the number of consumers per transformer to a ratio of about 10 consumers per distribution transformer.
- (iv) Illegal connections should be discouraged by the electricity power stakeholders.
- (v) The electricity consumers in Nigeria should show patriotism through prompt settlement of electricity bills.
- (vi) The successful governments in Nigerian should have to be more committed to the execution of good developmental projects left behind by pass administrations.
- (vii) A consumer friendly billing system should be developed by the appropriate government agencies.
- (viii) The bureaucracies surrounding the procurement of electricity meters should be jettisoned to encourage consumers to pay and have their meters within a reasonable period of time.

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