

# The Need to Expand and Modernise the Electricity Transmission Infrastructure in Nigeria

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**Abstract:** The Nigerian power system is suffering from inadequate generation and transmission capacity. The demand is much higher than the generation and this has led to constant load shedding and erratic power supply. Currently, the Federal government privatised Power Holding Company of Nigeria (PHCN) in other to solve the epileptic electricity power supply. More emphasis has been on power generation with near total neglect for the building of Transmission infrastructure prior to the on-going reform in the power sector, which will be able to evacuate the generated power. Ahead of the intending increase in power generation from the 10 National Integrated Power Project (NIPP) plants about to be energized, this paper takes a look at electricity transmission situation and the need to expand and modernise the transmission infrastructure, if Nigeria must achieve her vision 2020 electricity aspiration.

**Keywords:** Electricity , Transmission , Infrastructure , Vision 2020, Nigeria.

## I. INTRODUCTION

Electricity is very important to the social and economic development of any country. All aspects of the life of the citizenry is affected by power supply, ranging from keeping a clean home to running multinational companies. Without adequate power supply, businesses, homes and the society at large cannot function to their full capacity. Goods and services would cost more than they should if every business owner has to own a private generating unit; running a home will be rigorous if there is no means of storing food due to non functional refrigerating systems; health care provision would be substandard; unemployment would increase due to fewer companies and these may lead to high crime rates; life will be boring if access to entertainment is limited due to inadequate power supply. The electric power system of a country should be built to meet the electricity demand of the citizens. Every household and business office should have access to adequate power supply.

The problem of inadequate power supply can be tackled by generation upgrade and/or expansion. This means that more generating units can be added to existing power plants or new power plants can be built at new locations in a nation's power grid. Additional generation always result in increased power flow on transmission lines in the grid. If the existing

transmission network is not capable of transferring this added generation, then an upgrade or expansion of the transmission system is also needed [1]. The electrical utility is probably the largest and most complex industry in the world. The electrical engineer, who researches in this industry, will encounter challenging problems in designing future power systems to deliver increasing amounts of electrical energy in a safe, clean and economical manner [2]. The transmission network in Nigeria is characterised by several outages leading to disruption in the lives of the citizenry. Transmission expansion on the other hand involves the expansion of the power grid which usually entails building new transmission lines [3]. Substantial expansion in quantity, quality and access to infrastructure services, especially electricity, is fundamental to rapid and sustained economic growth, and poverty reduction [4]. The current instability in power supply in Nigeria has been linked to the inability of the transmission network to carry new lines, thereby aggravating the epileptic supply situation,

## II. ELECTRICITY TRANSMISSION SITUATION IN NIGERIA

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 [5]. Transmission Company of Nigeria (TCN) was incorporated in November 2005. TCN emerged from the defunct National Electric Power Authority (NEPA) as a product of the merger of the Transmission and Operations sectors on April 1, 2004. Being one of the 18 unbundled Business Units under the Power Holding Company of Nigeria (PHCN), the company was issued a transmission License on 1st July, 2006. TCN licensed activities include: electricity transmission, system operation and electricity trading which is ring fenced [6].

The existing transmission network which currently consists of mostly 330 KV power lines and a few 132 KV lines (Table 1) are weak with high energy losses [7]. Electric power transmission and distribution losses (% of output) in Nigeria were 17.22 as of 2010. Its highest value over the past 39 years was 49.27 in 1981, while its lowest value was 5.87 in 2009, (Figure 1).

TABLE 1

Nigeria Electric Power Transmission Capacity [11].

TRANSMISSION
<b>Length of Transmission Lines:</b>
● 330kv - 4,889.2km
● 132kv - 6,319.3km
<b>Substations:</b>
● 21 No. 330/132kv - 6.248MVA
● 108 No. 32/33/11kv - 8,305MVA



Fig. 1 Electric power transmission and distribution losses (% of output) in Nigeria [12].

Nigeria has one of the highest transmission losses in the world, this mainly because the average age of the transmission equipment is 30 years, the consequence of long neglect [8]. The network is also mostly radial. The existing transmission system is not sufficient to transfer the additional power injected to the grid by the new power plants [3]. The transmission system in Nigeria does not cover every part of the country. Currently it has the capacity to transmit a maximum of about 4,000 MW and it is technically weak, therefore very sensitive to major disturbances [9]. The Transmission Company of Nigeria (TCN), projected to have the capacity to deliver about 12,500 MW in 2013, has the capacity of delivering 4800 MW of electricity. Nigeria has a generating capacity of 5,228 MW but with peak production of 4500 MW against a peak demand forecast of 10,200MW. This shows that if the generation sector is to run at full production, the transmission grid will not have the capacity to handle the produced power reliably [10].

Therefore, there is urgent need to expand and modernise the electricity transmission infrastructure, in order to enjoy expected gains from the privatization of the power sector.

## NIGERIA VISION 2020 POWER GENERATION ASPIRATION

The broad vision for the energy sector is targeted at meeting the demand for energy in all sectors of the Nigerian economy, including the energy needs of households in all parts of the country with safe, clean and convenient energy at an affordable cost. This must be done in a technically efficient, economically viable and environmentally sustainable manner using different energy sources, conventional and non-conventional, as well as new and emerging energy sources to ensure supply at all times with minimal disruption.

An analysis of the power generation capacity required to support the vision 2020 economic vision, carried out by the Energy National Technical Working Group (NTWG), shows that by 2020 Nigeria will need to generate electricity in the range of between 25,000MW to 40,000MW. This is based on the assumption that the country will take a less energy intensive growth path (energy intensity of less than 0.4) with lower electricity consumption, KWh per unit of GDP, unlike china which has an energy intensity of 0.9 [13].

Ideally, transmission capacity should outpace generation capacity. If the problem of wheeling infrastructure were not fixed, ahead of the intending increase in power generation from the 10 National Integrated Power Project (NIPP) plants about to be energized, it can derail the high expectations of the Government, consumers and other stakeholders in the private sector-driven power sector.

### III. ISSUES AND CHALLENGES OF ELECTRICITY TRANSMISSION IN NIGERIA

The Nigerian power sector is faced with transmission problems, no doubt. Residents are grappling with the inadequate transmission capacity which is hurting the power sector deeply and is making many electricity-dependent activities in the country stagnant. Achieving stable power supply is still a far-fetched dream in the country as the necessary management and infrastructure to handle power supply and its transmission is unavailable.

The transmission system in Nigeria does not cover every part of the country. Currently it has the capacity to transmit a maximum of about 4,000 MW and it is technically weak, therefore very sensitive to major disturbances. The major problems identified are: It is funded solely by the Federal government whose resource allocation cannot adequately meet all the requirements, it is yet to cover many parts of the country, It's current maximum electricity wheeling capacity is 4,000 MW which is awfully below the required national needs, some sections of the grid are outdated with inadequate redundancies as opposed to the required mesh arrangement, the Federal government lack the required fund to regular, update, modernize, maintain and expand the network, there is regular vandalisation of the lines, associated with low level of

surveillance and security on all electrical infrastructure, the technologies used generally deliver very poor voltage stability and profiles, there is a high prevalence of inadequate working tools and vehicles for operating and maintaining the network, there is a serious lack of required modern technologies for communication and monitoring, the transformers deployed are overloaded in most service areas and inadequate of spare-parts for urgent maintenance [9].

#### IV. WAY FORWARD

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 is normally carried out after systems failure and is normally carried out without any forethought, control and records [14].

Massive investment would be required to achieve rapid expansion and modernisation of the transmission infrastructure, which is largely in a decrepit state. The public private partnership (PPP) model is now seen as necessary since failure to drive significant increase in transmission capacity, which is a very critical link along the electricity value chain, is capable of jeopardising the ongoing reforms in the sector.

Provide redundancies in the transmission system so as to ensure a fully integrated network that minimizes transmission losses while strengthening grid security [13]. Aggressively, pursue reform of the sector to ensure development of infrastructure. Improve TCN's revenue base to ensure a self sufficient and self improve TCN's revenue base to ensure a self sufficient and self sustaining company [6].

#### V. CONCLUSION

Transmission network is the 'life-blood' of this entire electricity 'eco-system' and it is also potentially the 'weakest link' in Nigeria at present, compared to the upstream

generation segment and downstream distribution. Nigeria need to have a bold and robust midstream; that will be able to evacuate the generated power, because over time, there has been so much misalignment between the upstream and the midstream, between the midstream and the downstream. Improvement in generation and distribution capacities without a strong transmission network to evacuate generated power would not translate to tangible upturn in power supply to consumers. With government's objective to achieve 40,000MW by 2020, the urgent need to expand and modernise our transmission capability to evacuate the projected additions becomes imminent.

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