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Nigerian Transmission System Constraints and Solutions

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Abstract – Power transmission system stands in between generation and distribution systems and remains one of the key stages in the supply of electricity. In a deregulated electricity market, such as that of Nigeria, power transmission system plays a pivotal role in the effective delivery of electricity to consumers. As a result, there is always the need for healthy transmission systems. In this study, we take a background look at the problems facing the Nigerian transmission system and its causes, with an aim to identifying the possible solutions.

Keywords: Transmission System, FACTS Controllers, Supergrids, Intelligent Monitoring, Government Policies

1.0 Introduction

The supply of electricity involves three stages: generation, transmission and distribution. This determines the organization of electric utility companies in a deregulated economy such as Nigeria. The transmission system act as the ‘‘middleman’’ between generation and distribution with a major objective of providing comparable and non-discriminatory services to independent generators and loads thereby providing a competitive environment for generation and retail services in a deregulated electricity market 9Wang, Song and Irvin, 2008). Since the conception of commercialization of electrical energy, the electrical utilities have been under the regulation of the government of a country, region or state as the case may be. This type of arrangement is termed Vertically Integrated Utility (VIU) (Anjaneyulu, NarasinhaRao and Prakash,2013; Kiran and Laxmi, 2014).

Motivated by the success of deregulation in industries such as telecommunications, airlines and transportations, electricity deregulation was introduced in many parts of the world (Nanduri and Das, 2009). In the deregulation regime, the former VIU, which was responsible for generation, transmission and distribution of electricity is dis-aggregated into separate companies devoted to different functions of generation, transmission and distribution (Jaisingpore, Chandrakar, and Mohril, 2014; Verma, 2014). Chile was the first country to introduce deregulation in 1978, but the world-wide trend towards deregulation can be dated from the start of the 1990s (Kattuman, Green, Bialek, 2011). The call for power sector reform in Nigeria was primarily as a result of inadequate electricity supply, incessant power outages, low generating plant availability and high technical and non-technical losses that have characterized the Nigerian electricity industry (Okoro, and Chikuni, 2007).

2.0 Overview of Nigerian Power System Author Artwork

Since the advent of democratic regime in Nigeria, there have been significant strides in the reform of the electricity sector. The federal government, in 2000, adopted a holistic approach of restructuring the power sector and privatizing of business units unbundled from National Electric Power Authority. Further restructuring steps led to the enactment of the Electric Power Sector Reform Act in 2005 to drive the reform process. National Electricity Regulatory Commission (NERC) was established in 2005 and Power Holding Company of Nigeria (PHCN) was unbundled into eighteen (18) successor companies comprising

Transmission Company of Nigeria (TCN), six (6) generating companies (GenCos) and eleven (11) distribution companies (DisCos) as shown in Table 1 (Irukera and Isiekwena, 2009; Nnaji, 2011; KPMG, 2013).

Table 1: PHCN Successor Companies (Olugenga, Jumah and Philips, 2013).

Generating Companies	Transmission Companies	Distribution Companies
Afam Power plc (I-IV)	Transmission Company of Nigeria (TCN)	Abuja Disco
Egbin Power plc		Bennin Disco
Kainji/Jebba Hydro Electric plc		Eko Disco
Sapele Power plc		Enugu Disco
Shiroro Hydro Electric plc		Ibadan Disco
Ughelli Power plc		Ikeja Disco
		Jos Disco
		Kaduna Disco
		Kano Disco
		Port Harcourt Disco
		Yola Disco

Transmission facilities in Nigeria include 330kV and 132kV transmission lines connected together (Enyong, Ogbekhiuhi and Okhaifor, 2010). The Nigerian transmission system is an interconnection of 9,454.8km length of 330kV transmission lines which are long, fragile and longitudinal in nature and are prone to frequent system collapse (Adepoju, Sanusi and Tijani, 2017). The energy demand projection for Nigeria by the year 2030 is estimated at 297,900MW using a 13% Gross Domestic Product and the energy supply is estimated at 276,229MW (Sambo, Sarma and Gaji, 2009). This is a very optimistic value but the big question is if the transmission system will be able to evacuate the supply because of its attendant problems. It is therefore pertinent to suggest possible solutions to the problems of the Nigerian transmission system.

3.0 Constraints of Nigerian Transmission System

The constraints or problems bedevilling the transmission system in Nigeria are multi-faceted. Numerous research and position papers have been published to narrate how pathetic the condition of the system is. Bada (2012) identified parts of the problem to include transmission capabilities inefficiency, poor reliability and voltage profiles, and high technical losses. Another problem is the length of the transmission lines which are rather too long and which causes high transmission losses along the lines

(Ibe and Okedu, 2009). The transmission system is also characterized by several outages leading to disruptions in the lives of Nigeria citizenry (Onohaebi, 2007).

Folorunsho and Olowu (2014) listed faulty planning, sharp increase in demand, delay in completion of power projects, vandals and terrorism as part of power system transmission crises in Nigeria. Faults were also identified as banes on many transmission lines in Nigeria Istrael and Enesi 2013). Aged equipment, lack of quick responses by fault clearing crew, overloading of equipment have also been claimed to contribute to the problems of the transmission system in Nigeria (Gyugyi, 1988).
In summary, the major problems facing Nigerian transmission system are highlighted as follows:

(i) Transmission equipment have become aged
(ii) High transmission losses in the system due to long transmission lines
(iii) Inadequate planning of the system
(iv) Untimely responses by the crews concerned with fault clearing on the system
(v) Overloading of the transmission system equipment
(vi) Inadequate working tools and unskilled labours
(vii) Unavailability of modern communication equipment
(viii) Transmission system equipment vandalization
(ix) Incessant faults on the system
(x) Ineffective power policies
(xi) Inadequate funding

4.0 Solutions to Transmission System Constraints

Many solutions have been proffered to the inherent problems of the transmission system of Nigeria. In this work, the suggested are broadly categorized into five classes and are discussed.

i. FACTS Controllers

In recent years, energy, environment, right-of-way and cost problems have delayed the construction of new transmission facilities which has necessitated a change in the traditional power system concepts and practices; better utilization of the existing transmission system has become imperative (Adepoju and Tijani, 2014). Introduction of Flexible Alternating Current Transmission System devices have been a practical solution and have offered the required better utilization of the existing transmission system (Adepoju, Komolafe and Aborishade, 2011). FACTS controllers have been found to be useful in the enhancement of power system analyses and operations.

Compensation devices such as Reactive and Static Var Compensators (SVC) are been used for voltage control on Nigerian transmission system (Bada, 2012). The problem with this is that SVC is considered as a first generation FACTS controller and its operations are limited. It is almost out-dated. Many research works which include(Adepoju, Sanusi and Tijani, 2017; Adepoju and Tijani, 2013; Adepoju, Komolafe and Aborishade, 2011) have been carried out and the results showed that the performance of the existing Nigerian transmission system can be greatly enhanced. Introduction of FACTS devices will solve the problems of high technical losses and overloading of the existing transmission system.

ii. Super Grid

Super grid is a transmission system with a much higher voltage. The super grid in America transmits at 750kV. Due to long distance that has to be traversed from generation to distribution,

there is inevitable high transmission losses on the system because of the materials the transmission lines are made; therefore, at the receiving ends, low voltages are received. In super grids, the amount of power that gets to the receiving end is higher and the loss, thought may be higher, has a negligible resultant effect. In the USA, the highest voltage was raised to 132kV in 1916, 220kV in 1922, 278kV in 1953, 500kV in 1969. An experimental 1100kV line was built and its commercial version was then about to start (Gupta, 2006). It is easily understood that super grids offer a better advantage over what Nigeria presently has. Construction of a super grid will solve the problems of transmission losses in the transmission system.

iii. Intelligent Monitoring

The operations of an intelligent transmission system will consist of system monitoring, fault detection and fault reporting. The deployment of full automation equipment helps in detecting faults faster and reports the faults immediately. Today's electrical system tends towards a self-healing system that detects and rectifies faults with little or no human interference. Implementation of intelligent monitoring systems on the Nigerian transmission system will combat the problems of untimely responses by the crews involved and the incessant faults on the system.

iv. Favourable Government Policies

Most of the problems associated with the transmission system in Nigeria are caused by the government policies. There is a great lack of commitment from the side of the government. In the deregulated Nigerian power system, the Transmission Company of Nigeria (TCN) is still being owned and controlled by the government. Lack of will from government has prevented the construction of new transmission stations and even maintenance of the existing system. Favourable government policies will solve the problems of aged transmission equipment, inadequate planning, lack of working tools and ineffective power policies.

v. Adequate Skilled Manpower

For every sector to be successful there should be the provision of adequate manpower who will be able to use the equipment maximally; they should have enough knowledge on the operation of transmission system equipment. These people are trained to become specialists. Many position papers have shown that adequately trained and experienced manpower are lacking in the operation of the Nigerian transmission system. It is required that there should be provision of adequate skilled manpower in the Nigerian transmission system.

5.0 Conclusion

In this work, a background study of the problems facing the Nigerian transmission system is made. Attempts were also made to identify the causes of the problems. A suggestion of five different solutions to the problems have been identified to include; the use of FACTS controllers, deployment of super grid, installation of intelligent monitoring systems, favourable government policies and employment of adequately trained and experienced manpower.

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