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POOR POWER QUALITY AND OUTAGE IN NIGERIAN POWER SYSTEM INDUSTRY

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Abstract: *The Nigerian power system is bedeviled with series of constant power failures and outage, most of which are either technical or non-technical in nature. These problems can range from tripping of lines on account of faulty equipment to constant increase in load more than the available power supply. Others are natural or weather related problems like wind, flood, earthquakes and the likes. Presented is the data showing the incidence of outages in Nigeria for 2003, 2004 and 2005[3] and data showing total and partial collapses from 2009 – 2012. These data were analysed to show the incessant occurrence of outages in the system, followed by some recommendations.*

Keywords*: Poor power quality, Power outage, Transmission line, System stability, Voltage collapse.*

1.0 INTRODUCTION

The Nigerian electric power system comprises electric generating plants or stations, transmission lines – high voltage or bulk power substations, sub-transmission and distribution systems. The transmission and distribution lines are categorized by their voltage ratings. Transmission voltage is defined as 330KV while sub-transmission voltage is 132KV. The distribution system operates at 33KV, 11KV and 415V. The Generation Transmission and Distribution Company of Nigeria generates electricity through a mix of both thermal and hydropower stations at a frequency of 50Hz and usually in the 11KV to 16KV range and stepped up for transmission[6].The transmission system designates the highest voltage of about 330KV and carries bulk electric energy from power plants to the distribution system.

The transmission system uses overhead, alternating current, lines, although some underground lines exist as well.

Power transformers are used in the generating stations to raise the voltage of the produced power to the transmission voltage, and in the distribution substations to reduce the voltage of the power delivered to the distribution system voltages. The bulk power stations of 330KV, supply power to the sub-transmission systems from where electricity is carried to the residential and commercial customers and to some smaller industrial customers. Switching stations and substations are used to transform the electrical energy to different voltage levels from one line to another, and also redirect the flow of power whenever a fault occurs on a transmission line or other equipment in the system and hence, preserve the system operation from collapse.

2.0 POWER OUTAGES IN THE NIGERIA TRANSMISSION NETWORK

There are many reasons for a power system collapse and hence, outage in Nigeria power system. The Nigerian power stations are mainly hydro and thermal plants. In 2006 alone, the defunct Power Holding Company of Nigeria (PHCN) generated about 6200MW, out of which 1920MW is hydro and 4280MW thermal – gas fired[6]. The Nigerian Electricity network comprises 11,000Km transmission lines (330 and 132KV), 24,000Km of sub-transmission lines (33KV), 19,000Km of distribution line (11KV) and 22,500 substations[6]. This has only one major loop system: Benin – Ikeja West – Ayede – Oshogbo – Benin. The absence of loops is responsible for the weak and unreliable power system in the country. This results in very low efficiency and disruption in the lives of the citizenry.

Again, most of the transmission lines are very long and fragile leading to frequent conductor cuts, thus giving rise to high voltage drops and power losses in the network[6]. These voltages can be as low as 217 for 330KV line and 92 for 132KV. Moreover, poor maintenance culture and overage have characterized most of the transmission networks thus, leading to the collapse of several spans. Furthermore, high voltages are experienced in some very long lines where the reactors are out of circuits due to low resistance, winding faults and damaged cables[2].

Other related problems that can contribute to voltage collapse are when the increase in load demand of the consumers overshoot the available power in the system. This is more

prevalent in places where load-shedding and all those are not practiced. Moreover, many distribution transformers are overloaded leading to very low voltages of about 40V in some areas[3]. It is very painful at this 21st century to see feeder pillars in Nigerian power system without proper rated fuses, instead iron bars are inserted into the fuse compartments. This is un-engineering and ought to stop.

A summary of outages recorded for 2003, 2004 and 2005 by PHCN and NCC, 2005 and 2006 respectively is shown in table 1 while incidences of total and partial collapse is shown in table 2 for 2009 – 2012. Another serious problem causing poor power quality and outage is vandalization of transmission cables by unscrupulous elements in the society. These hoodlums cut and cart away the valuable cables for selfish interest and money. In other related developments, power outages are also caused by natural phenomena or weather related problems like rain, lightning, snow, ice, dust, wind and sometimes natural calamities like flood, hurricane, windstorm, earthquakes, tsunamis etc. All these problems can be technical or non-technical in nature as can be seen.

Table 1: Summary of Outages in Nigeria for 2003, 2004 and 2005 (PHCN, 2005; NCC, 2006)

Year	Network (KV)	Forced Outage	Planned Outage	Urgent Outage	Emergency Outage	Total
2003	330	252	90	69	48	459
2004	330	277	190	139	179	785
2005	330	225	181	59	64	529
2003	132	884	169	321	1361	2735
2004	132	759	130	240	752	1881
2005	132	731	200	296	2358	3585

Table 2: Statistical Data of Partial and Total Collapse on the Nigerian 330KV Grid from January 2009 – July 2012 (PHCN, 2012).

Period	Failure Type	Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sept.	Oct.	Nov.	Dec.	Total
2009	T/C	01	-	-	-	02	05	05	04	01	-	-	01	19
	P/C	-	05	04	03	03	-	-	01	-	02	01	01	20
2010	T/C	-	03	01	-	03	03	03	-	02	02	01	04	22
	P/C	01	-	-	01	01	03	04	04	03	02	-	01	20
2011	T/C	-	-	-	-	04	03	01	01	01	02	01	-	13
	P/C	-	01	01	-	-	-	-	01	01	01	01	-	06
2012	T/C	-	-	-	01	05	01	01	-	-	-	02	-	10
	P/C	-	-	-	02	-	-	-	-	-	-	-	-	02

3.0 ANALYSIS OF SYSTEM COLLAPSE AND OUTAGE IN NIGERIAN POWER SYSTEM INDUSTRY

The effects of poor power quality and outage in Nigeria power system cannot be over-emphasized. The reactive power which runs in the grid system throughout the nation rises and falls (very unsteady) and may result in high power loss when it is high with mostly low output voltages. This may result in the loss of high voltage components/ equipment ranging from transformers, circuit breakers, insulator transmission lines to total loss of high voltage power substation with fire outbreak if the reactive power continues to rise with upsurge of current in the system[6]. Most of the reasons given for the poor power quality and outage in the system can combine to cause the above problems.

The after effect is that most multinational industries in Nigeria have relocated to other neighbouring West African countries like Ghana, Togo, Benin Republic to mention but a few. Again, the present economic recession in Nigeria is not far-fetched from poor power quality and management and hence, needs urgent attention. Table 1 shows the summary of outages in Nigeria for 2003, 2004 and 2005 represented in a bar chart as shown in figure 1 while table 2 shows the statistical data of total and partial collapse on Nigerian 330KV grid system from January 2009 – July 2012. Figure 2 shows the various types of collapses on the 330KV grid system from 2009 – 2012.

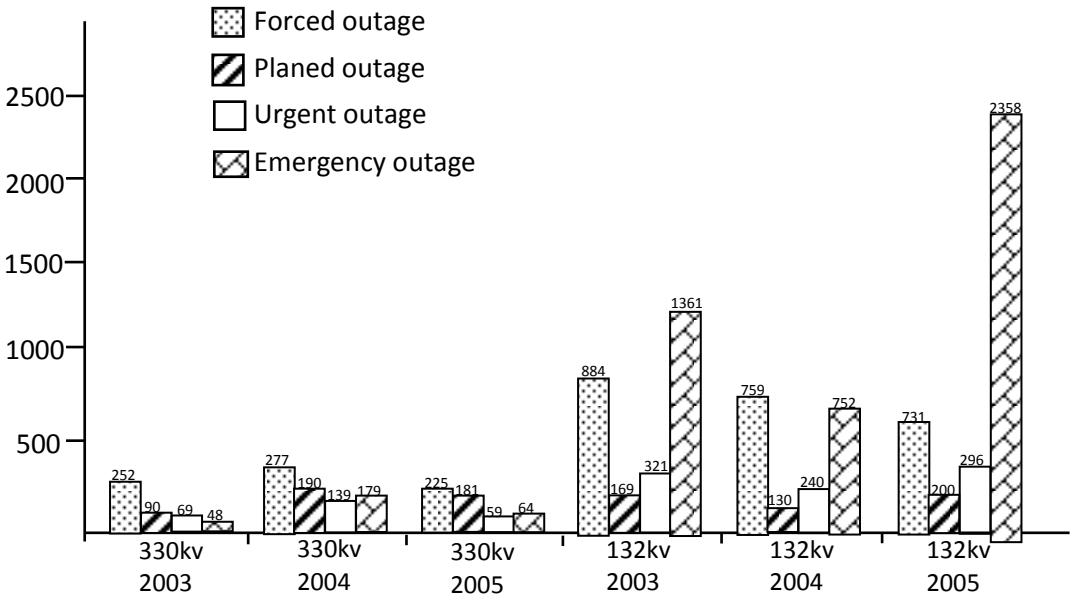

Fig. 1: Various types of outages on the 330 and 132kv for 2003 – 2005.

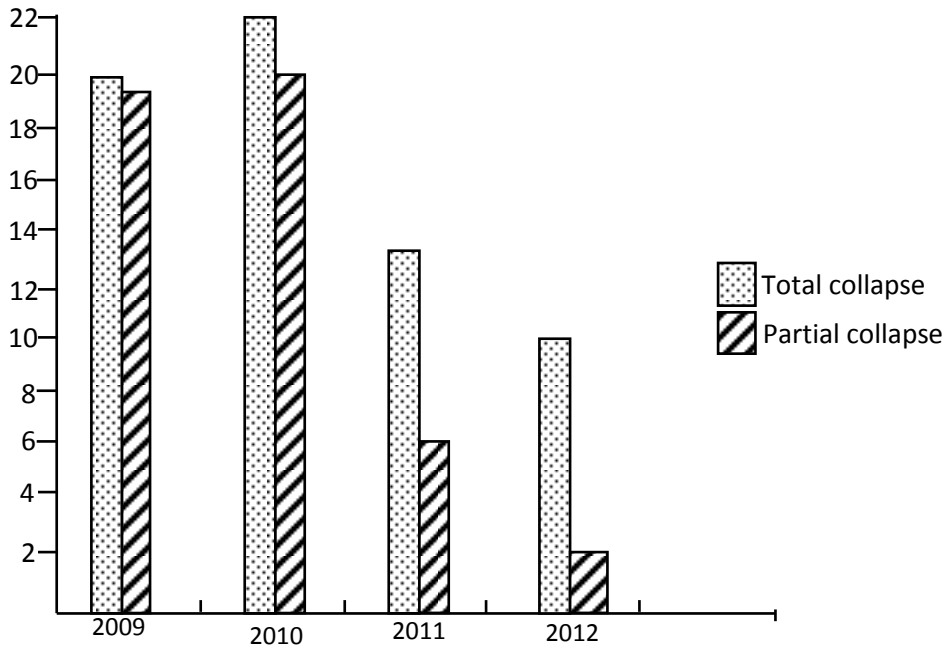

Fig. 2: Shows various types of collapse on 330KV grid system from 2009 – 2012.

In figure 1, it was observed that planned outages for 330 and 132KV recorded the lowest value of 960 (or 9.62%) while the others are either due to forced outages or emergency /urgent outages. This suggested that the reliability of the system is very low giving rise to low efficiency and disruption in the lives of the citizenry. In this figure 1, it can be shown that Nigeria power system experienced the least power outage in 2203 and the highest in 2005. This again can suggest what billions of naira lost within a space of two (2) years. The problem continued because according to figure 2, year 2009 – 2012 were again characterized with total and partial collapses, and the present day is even worse-off.

4.0 RECOMMENDATIONS

To restore power quality and reduce outages in the transmission system, the following steps should be taken:

(i) Planned maintenance culture on the network has to be acquired to reduce the incidences of collapsed spans.

(ii) System stability and efficiency will improve if all the long and fragile transmission lines are reinforced.

(iii) To help to reduce the long lines, more substations ought to be built to improve the voltage profiles of the network.

(iv) Faults should be promptly rectified and all the lines energized to scare the hoodlums and vandals away.

5.0 CONCLUSIONS

A complete overhaul of Nigeria power system should be carried out to overcome all the above enumerated problems to maintain the power quality and eradicate outages.

REFERENCES

[1] Komolafe, O.A., Momoh, A. and Omoigui, M.O.2003, "Reliability Investigation of the Nigeria Electric Power Authority Transmission Network in a Deregulated Environment." *Conference Record of the IEEE Industrial Application Conference*, 12-16, Vol. 2, PP 1328 – 1335, Oct., 2003.

[2] Onohaebi, O.S., 2009, "Power Outages in Nigerian Transmission Grid." *Research Journal of Applied Sciences*, 4(1): 1-9, ISSN: 1815 – 932X.

[3] PHCN, National Control Centre, Oshogbo, 2005 "Generation and Transmission Grid Operations." *Annual Technical Report for 2004*.

[4] Sadiq, A.A. and Nwohu, M.N., "Evaluation of Inter-area available Transfer Capability of Nigeria 330KV Network." *International Journal of Engineering and Technology*.

[5] Sadoh, J., 2005. Ph.D Thesis on Power System Protection: "Investigation of System Protection Schemes on the 330KV of Nigeria Transmission Network." (Unpublished) University of Benin, PP. 27.

[6] Ibekwe, B.E., 2016. Ph.D Thesis on Nigeria 330KV Grid System: "Dynamic Compensation of Reactive Power in 330KV Transmission Line using Fuzzy Controller Static var Compensator." (Unpublished)Enugu State University of Science and Technology (ESUT), Enugu.

[7] PHCN National Control Centre (NCC) Oshogbo Daily Operational Report, 2012.