

Experiences and Challenges in the Use of Locally Sourced Materials in Electrical Distribution Systems in Nigeria

¹J.C. Ekeh, ²E.O. Ikwu, ³H.R., Torru and ²C. Akpor

¹Department of Electrical and Information Engineering, Covenant University, Ota, Nigeria

²Benin Distribution Company, Benin, Nigeria

³Abuja Distribution Company, Abuja, Nigeria

Abstract: In this study, a comprehensive survey is made on the state of the art of several important materials associated with electricity distribution systems in Nigeria. It presents estimate of percentage contributions of local contents in electrical distribution systems in Nigeria. The study identified about 50 items commonly used in power distribution system in Nigeria. It revealed that about 80% of these items could be locally sourced. The remaining 20% which included transformers and circuit breakers could be locally assembled. A number of challenges and opportunities in the emerging market in the distribution system are presented. The study will be of value to the manufacturers and power system engineers involve in the development and use of the local materials in power distribution systems.

Key words: Local materials, performance, distribution system, distribution investment, challenges

INTRODUCTION

The distribution system is one of the most important sectors in the power supply industry. They are integral part in ascertaining the reliability, security and efficiency of the power utility. Therefore, one of the most serious challenges for power industry restructuring is to maintain power system reliability at an appropriate level and to promote the overall economic efficiency of the whole power industry (Wen *et al.*, 2006). To this end, huge capital investments in power system infrastructure are necessary to achieve the above objectives (Ekeh *et al.*, 2005).

Nigeria currently import about 90% of the materials used in the power sector. This is definitely too high for a country blessed in both natural and human resources (Makoju, 2006).

A study by Ekeh, Nwadinobi and Ikwu has reported that a number of locally made and locally assembled materials have been injected into the distribution systems especially in the rural areas. These become visible following the introduction of Structural Adjustment Programme (Ekeh *et al.*, 2005).

Hitherto, power generation, transmission and distribution were vested in the hands of the Power Holding Company of Nigeria (PHCN). The electricity business was an exclusive right of the PHCN (Aster, 2006).

In a deregulated electricity market, cutting operations and maintenance costs and preserving service reliability are the top priorities for managers of power utility systems.

Thus, the need to ensure adequate local contents in manufacture and supply of materials cannot be overemphasized. An intentional effort made to transfer technology effectively can be utilized to reduce the high percentage of imported materials used in the power sector. In addition, local contents will lower the overall cost of service delivery, provide spares for breakdown facilities, create consultancy services, simulate local research by transforming technology to backwardly integrate other service sectors and save the nation huge foreign exchange spent on the importation of materials.

The study proposes a number of ways to properly introduce and integrate locally sourced materials into the Nigerian power industry.

THE DISTRIBUTION NETWORK

The power distribution business is at the down stream of the electricity business supply chain. It starts from the interface point of the transmission substation bus/gantry on a voltage level of 33 kV (Ikwu, 2006). This is then stepped down to 11-415 kV to make it usable by machineries and household appliances (Ikwu, 2006). Going by the reform programme, the distribution

companies are basically retailers of electricity that purchases power in bulk from the generation stations at an agreed and regulated tariff or through competitive price bidding where the system has excess generating capacity.

EXPERIENCES GAINED IN THE USE OF LOCAL CONTENTS IN ELECTRICAL DISTRIBUTION SYSTEMS

The field experiences on a number of locally made and sourced materials in the distribution systems have been reported (Ekeh *et al.*, 2005). With the exception of made in Nigerian conductors and cables, all other locally sourced materials fall short of their expected life span. The locally made distribution insulators shattered while in service. A laboratory test conducted on the insulators revealed that the locally made insulators did not meet up with the standard required of the insulation required in the distribution network. At very low voltage level of 415 volts, the shackle insulators were seen to cope with voltages, though the leakage current was so small that its effect was not noticed on the distribution system. However, at 33 kV and 11 kV lines, the leakage currents were high enough to cause incessant tripping on earth fault resulting to breakdown of the insulation resistance.

Another test results conducted on the locally made earthing electrodes revealed that they are inferior in

quality and heavier in weight when compared with the imported counterparts. The value of 50 ohms per volt was recorded for most locally made earthing rods. This is too low compared with the average value of 300 ohms per volt recorded for the imported ones. Also, the locally made earth rods corrode easily when buried into the soil and leakage current made to pass through them. This may be attributed to the fact that the locally made earthing electrodes are made of irons coated with paints.

On the distribution poles, field experiences and test results had revealed that while the wooden poles rot with termites attach over years, the concrete poles break with the slightest pressure. This raises the question of their quality. Therefore, the strength of the locally produced concrete poles should be made to comply with the recommended values of the British Standard values of 15N mm⁻² at 28 days curing period. If wooden poles must be used, they should be of standard size and be treated with quality chemical, to prevent termites' attack and rot at the pole base and for high resistance to fire.

Other local substitutes of electrical materials have been successively employed in the distribution systems. These include: Galvanized stay rods, feeder pillars, clamps, J. hooks, etc. More details on the estimate of local contents in electrical distribution systems are contained in Table 1.

Table 1: Estimate of local contents in electrical distribution systems

S/No	Distribution items	Percentage local contents	Percentage of foreign contents	Remarks
1	Distribution poles			
	28FT wooden pole	95	5	
	34FT wooden pole	80	20	
	28FT concrete pole	100	-	Can be sourced locally
	34FT concrete pole	100	-	Can be made in Nigeria
2	Distribution pole Accessories			
	11kV wooden cross arm	100	-	
	33kV wooden cross arm	90	10	Can be locally sourced
3	Circuit breakers			
	Miniature circuit breaker (MCB)	30	70	
	11kV and 33kV CBs	-	100	Made in Nigeria
4	Conductors			
	Overhead of all voltage levels	100	-	Presently manufactured
	Underground of all voltage level	95	5	in Nigeria. Has proven better than imported ones
5	Up risers cables	95	5	
	Insulators			
	11 kV pin insulator	60	40	Can be locally made
6	33 kV pin insulator	60	40	using appropriate technology
	Shackle insulator	60	40	
	Isolators	95	5	
7	Distribution transformers			
	11/0.415 kV transformer	-	100	But can be locally assembled
	33/11 kV transformer	-	100	
8	Feeder pillars	90	10	Can be locally made
9	Ladder			Made in Nigeria
	HT ladder	95	5	
	LT ladder	95	5	
10	Sealing wire	100	-	Made in Nigeria

Table 1: Continued

S/No	Distribution items	Percentage local contents	Percentage of foreign contents	Remarks
11	Cable terminations			
	Plumber metal	100	100	
	Fluxite paste	-	-	
12	Spindle jumper			
	11 kV spindle jumper	80	20	Made in Nigeria
	33 kV spindle jumper	80	20	
13	Clamp for alluminum conductor			
	11 kV tie strap clamp	80	20	
	33 kV tie strap clamp	80	20	Can be locally made
	Six bolts clamp	90	10	
14	Galvanize stay rod	85	15	Made in Nigeria
15	Cable termination			
	Clavis adaptor	85	15	
	Clavis ball socket	85	15	
	Tin-man solder	100	-	
	Sealing lead	100	-	
	150 mm ² spill-tap connector	100	-	
16	D-iron complete	95	5	Made in Nigeria
	D-shackle	95	5	Made in Nigeria
17	HT complete stay	95	5	Made in Nigeria
18	9FT channel iron	95	5	Made in Nigeria
19	7FT angle iron	95	5	Made in Nigeria
20	Extension straps	95	5	
21	Earth rod	95	5	Made in Nigeria
22	Aluminum copper line tap	95	5	
23	Terminating strap	95	5	
24	Danger plate	100	-	Made in Nigeria
25	11kV operating rod	5	95	Can be locally made
26	Hook ball J.type	95	5	Made in Nigeria
27	J. Hook	95	5	Made in Nigeria
28	Universal bi – metal	95	5	

CHALLENGES AND OPPORTUNITIES

A major obstacle hindering electricity distribution system in Nigeria and most developing nations is lack of appropriate technology and local contents. To this end, the following challenges and opportunities are bound (Aster, 2006; Ikwu, 2006).

Meter manufacture: The level of metering of known customers of about 4 million is just around 40%. The meters are not only analogue but have become old and absolute. At a cost of N44000/meter an opportunity of N176 trillion is lying untapped. There is a great opportunity for local investors to partner with the distributing companies in providing and installing digital/intelligent meters that have scratch cards technology.

Manufacture of cables and wires: Just like it happened in the telecommunication sector, customer population explosion is expected in the power sector when fully privatized as such there will be need for the provision of service cables, mains cables and even installation and/control cables. Although, a number of success has been recorded in the use of Nigerian made cable, efforts should be geared towards improving on the quality of these cables.

Information technology infrastructure: There are lots of window of opportunity in the sector as far as IT infrastructure is concerned. Be it in terms of network automation (SCADA), supply of computers for support services, development of specialized software for specific tasks, manufacture of scratch cards and vending machines, etc. as well as for data base management and secretary duty.

Manufacture of fast moving accessories/tools: Local investors can as well engage in the manufacture of reinforced concrete poles, preparation of treated wood to produce wood cross-arms, establishment of foundries for manufacture of bolts/nuts, tie straps, tension clamps, galvanized earth rods, stay rods, insulators (made from glazed clay), lightning arrestors, etc.

Manufacture of transformers, feeder pillars and units: Uptill this moment, its just about one or two investors that are assembling transformers in Nigeria. Faulty ones are repaired by road side artisans which often fail after been taken to the network. Switchgears of all sizes, make and ratings are completely not manufactured or assembled locally. Fuses of all sizes are also obtained off shore. Local investors with the expertise should open a standard workshops for refurbishing old/faulty transformers that are scattered all over the old PHCN stores.

Consultancy services: There is a great room of opportunity to offer consultancy services in all areas of need in the distribution sector.

Creation of job: Establishment of manufacturing and repair facilities will definitely create jobs for our local engineers, technicians and school leavers. This will go a long way in reducing the unemployment rate in the country.

The drawbacks on the use of locally made and sourced materials in the power supply industry are widely regarded as temporary ones against the longer term benefits. Local research and technology driven and supported by academia and private sector is extremely vital to achieve local contents and power industry sustainability.

CONCLUSION

This study has revealed that significant benefits are bound from the use of locally sourced materials in electricity distribution systems. Practically, it will lower the overall cost of service delivery, provide spares for breakdown facilities, create consultancy services, simulate local research and technology, create employment for

young engineers and technicians and save the nation huge foreign exchange spent on the importation of materials.

REFERENCES

- Atser, G., 2006. Nigeria's Electricity Policy offers fresh Opportunities. The Punch Newspaper, Nigeria, pp: 19.
- Ekeh, J.C., C.C. Nwadinobi and E.O. Ikwu, 2005. Evaluation of the Performance of the Use of Local Materials in Electrical Distribution Systems. *J. Applied Basic Sci. (JABS)*, 3: 135-143.
- Makoju, J.O., 2006. A Privatized Power Utility Company for Nigerian Economy: Technology and Human Capacity Needs, Paper presented at the 4th USA-African Research and Education Collaboration Workshop, Abuja Sheraton Hotels and Tower, Abuja, Nigeria.
- Ikwu, E.O., 2006. Power Distribution in Developing Economy: The Nigerian Perspective, Paper presented at the Top Rank Hotel, Garki Abuja.
- Wen, R., F. Zheng and F.F. Wu, 2006. Transmission Investment and Planning in Deregulated Market Environment: A Literature Survey (Part 1), IASTED Conference on Energy and Power Systems, Chiangi Mai, Thailand.