

Engineering Based Process of Achieving a Constant Power Supply in Nigeria

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DEDICATION

The journal is dedicated to the almighty, our heavenly father.

Abstract

Several countries of the world enjoy steady (uninterrupted) power supply. This has been possible through aggressive investment in the generation, transmission and distribution of electric power. Some of these countries lack the natural resources required for the power generation but have been able to attain their present states of power availability through applying the principles of engineering to their situation. Nigeria as a nation endowed with enormous natural resources can attain the same level of steady power supply by harnessing these resources to increase generation capacity, expand the transmission network and improve the distribution system. The existing system has the solution of its problems in the implementation of the engineering prospects presented in this work. This work presents, among other things, a comprehensive analysis of the existing system, identifying its problems and constraints. It went further to offer engineering-based solutions to the identified problems suggesting some state-of-the-art application of engineering to the existing system to ensure power availability and stability.

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INTRODUCTION

The persistent problem of epileptic power supply in Nigeria has been in the news for over a decade now. Several attempts have been made by different administrations towards providing a solution to the power problem.

A large percentage of Nigerians depend on the supply of electric power for their daily income. Several industries and factories require public electric power supply for cost-effective production. In fact, many Nigerians believe that a complete national blackout for one week is enough to collapse the Nigerian economy.

In view of the foregoing, it has become necessary to delve into the issues confronting the Nigerian electricity sector with a view to proffering engineering-based solutions to the power problem.

PROBLEM FORMULATION

Several countries of the world (including some African countries) have provided and sustained uninterrupted power supply for many years now. Countries like the USA, Japan, Germany, Russia, etc have spinning power reserves in excess of their estimated power demand for the next ten years. Several other countries have been able to sustain constant power availability for all regions in those countries up - to the present time. Others have power generation in excess of daily power demands and are making positive moves to increase spinning reserves with a view to meeting future demands.

Developed countries have core vision on electricity development road map. This is because they have appreciated that electricity is more than energy and that its demand has continued to increase. Electricity has not only acquired the position of a prime mover that drives nations to economic growth development and improves technology base but has also become an enabler of social development and transformation of the society. This leads to overall improvement in the standard of living in line with the objectives of Millennium Development Goals (MDGs) and National Economic Empowerment Development Strategy (NEEDS), the two philosophies of economic growth and development of nations.

Objectives

To present a step by step engineering based process of achieving a failure-free power system in Nigeria.

To buttress the idea that the attainment of uninterrupted power supply is possible in Nigeria providing an engineering view of this possibility.

To bring the recognition of engineers as the most important players in the power industry stressing the fact that the involvement of engineering professional in electricity policy formulation will place Nigeria in the path of achieving a future of electrical energy availability for all sectors of the economy.

Research questions

- a) What factors have contributed to the epileptic power supply in Nigeria?
- b) Is uninterrupted power supply possible in Nigeria, in the light of several attempts to address the power problem?
- c) What engineering prospects are available for moving the Nigerian power industry to the level of providing steady power supply?
- d) Does Nigeria have the human and material resources needed for the implementation of these prospects?

Review of related literature

Several engineers, politicians, individuals and newspaper columnists have written various comments and provided a number of ideas on the Nigerian power situation, and some have given suggestions towards solving the problem. A few of these comments and/or suggestions are reviewed here:

Obikwelu, G. N., (2007) observed that “In many developing countries improving electricity remains a regular feature of political campaign agenda along with such laudable programmes as employment generation, qualitative education, affordable housing etc.

“Although present availability of electricity in Nigeria stands at 4000MW, it is reported that demand will more than triple the year 2007 availability target of 10,000MW within the next 10 years. It is imperative for Nigeria to reposition herself to meet the rising demand for electricity within the next 10 years. This can only be met not by wishful thinking, ad-hoc measures and folding of arms but through aggressive and sustained investment in the industry to make electricity available and affordable to realize the Millennium Development Goals”

Olotu, J., (2007) saw it that “The electricity supply industry reform program (Electric Power Sector reform Act of 2005, unbundling of PHCN, competitive will lead to capacity expansion in due course. Meanwhile a major public sector intervention to expand generation, transmission and distribution capacity is needed. The National Integrated Power Report (NIPP) was conceived in 2004 as a fast-track government funded initiative to add significant new generation, transmission, distribution and gas supply capacity”

Makoju, J. O., (2006) made it clear that “For any country that intends to move its economy from the status of underdevelopment to that of an industrialized economy like China, India, and apparently Singapore and Malaysia, the bottom line is the provision of cheap and efficient power supply. If Nigeria must make that transition, we must put right the problem of power.

“Recall that in 1999, when this administration took office under the leadership of General Obasanjo, the power sector was indeed in crisis. Federal government inherited a collapsed infrastructure. Eighteen years prior to 1999 investment in the power sector. There were no power stations built, and no new transmission lines. The newest power station in Nigeria was built in 1985 and the newest line was built in 1987, and with the increasing population, and consequently increasing demand, there was nothing going into the sector.

Inugonum, T., (2006) wrote that “The purpose of load shedding in a system is to balance the load (customers demand) and the generation (plant capacity) in the event that there is no balance in load demand/supply and the system becomes overloaded i.e. the load becomes more than the generation thus impacting on the generator negatively by slowing it down or in the event of circuit or equipment being loaded above its capacity.

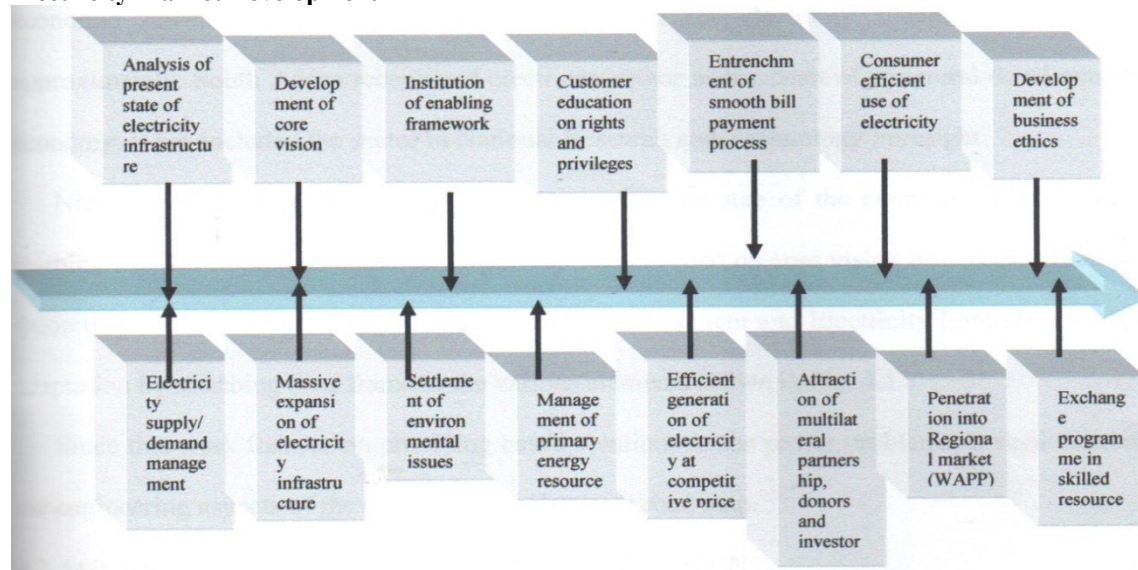
SYSTEM DESIGN

The possibility of achieving uninterrupted power supply in Nigeria is not for fetched. It is etched on the nation’s vision of the role and importance of electricity in the development and so, placing the provision of electric power supply on the proper pedestal. The present electricity supply system is a major contributor to the low level of economic development in Nigeria and shall continue to impede the rate of Nigeria’s development if no serious step is taken towards addressing the problem.

DEVELOPMENT OF CORE VISION ON ELECTRICITY

Developed countries have core vision on electricity development road map. This is because they have appreciated that electricity is more important than other forms of energy and that its demand has continued to increase. Electricity has not only acquired the position of a prime mover that drives nations to economic growth/development and improves technology base but has also become an enabler of social development and transformation of the society. This leads to overall improvement in the standard of living in line with

Electricity Market Development



Electricity Enterprise Development

Since this work focuses on providing based solutions to the power problems, it shall concentrate on the engineering aspects of the electricity development road map.

AGGRESSIVE PURSUANCE OF THE CORE VISION

With a good understanding of this core vision, time should not be wasted any longer in the pursuance of the various aspects enumerated. Moved by the determination to achieve highly accelerated development, the vigour with the core objectives are pursued should be high and efforts already made in this direction counted as inadequate. Therefore, the following measures are necessary to alliterate the achievement of the desired goals.

Increased Electricity Generation

The first approach towards ensuring an electricity availability situation is the increase of generation capacity

Investment in New Power Generating Stations

The new power generating stations under construction. This will give a total installed capacity of 12676.45MW in Nigeria upon completion.

Rehabilitation of Existing Generating Stations

It is clear that equipment availability at generating stations stand at 60.32%. Already intalled capacity is far above 5000MW expected by Nigerians. To date, the situation has worsened beyond what was obtainable in 2007 . The summary of the situation is that the existing generating stations are not properly maintained.

Energy Imports

Several countries of the world see it a good option in electric power availability planning to import power from other countries. As a result, various regions have developed transnational power grids. Examples abound, including the Latin American power grid, the European power grid, the Mediterranean power grid, the North African Interconnection, the South African power pool (SAPP), etc. Nigeria is already making plans to import power from the Congo

Harnessing Other Sources of Energy

All the new generating plants are gas fired. Through Nigeria has enormous gas deposit, overdependence on one natural resource is detrimental to development as any cause of scarcity (probably through pipeline vandalization or any other cause) will cripple power generation and return the country back to the same situation today.

Germany's total generation plan of 576 TW11, 2001 to 2020 has its fuel mix in electricity generation as follows: Coal, 52%; oil, 1%; gas, 9%; combustible 'renewable' and waste, 2%; nuclear, 30%; solar/tidal/wind, 2%; and hydro, 4%. As at 1999, Germany generates about 330 billion KW (330 TW) of electricity from coal alone. Such a fuel mix guarantees that scarcity of one type of the! will not have a total effect on the power availability.

Expansion of Transmission Infrastructure

The Nigerian 330kv grid map reveals the inadequacy of the transmission network for wheeling power to all parts of the country. Transmission capacity (lines and substations) fall far below what is required for effective power transformation for a country as vast as Nigeria. As measures to boost the transmission system, the following should be adopted.

Construction of New Transmission Lines

New transmission capacity is imperative in the achievement of uninterrupted power supply in Nigeria. In countries where electricity availability has been prioritized, the manner of deciding the route and location of new transmission facility is easy using engineering software tools for spatial load forecasting transmission load, geographic information system and asset management system.

Upgrading of Existing Transmission Lines

By design, each transmission line has voltage and current ratings (and consequently, power ratings). Exceeding the rating of the line results in excess electrical stresses on the line conductors leading to sagging and line snaps. As a measure to increase capacity, existing transmission lines should be upgraded to higher capacity lines.

Closing the Transmission Loop/Ring

With the construction of more transmission lines aimed at making up a transmission ring/loop, any line fault would only have a momentary effect on power supply (lasting seconds to a few minutes) as the area affected would be supplied from another part of the ring.

Construction of New Transmission Substations

Ideally, the construction of new transmission lines would require the construction of new substations to receive this power or the expansion and upgrading of existing substations. This will therefore entail heavy investments in substation equipments including transformers, circuit breakers, isolators, metering equipment, communication equipment, busbars, etc.

Distribution System Improvement

For optimal power delivery to consumer points, a distribution system development plan should be adopted. This would involve the following:

Substation capacity Enhancement

This will involve the construction of new distribution substations, and the expansion and upgrading of existing substation. As a result, it will attract heavy investments in distribution substation equipment including transformers, circuit breakers, metering equipment, etc.

Distribution Network Upgrading and Expansion

The existing distribution network is substandard and in a state of disrepair. The distribution network of lines should be aggressively repaired and where reconductoring is required, to increase capacity, this should be carried out.

CONCLUSIONS

Electric power, being an engineering concept, can only be developed through engineering. The three important sectors of the electric industry namely; generation, transmission and distribution require upgrading and expansion before Nigeria can think of uninterrupted power supply. With concerted efforts in that direction, a future of steady power supply in Nigeria will be achieved.

RECOMMENDATIONS

- Nigeria should set aside a substantial part of her annual budget for expansion of the power system.
- Future load forecasts should be carried out and updated annually with a view to properly channeling expenditures on power system infrastructure.
- Training and retaining of power system personnel should be embarked upon as a means of preparing them for the proposed provision and sustenance of uninterrupted power supply in Nigeria.
- Political influences should not be allowed to influence the siting of power infrastructure.
- The federal government should sponsor the establishment of an Institute of Power System Engineering to serve as a final training ground for power system graduates

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