2nd Stakeholders FORUM On Enforcement Of Technical Standards And Regulations, Safety And Certification In Nigeria

National Grid stability: TCN/Discos Interface Challenges/Constraints and Solutions for Power Supply Improvement in Nigeria

by

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Introduction and Brief History

The Nigerian electricity supply industry like any other electric power industry is large and complex, involving technical, business, and governmental aspects. It cannot be viewed or understood unless one is also familiar with the regulatory environment in which it operates.

Most of our transmission lines and substations were constructed more than 40 years ago and are based on 1950s' technology, but demands on the electric power system have increased significantly over the years.

A focus on system reliability as the entire electrical grid is becoming more fragile at the same time the appliances in your home are getting more sensitive to electrical variations. Other things being equal, the reliability of electrical power in the Country will continue to decline for the next decade or so. This undesirable effect stemmed from lack of capacity expansion, which should have been done before the privatization of the sector. Billions of dollars would be needed to finance the required improvement and capacity growth.

Given the post-unbundling process and the contemporary dynamic of liberalization, deregulation and corporatization, many Nigerians have expected a quantum leap in power supply. Unfortunately, the expectations quietly fizzled out due to more interruptions in the supply of electricity. The duration of the interruption being affected by the severity of the disturbance, the power system facilities affected, the redundancy or reserve built into the system if any at all, and the preparedness of the involved operating entities to respond.

The distribution system is an important part of the total electric supply system and provides the final link between a utility's bulk transmission system and its ultimate customers. It has been reported in many technical publications that over eighty percent (80%) of all customer supply interruptions occur due to failures in the distribution systems.

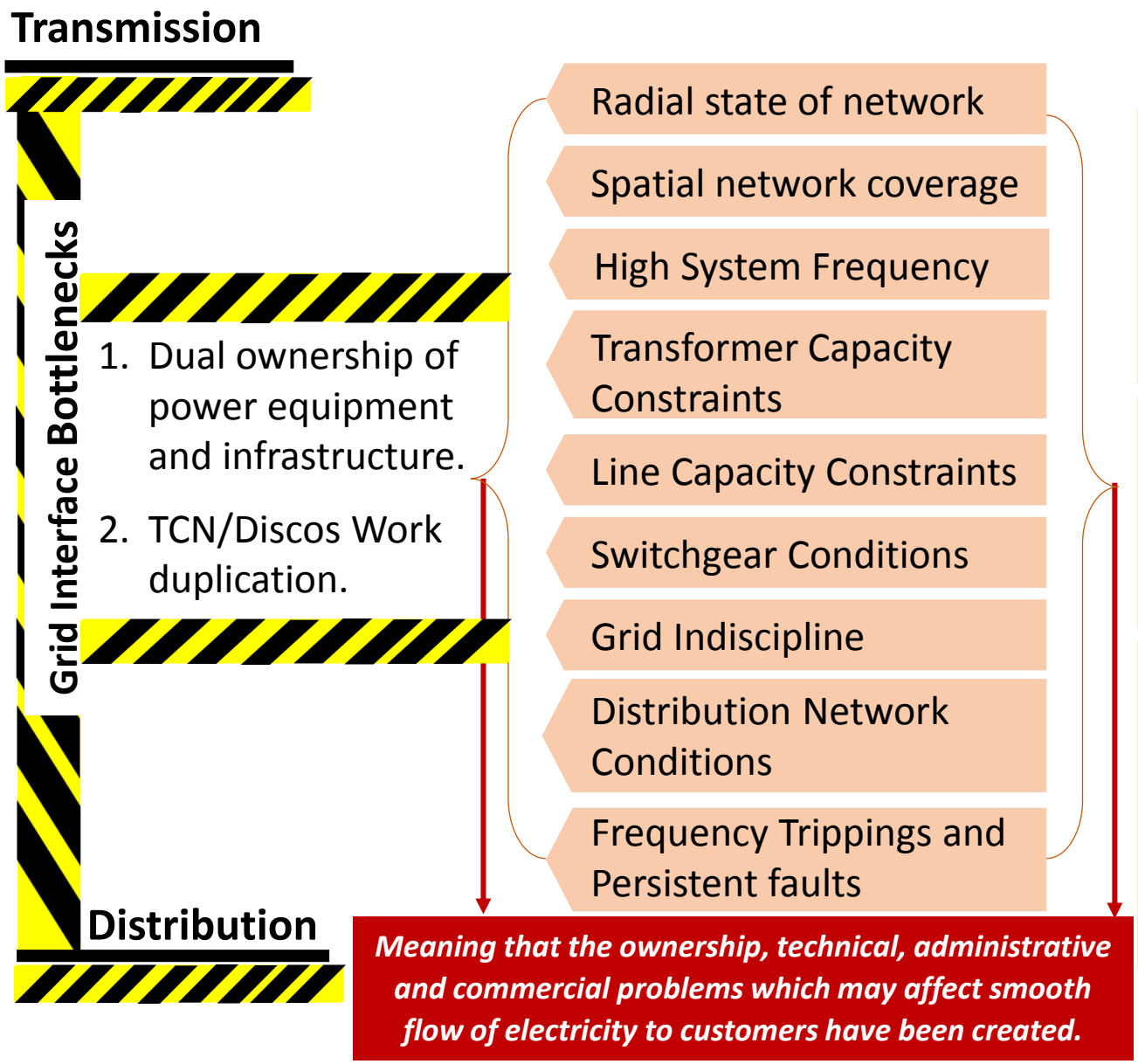
There are strong reasons for this high percentage. Distribution relies on highly branched topology, often in close proximity to communities, roadways, trees, and other potential interfering objects. Thus, the physical environment and exposure to the elements where distribution resides causes a significant number of unplanned outages. They can also be caused by the unavailability of adequate resources to supply the customer load. Outages and abnormal circuit configurations can create capacity constraint conditions on a distribution grid, which in turn will invariably lead to load rejection by the Discos.

On rare occasions, **interruptions can as well be caused by generation or transmission system.** Except that generation and transmission-related outages are less common than those related to the distribution system, but they often have much more serious consequences because of the number of customers affected and the duration of the outage.

On safety: Electrocution is one of the leading causes of death of young workers. Contact with overhead wires is a common cause of electrocution. This can happen when people are carrying ladders or poles or using equipment that is tall enough to touch electrical wires. In 2017, it was reported that 146 electrical accidents killed 113 and injured 77.

Consequently, NEMSA has continued to enforce the use of the right quality and standard electrical materials, appliances, equipment in NESI and other work places. The agency commenced Nationwide Technical Monitoring and Evaluation of the primary 33KV feeder lines and associated 33/11KV injection substations in October 2017.

Transmission and Distribution Interface Bottlenecks



The cost of not having power when it is needed is far greater to the user than the lost revenues to the utility that cannot provide it.

The present TCN/Discos interface, which is also the **trading point for Discos** is the 33kV side of the 132/33kV power transformers and associated feeder circuit breakers in the 33kV switchyard which all belong to TCN. This creates dual ownership of the power equipment, switchgears and some part of the TCN premises between TCN and Discos.

Remote switching and monitoring of the circuit breaker status and its measurands are all done by the TCN system operator from the control room. The circuit breakers are also maintained at the expanse of TCN, and the cost of doing so was never factored into the wheeling charges.

The primary function of the 33kV feeder circuit breaker is to protect the TCN power transformer to which it is tied from electrical faults occurring downstream between the TCN 33kV switchyard and the Disco Injection Substation fed. The function of the circuit breaker is not the preventive one its name would imply, in that it takes action only after a fault has occurred: it is the ambulance at the foot of the cliff rather than the fence at the top.

Recommended Solution

Challenges/Constraints	Solutions
Radial state of network	- Timely completion of the construction work to close the loop to Jos with a DC 330KV line by NIPP.
Spatial network coverage	- Contract to be awarded for construction of additional transmission stations and lines.
Transformer plinth connection at the Transmission Station	- Installation and Commissioning of the Transformer required.
Power limitation on transformer at Transmission Station	- Transformer upgrade should be carried out.
Overloaded transformer and lack of enough bays at Transmission Station	- Required Additional capacity Transformer.

Recommended Solution

Challenges/Constraints	Solutions
Faulty transformers at both Transmission and Distribution Station	- Upgrading Power Substation by replacing existing capacity Power Transformers additional capacity Transformers.
Hotspot occurring at Power stations under high loading conditions	- Required efficient and timely completion of re-conductoring work on Transmission lines
Line Trace	- Regular line maintenance and engagement of contractors with requisite tools and capability to work on difficult terrains to prevent frequent line trips.
Low Voltage occurrence in Transmission Stations	- Commissioning of MX Reactors, appropriate transformer capacity, Lines, and Transformer Feeders as deemed necessary.

Recommended Solution

Challenges/Constraints	Solutions
Power House Capacity Limitation	- Installation of additional Transformers as reinforcement to the existing Transformer capacity and the re-conductoring of transmission Lines were necessary.
Low Voltage and Phase voltage imbalance on 330KV line	- Phase interposition required
Faulty 132KV GIS Breaker at Transmission Stations	- Culture of routine maintenance to be encouraged and practice, thereby reducing cost due to repairs and rehabilitations of faulty capacity GIS Breaker at at Transmission Stations.
Size of Transmission Stations Switch room.	- The need to expand existing Transmission Stations switch room to accommodate additional install panels. Switch room Size issues is common with the NIPP Project.

Recommended Solution

Challenges/Constraints	Solutions
Transmission Stations Load limitation due to undersized conductor on the Transmission lines	- Timely completion of all on going construction work at the Transmission Stations to relief the various transmission lines.
Manifestation of High System Frequency	- The need to constantly ensure that frequency stability is supported with additional units in form of ***reserve margins*** to forestall incidences of low gas consumption/supply and delivery pleasure, generating plants shut-down, and Discos load rejection.
Communication between TCN Control Rooms and Discos Injection Substations	Establishment of a clear process or provision of HF radios to provide online means of communication, to enhance the System Operator visibility when issuing dispatch resources to balance supply and demand and manage constraints on the transmission and distribution system.

Recommended Solution

Challenges/Constraints	Solutions
Trading point	- The Authorities that defined the present trading point for Discos should reconsider their decision and relocate the trading point just outside the TCN premises. - Autoreclosers should be installed from where all the 33kV and 11kV feeders take off. The Autoreclosers now become trading points for the Discos rather than the 33kV or 11kV side of the TCN power transformers. - All feeder faults should now terminate at the Autorecloser rather than at the 33kV feeder circuit breaker in TCN 33kV switchyard. - The Discos should be responsible for the maintenance, servicing and repairing of their Autoreclosers.

Recommended Solution

Challenges/Constraints	Solutions
Physical limitations of the 330kV Transmission Lines	Adopt a cost-effective means to enhance additional transmission capacity, upgrade the capability of the existing transmission lines, and corresponding substations along existing corridors to forestall indecencies of system collapse due to stressed grid.
Inadequate system maintenance	Authority to ensure that both TCN and Discos take the necessary action require on maintenance of power system to prevent the likelihood of major transmission system failure. They should be are held responsible, penalty and sanction should be issued were necessary.

… Recommended Solution

Challenges/Constraints	Solutions
Discos Defective Networks	- Discos should not overlook the engineering side of their business such as: total absence of protection devices, non-adherence to safety rules and regulations, poor response to monitored networks, use of substandard materials, vandalism, dependence on TCN 33kV or 11kV breakers to provide protection for their feeders, etc. and only concentrate on revenue collection as the usual practice. - Discos should intensify efforts at revamping and calibrating their protection schemes and equipment, rectify all defective networks to prevent electrical accidents and reduce technical losses.

… Recommended Solution

Challenges/Constraints	Solutions
Inadequate 33kV Evacuation Corridor	- Discos to ensure adequate survey of line routes before construction to obtain the minimum clearances. - Discos to invest in upgrading the 33kV feeder lines using minimum 150mm^2 ACSR for better network stability and load capacity.
Under-utilisation of available capacity	Discos should endeavour to maximize the utilisation of capacity provided by TCN and the Gencos. This will have positive impact on grid system stability and frequency. Operators to have a holistic approach towards achieving incremental and stable power supply.
Discos Low Investment Portfolio	Discos should endeavour to increase investment in network maintenance and expansion, standardisation of construction practices

… Recommended Solution

Challenges/Constraints	Solutions
System Reactive Power	TCN should conduct a thorough and proper study of the Grid to quantify the needed system reactive power to minimize transmission losses and ensure proper function of the Grid.
Technical Specification for Power Equipment	- NEMSA to henceforth be involved in factory inspection and sample tests for all power equipment ordered abroad by TCN. - NEMSA to also participate in drafting or reviewing existing technical specifications for power equipment by TCN.
Renewable Energy Sources	The need to revisit the Renewable Energy Master Plan (REMP) developed by the Energy Commission of Nigeria which provides a detailed guide for the development of all renewable energy sources in Nigeria that could be used to boost the Grid power.

… Recommended Solution

Challenges/Constraints	Solutions
Mini-Grid	Operators to synergize with investors on applicability of the mini-grid regulation as a means of improving / delivering power supply to currently dormant networks, unserved and underserved communities.

Nigeria Transmission Grid

Source: Transmission Company of Nigeria website

NIGERIAN ELECTRICITY MANAGEMENT SERVICES AGENCY
NEMSA

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Thank You