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Contingency Analysis of 330kv Nigeria Network

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Abstract

This paper highlights the contingency analysis of Nigeria 330kV network to examine the risk of possible contingencies posed to the network under generators outage condition. The problems of the system in future are equipment malfunctions, under voltage at various buses, shortage of reactive power support, increased transmission losses and the tendency of system collapse. The design and simulation of the network was carried-out using power world simulator. The analysis was done using Newton-Raphson AC power flow method. Thereafter, three generators outage applied in the network was resolved using double circuit and reactive power compensation remedial actions. Consequently, a stable network that ensured adequate power delivery to the end users was achieved.

Keywords: Contingency Analysis, Power Flow, Transmission losses, Remedial actions, System collapse, Power world simulator

1. Introduction

Component outages in the distribution systems account for the absolute majority of the faults that result in an interruption of supply for the end consumers (Billinton and Allan, 1994). The consequences to modern society of a large interruption of supply (blackout) in the transmission system are considerable high. Important and vulnerable functions in the society, such as telecommunication, heating and water supply, normally function a few hours after an interruption of supply. Local backup generators can be available for some of the critical functions in the society, but this requires an organized distribution of fuel to the affected areas. The associated cost for the society of a large scale interruption is significant (Wacker and Billinton, 1989).

Since an outage event in the transmission system can propagate and paralyze the society in a widespread geographical area, the system has been constructed to meet the high needs of reliability. It is generally designed, operated and planned with the deterministic N- 1 criterion of contingency analysis, which is a rule according to which the system must be able to withstand the loss of any principal single component (ENTSOE, 2007). Clearly this criterion provides a security margin against unwanted conditions in the system.

As some propose for new sources of power in order to meet up the Nigeria energy demand, it is important to examine the security level of the existing grid in order to devise a more defensive approach of operation. Transmission Company of Nigeria (TCN), projected to have the capacity of delivering 12,500 MW in 2013, now has the capacity of delivering about 4800 MW of electricity. Nigeria has a generating capacity of 5,228 MW but with peak production of 4500 MW against a peak demand forecast of 10,200MW. This shows that if the generation sector is to run at full production, the transmission grid will not have the capacity to handle the produced power reliably (Nigeria Compass, 2013). This goes a long way to tell that the 330 KV transmission system is not running effectively as expected. Therefore to maintain and ensure a secure operation of this delicate system, the need for contingency analysis cannot be over emphasized.

2.0 Contingency analysis

Contingency Analysis (CA) in the simplest of term is the "what if" scenario analysis that determines the effect of electric components (elements) outage, provides information used to prioritize facilities and operating condition available to the electric power system.