Short Circuit Analysis of Benin Sub-Region 132 kV Transmission Network for Distance Protection Scheme

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Abstract

Transmission lines have modern interconnected elements that help in fast decision making and tripping time of the relay during fault conditions. The conventional distance protection scheme is gradually becoming unreliable in handling the delay in the diverse relay trips due to its inability to protect the zones of protection of transmission lines adequately, the drive for this research. In this paper, a short circuit analysis of the Benin sub-region 132 kV Transmission Network was carried out. The network comprises of Benin Transmission mains connecting Irrua 132 kV transmission line through Ajaokuta town 132 kV transmission line terminating at Itakpe 132 kV transmission bus were considered as the first layer of the network. The second layer of the network connecting Oghara 132 kV transmission line through Amukpe 132kV transmission line terminating at Ughelli 132 kV transmission bus. This network was modelled using Neplan software to determine three-phase short circuit current. The result from this study provides an improvement opportunity in the application of distance protection scheme as currently being experienced.

Key words: Transmission, distance Protection scheme, short circuit current, network, impedance etc.

I. INTRODUCTION

The distance protection scheme is used for the protection of transmission lines [3]. It acts as the main protection for transmission lines. It functions as a back-up protection to the connecting parts of the network such as bus bars, generators, transformers, motors and feeder lines [14]. Distance protection is faster and more selective than over-current protection because it is less prone to power system fluctuations [6], [8]. A distance protection can be adapted easily to a unit protection scheme when applied with a communication connector [2], [9]. Basically, a distance relay controls the impedance of the faulted portion of a transmission line from the measured voltages and currents at the relay location [13]. When the measured fault impedance is matched with the impedance of the transmission line to be protected, the existence of fault on the transmission line can be determined between the relay and the fault point [5]. This suggests that the distance protection method can reach a protection decision with the measured voltage and current at the relay location [1]. The protection of any system or network is done through distinctive protective and automation equipment [6]. The continuity of electricity supply to consumers is guaranteed through standard automation techniques [4]. A short circuit study that determines the fault current is the prerequisite for distance protection scheme [8], [11]. Short circuit study used to determine the magnitude of short circuit current in the transmission network during short circuit condition [12]. An interrupting device that interrupts short circuit current is connected to the transmission station under study in order to provide protection against excessive destruction when a short circuit fault occurs [7], [12]. A short circuit current is usually very large. It can result to large release of energy in the form of heat, strong magnetic fields and as explosions, which is known as an arc blast or arc fault. The heat can destroy the wiring insulation and electrical components [11]. An arc blast produces a shock wave that could carry molten metal or vapour, which can be fatal to unprotected people who are close by. Thus, a short-circuit calculation is required for the coordination of distance protective relays and the rating of equipment is also determined [11]. Hence, the simulation of the three-phase short circuit study was carried out on the transmission network under consideration to identify improvement opportunities that may lead to a novel application of distance protection scheme, a further interest of the researchers which is on-going.

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