American Journal of Engineering Research (AJER) 2021
American Journal of Engineering Research (AJER)
e-ISSN: 2320-0847 p-ISSN : 2320-0936
Volume-10, Issue-05, pp: 292-298
www.ajer.org
Research Paper Open Access

Upgrade Trans-Amadi 33kv Network For Protective Relay Coordination Using Short-Circuit Current Calculations Technique

OHORE, Timipre Utomeno, D.C. IDONIBOYEOBU, S.L. BRAIDE
[1,2&3]*(Electrical Engineering Department, Rivers State University.)*

ABSTRACT: *The Trans-Amadi 33kV Network in this study was updated to include safety relays using short circuit current calculation and a new coordination method; Protective relay equipment isolates easily the portion of low voltage and medium voltage industrial and commercial power systems. For case study simulation was used for the Electrical Transient Analyzer (ETAP version 12.6). Each of 11 kV bar voltages was supplied with only one transformer. The symmetrical interruption task of the worst case in case of defect will be reduced to around 250 MVA. The system, its parts and the use of the equipment it supplies would therefore mitigate potential harm. The Time Dial Setting (TDS) relay number was simulated at close end fault. The highest setting for the time dial of 1.155 sec is from our data, followed by the 12th relay with 1.019 sec time dial, while 13 and 15 are with the lowest setting for the time dial of 0.14 seq. Similarly, the change in the relay number was also simulated with the operating time (Near End Fault) and TDS. The results showed that the time dial settings (not DGs) had relay number 14 to run the highest. The 1.054 sec time dial setting is followed by the 16-sec relay with a 1.036 sec time dial setting, and 14 has a 0.145 sec minimum time dial setting. The fault is almost ten times the current through the feeder. As a result of this higher current value, operating time of current relays can decrease when the system is not faulty relative to the situation.*

Keywords*: Relay, Protections, Short Circuit, Current, Power System, Faults.*

Date of Submission: 12-05-2021 Date of acceptance: 25-05-2021

I. INTRODUCTION

In a case study on the trans-Amadi/ Gas Turbine, a 33KV Radial Distribution Network was investigated, from the Oginigba connection to the Trans-Amadi Ordinance Ring Road (generators). Coordination of relays is an instrument in which any relay nearest to the defect location works, but the backup relay works sequentially to secure the backup in cases of failure. A distinction is made when selecting or setting the operating order of the relays for the various stages of the current levels. In an ordered (healthy) portion of the network, irregular relay synchronization often ends needed trips.

Basically, the correct syncing of relays, combined with backup protection, often protects the power grid. To allow its correct operational series, a specific time interval must be preserved and the selectivity, taking into account the time interval, must be retained. But the time grading technique will tackle the issue of selectivity of current relays. In case of failure to operate, backup protection for each primary relay unit is given. The backup relay needs to be able to remove the fault in order to coordinate this protection with the main relay and related breaker (Javadian et al., 2009).

PHEDC (Port Harcourt Electricity Distribution Company) office obtained a single line diagram of the 33KV trans-Amadi network from Oginigba connecting road to the Ordinance roundabout. The power systems are very critical if fault is to be properly recognized and if the current and earth failure relay co-ordination is to be corrected. These relays should be in a position to differentiate normal from continuous operating currents over current, because of irregular network conditions, to operate in poor circumstances and to maintain healthy circuits as quickly as possible. If primary relays do not succeed, backup relays must work after a time delay, since they are synchronized for smooth operations (Rinzin et al., 2007).

OCRs based on the complete power system part charging current by defining the concept (Tuitemwong & Premrudeepreechacharn, 2007). The first relay to protect the power grid, which has been supplied with current and voltage from current and power transformers was electromechanical relays. This was the solid state form that uses operational amplifiers. The use of the microprocessor needed computers that basically have digital and numerical relays to protect the power system

II. RELATED WORKS

This work evaluates the analytical approach and the method proposed for optimal dimensioning and positioning of the DG in the area of interest to help minimize the network's active power losses. The Distributed Generator (DG) is a generator linked to the distribution network, says Ahmed et al. (2013). They can minimize or delay, where optimally placed, investments in the transport and distribution networks, even reduce technical losses within the distribution network and increase overall power quality and system reliability Nigeria suffers from power supply, voltage instability, high transmission and distribution losses as well as poor efficiency (Nebo, 2013). Distribution generators (DGs) are not intended to be centrally planned or dispatched. The distribution network is typically connected between 50 and 100 MW. The distribution network.

DGs are integrated into distribution networks by frequency breaks, onset pureness, the ability to rapidly isolate failing machinery from other instruments and the ability to withstand irregular conditions. The DG has been determined to have optimum size and location in order to mitigate active power loss using an exact loss formula (ACHARYA et al. 2006). This is best found by the DG for a single DG system positioning when only active power is provided. The precise position of single DG placing has also been selected by the loss-sensitivity factors to minimize the number of bus bars in the search room. In order to assign DGs in a standard network, a solution based on a Hereford ranch algorithm was proposed (Loanna & Marjan, 2010).

The algorithm is designed to assign DGs to optimize output by minimizing network loss. The findings are similar to traditional second-order and generic (GA) techniques. The findings have been shown. The GA procedure was used to find an optimum network device size and bus location based on bus admission, system generation data and load delivery. On 16, 37 and 75-bus systems the efficiency of the proposed method is checked. As suggested by Abbagana etal. (2012), an approach to differential evolution has established the optimum location and size of DG units.

DG services were primarily incorporated into the network in order to reduce power loss and increase device voltage profile as was the case with previous upgrades. The technology of optimization used in single DG sizing and positioning, however, did not take multiple DG injections into account In recent years, Single et al. (2012) has implemented an exact loss formula for DG placement on the site with a view to reducing system power loss in the radial distribution network to minimizing losses. This involves calculating the optimum size of the DG on different buses using the exact loss format-based expression and estimated total losses using an autobus-injection-based DG algorithm in order to identify the best spot. An algorithm based on Bus Injecting into Branch Current (BIBC) and Bus Voltage (BCBV) matrices can solve the load flow problem of radial distributor networks. The proposal is computer-intensive, which can cause error at the best DG position and minimize device power loss.

III. ANALYSIS

This analysis shows that the electricity distribution system for the Trans Amadi Network has a short-circuit study and relay coordination. This network shows the electricity efficiency of the entire system for delivery, so that increased load capacity, better reliable and secure for the network are achieved and the necessary data were collected from Port Harcourt Electricity Distribution Corporation (PHEDC). A tool was used for hand calculations to verify the safety of arresters of lightning, voltage and differential protection of transformers while Electrical Transient and Analyzer Program software was used to verify the protection of relays (ETAP Version 12.6). A new 33kV feeder from the current structure between the 2 x 15 MVA, 33/11kV containing a primary circuit switch is being installed to increase the electricity efficiency of a network by modernizing power house electrical facilities. A new secondary air system breaker and a new inbound air circuit breaker would be deliberately supplied from the transformer to the powerhouse. With the appropriate relay synchronization throughout the device, the new incoming circuit breaker is associated.

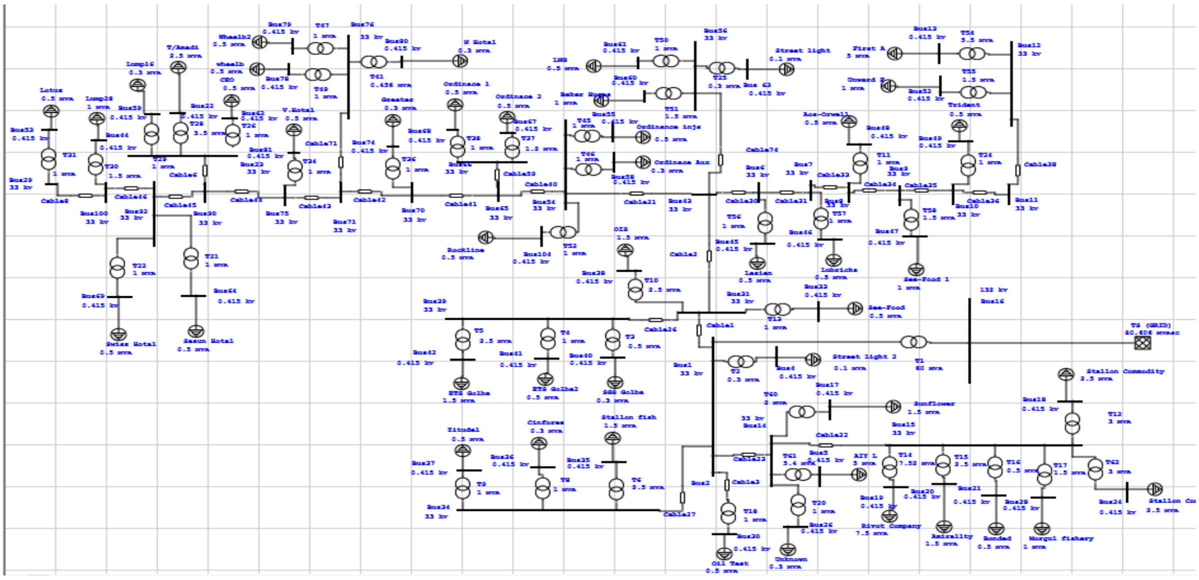

Figure 1: Single Line Diagram of Trans-Amadi 2 X 15MVA, 33/11kv Injection Substation

IV. RESULTS AND DISCUSSION

This work presents the various results obtained when the network was simulated as well as the calculated cases, and discuss what such results depicts in reality. The various tables gotten from simulation and calculation are presented below. This discussion begins with the presentation of the various network simulated results obtained from Electrical Transient Analyser Program (ETAP) software version 12.6.

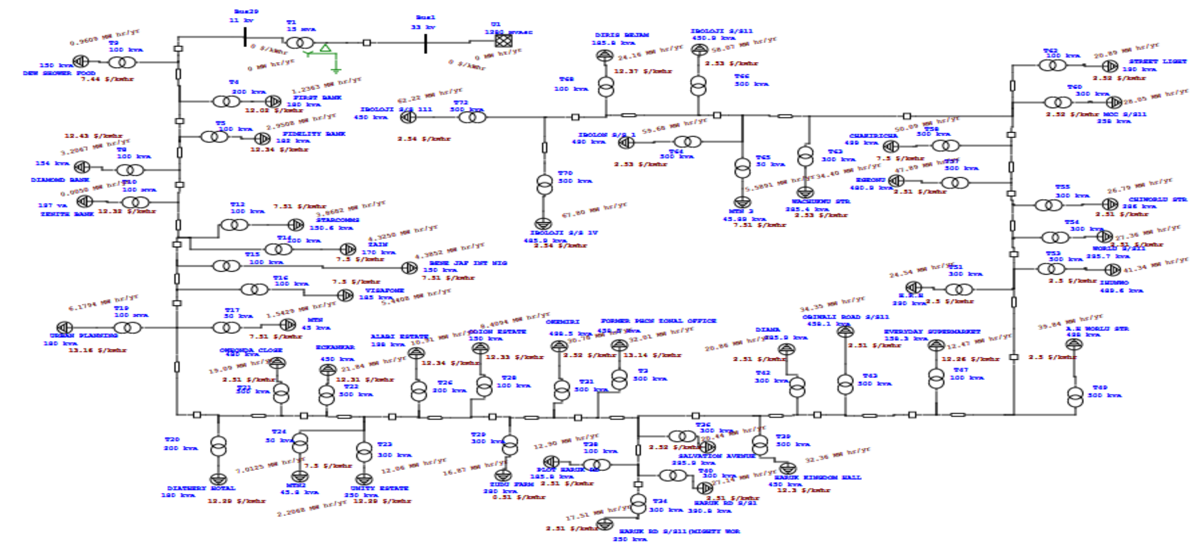

Figure 2: Simulated Network Diagram of Trans-Amadi Injection Substation

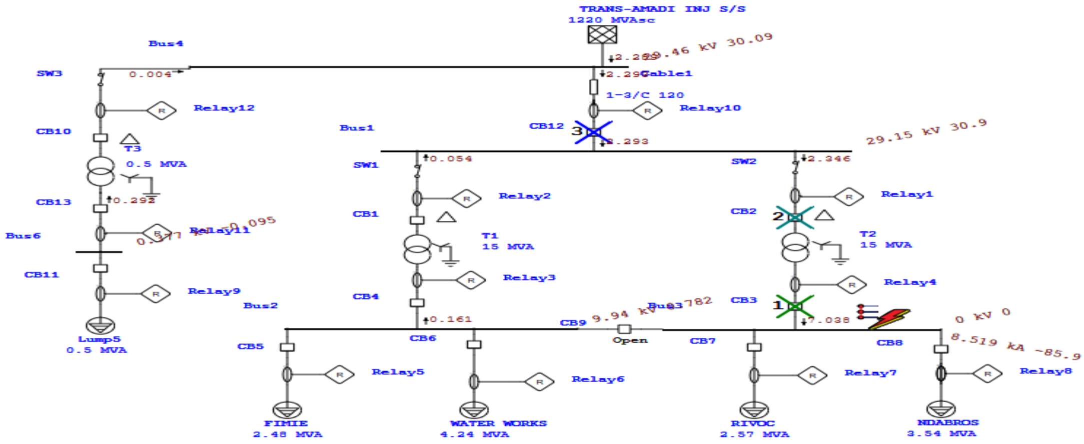

Figure 3: Simulated Network Diagram of T2 11kV Incomer (New case)

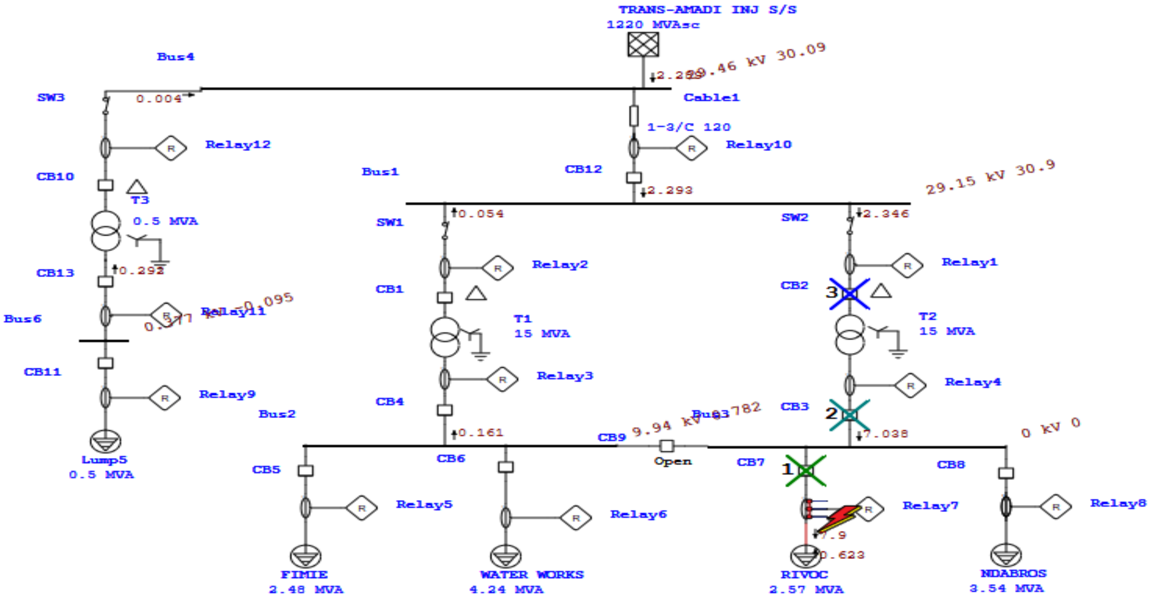

Figure 4: Simulated Network diagram of RIVOC 11kV Feeder (New case)

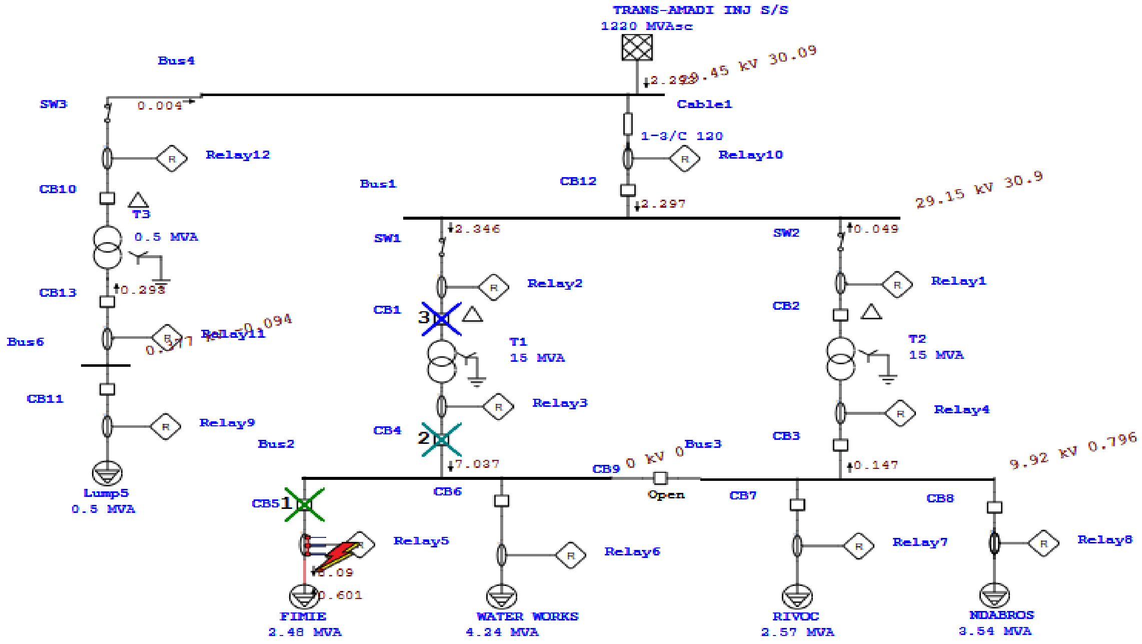

Figure 5: Simulated Network diagram of T1A 11kV Incomer (New case)

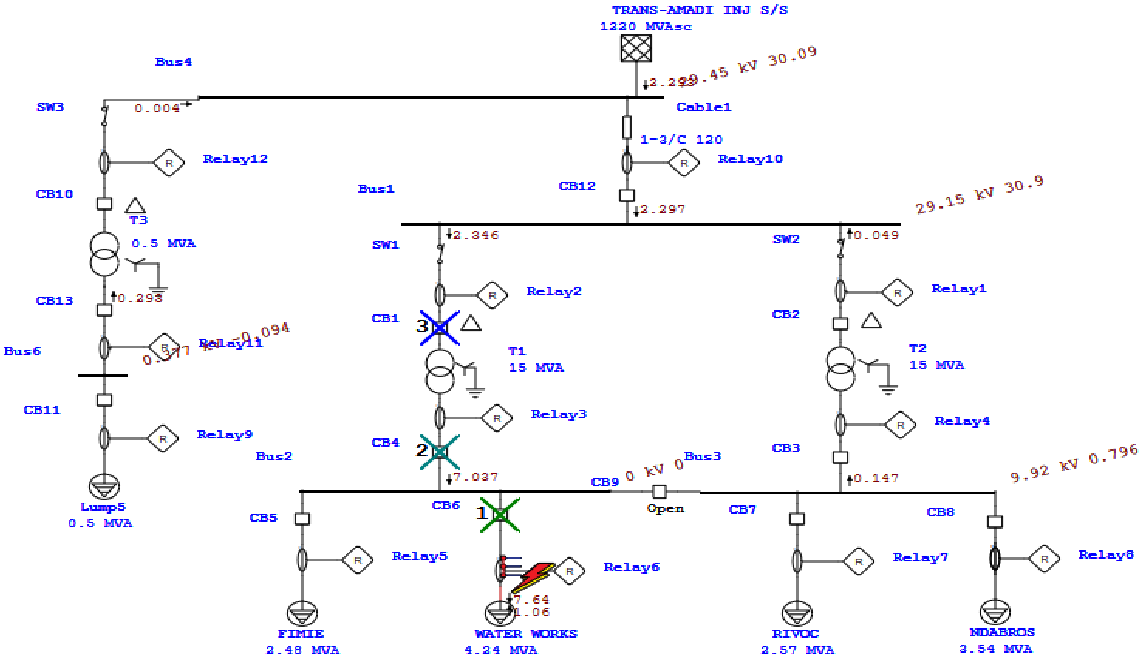

Figure 6: Simulated Network Diagram of Water Work 11kV Feeder (New case)

Table 1: Calculation of Operating Time and TDS in Grid Connected Mode

Relay No.	Operating	*Time and TDS	
	TDS	Near End Fault	Far End Fault
1	0.192	0.883	0.960
2	0.050	0.680	…
3	0.191	0.859	0.9468
4	0.050	1.000	…
5	0.132	0.646	0.688
6	0.144	0.993	1.300
7	0.150	0.660	0.707
8	0.032	0.544	0.980
9	0.110	0.407	0.440
10	0.084	0.633	0.844

11	0.097	0.388	0.440
12	0.182	1.019	1.293
13	0.050	0.140	…
14	0.231	1.155	1.319
15	0.050	0.140	…
16	0.173	0.761	0.933

Table 1 shows the simulation results for the calculation of TDS and operating time for the various overcurrent relays connected to the distribution system.

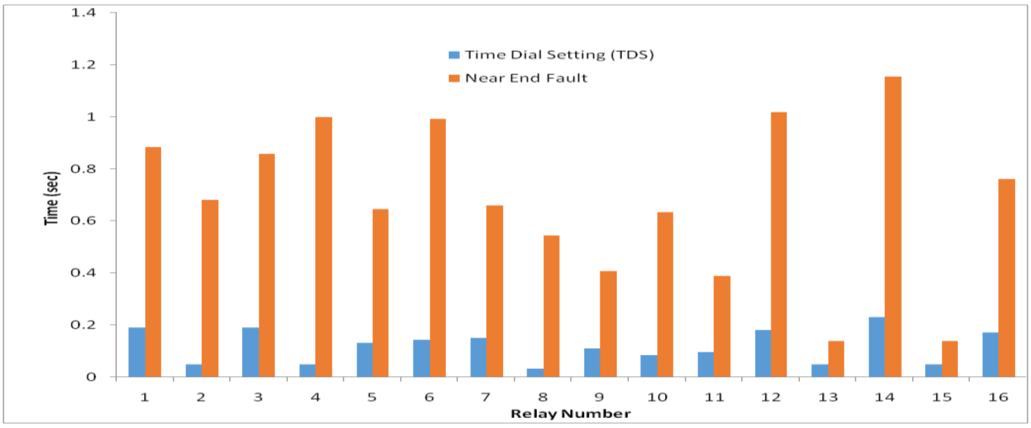

Figure 7: Variation of Relay Number with TDS and Near End Fault

Figure 1 illustrate the variation of relays number with Time Dial Setting (TDS) and near end fault. From the result relay number 14 has the highest Time dial setting with 1.155 sec followed by relay number 12 with Time dial setting of 1.019 sec while 13 and 15 has the lowest time dial setting of 0.14 sec respectively.

Table 2: Optimized calculation of TDS and its comparison in grid connected mode

Relay No.	Calculation of TDS by using DG and comparison with un-optimized value	
	TDS (without DG)	TDS (with DG)
1	0.192	0.1002
2	0.050	0.0160
3	0.191	0.1020
4	0.050	0.0116
5	0.132	0.0411
6	0.144	0.0549
7	0.150	0.0459
8	0.032	0.0250
9	0.110	0.1300
10	0.084	0.0270
11	0.097	0.1180
12	0.182	0.0340
13	0.050	0.0751
14	0.231	0.0826
15	0.050	0.0729
16	0.173	0.0954

Table 2 demonstrates the comparison of TDS of individual relays with and without optimization. For majority of relays available in the system, the optimized value of TDS is slightly lower than the un-optimized value. Thus the range of coordination for OCRs in the system increases and also the relay operating time will be more.

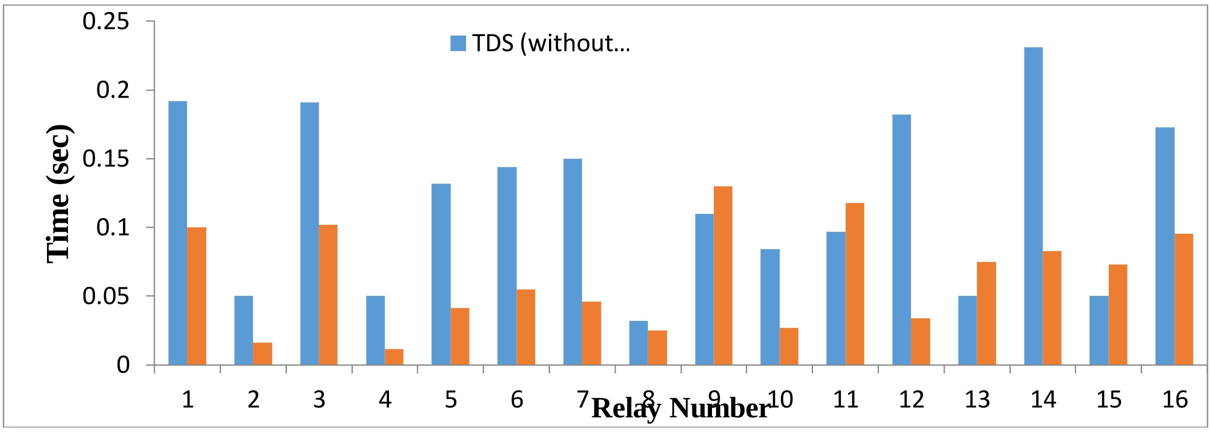

Figure 8: Variation of Relay Number with TDS (without DG) and TDS (with DG)

Figure 2 illustrate the variation of relay number with TDS (without DG) and TDS (with DG). From the result, the Time Dial Setting (without DG) has relay number 14 to operate with the highest Time dial setting of 0.231 sec followed by relay number 1 with Time dial setting of 0.192 sec while 2 and 13 has the lowest time dial setting of 0.14 sec respectively. Similarly, for Time Dial Setting (with DG) has relay number 11 to operate with the highest Time dial setting of 0.118 sec followed by relay number 3 with Time dial setting of 0.102 sec while 4 has the lowest time dial setting of 0.0116 sec respectively.

V. CONCLUSION

This research work critically examined the upgrade of Trans-Amadi 33kV Network Distributed Generation for Protective Relay Coordination using short-circuit-current calculations methods as new method of coordination by means of protecting relays for quick isolation of the affected portion of low-voltage and medium-voltage industrial and commercial power systems. However, the use of Electrical Transient and Analysis Program (ETAP Version 12.6) was used for simulation of the case study.

REFERENCES

[1]. Abbagana, M., Bakare G. A., & Mustapha I. (2012). Optimal Placement and sizing of distributed Generator in a power Distribution System Using Differential Evolution", International journal of Research in Engineering, 2(4), 26-42.

[2]. Acharya, N., Mahat, P., & Mithulananthan, N. (2006). "An Analytical Approach for DG Allocation in Primary Distribution Network", International Journal of Power and Energy systems, 7(3), 669.

[3]. Ahmed, K., Alaam, M. A., Ahmed M. A., & Abdelaziz, A. Y. (2013)." Protection coordination for distribution systems in presence of distributed generators", Electric power Components and systems, 41(5),1555-1566.

[4]. Rinzin, C., Tashi, N.,& Tshewang, S. (2017). Overcurrent Relay Coordination in Distribution System. (A Case Study on Phuentsholing Low Voltage Distribution Network), Department of Electrical Engineering, Royal University of Bhutan, 3-5.

[5]. Tuitemwong, K., & Premrudeepreechacharn, P. (2007). "Expert System for Protective Devices Coordination in Radial Distribution Network with Small Power Producers", *Power Tech,2007 IEEE Lausanne*, 20(10): 1159-1164.

[6]. Javadian, S. M., Haghifam, M. R., &Rezaei, N. (2009). "A fault location and protection scheme for distribution systems in presence of dg using MLP neural networks", IEEE power & energy society general meeting; 20(5):1–8.

[7]. Loanna, X., &Marjan, P. (2010). "Smart Protection in Dutch medium voltage distributed generation", *Intelligent power system project 10P-EMVT program (Innovation Oriented Research program-Electromagnetic power technologies, IEEE PES Innovative smart Grid Technologies Conference, pp. 1-8.*

[8]. Nebo, C. & Kuchi, H. (2011). "Federal Ministry of power presentation at the Ministerial Platform for the period presented on July 23rd 2013" *Retrieved from fml.gov.ng/wp.*

[9]. Ram, S., Gursewalk, S., &Navdeep, K. (2012). "Optimal placement of DG in Radial distribution Network for Minimization of Losses", *International Journal of Advanced Research in electrical, Electronics and Instrumentation Engineering* vol. 1(2): 84–90.

OHORE, Timipre Utomeno, et. al. "Upgrade Trans-Amadi 33kv Network For Protective Relay Coordination Using Short-Circuit Current Calculations Technique."*American Journal of Engineering Research (AJER),* vol. 10(5), 2021, pp. 292-298.