EVALUATION AND IMPROVEMENT OF POWER QUALITY ON DISTRIBUTION NETWORK: A CASE STUDY OF COVENANT UNIVERSITY, OTA

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SEPTEMBER, 2020

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A DISSERTATION SUBMITTED TO THE SCHOOL OF POSTGRADUATE STUDIES IN PARTIAL FULFILLMENT OF THE REQUIREMENTS FOR THE AWARD OF MASTER OF ENGINEERING (M.ENG) DEGREE IN ELECTRICAL AND ELECTRONICS ENGINEERING IN THE DEPARTMENT OF ELECTRICAL AND INFORMATION ENGINEERING, COLLEGE OF ENGINEERING, COVENANT UNIVERSITY.

SEPTEMBER, 2020

ACCEPTANCE

This is to attest that this dissertation is accepted in partial fulfilment of the requirements for the award of the degree of Master of Engineering in Electrical and Electronics Engineering in the Department of Electrical and Electronics Engineering, College of Engineering, Covenant University, Ota, Nigeria.

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DECLARATION

I, **DAUDU, AFAH TOYIN (18PCK01777)** declare that this research was carried out by me under the supervision of Dr. Isaac A. Samuel of the Department of Electrical and Information Engineering, College of Engineering, Covenant University, Ota, Nigeria. I attest that the dissertation has not been presented either wholly or partially for the award of any degree elsewhere. All sources of data and scholarly information used in this dissertation are duly acknowledged.

DAUDU, AFAH TOYIN **Signature and Date**

CERTIFICATION

We certify that this dissertation titled "**EVALUATION AND IMPROVEMENT OF POWER QUALITY ON DISTRIBUTION NETWORK: A CASE STUDY OF COVENANT UNIVERSITY, OTA**" is an original research work carried out by **DAUDU, AFAH TOYIN (18PCK01777)** in the Department of Electrical and Information Engineering, College of Engineering, Covenant University, Ota, Ogun State, Nigeria under the supervision of Dr. Isaac A. Samuel. We have examined and found this work acceptable as part of the requirements for the award of Masters of Engineering in Electrical and Electronics Engineering.

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DEDICATION

This dissertation is dedicated, first of all, to the Almighty God for His mercies, grace, wisdom, and favour throughout the Masters' programme. It is also committed to my dear parents, Mr and Mrs Daudu, siblings Engr. Moses and ACA David and friends for all their love, guidance, support, and prayers.

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LIST OF ABBREVIATIONS

APF	Active Power Filter
CDS	College of Development Studies
CF	Composite Filter
CFL	Compact-Fluorescent Lamps
CST	College of Science and Technology
DL	Dump Load
DPF	Displacement Power Factor
DVR	Dynamic Voltage Restorer
EFT's	Extremely Fast Transients
EIE	Electrical and Information Engineering
FFT	Fast Fourier Transform
HLF	Harmonic Load Flow
IC	Incandescent Lamps
IEC	International Electro-technical Commission
IEEE	Institute of Electrical and Electronics Engineering
I_L	Maximum Demand Load Current
I_{SC}	Maximum Short-Circuit Current
LED	Light Emitting Diode
MPSOA	Modified Particle Swarm Optimization Algorithm
PCC	Point of Common Coupling
PF	Power Factor
Plt	Long-term flicker
Pst	Short term flicker
RMS	Root-Mean-Square
RVC	Rapid Voltage Change
SMPS	Switch Mode Power Supplies
STFT	Short Time Fourier Transform
SVC	Static Var Compensators
TCR	Thyristor Controlled Reactor
TDD	Total Demand Distortion

THD	Total Harmonic Distortion
TPF	True Power Factor
TRMS	True Root Mean Square
TSC	Thyristor Switched Capacitor
TVSS	Transient Voltage Surge Suppressor
UPQC	Unified Power Quality Conditioner
UPS	Uninterrupted Power Supply

ABSTRACT

Power quality is a global issue due to electronic equipment becoming the backbone of the modern-day economy; it affects consumers, distribution, and transmission networks. This research work focuses on evaluating and proposing improvement of the measured power quality on the distribution network in Covenant University. Electrical equipment used in Covenant University can lead to power quality problems, measurements and evaluations are to be done from time to time to monitor the distribution network. In the proposed approach, this is done in three phases. First, the measurement was carried out on five powerhouses in Covenant University using the Circutor aR6 power analyzer. Secondly, the power vision software was used to get the evaluations which include tables and graphs and thirdly the NEPLAN software was used to simulate the network evaluated. The measurement was taken during the school session while students were still at the University. The evaluation result was compared with the IEEE power quality standard that has been put in place. The measurement was carried out at 500kVA, 11KV/415V/230V on the outgoing circuit for each of the transformers. The power quality issues identified in the powerhouses were harmonics, total harmonics distortion (THD), overload, and lagging power factor. The proposed improvement gotten from simulation using NEPLAN software in this Research is active harmonic filters which reduces the harmonics; shunt capacitor for power factor correction for the lagging power factor, and load sharing for the overloaded transformer. This proposed improvements will improve equipment life, reduce heat losses, and reduce utility costs.

The shunt capacitor was connected to compensate for the lagging power factor which draws current leading to the source voltage, which gave a value of 0.96 from -0.96. The active filter connected to the College of Development Studies powerhouse gave a THD value of 0.91% from 7.28%, the THD for Electrical and Information Engineering powerhouse had a value of 3.54% from 10.52%, the THD for College of Science and Technology powerhouse had a value of 0.58% from 16.03%, the THD for the Library powerhouse had a value of 0.12% from 11.92%, and the THD for the Male hostel powerhouse had a value of 0.24% from 16.71%. These imply that the active filter improved the THD across all the powerhouses as it within the specified range.

Keywords: Power quality, IEEE, NEPLAN, Circutor aR6 power analyzer, Power vision software, Harmonics, THD, Capacitors, Filters.