DUT DURBAN UNIVERSITY OF TECHNOLOGY

ELECTRICAL POWER ENGINEERING

Department of Electrical Power Engineering

Postgraduate Research Template

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	Student Name / Surname	Abayomi Aduragba Adebiyi	**Start Date**	February 2018	**Supervisor**	Prof. I.J Lazarus
	Title of Project	Performance Analysis and Optimization of a distribution grid-tied photovoltaic system	**Completion**	September 2020	**Co-Supervisor(s)**	Prof. A.K Saha Dr. E.E Ojo
	Program of Study (M Eng. / D.Eng.)		D. Eng.			
	Student #	21556780	**Email Address**		abassbiyi@gmail.com 21556780@dut4life.co.za	

Synopsis of Research Project: (< 300 words)

The global acceptance of usage of the grid-tied photovoltaic (PV) system has improved greatly in order to meet the rising demand for clean energy. The exponential acceptance and extensive integration of PV systems in existing low voltage (LV) distribution grids is raising additional new challenges in terms of power quality, stability and protection.

In distribution grids, poor power quality (PQ) is the most serious concern. Characteristically, distribution grids are not designed for bi-directional flow of power. Also, these grids are unbalanced in nature due to unevenness in system impedances and single-phase loads. This together with a large number of small-scale PV system integrations on the grids can cause poor PQ challenges in terms of voltage quality and harmonics.

PV systems can themselves generate harmonics, due to the usage of power electronic inverters. In addition, the increase of power electronics based appliances; the loads are becoming voltage sensitive and nonlinear in nature. The proliferation of widespread PV penetrations and a multitude of nonlinear load characteristics can have a stringent impact on the network harmonic levels.

Therefore, the main objective of this research is to investigate and analyse the impacts of high PV systems penetration on PQ of the distribution grid and aim to mitigate them via a novel optimization algorithm.

In the first part of this study, the performance analysis of voltage quality challenges in the distribution network with high PV penetration will be discussed. Also, various voltage quality issues such as voltage rise, unbalance, fluctuations/flicker and sag/swell issues will be explored.

Primarily, the analysis of results will be carried out through MATLAB/Simulink simulations in

different scenarios. For this purpose, an IEEE-13 bus unbalanced distribution network is considered as a test system.

Furthermore, to evaluate the severity of voltage quality issues in real-time grid-tied PV systems, field measurement based investigations will be performed. Practical field tests will be conducted at the 8kW PV systems located at the Durban University of Technology (DUT). The impact of dynamic variations in solar irradiation also will be taken into account for the analysis.

In the second part of this study, the characteristics of harmonic emissions from PV inverters and their accumulations during various operating conditions will be analysed. The simulation results will be validated with the field measurement data collected by various PQ analysers connected at the DUT PV site. Furthermore, this research will suggest a novel solution to overcome the above PQ issues.