Impact of Distributed Generation on Voltage Profile and Losses of Distribution Network

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CERTIFICATE

We accept the work contained in this report as a confirmation to the required standard for the partial fulfillment of the degree of MS (EE).

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DECLARATION OF AUTHORSHIP

I hereby declare that content of this thesis is my own work and that it is the result of work done during the period of registration. To the best of my knowledge, it contains no material previously published or written by another person nor material which to a substantial extent has been accepted for the award of any other degree or diploma of the university or other institute of higher learning, except where due acknowledgement has been made in the text.

Parts of this thesis appeared in the following publication, to which I have made substantial contributions:

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ABSTRACT

Energy crises are rising all over the world. The demand of electricity is increasing as the industrialization as well as the population of the World is increasing day by day. In this context not only the energy production is a key to fulfil consumer demands but also the losses of the distribution network need to be minimized. In addition to this, Electricity has to be delivered within the claimed levels by the utility to the end consumer. Distributed generation (DG) together with the centralized generation (CG) can be used to fulfil the energy demands.

Distributed generation integration into the system can improve the voltage profile of the system as well as reduce the losses of the system, though it depends on the nature of a distributed generation source as well as its location of integration into the system.

In this research project, work has been done on the system to improve its voltage profile, minimize the amount of losses of the network and enhance energy production. For this purpose, a test system is designed in ETAP and this test system is analyzed with and without the impact of different DG sources. Different DG sources with different nature from each other are selected for test purposes. These sources include synchronous generator, wind turbine generator and photovoltaic modules. These DG sources are designed in ETAP and then integrated into the test system. After simulation of different DG scenarios results are compared with the base cases and recommendation are made.

Keywords: Distributed Generation, Distributed Generation Integration, Point of Common Coupling, Voltage Profile Improvement, Power Losses, Renewable Energy, Photovoltaic, Wind Turbine Generator, Synchronous Generator.

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ABBREVIATIONS

DG: Distributed Generation

ETAP: Electrical Transient Analyzer Program

CG: Centralized Generation

PV: Photovoltaic

WTG: Wind Turbine Generator

SG: Synchronous Generator

IEA: International Energy Agency

GW: Gigawatt

MW: Megawatt

IEEE: Institute of Electrical and Electronics Engineers

CIGRE: International Council on Large Electricity Systems

EPRI: Electric Power Research Institute

DC: Direct Current

AC: Alternating Current

MPPT: Maximum Power Point Tracking system

MVA: Mega Volt Ampere

MVAR: Mega Volt Amperes Reactive

MW: Megawatts

WECC: Western Electricity Coordinating Council

WAPDA: Water and Power Development Authority

PESCO: Peshawar Electric Supply Company