

# TRANSIENT STABILITY ANALYSIS OF DISTRIBUTED GENERATION

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## Abstract

The commonly used distributed generation technologies include wind generators, photo voltaic and biomass generators with their sizes varying between KW to a few MW. Due to increased demand in power supply the role of these distributed generators become inevitable in power systems. This work deals with analyzing the transient stability indicators i.e., the variation of distributed generator terminal voltage, local side terminal voltage and rotor speed during different fault conditions when it is connected to the electric grid along with storage device (Lithium-ion battery). Three bus test system is considered for the analysis and MATLAB / Simulink power systems tool is used as a software tool to show the performance.

**Keywords:-** Transient Stability, Distributed Generator, Lithium Ion Battery, Terminal Voltage and Rotor Speed Deviation.

## 1. INTRODUCTION

Distributed generation is getting a lot of focus in recent years due to various energy and environmental concerns. Unlike the conventional generators, the distributed generators use both non-renewable and renewable sources of energy to generate electricity. Major technical and economic issues arise when these DG's are interconnected with the electric grid. The technical issues include stability, power quality, protection issues and voltage fluctuations. It has to be noted that certain renewable generators such as wind and solar do not produce power at a constant rate since they are dependent on the natural forces. This makes the use of storage devices very essential.

There has been increased point up in the decades on the concept of smoothing intermittent output of distributed generation (DG) using energy storage [1]. DGs can be defined as the concept of connecting generating units of small sizes, between several kW to a few MW. The primary source of energy for these generators can be the traditional non - renewable sources such as gas or the renewable sources such as wind, solar, hyden, and biomass [3]. These generators are connected either to the medium voltage or low voltage sections of the electric grid. Most often they are connected near the load centers or the low voltage networks.

In case of certain renewable technologies, such as wind turbines and solar panels, the output power depends upon the availability of renewable resource and therefore may not always be constant. In such cases, in order to augment the DGs during low power periods, energy storage devices are used [3]. Other than wind and solar, storage can help in

smoothing the power in conjunction with biomass especially for rural combined heating and power applications. These devices store energy during periods of high power or low demand and use the stored energy to supply the excess loads during periods of low power. Different types of energy storage devices that are used in a distributed environment include batteries, ultra capacitors, flywheels, fuel cells and superconducting magnetic energy storage [4]-[7]. In addition to supporting the DGs during peak demand, the storage devices may also help in improving the overall stability of the entire system. These energy storage devices are connected to the electric grid by means of suitable power conversion devices [8]-[10].

Certain DG techniques such as wind and solar, do not output constant power at all times. In such cases, storage of power for later use becomes essential. The energy storage devices store power from the DG's during times of normal output and low loads. This stored energy can be used at time when there is no DG output or during periods of high demands. The storage device that needs to be used depends upon the application, amount of storage needed and the duration of storage. Most of the storage devices are DC, so we need power electronic interfaces to connect them to the AC system.

DG's can operate in two modes namely stand-alone and grid connected. The grid connected mode has drawn a lot of attention and analysis recently, due to its impacts on the grid. Though the DG has a lot of advantages, it also has some negative impacts especially when connected to the grid.

# Transient Stability Analysis Of Distributed Generation

**Robert R. Redfield**



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