Power Quality Enhancement for a Grid Connected Wind Turbine Energy System

Introduction:
Global capacity of installed wind turbines has rapidly increased in the last few years, by there were About 300 GW of installed wind capacity. There have been tremendous developments in the wind turbine industry supporting this energy source as a mainstream renewable resource, with competitive costs in /kwh when compared to traditional fossil fuel power plants.

This development is due to the advancement in electrical generators and power electronics. The main issue with renewable energy is that the power is not always available when it is needed.

Existing system:
Different power theories have been proposed and implemented in electrical power systems to analyze current and voltage components, such as the instantaneous power (PQ) theory for a three-phase system made .In PQ theory, the three-phase is transformed into a two-phase reference frame in order to extract active and reactive components in a simplified manner.

A three-phase power theory in a broader perspective has been introduced, known as the conservative power theory (CPT), where the current and voltage components are derived in the Three-phase form, without requiring any reference-frame transformation.
Dis-advantages:

- More complexity.
- Poor efficiency.

Proposed system:

A control structure in three-phase four wire systems that provide more functionality to the grid-side Converter of a wind turbine system using the CPT as an alternative to generating different current references for selective disturbances compensation, where both single- and three-phase loads are fed. Three-phase, four-wire inverters have been realized using conventional three-leg converters with “split capacitor” or four-leg converters.

In a three-leg conventional converter, the ac neutral wire is directly connected to the electrical midpoint of the dc bus. In four-leg converter, the ac neutral wire connection is provided through the fourth switch leg. The “four-leg” converter topology has better controllability than the “split-capacitor” converter topology.

The Considered system consists of single- and three-phase linear and nonlinear (balanced and unbalanced) loads. The CPT is used to identify and to quantify the amount of resistive, reactive, unbalanced, and nonlinear characteristics of a particular load under different supply voltages condition for four-wire system.

Advantages:

- Significant flexibility to the control structure.
- Impress the set-point reference and impose disturbances mitigation.
Applications:
- Power distribution applications.

Block Diagram:

- Wind source
- PMSG
- Machine Side Converter
- Four Leg CPT based Grid Side Converter
- Load
- 12VDC
- Gate driver circuit
- Buffer circuit
- 5VDC
- Microcontroller circuit