Chapter 2

2. Wind Modelling

2.1. System configuration

Puttlam 132/33kV Grid Substation (GS) and Puttlam Power Station (PS) Switchyard were considered as the grid integration points for the wind power generated around Kalpitiya area as they are located in the vicinity of the wind sites. This study assumes that the wind power generated at various sites around Kalpitiya area will be taken in to Puttlam GS or Puttlam PS using 33kV feeders. This study uses GE 3.6 MW wind turbines to model wind machines. Relevant WTG data are depicted on table 2-1 [10].

Description	Unit	Value
Generator Rating	MVA	4
P_{max}	MW	3.6
P_{min}	MW	0.16
Q_{max}	Mvar	2.08
Q_{min}	Mvar	-1.55
Terminal voltage for 50 Hz	V	3300
X_{source}	p.u	0.8
Unit transformer rating	MVA	4
Unit transformer impedance	%	7
Unit transformer	X/R	7.5

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Table 2-1: Data for GE 3.6 MW WTG model.

As the terminal voltage of the 3.6MW GE wind turbine for 50Hz system is 3.3kV, appropriately rated 3.3/33kV transformers were used for each WTG. The point of common coupling (PCC) was taken as 33kV for year 2010 system. The absorption capabilities were analyzed by considering both 220kV and 132kV voltage levels as PCC for year 2012, 2014 and 2016 systems. It was proposed that 33/220kV transformers at Puttlam coal power plant site be used to integrate wind power at 220kV level. The proposed system configuration is shown in figure 2.1.

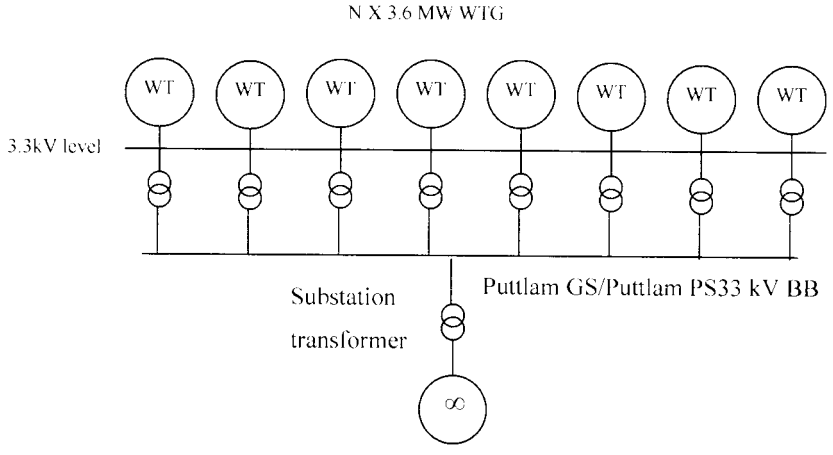

Figure 2.1: Proposed system configuration

2.2. Modelling in power flow

A wind turbine in power flow is treated as a conventional machine. Although the wind farm is made-up of a large number of individual wind generators, this study is based on a reasonable assumption. The assumption is that all machines parallel into a single equivalent large machine behind a single equivalent reactance. Such a model is shown in figure 2.2.

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The GE 3.6 MW model which is used in this study is applicable to other vintage wind turbine generators as long as the basic principle of power conversion and control are the same [10].

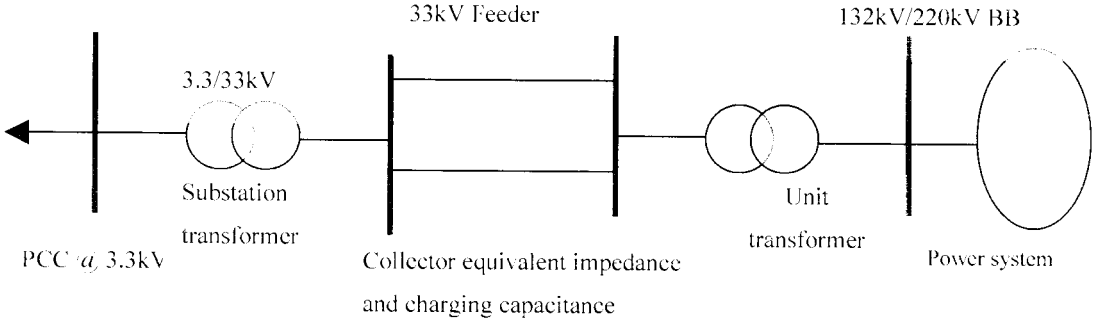

Figure 2.2: Simplified wind farm power flow model

2.3. Modelling for dynamics

The DIFG model used for this study has seven modules. They are:

1. Generator and converter module – GEWTG1
2. Electrical control module – GEWTE1

3. Shaft module - GEWTT
4. Pitch control module - GEWTP
5. Aerodynamic module - GEWTA
6. Active power control module – GEW1E1
7. Wind gust module - WGUSTC

Functional descriptions of each module is provided in the technical guide "Modelling of GE Wind Turbine Generators for Grid Studies", which is available with the software package. The connectivity diagram is shown in figure 2.3[11].

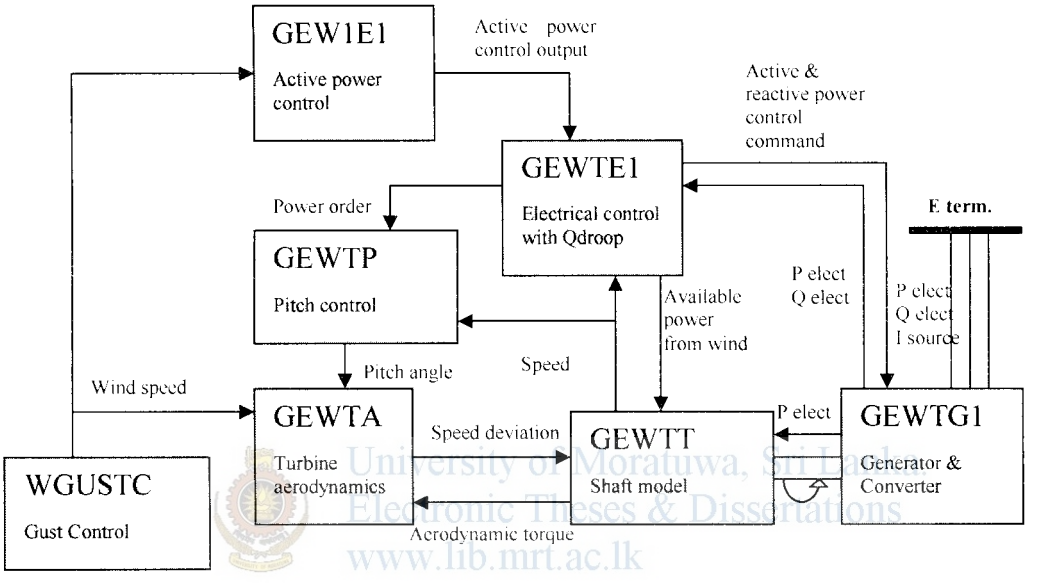

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Figure 2.3: Connectivity diagram