Improvement study of grid-connected wind-farm using Static Var Compensators (SVC)

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ABSTRACT

In order to minimize CO_2 emission from power generation a number of countries have recognized the requirement of developing and implementing renewable energy sources. Among the renewable energy sources, wind generation is dominating. Sri Lanka also contributed to this trend by implementing a pilot wind farm project. However, further development of wind generation is delayed due to restrictions imposed by the utility for connecting wind turbines to the grid especially at the medium-voltage level.

This paper addresses an application of a Static Var Compensator (SVC) to mitigate some of the concerns utilities are having when connecting wind farm at the medium-voltage level. A combined feed-forward and feedback control was developed. The main function of this control is described in detail with simulations.

KEYWORDS

Grid-connected wind turbines, SVC, Fast acting control

1. INTRODUCTION

In 1992, the wind studies carried out by the Ceylon Electricity Board have shown that the wind is the most promising option of the available renewable sources for grid connected power generation in Sri Lanka. This resulted in implementing a pilot grid connected wind farm project at Hambantota in 1999. This project was completed and certified in May 2000.

The plant consists of five 600 kW turbines and supplying a total annual average energy of 4.5 GWh. Total project cost was amounted to 1,175 US$ per kW. This was acceptable for a first grid-connected wind farm operation in the country. This project demonstrated the feasibility of small-scale wind power generation in Sri Lanka from a technical and commercial standpoint [1].

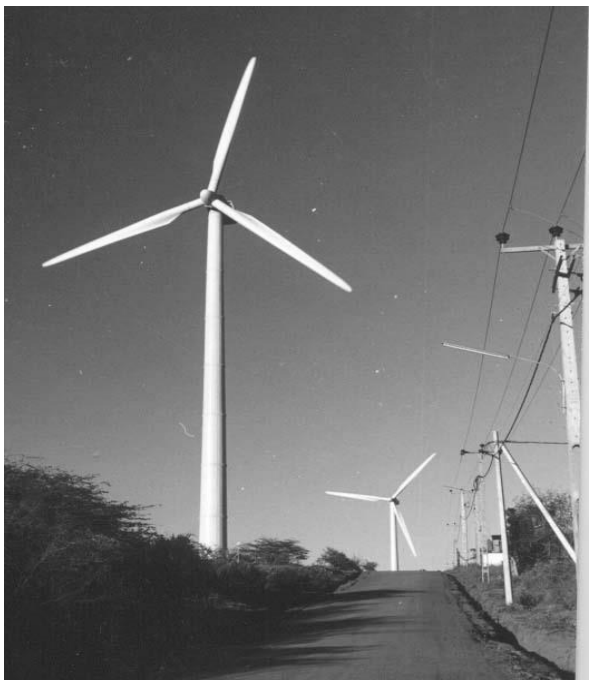

Figure 1 - Pilot wind farm at hampanthota

The Ceylon Electricity Board continues to monitor and record wind speed data in many parts of the country [2]. Even though promising sites are available the utility is reluctant to install large scale grid connected wind farms in these sites. One of the main barriers is the possible operational constraints due to a large amount of reactive power absorbed by a wind farm.

This paper addressed a mitigation technique using a Static Var Compensator (SVC) to overcome these barriers. More details about SVCs can be found in [3, 4]. In reference [5] and [6] application of a Static Condenser (STATCOM) to eliminate many problems associated with reactive power absorption, power fluctuation and flicker with the increase penetration of wind into power grid was analyzed. However, STATCOM is not suitable for our situation due to high cost involved. Therefore, in this paper a new control technique for an SVC to overcome problems due to lagging power factor operation and voltage flicker is presented. Simulations based on