Impacts of Wind Power Variations on Frequency Related Power System Operations

Abstract

Wind power is seen as the most cost effective way to generate electricity from renewable sources. The wind turbine prime mover, wind, is uncontrollable as compared to the conventional power plant prime mover. Therefore, it becomes very important to carry out investigations on the dynamic behavior of wind power generating systems. In this paper, the dynamic model of 1 MVA unit is extrapolated from 100 kW unit existing in NASA –Lewis Research Centre. The various types of investigations are carried out to study the dynamic performance of various states of the model considering variations in the wind speed. At the outset of the work, state space model of the system is developed. To study the dynamic behavior of the system, optimal controllers are designed using full state feedback control strategy. Following the controller designs, the closed loop system eigenvalues and dynamic response plots are obtained. The Strip Eigenvalue Assignment method is applied to design sub-optimal controllers using feedback of few states which are accessible for their observation and measurement. The comparative study of closed loop eigenvalues and dynamic response plots obtained for various operating conditions shows a comparable system dynamic performance. The optimal controllers are designed for various operating conditions using pole placement technique. The dynamic response plots and closed loop eigenvalues are obtained for various system states considering various operating conditions. The investigations of these reveal that the implementation of optimal controllers offer not only good dynamic performance, also ensure system dynamic stability.
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