Development of Permanent Magnet Generator based Wind Energy System Model for DG embedded Power System Studies

T. Takagi, S.C. Verma, S. Sugimoto
Chubu Electric Power Co. Inc.
Nagoya, Japan

Y. Kono, S. Fujiwara
Mitsubishi Electric Corp.
Kobe, Japan

With a rapid increase of DG (Dispersed Generation) like wind power or solar power generation sources etc. in Japan and around the world, the assessment studies of DG embedded power system are important in order to appraise their positive as well negative effects. This is, particularly, all the more important for the wind type power generation systems which are characterized by a variable output sensitive to a wind speed and by a relatively large size. Moreover, the wind power generation system itself employs the different kinds of machines ranging from the simplest induction machines to more controllable machines like double fed machines or permanent magnet excited machines with a BTB (Back To Back) type DC link and all these types have varying degrees of impact on their induction to the existing power system.

In view of the aforementioned features, the integration of wind type DGs to the existing power system needs thorough simulations studies under different scenarios of wind speed and types of wind power generation system. To deal with such situation, it is necessary to develop reliable and accurate simulation models for these types of generation systems. Hence, in this paper, a relatively new wind type DG system, i.e., a permanent magnet generator based wind energy conversion system, consisting of a wind turbine with pitch control and BTB type DC link along with a controller, is considered and a simulation model for this system is developed and verified. The developed simulation model is based on instantaneous value, and runs on HYPERSIM, a simulator developed by IREQ in Canada. However the developed model is not HYPERSIM specific, rather it is generic in nature and can be interfaced with any other general tools with little or no modifications.

In assessing the impact of an integration of wind type DGs to a power system, we considered induction machine types and permanent magnet excited generator type wind energy conversion systems in different proportions in relation to the power system capacity. Taking the voltage variation as a main parameter for assessing the impact on a power system, the effects of start or stop of wind type DG system along with sudden variation in outputs are also simulated on our 77kV power system and are reported in this paper.