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Investigation of Wind Farm Interaction with Ethiopian Electric Power's Grid: A Case Study at Ashegoda Wind Farm

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Abstract : Ethiopia is currently on the move with various projects to raise the amount of power generated in the country. The progress observed in recent years indicates this fact clearly and indisputably. The rural electrification program, the modernization of the power transmission system, the development of wind farm is some of the main accomplishments worth mentioning. As it is well known, currently, wind power is globally embraced as one of the most important sources of energy mainly for its environmentally friendly characteristics, and also that once it is installed, it is a source available free of charge. However, integration of wind power plant with an existing network has many challenges that need to be given serious attention. In Ethiopia, a number of wind farms are either installed or are under construction. A series of wind farm is planned to be installed in the near future. Ashegoda Wind farm (13.2°, 39.6°), which is the subject of this study, is the first large scale wind farm under construction with the capacity of 120 MW. The first phase of 120 MW (30 MW) has been completed and is expected to be connected to the grid soon. This paper is concerned with the investigation of the wind farm interaction with the national grid under transient operating condition. The main concern is the fault ride through (FRT) capability of the system when the grid voltage drops to exceedingly low values because of short circuit fault and also the active and reactive power behavior of wind turbines after the fault is cleared. On the wind turbine side, a detailed dynamic modelling of variable speed wind turbine of a 1 MW capacity running with a squirrel cage induction generator and full-scale power electronics converters is done and analyzed using simulation software DIgSILENT PowerFactory. On the Ethiopian electric power corporation side, after having collected sufficient data for the analysis, the grid network is modeled. In the model, a fault ride-through (FRT) capability of the plant is studied by applying 3-phase short circuit on the grid terminal near the wind farm. The results show that the Ashegoda wind farm can ride from voltage deep within a short time and the active and reactive power performance of the wind farm is also promising.

Keywords : squirrel cage induction generator, active and reactive power, DIgSILENT PowerFactory, fault ride-through capability, 3-phase short circuit
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