

Brazilian experience with large wind penetration in the bulk power system

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The growing trend in renewable generation development which most of them have intermittent nature, has presented new challenges for the electricity markets and system operators. These challenges include: planning resource adequacy for long and short terms, providing adequate transmission facilities to incorporate these sources, mitigating transmission constraints due to the rapid loss of a large amount of such generation, managing increased system reserve and ancillary service requirements, and ensuring acceptable performance by these generators.

Brazil has increased the installed capacity of wind power plants due to great wind potential existent, especially in northeast and south regions, as well due to the decrease of energy final price, motivated by improvements in the technologies of wind turbine generators and plants, and the generation expansion model based on energy auctions. The installed capacity in 2005 was 30 MW and reached 2.000 MW in 2012 and it will be 10.000 MW by 2016.

The intermittent and seasonal characteristics of the wind generation cause impacts on the power system operation that demand special operational requirements and measures in order to guarantee the power system security.

The objective is to present the studies and analyses performed about this challenge, whose results can define new requirements for the grid codes covering the following aspects:

- The impacts caused by the wind generation on the power system, including normal conditions and during contingencies.
- The improvements in the technical requirements and computational models of the wind generators used in studies to analyze the integration of wind power plants in large scale in the power system.
- Aspects related to the dynamic and voltage stability and control, considering in details the impacts on the additional generation reserve necessary in face of the deep and fast loss of wind generation, including requirements for power system frequency and voltage control, with special attention to system protection schemes and other requirements to guarantee the power system security and performance according to the grid codes.
- Conclusions and remarks on the Brazilian interconnected power system, including results obtained, occurred and overcome problems, and perspectives referred to the integration of wind power plants, keeping the power system security and performance as well some experiences and practical results obtained on this subject.