Dynamic probabilistic security assessment of power systems

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The security of a power system is its ability to withstand disturbances arising from faults and unscheduled removal of bulk power supply equipment without further loss of facilities or cascading outages. The security analysis of the transmission grid requires both deterministic and probabilistic approaches. The "N-1 security rule" is the deterministic approach classically used by Transmission System Operators for network planning and real-time operation. This rule relies on the assumption that an electrical grid will be secure if it stays electrically stable after any single failure among the N initially active network elements. Probabilistic studies can then complement (or replace?) this deterministic approach to assess the residual risk of cascading outages leading to an important amount of loss of load and to identify corresponding accidental scenarios. Their importance is increasing with the massive integration of renewable energy resources in the grid. Because cascading phenomena are not only static but also dynamic (e.g., loss of stability), probabilistic studies should be coupled with dynamic simulations to estimate accurately the security level of power systems, leading to dynamic probabilistic security assessment methodologies. This MSc thesis will explore the use of such methodologies for decarbonized power systems and/or power systems dominated by renewable energy resources, and their use as a tool in planning and/or in operation.