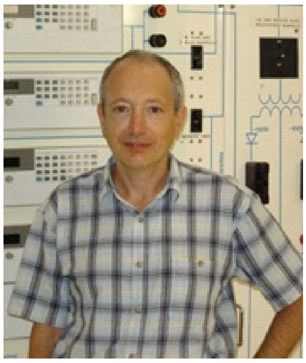
EIER 2022

The 3rd workshop on Energy, Infrastructure and Environment Research

Sustainability for resilience, and resilience for sustainability

High Renewable Energy Penetration and Power System Security: New Challenges and Opportunities

The word “security” in the context of a power system implies its security against a complete collapse, or a blackout. An increasing penetration of intermittent renewable energy generation introduces additional uncertainties in power systems. The main challenge facing a power system with high penetration of renewables is the displacement of conventional synchronous generation by non-synchronous generation. Kinetic energy stored in the rotating masses of synchronous generators provides the system rotational inertia. Wind power generators are either partially or completely decoupled from the grid by electronic converters; they do not provide inertia to the system. This reduces the total system inertia, and as a result, the system becomes more vulnerable to contingencies. Traditionally security assessment is based on the worst-case scenario criterion and provides a simple rule in the system design and operation. It has satisfied the needs of the power industry for decades. However, the deterministic approach to security is not adequate in modern power systems with market driven dispatch and high penetration of renewable energy and distributed generation. In this paper, security is defined as the risk in the system's ability to withstand random contingencies without interruption to customer service. In calculating the operational risk, we take into account not just the likelihood of contingencies, but also uncertainties in load variability and renewable energy generation. In risk-based security assessment, we generate contingencies at random, based on their probabilities.



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