Situational Awareness and Decision Tools for EMS/DMS On-line Operation

Rena Avila Rosales (Principal Power System Engineer), ALSTOM Grid Inc., USA

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Abstract

Enhancing Grid Reliability and Stability with a Better, Smarter, Faster Control System Is the Key to Avoiding Total System Collapse. The very first large-scale North American blackout happened in 1965, disrupting the supply of electricity to 25 million people in the United States and Ontario, Canada, for 12 hours. The failure was attributed to a maintenance error. In 1978, 80 percent of France was affected by a blackout caused by the breakdown of a transmission line. In 1989, a geomagnetic storm caused an outage that left 6 million people in Quebec, Canada, without power for nine hours. And in August 2003, a wide-area power collapse in the northern United States and central Canada affected 50 million people; a thorough inquiry revealed that the causes were computer failures and power lines that came in contact with "overgrown trees."

In a number of other countries, including Australia, Japan, Peru, Greece, Britain, Russia, Mexico and Italy, many other large-scale blackouts have happened since that time. The scenarios of major blackouts are never the same. The starting event may be a planned or unplanned event, such as a generation-load imbalance; a short circuit; human action (or inaction); sudden grid topology changes; lack of voltage support; or a natural cause like lightning, a storm, or untrimmed trees. The one factor they all have in common is a resulting failure process that cascades.

Occasionally, to prevent network components from overloading, parts of a power system automatically disconnect or shut down—like relays and fuses in the home—to avoid damage and isolate the problem component from the rest of the grid. Under certain conditions, the shutdown of the component can cause significant current fluctuations in the remaining segments of the network, akin to the large oscillations that occur when an interconnected spring is cut. These fluctuations may propagate and amplify, leading to uncontrollable power system dynamic oscillations and cascading failure, which spreads to wider parts of the grid and, in some cases, the entire grid.

The infrastructure of the North American grid is almost 50 years old and definitely shows signs of aging. It is almost certain that blackouts will occur again in the future. The challenge is to prevent events from spreading into cascading failure and, when required, to restore service to customers as quickly as possible.

This presentation focuses on PMU technology and situational awareness to prevent and improve power system reliability by using new technology as part of an overall plan towards self-healing.