Controlled Islanding

Determining an Islanding Solution for an Electrical Power System

Background

An electrical power system is a network of electrical components used to generate, transmit and consume electrical power. Large power systems inevitably contain groups of generators that are more coherent with one another than with other generators in the system. These generator groups swing against one another in the form of oscillations in their instantaneous generation.

Islanding seeks to prevent a blackout by separating the generators that are not coherent and eliminating the source of the oscillations that are threatening the stability of the system. Minimising the power flow distribution that occurs during this separation will in turn minimise the disturbance experienced by each island at the time of separation. This will serve to reduce the post disturbance oscillations within each island and increase the likelihood that the islands will survive as isolated power systems.

Researchers at the University of Manchester have developed an improved method of determining an islanding solution that separates an electrical power system comprising a number of generator buses, and load buses, into an appropriate number of electrically isolated islands.

The Technology

Previous islanding methods have used the existence of weak connections (WCs) to separate generator groups. However, embodiments of the present invention extend these WCs to define a set of weak areas (WAs) that separate the coherent groups. Extending the WCs into WAs allows an additional criterion to be considered when designing the islanding strategy. This is of great benefit as simply using the WCs would design an islanding strategy based on only one of the many constraints that must be considered when creating stable power system islands.

The patented technology comprises a two-step method for the prevention of blackouts in a power system by splitting it into a number of islands; by creating a number of strong internally connected islands with minimal power flow disruption.

In the first stage, graph theory is used to define a dynamic graph that may represent the dynamic properties of the considered power system. These are; synchronising coefficients, power flows and sources of inertia within the entire system. This dynamic graph is used to identify the WAs based on the similarity of each bus in the system to one of the reference generators.

In the second stage, graph theory is used to define a set of static graphs that describe the power flow in each of the WAs. The graph theory method of spectral clustering may then be applied to these static graphs to identify the solution that will allow each coherent group to be separated from the others with the minimal power flow disruption. The edges (in reality transmission lines) identified in this process will define the final splitting strategy (FSS).

Key Benefits

Only the WAs are considered when searching for this FSS. This dramatically reduces the searching space considered, and consequently the execution time, with no loss of information; as the contributions of every bus in the system are considered in the first stage.

Intellectual Property

The invention has been implemented in software code (Matlab); protected by copyright and the following patent applications (both with priority date 26th November 2013):

- European application EP14803239.4 (publication ref. EP3075057).
- US patent application US15/038704 (publication ref. US2016301216).

Commercial Opportunity

We are seeking to licence the technology to existing providers of network management services.

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