

Smart Grids Management and Control: A New Approach to Integrating Isolated Power Systems

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Abstract

Isolated communities are located far from major electrical networks and sources (i.e., bulk interconnected power systems) and, therefore, grid connection to these sources may not be practical or economically justified. Electricity in isolated remote areas is generated and consumed locally within an arrangement of electrical components deployed to supply, transfer and consume local electricity. Such networks are called Isolated Power Systems (IPSs), which subject to their specific application can have different composition and configuration.

As IPSs integrate increasing penetrations of renewable energy, they face technical challenges in hosting a greater capacity of inverter-based generation. Inverter-based technologies are unable to supply the full range of service commonly provided via synchronous thermal generation, and new applications and approaches must be developed to ensure system security and reliability. Known issues include the limited ability for fault current contribution, typically 1.5 times inverter rating or less and the inability of synthetic inertia to fully replicate mechanical inertia. The issues become particularly acute in system with high penetration of inverter-based generation based on intermittent resources (i.e. wind and solar). In response to these issues, the Centre for Renewable Energy and Power Systems has developed a range of flexible supply side technologies able to support high renewable penetrations while preserving much of the ancillary service traditionally sourced from synchronous generation. A range of these applications are discussed in this paper including low load diesel, variable speed diesel, and different type of storage.

This key-note paper discusses the common characteristics seen in the legacy IPSs and trends and challenges of system transformation to a clean and sustainable way of operation. While discussions and illustrations mostly centre around IPSs located on islands, similar trends can be observed in other remote coastal and inland locations (e.g., mines, military bases, remote communities such as Alaska and other rural settlements).