PLANNING FOR OPTIMAL ACCOMMODATION OF DISPERSED GENERATION IN DISTRIBUTION NETWORKS

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With the largest wind and marine energy resources in Europe to be found on and off the West coast of Scotland, commercial incentives within the de-regulated electricity market have evoked a significant increase in the number of applications for network connection.

The distribution network in these remote areas is usually radially-tapered towards its edges, serving progressively more dispersed loads. Its operation has long been well understood and has operated reliably in a passive way with power flow from bulk supply points out towards its edges. It was not originally designed to accept injections from dispersed generating plant located at its edges, leading to reversals of power flow. The connection of new plant has implications that network operators must consider if they are to preserve quality of supply to local customers and to protect their own assets. The various fault level, thermal, voltage profile and harmonic effects must be assessed and either accepted or mitigated. The consequent network reinforcement for shallow connections or compelled deep connection can be costly to the developer and network operator.

Accommodating this increasing population of dispersed generation involves network studies to avoid congestion, sterilisation of development or stranding of assets. A major planning requirement is for tools or techniques that allow planners to rapidly determine the maximum capacity of generation that may be accommodated within a given network. In response to this, we outline optimal power flow (OPF) techniques developed for this purpose.

While such techniques could be used to suggest the simultaneous maximum capacity of plant that may be connected within an area of network, in reality, all possible connections will not take place at the same time and prospective applications may not be below the capacities suggested. Additionally, successive single site analysis will not yield the maximum capacity and opportunity for connection. As such, we illustrate the application of the OPF techniques to phased development scenarios to identify potentially greater access to the network. The consequences for and limitations on renewable development are discussed.