DETECTION AND PREVENTION OF FORMATION OF ISLANDS VIA SCADA - A PROOF OF CONCEPT PAPER

PROBLEM

Due to incentives offered by the government the amount of generation connected to distribution networks has steadily increased in recent years. This has led to parts of the network where generation matches or exceeds demand at certain points on the load curve which risks the formation of an island should a network fault occur.

Islanded operation is usually avoided is due to safety concerns and issues surrounding protection coordination. The current practice is to avoid islanded networks from being formed using Loss of Mains protection on each distributed generator so that if the generator detects a loss of the network, it will disconnect and prevent the network it is connected to from being continuously energised.

The new requirements for grid connection of generators detailed in the European Network Code allows the dynamic behaviour of generators and their protection and control facilities to change under certain fault conditions in order to preserve or to re-establish system security. This additional control capability allows “fault ride through”. In addition to the EU Network Code changes there have been changes to the GB Distribution Code to alter the Rate of Change of Frequency settings for generators.

The combination of altering settings or control on generators to allow them to remain connected for smaller system disturbances and the increase in low carbon technologies will potentially lead to an increase in the risk of a generator supporting an islanded network. The problem facing DNOs is how to reliably detect when an island has formed and what steps to take once an island has been detected.

PROPOSED SOLUTION

All events which lead to the formation of an island involve the operation of switchgear on the DNO network which is reported by the Network Management System (NMS) in real time together with power flows on circuits.

The NMS will only recognise islands if the network is supplied from a generator with the “Island operation” attribute set to true. This is not conclusive proof that the generator is still supplying the network and real time analogues would provide the additional evidence.

Using the analogues and network topology the NMS can successfully detect the island; currently this would be recorded in a tabular report which requires a control engineer to open, review and act on if necessary.

To enable an automatic response to this tabular report the NMS configuration requires modification to the coding to recognise if a network is islanded and generate an alarm alerting the control engineer. This alarm should ask the control engineer if they wish to “maintain” or “shut down” the island. Allowing the NMS to decide automatically whether to keep the island running or not could prove difficult to achieve considering the dynamic nature of some of the islands that could be created. At this time there is not enough experience in the formation of islands to successfully develop this functionality.

If the island is to be maintained it will need to be reconnected to the DNO network following investigation and/or repair work. This can be done in one of two ways:

i. If synchronising equipment is installed, checks can be made to ensure that there are no voltage and frequency deviations and the networks can be reconnected automatically.

ii. If there is no synchronising equipment is available, the NMS and associated automation can be used to shut the island down and then re-energise from the DNO network. Pre-defined sequences can be programmed so this can be carried out within three minutes thereby avoiding the associated CIs / CMLs.

If the island is to be shut down it can be done using a set of pre-defined procedures built in to the NMS which would simultaneously open all circuit breakers within the island or open a remotely controlled device at the generator. Given the complexities which may be involved in pre-defining procedures the current preferred option would be for the island to be shut down manually by the control engineer.