Metering Of Embedded Generation – Operational Viewpoint

Operational metering obligations are placed on large embedded generators, defined in Scotland as greater than 5MW and 30MW in S&SE and Scottish Power areas respectively and defined in England & Wales as 100MW or greater. Embedded generation with an output of between 50MW and 99MW connected in England & Wales is classified as being medium sized. For this category of generation the Grid Code obligations are placed upon the generator through the host DNO. These are then backed off through the Distribution Code to the generator.

Large embedded generators are obliged to provide operational metering due to their operational impact on the system. Under CC.6.4.4 of the Grid Code, operational metering will be made available on medium embedded generation if National Grid can demonstrate that the generator has a significant effect on the transmission system.

In the Grid Code operational metering is the real time measurements of voltage, current, frequency, active power, reactive power and wind speed indications of plant status and alarms. This requirement for operational metering on medium (when necessary) and large embedded generation it will be limited to real time measurements of power output and wind speed.

This information will enable the system operator to account for the generators output in the strategy for securing the system from real time out to some appropriate time in the near future. For wind powered generation the expected output would be derived from the current output and the predicted wind-speed profile over the relevant time period. Predictions of output for non-wind powered generation would be based on historic running regimes and commercial information.

The generator would bear the cost of providing the measurement inputs to the data collection system which would be provided by National Grid. The data collection system would be located in a convenient DNO or TO substation.

Impact of Embedded Generation on the Transmission System

Embedded generation affects the following aspects system operation:

1. Flows across transmission constraint boundaries.
2. Demand forecasting.
    i. National,
    ii. GSP level.
3. SGT loading.
4. Response holding.
5. Reserve holding.

Flows across Transmission Constraint Boundaries

Embedded generation will contribute to power flows across import and export constraint boundaries. Where there is limited BM generation available to manage the constraint and the magnitude of the constraint is commensurate with the capacity of (medium / large) embedded generation, the system operator must know the current and future power output to ensure that pre and post-fault actions are not being taken unnecessarily. An example of this is the management of the South West of England Peninsula voltage constraint where the output from a medium sized, embedded generator could reduce the requirement to take demand management actions.

Demand Forecasting

National Demand Forecasting – Is derived from the summation of the output of BMUs measured in real time. Non-BM embedded generation (of which there is currently around 5GW of capacity) is not included in the derivation as it is assumed that the diversification of output and demand across the system results in the net effect being more or less constant across similar time periods. The assumption of diversity is applicable to medium / large embedded generation, hence operational metering will is not necessarily required for producing national demand forecasts.

GSP Demand Forecasting – Accurate division of national demand between GSPs is required for off-line power system analysis and to enable SGT outages to be optimally placed in terms of GSP demand. When embedded generation is running it will effectively reduce the demand at the GSP hence a correction must be applied. Retrospective measurements of power output e.g. Settlement data can be used to for this correction and therefore operational metering on medium / large embedded generation is not necessarily required for GSP demand forecasting.

Managing SGT Loads

There are a number of substations where the SGT Loading Document shows limited capacity margin, i.e. firm capacity based on continuous rating less demand under outage conditions. Furthermore in some cases there is a reliance on embedded BM generation to secure the outage. Under these circumstances the output from a medium / large sized generator could make the difference between secure and insecure operation. Outages would be placed on the assumption of zero output from medium / large embedded generation. However, there will be occasions during the outage when the outturn demand is higher than expected or the output from BM generation is lower than expected. In order to maintain security the system operator will have to take mitigating actions, for example: -

Buy on embedded BM generation,
Arrange demand transfers / reductions,
Recall the outage.

Where the capacity of the embedded generation is sufficient to reduce the need for these actions knowing the real time output, and (from this) being able to predict the output will improve the management of an outage once it has started. Real time measurement of power output and (if applicable) wind speed will be required where: -

The SGT loading document shows expected demand be 90% or more of the continuous SGT capacity under outage or intact conditions

Or

There is reliance on an embedded generation to secure demand.

Reserve Requirements

The system operator needs to predict the expected plant margin from up to six hours ahead, down to real time. The prediction of national system demand will account for the medium / large embedded generation though the assumptions on diversity of output mentioned previously. Hence operational metering on medium / large embedded generation is not necessarily required for calculating reserve.

Response Holding

In some instances an embedded wind farm may contribute to the largest system in-feed loss. Moreover for some connection configurations, the system operator will need to know the output of the embedded generator explicitly to determine the response holding. An example of this is North Hoyle Wind farm where due to a lack of fault ride through capability, the disconnection of Dinorwig and Wylfa power stations (under MIS outage conditions in North Wales) will also result in the loss of North Hoyle.