Engineering Recommendation G99

An overview of the latest standard applicable for new generation connecting to the GB network.

Engineering Recommendation (EREC) G99 was issued in July 2018 by the Energy Networks Association (ENA) and replaces the long standing EREC G59. The new G99 standard brings revisions to the application, performance, simulation and commissioning requirements when connecting new generation to the GB network.

G99 Type Classification

The G99 standard classifies new generation connections within 4 categories based upon connection voltage and rated output power. Within each of these classifications' different performance, simulation and commissioning criteria must be met to obtain compliance.

Type	Criteria
A	<110kV and 0.8kW – 1MW
B	<110kV and 1MW – 10MW
C	<110kV and 10MW – 50MW
D	>=110kV or >=50MW

Figure 1 – G99 Categories

The requirements get more onerous as you progress through the generation categories. Type A connection are relatively unchanged from the G59 process and are mainly based around providing manufacturer data. However, types B, C and D get more involved and require various simulation to prove performance.

Required Simulations

Reactive Power Flow – This is detailed within section 12.5 of G99 and requires power park modules to operate continuously within a certain power envelope. That is, the site must be capable of continuous operation while maintaining the ability to operate within the band of 0.95 lagging to 0.95 leading.

Fault Ride Through & Fast Fault Injection – This is detailed within section 12.3 of G99 and requires power park modules to ride through various faults on the network. This requirement must be met for 4

fault types: 3-phase faults, phase-phase faults, phase-earth faults and phase-phase-earth faults. G99 outlines the required retained voltage based on the generator and fault type. It also requires, as per section 12.6, for power park modules to inject reactive power into the system to support the fault.

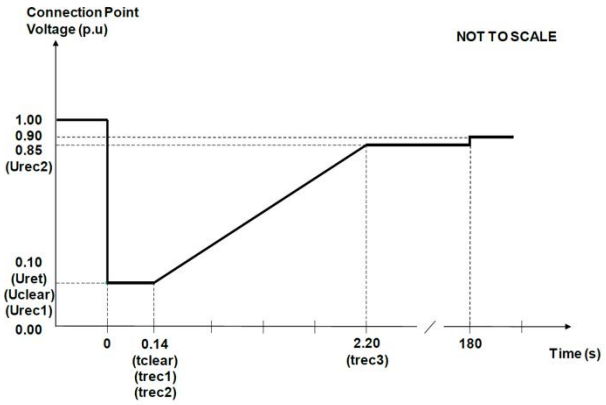

Figure 2 - Fault Ride Through Requirements

Limited Frequency Sensitive Mode – Over Frequency – This is detailed within section 12.2 and requires power park modules to raise or lower their power output depending on the measured system frequency. This simulation requires a time-based analysis where the park starts at rated output and then its response is explored when the frequency is increased to 52Hz.

Reactive Power Flow Stability – This is in addition to the reactive power flow requirements and only applies to type C and D plants. This involves four specific time-based load-flow studies to show the full capabilities of the plant in relation to voltage changes. This simulation requires an inverter model from the manufacturer.

Limited Frequency Sensitive Mode – Under Frequency – This is similar to the over frequency mode but explores the generators ramp up following a possible curtailment. This once again requires a full inverter model from the manufacturer.

Frequency Sensitive Mode – Under Frequency – This is a further requirement for types C and D and is outlined in section 13.2.6 of G99. This demonstrates the power parks ability to vary its output in response to the system frequency.

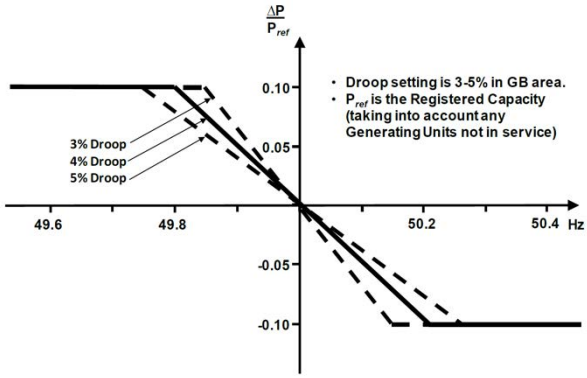

Figure 3 - FSM requirements

Requirements for each type

Type B – Required to show compliance with Reactive Power Flow, Fault Ride Through, Fast Fault Injection and Limited Frequency Sensitive Mode – Over Frequency.

Type C and D – All of the above in addition to Reactive Power Flow Stability, Limited Frequency Sensitive Mode – Under Frequency and Frequency Sensitive Mode – Under Frequency.

Summary

Type A connections are fairly straightforward and not much different to the requirements under G59. Type B connections are now more involved, but the simulations are not that onerous, and no specific inverter model is required from the manufacturer. Type C and D simulations are more involved and lengthier, the key difficulty here is the requirement to have a fully functioning inverter model in DIgSILENT or PSS/E. In cases of types B, C and D studies should be carried out early in the project to ensure deadlines are met and any shortcomings in performance can be addressed early.

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