STAMFORD | AvK ™

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Application Guidance Notes: Technical Information from STAMFORD | AvK

# AGN 237 – EREC G99 Grid Code for Great Britain

## INTRODUCTION

The Engineering Recommendation (EREC) G99 Issue 1 released on 16 May 2018 with the third amendment, (published on 10th Dec 2018) provides the technical and operational requirements for the connection of generation equipment in parallel with public distribution networks on or after 27 April 2019. It illustrates the requirements for the connection of power generating facilities to the distribution networks of licensed Distribution Network Operators (DNOs).

The G99 gives the technical requirements for the connection of Type A, Type B, Type C and Type D Power Generating Modules to the DNOs in Great Britain synchronous area in-line with the ENTSO-e RFG network code regulations.

A power generating module is any source of electrical energy, irrespective of the generating technology and power generating module type.

The G99 applies to all power generating modules which are not in the scope of EREC G98, requirements for the connection of fully type tested micro-generators (up to and including 16A per phase) in parallel with public low voltage distribution networks on or after 27 April 2019, or are not compliant with EREC G98 requirements.

Low voltage defines as voltage normally exceeding extra-low voltage (50V) but not exceeding 1000Vac or 1500Vdc between conductors or 600Vac or 900Vdc between conductors and earth.

High voltage defines as voltage exceeding 1000Vac or 1500Vdc between conductors, or 600Vac or 900Vdc between conductors and earth.

Where an installation comprises, a single synchronous power generating module or multiple synchronous power generating modules, the application process, technical and commissioning requirements are based on the registered capacity of each synchronous power generating module, (i.e. as per the name plate of each synchronous generator unit).

If one or more new synchronous power generating module(s) is to be connected to an existing installation then each new power generating module will be treated as a separate synchronous power generating module. Only the new power generating module will be required to meet the requirements of EREC G99, or EREC G98 if applicable.

## TYPE TESTED

A product which has been tested to ensure that the design meets the relevant requirements of the EREC G99, and for which the manufacturer has declared that all similar products supplied, will be constructed to the same standards and will have the same performance. The manufacturer's declaration will define clearly the extent of the equipment that is subject to the tests and declaration. In the case where interface protection functionality is included in the tested equipment, all similar products will be manufactured with the same protection settings as the tested product.

Examples of products which could be type tested include generating units, inverters and the interface protection.

## FAST FAULT CURRENT INJECTION

Fast fault current injection is necessary to support the total system during a fault on the transmission system. The design of fast fault current injection is tailored to this, and does not relate directly to faults on the distribution network, not least as those will tend to have longer clearing times than those of the transmission system for which fast fault current injection is designed. The faults referred to are transmission system faults which clear within 140ms. Not applicable to type A.

## SUMMARY OF EREC G99 REQUIREMENTS

The major requirements and specifications of EREC G99 that impact the selection of the alternators per power module type are summarized in the table 1. The compliance piece is not that straightforward and needs to be agreed with the relevant DNO.

| | Type A | Type B | Type C | Type D |
|---|---|---|---|---|
| | 0.8kW ≤ Power < 1MW | 1MW ≤ Power < 10MW | 10MW ≤ Power < 50MW | 50MW ≤ Power |
| | Connection point below 110kV | | | or Connection point above 110kV |
| | Any power generation modules with connection point above 110kV are of Type D | | | |
| | **Requirements** | | | |
| **Frequency range (Hz)** | 47 to 52 | | | |
| **Voltage Range** | ±10% of Un | | | |
| **Simulation study** | | x | x | x |
| **Reactive power capability** | 0.95 Lead to 0.95 Lag (relative to voltage) | | 0.92 Lead to 0.92 Lag (with ± 5% voltage) | |
| **RoCoF** | 1Hz/sec with 500msec delay | | | |
| **Constant output at target active power** | 49.5Hz to 50.5Hz | | | |
| **Output power with falling frequency** | 49.5Hz to 47Hz linear reduction, 5% decrease of active power at 47Hz | | | |
| **LFSM-O** | 2% at 0.1Hz above 50.4Hz (2 sec delay) | | | |
| **LFSM-U** | | | 49.5Hz, increase active power, 2% drop with 0.1% (2 sec delay) | |
| **Fault Ride Through and Phase Voltage Unbalance** | No UVRT, just to withstand the voltage unbalance conditions | 140msec at 30% remaining voltage (Figure 12.3) | 140msec at 10% remaining voltage (connected below 110kV, Figure 13.6)<br>140msec at 0% remaining voltage (connected above 110kV, Figure 13.7) | |
| **Fast fault current injection** | | x | x | x |
| **Load flow and system stability studies** | x | x | x | x |
| **Frequency Sensitive Mode – (FSM)** | | | Active power response in accordance with the performance characteristic shown in Figure 13.4 and parameters in Table 13.1, (also figure 13.5 and table 13.2). | |
| **Black Start Capability** | | | x | x |
| **Compliance** | Type Test Report and Manufacturers' information (Appendix A) | Type Test Report and Manufacturers' information (Appendix B) | Complex process, refer to all sections of appendix C for full compliance process | |
| **Infrequent paralleling** | 5 mins/month, once a week (DNO agreement) | | | |

**Table 1: Summary of G99 requirements**

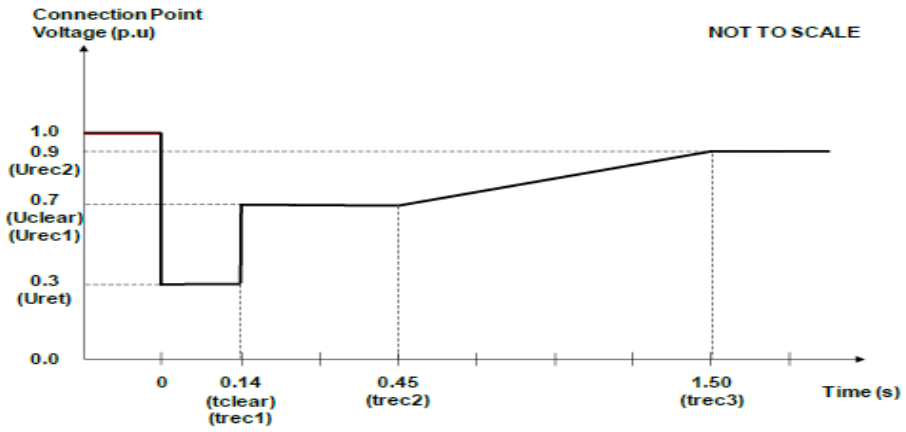


**Figure 12.3 - Voltage against time curve applicable to Type B Synchronous Power Generating Modules**

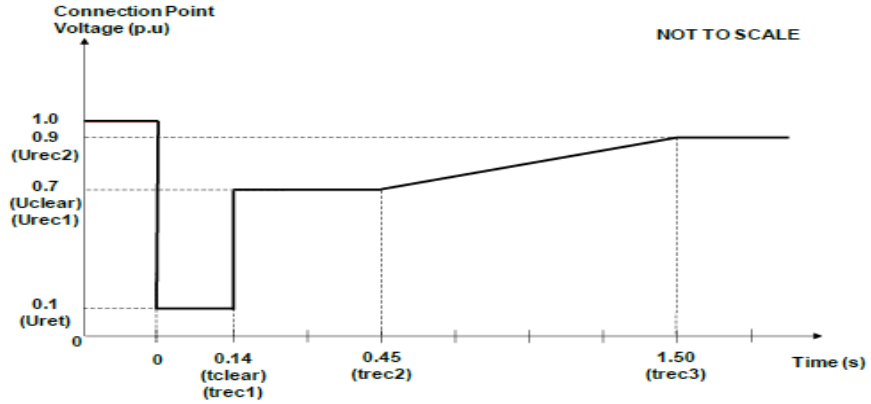


**Figure 13.6 Voltage against time curve applicable to Type C and Type D Synchronous Power Generating Modules connected below 110 kV**

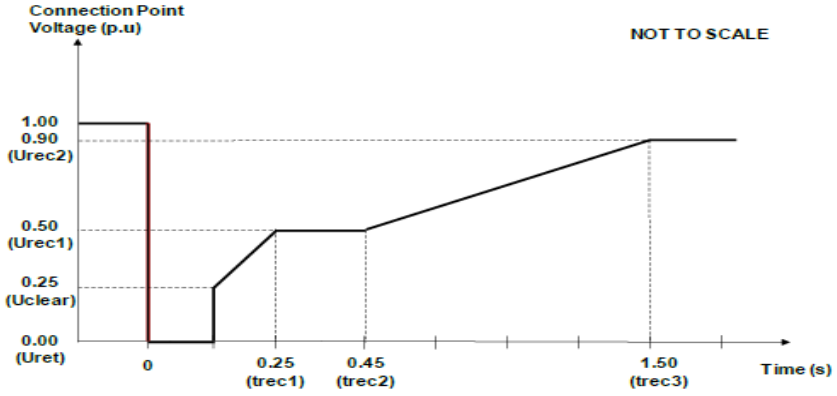


**Figure 13.7 - Voltage against time curve applicable to Type D Synchronous Power Generating Modules connected at or above 110 kV**

## CONCLUSION

STAMFORD and AvK alternators can meet the requirements of the EREC G99 with optimal sizing according to the rules:

- -15% de-rate for all alternators with a Class H insulation system.
- -5% de-rate for all alternators with a Class F insulation system.
- The rating may then need to be de-rated further to satisfy the leading power factor requirement.
- STAMFORD and AvK alternators are electrically, mechanically and thermally capable of meeting the grid code requirements however, Cummins Generator Technologies (CGT) recommend two bearing alternators in conjunction with a flexible coupling to help absorb any transient rotational torque events during fault ride through conditions. If a single bearing coupling arrangement is used, where there is a solid connection between the alternator rotor and the engine flywheel, mechanical damage may occur as result of this configuration.
- Separately excitation system with three-phase voltage sensing is recommended by CGT to cope with networks disturbances.
- Digital AVR with advanced features will be required for type C and D power modules.
- We must remember that grid code compliance is for a complete generating set and not just for the alternator.

For the alternator, Application Engineering can assist with the considerations that are necessary to comply with the expectations contained within the G99 grid code regulations.

Please contact: applications@cummins.com.

## ACRONYMS

ENTSO-E: European Network of Transmission System Operators for Electricity

RfG: Requirements for Generators

LFSM-O: Limited Frequency Sensitive Mode – Over Frequency

LFSM-U: Limited Frequency Sensitive Mode – Under Frequency

RoCoF: Rate of Change of Frequency

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