

G59 Protection Update

23/05/2018

GENERATOR INTERFACE PROTECTION (G59) SETTINGS AMENDMENTS

The electricity supply system is continually developing and the pace of change has increased as industry responds to government targets for carbon reduction, renewable generation, and energy efficiency. SONI, the transmission system operator, regularly assesses how the electricity supply system has behaved to system incidents and tries to forecast how it will behave in the future. SONI has already observed a change in system frequency behavior during recent events and expects this to become more prevalent in future.

The evidence to date is that higher rates of change of frequency (RoCoF) will occur, which in turn means that there is a higher risk that RoCoF based Loss of Mains protection will operate during normal system disturbances such as a loss of largest infeed event. Spurious protection operation has adverse effects on the overall resilience and security of the electricity supply system and generators may suffer loss of production as a result.

Loss of Mains protection forms part of the overall distribution system protection. To ensure the safety of the distribution network there is a need to ensure that all protection schemes meet both the requirements of the distribution network and the wider Northern Ireland system. After extensive analysis, NIE Networks issued a Distribution Code (D-Code) consultation on Generator Interface Protection Amendments. This consultation proposed that the current Generator interface protection (G59) settings associated with Small Scale Generation (SSG) <5MW connected to the NIE Networks' distribution system should be amended to allow for higher levels of non-synchronous renewable generation on the electricity system.

Following the consultation NIE Networks submitted to the Utility Regulator (UR), proposed amendments to the D-Code to incorporate new Generator Interface Protection settings for Small Scale Generators. The UR approved these amendments and Issue 4 of the D-Code was published on 11th May 2018.

The latest Distribution Code amendments are designed to:

- Reduce nuisance tripping and ad hoc disconnection of Small Scale Generators.
- Enable the 2020 Government targets for renewable energy to be met.
- Bring Small Scale Generators in line with Large Scale Generators.

The NIE Networks D-Code now requires all Small Scale Generators to amend their Interface Protection (G59) Settings in line with paragraph CC7.11, the new settings are given in Table 1 below, and in summary the main changes are:

- Amendment of Loss of Mains (LoM) protection to a RoCoF setting of 1Hz/s with a 500ms time delay, Vector Shift is no longer allowed as a LoM protection.
- Amendment to Over-frequency protection to a setting of 52Hz.
- Amendment of Under-voltage protection to include a 2 stage setting.

In addition, as part of the analysis into whether SSG interface protection settings could be changed, NIE Networks concluded that to further reduce the risks of islanding there would be a change required to Neutral Voltage displacement (NVD) protection. The voltage setting would remain the same however the time delay would be reduced to 7 seconds.

In line with D-Code paragraph CC7.11.3, all Small Scale Generators with G59 protection, connected to the system prior to 11th May 2018 shall ensure that the protection settings as per paragraph CC7.11 are applied by 30th September 2019. Small Scale Generators that have not made the required changes by the due date will be deemed non-compliant with the D-Code and would be subject to the non-compliance process set out in the D-Code.

In addition, given that the interface protection changes being made are critical for the future operation of a secure electricity network, system operators require assurance that the G59 settings changes have been carried out and tested correctly. To deliver the required assurance, NIE Networks have established a list of approved G59 contractors which can be accessed using the following link, www.nienetworks.co.uk/G59contractors. Generators wishing to use a G59 contractor not on the list should contact NIE Networks prior to the changes being made to confirm that the contractor meets the requirements to be considered an approved G59 contractor. Whilst it will be up to each generator to agree the cost for making the changes to their protection settings with their chosen G59 contractor, NIE Networks understands that this cost is unlikely to exceed £1000 ex VAT in cases where only the settings need to be amended.

To ensure D-Code compliance NIE Networks now request that the following actions are completed:

1. Confirm to NIE Networks by 29th June 2018 that you have received the G59 Settings Notification letter and that you have engaged a G59 contractor. This can be done online at www.nienetworks.co.uk/G59replyform or by post using the acknowledgement form and one of the return envelopes.
2. The protection settings detailed in Table 1, are applied and tested by an approved G59 contractor. At generators where the connection point to the NIE Networks' system is at 11kV and above, the testing must be witnessed by an NIE Networks' Protection Engineer. Please note that settings should not be amended until the date of the witness test, see below details for arranging this.
3. Where NVD protection has been installed by the generator as part of the terms of their original connection offer, then a new time delay setting of 7 seconds should be applied. Where possible the NVD protection should be tested and the results added to the Schedule 1A return. During testing, it is important that adequate isolation/separation is maintained to ensure that test voltages are not applied to the Open-Delta multicore cable which is connected to the live NIE Networks voltage transformer.
4. The Schedule 1A form enclosed is completed and returned by scanning and emailing it to G59@nienetworks.co.uk or alternatively, by post using one of the return envelopes.
5. Any internal protection employed by the generator should be amended to ensure that the generator remains connected and is capable of operating under any variation in distribution system frequency and voltage as set out in D-Code paragraphs CC5.2, CC5.3 and CC7.14.2(b)
6. All internal protection settings should be entered on the last page of the Schedule 1A form.

In addition HSENI have asked NIE Networks to communicate to generators that the full consequences of these modified protection settings will need assessing from a health and safety perspective to ensure they do not give rise to an unacceptable increase in risk associated with the continued operation of the generating equipment. The responsibility for this assessment will fall to the individual generator operator and HSENI recommends that relevant risk assessments are reviewed and updated to ensure ongoing compliance with health and safety requirements. This technical matter will most likely require advice from a competent specialist organisation as well as, possibly, the generator manufacturer. Further guidance on Risk assessment when using RoCoF LoM protection is given in Appendix 4 of the D-Code Connection Conditions.

NIE Networks recognise that the timescales for the implementation of new protection settings are challenging. We would therefore ask that generators with a connection point at 11kV and above contact us at the earliest opportunity to book appointments for our protection engineers to carry out the witness testing of the new settings. Appointments can be requested by emailing G59@nienetworks.co.uk. Where the connection point to the NIE Networks' system is at 11kV and above, NIE Networks will issue the generator with an invoice to cover the NIE Networks' costs associated with the witness testing of the new settings. This cost will be approximately £600 ex Vat.

Table 1 below taken from D-Code paragraph CC7.11 gives the generator interface protection settings to be applied.

Protection Function	All Power Stations >11.04kW ¹	
	Setting	Time Delay
U/V stage 1	0.85pu ^{\$}	3.0s
U/V stage 2	0.6pu ^{\$}	2.0s
O/V	1.1pu ^{\$}	0.5s
U/F	48Hz	0.5s
O/F	52Hz [#]	1.0s
LoM(RoCoF)¥	1.0Hz/s	0.5s [∞]

Table 1. Interface Protection Settings

Note: [∞] The required protection requirement is expressed in Hertz per second (Hz/s). The time delay should begin when the measured rate exceeds the threshold expressed in Hz/s and be reset if it falls below that threshold. The relay must not trip unless the measured rate remains above the threshold expressed in Hz/s continuously for 500ms. Setting the number of cycles on the relay used to calculate the RoCoF is not an acceptable implementation of the time delay since the relay would trip in less than 500ms if the rate was significantly higher than the threshold.

¥ RoCoF – Rate of Change of Frequency.

\$ Base unit is defined as the nominal voltage at the Connection Point. This applies to phase-phase and phase-neutral voltages.

A default setting of 52Hz will apply unless a lower setting is requested by the DNO.

For each of the protection functions, the Circuit Breaker opening should occur with no inherent time delay following a protection trip operation from the relay.

¹ The lower limit for single phase power stations is 3.68kW