

G59 Information Evening



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Contact Information



- For further Information or to contact us:
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G59 PROTECTION CHANGES IMPLEMENTATION



Background – Why changes are required



- Active power and frequency are controlled by SONI
- Conventional power stations – Synchronous generation
- Renewables, Wind turbines, PV – Non-Synchronous generation
- SNSP is the amount of System Non-Synchronous Penetration
- SNSP is currently limited to 65% - Renewable Generation is curtailed to maintain limit
- Increasing SNSP permits greater use of renewable energy but decreases system stability
- Increased SNSP can't be achieved without the proposed SSG RoCoF changes



The Benefits



- Reduction in nuisance tripping of G59 protection relays
 - New G59 settings are less sensitive
- Reduction in SEM production costs by €13m/annum
 - Less reserve and balancing services required
- 4.4% reduction in wind curtailment levels
 - Higher SNSP allows more renewables more of the time
- 1.5% increase towards 40% renewables target

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G59 Changes



- The SSG RoCoF programme commenced on 01 June 2018
- The required G59 protection changes must be completed by 30th September 2019
- The G59 RoCoF changes were included in the Distribution Code and approved by the Utility Regulator
- Generator owners are required to be compliant with the Distribution Code
- Failure to make the G59 changes by 30th September 2019 will result in non-compliance with the Distribution Code
- This will also breach the Generators' Connection Agreement with NIE Networks

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G59 Changes – Non-Compliance



- Generators who are non-compliant with the Distribution Code on 1st October 2019 will be issued with de-energisation notices
- Metered data will be used to monitor compliance with the de-energisation notice
- De-energisation may also affect any contractual arrangements in place with Ofgem, Supplier and the funder of your generation plant
- Non-compliance with the de-energisation notice will result in termination of the generators Connection Agreement with NIE Networks

G59 Changes – Non-Compliance



- Generators non-compliant with the Distribution Code at the end of the de-energisation notice period will have their Connection Agreement terminated
- Termination will result in loss of export capacity
- Re-connection of generator will require a new application
- No guarantee that previous capacity will still be available
- Metered data will be used to monitor compliance with the termination notice
- Non-compliance with the Connection Agreement termination will be reported to DfE for breach of Regulation 23 of the Electricity Safety, Quality and Continuity Regulations (Northern Ireland)

G59 FREQUENTLY ASKED QUESTIONS



G59 Changes – FAQ's

"What are the implications of higher Rates of Change of Frequency on the grid?"

During normal system operation SONI, the Transmission System Operator (TSO) in NI, manages generation and demand so as to ensure that system frequency remains stable at 50Hz. During large system faults or loss of significant generation, the frequency can deviate from 50Hz during these events. Historically when generation was provided from large conventional Power Stations, the synchronous torque inherent in these machines was able to limit the Rate of Change of Frequency (RoCoF) to very low levels during these faults. More recently, with large volumes of non-synchronous renewable generators providing a significant portion of the generation required, then during large faults the system has less synchronous torque available with the result that higher RoCoFs are experienced.

G59 protection settings are applied at distribution connected generators to ensure that they trip off in the event of a loss of mains. One aspect of the G59 settings is the RoCoF element which traditionally has been set at a low value, typically 0.125 – 0.4 Hz/s. SONI has confirmed that in order to integrate more renewables onto the system in order to meet government targets, RoCoFs of up to 1Hz/s could be experienced during system faults. This would result in generators with a low RoCoF setting on their G59 relay tripping off unnecessarily, and additionally if a significant volume of generators tripped simultaneously on RoCoF protection, could cause a shortfall in generation and lead to load shedding (significant number of customers going off supply).

G59 Changes – FAQ's



"What about demand customers? Has there been any modelling work carried out to consider the impact of the settings amendments upon such customers?"

Making the G59 protection amendments will have no impact on demand customers. There have however been concerns raised during a number of public consultations about the impact on demand customers of SONI operating the system in such a way as to give rise to larger RoCoFs of up to 1Hz/s during large system faults.

NIE Networks have raised this issue with SONI, and they have confirmed that research carried out on the subject suggests that higher RoCoFs should have minimal impact on demand customers.

G59 Changes – FAQ's



"Reassurances that there will be no further settings changes. There are concerns that further settings change may necessitate additional work to be carried out on generation units"

The current G59 protection changes are required as a result of SONI and Eirgrid, the TSO in the Republic of Ireland, proposing a new operational RoCoF limit of 1Hz/s. The new limit was consulted on and approved by utility regulators in both jurisdictions and whilst NIE Networks were involved in the process, we had no control over the outcome and cannot therefore provide reassurances in this area.

Given that governments are due to announce their 2030 Carbon emissions targets soon, it is likely that the penetration of renewables on the electricity system will increase. Whilst we currently don't envisage more changes it is not possible to predict at this stage how increasing renewables will affect system operation.

G59 Changes – FAQ's



"Why were these changes not actioned when the generating unit was connected to the grid particularly for units connected as recently as 18 months ago?"

G59 protection is required on distribution connected generators to ensure that they trip off following a loss of mains so as to avoid danger to the public and damage to the generator. Following the regulators approval of the new 1Hz/s RoCoF limit NIE Networks were requested to move the G59 RoCoF setting on all distribution connected generation to accommodate the new standard.

In order to alter the existing G59 settings a full assessment of the risks associated with changing the RoCoF setting had to be carried out. This assessment was completed in collaboration with Strathclyde University to determine whether the additional risks associated with the new settings could be justified. Following this NIE Networks issued a consultation on 'Small Scale Generator Interface Protection Amendments' on 11 December 2017, the consultation document confirmed that these amendments would apply retrospectively to all SSG sites.

As confirmed by the NIE Networks consultation report of 19 February 2018 and subsequent UR approval, the deadline for implementation of the new protection settings by generators connected prior to 11 May 2018 is 30 September 2019. This gave rise to the situation that generators connected in the period just before the approval were connected on the old settings and then subsequently had to make the changes.

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G59 Changes – FAQ's



"Phase imbalances in the West of Northern Ireland – how much of a problem is this and what can be done to address this?"

Phase imbalance on 3-phase overhead lines is more prevalent when there are significant numbers of single phase spur lines and transformers connected to the circuit. The issue arises more so in rural areas of Northern Ireland where typically there are higher numbers of single phase transformers. Whilst NIE Networks endeavour to operate the distribution system within standard phase imbalance tolerances, there are instances where this is not the case, however the issue only comes to light when a 3-phase generator or demand customer is connected.

We have dealt with a number of cases to date where phase imbalance was outside of tolerance and corrective actions (such as re-jumpering of large single phase spurs) resolved the issue. Upon receipt of any such complaint, NIE Networks will install sensitive monitoring equipment at the generator to measure parameters such as Voltage, Current, Watts, Reactive Power and Harmonics to fully assess the performance of both the distribution network and the generator. Where issues are identified with the distribution system we will take the necessary remedial actions.

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G59 Changes – FAQ's



"Commitment from NIE Networks that resource is in place to deal with any queries."

NIE Networks have an experienced team working on this important project. To date we have dealt with 182 email queries from generators and contacted 63 generators by telephone to discuss issues raised. In addition we are in regular contact with the G59 contractors who raise queries on generators' behalf.

NIE Networks can give a commitment that all queries raised either by telephone or by email to G59@nienetworks.co.uk will be contacted by a member of the team.

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 CC7.11.5, 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

G59 Contractors

The following contractors have demonstrated to NIE Networks that they are capable of applying and testing the G59 protection settings set out in the Distribution Code. All generators will be able to contact any of the contractors to undertake the works. All reimbursement for any works and the establishment of particular terms and conditions will be agreed solely between the contractor and the generators. NIE Networks will not be liable for any disagreement that arises between the contractors and the generators.

Company Name	Address	Website	Telephone	Email
Lagan Power Engineering	Unit 3B Bankmore Business Park Omagh BT79 0BE	laganpowereng.com	+44(0)28 8283 9770	emmet@laganpowereng.com
Conlon Power Services Ltd	8 The Lawn Walshestown Park Newbridge Co. Kildare W12 P938 Ireland	conlonpower.ie	+353 (0)86 6044 237	simon@conlonpower.ie
Nahanagan Electrical Engineering Services Ltd	Nahanagan Electrical Engineering Services Ltd	nahanagan.com	+353 (0)53 924 3330	engineering@nahanagan.com
IBO Ltd	2 Dartmouth Road Chorlton Manchester M21 8XJ		+44 (0)7557 667 640	sales@ibolimited.co.uk
Mountview Generator Services Ltd	85 Tullynora Road Hillsborough BT26 6QD		+44 (0)28 9268 3425	gary@mountgens.co.uk

Company Name	Address	Website	Telephone	Email
Innovative Automated Solutions Ltd	4 Brustin Lee, Ballygally, Larne	ias-ni.com	+44 (0)787 969 0449	John.rodgers@ias-ni.com
Carnaff Ltd	197 Castlecatt Road, Carnaff, Ballymone y, Co Antrim, BT53 8AT		+44 (0)28 2076 8770	gmd@btinternet.com
Duncan Plant	54 Glenshesk Road, Ballycastle , Co Antrim, BT54 6PY	www.duncanplant.com	028 2076 3828	info@duncanplant.com
Powercomm Engineering Ltd	Unit A5, Clane Business Park, College Road, Clane, Co.Kildare, W91 EF10	www.powercomm.ie	Tel. +35345989 001 Fax. +35345834 209	info@powercomm.ie
H&MV Engineering	Unit 35, McLoughlin Road, National Technology Park, Castletroy, Limerick	www.hmveng.ie	+353 61 35 74 96	martin.whelan@hmveng.ie
Sperrin Switchgear Ltd	Unit 1 Magherafelt Road Industrial Estate Draperstown BT45 7JT		028 7962 7770	niall@sperrinswitchgear.com

Company Name	Address	Website	Telephone	Email
Si Energy Ltd	1 Davies Road, Newtownstewart, Co. Tyrone	www.sienergy.com	07775768179	info@sienergy.co.uk
D&J Generators Ltd	No 3 Irwinstown Lane, Upper Ballinderry Lisburn, BT28 2HD	www.dandjgenerators.co.uk	02894470455 or 07818077774	j.mcgowan@dandjgenerators.co.uk
Blackbourne Ltd	Ballymena Rd, Antrim, BT41 4NZ	www.blackbourne.co.uk	02894 464231	willie.donaghy@blackbourne.co.uk
AC Automation (UK) Ltd	5 Sloefield Park, Carrickfergus, Co Antrim, BT38 8GR	www.acautomation.co.uk	028 9336 4779	davidcallaghan@acautomation.co.uk
MCN Automation	MCN Automation Ltd, 29 Mullafergan Road, Dromore, Co Down, BT25 1JZ		+44 28 9269 3495	robert.mcnaugher@mcnautomation.co.uk
Shane Mawhinney	Primrose Park, Portrush		07710 621471	Hvprotest@btinternet.com
Ensix Turbine Services	33 Carnaman Road, Knockloughrim, Magherafelt, BT45 8PN		+44(0)28 7938 7402 or 07738 291 292	martin.duggan@ensix.com or service@ensix.com

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