THE DISTRIBUTION CODE OF LICENSED DISTRIBUTION NETWORK OPERATORS OF GREAT BRITAIN

Distribution Code Consultation DCRP/18/07

Title: G99 – clarification of Limited Frequency Sensitive Mode – Overfrequency requirements for Type A and B Power Generating Modules

Target Audience: All current and prospective manufacturers, developers, owners and operators of generation (and storage) of any size connecting new generation equipment to distribution networks.

Date Published: 02 July 2018

Deadline for responses: 27 July 2018

Summary:

This Distribution Code public consultation is seeking the views from stakeholders on the proposed modifications to the Distribution Code to clarify the requirements and compliance assessment of limited frequency sensitive mode – overfrequency for Type A and Type B power generating modules.

1 Introduction

Ofgem approved the implementation of the EU Network Code "Requirements for Generators" (RfG) on 15 May 2018 (with compliance required from 27 April 2019). The implementation consisted of parallel changes to the Grid and Distribution Codes, and the introduction of ERECs G98 and G99. Very late in the process of drafting G99 it was noticed by some stakeholders that the specification of the limited frequency sensitive mode – overfrequency (LFSM-O) was not completely clear. Recognizing it was inappropriate to try to work a clarification into the drafting process at that time, the issue was flagged at the Grid Code Development Forum on 7 March, at the Distribution Code Review Panel on 5 April and at the Grid Code Review Panel on 18 April. Both the Grid and Distribution Code Review Panels agreed that there was a defect to be addressed, or would be once Ofgem had approved the G99 text (which they did on 15 May) and agreed to form a joint WG address it without delay.

The Work Group met on 6 June, discussed the issue and the legal text and agreed that the modification should be progressed immediately to consultation.

2 The Defect

The defect stems from the implementation of Article 13.2 of the RfG. LFSM-O is a new requirement for all distribution connected generation (apart from embedded large or medium power stations) and applies to all sizes right down to 800W.

It is worth noting that large or medium power stations have always had to provide LFSM-O, although crucially as part of a more extensive set of frequency sensitive mode requirements, within which

LFSM-O is a relatively straightforward requirements. However for Type A and B generation, LFSM-O is the only requirements, ie it is not a subset of more onerous FSM requirements.

Article 13.2(a), (c) and (d) specify the LFSM-O range of parameters within which National Grid must specify the requirements for GB. This was done in GC0101 and implemented in both the Grid Code and G99.

There is nothing in the RfG that sets any requirements for how quickly the LFSM-O response must be delivered. The drafting in both the Grid Code and G99 is based on the existing Grid Code requirements in the Grid Code Connexion Conditions. For LFSM-O it includes the phrase “as much as possible in 10s”. Whilst this has never presented problems in establishing the compliance of generation modules at large or medium power stations, it is not precise enough to define what compliance means for smaller mass produced generation modules of Types A and B.

3 The Proposal

Currently in GB Article 13.2 of the Requirements for Generators sets out the requirement for (LFSM-O which in GB has been detailed the Grid Code section ECC.6.3.7.1.

The LFSM-O trigger frequency has been set at 50.4Hz across the GB synchronous area in ECC.6.3.7.1.1. This requirement applies to all Type A-D Power Generating Modules regardless of their connection point and so applies equally to transmission and distribution connected plant.

Within GB the maximum permissible frequency ahead of Generators being permitted to take independent action is 52Hz, which gives maximum controllable frequency deviation of 52.0 – 50.4 = 1.6Hz.

For LFSM-O the minimum steady state frequency response requirement is set in ECC.6.3.7.1.2(i) at 2% / 0.1Hz (ie 10% droop) with table 1 column 3 showing the minimum steady state response values for incremental deviations in frequency over the frequency range. This also shows for the maximum frequency deviation of 1.6Hz, a 10% droop would represent a 32% steady state output reduction. Any controlled steady state response in excess of the 32% minimum reduction is acceptable.

Frequency (Hz)	**Frequency Deviation above 50.4Hz**	**Minimum acceptable steady state response as a % of maximum generation**	**50% of steady state response in 10s capped at 5% as a % of maximum generation**
50.4	0	0%	0
50.5	0.1	2%	1%
50.6	0.2	4%	2%
50.7	0.3	6%	3%
50.8	0.4	8%	4%
50.9	0.5	10%	5%
51.0	0.6	12%	5%
51.1	0.7	14%	5%
51.2	0.8	16%	5%
51.3	0.9	18%	5%
51.4	1.0	20%	5%
51.5	1.1	22%	5%
51.6	1.2	24%	5%
51.7	1.3	26%	5%
51.8	1.4	28%	5%

51.9	1.5	30%	5%
52.0	1.6	32%	5%

Table 1 – Detailing the minimum responses for different frequency deviations

Whilst it might appear that the requirement is clearly defined the difficulty occurs in that it is not clear how quickly the steady state response needs to be delivered and the current Grid Code requirement in ECC.6.3.7.1.2.(iii) has the vague statement “of as much as possible of the reduction in 10 seconds”, hence further consideration is required as follows.

The current GB Grid Code requires as much as possible of the steady state deviation to be achieved in 10 seconds but offers no further guidance on what represents an acceptable level for this. In addition, there is no indication of an acceptable delivery time for the full droop response. In lay terms, “as much as possible”, could sensibly be interpreted as a delivery at least in excess of 50% of the total.

Automatic frequency control is managed by the operation of a governor or frequency control device. In GB, FSM plant is required to achieve a minimum response standard of 10% of its maximum output capability delivered in 10 seconds in response to falling or rising frequency of ± 0.5Hz.

The LFSM-O requirement also seeks automatic action in response to high frequency in excess of 50.4Hz. In managing a high frequency event, it therefore makes sense that in this mode, a similar response capability should be sought as a measure of “as much as possible” for the largest deviations in frequency. However as the minimum acceptable droop is 10% and therefore the steady state response expectation is half that of FSM mode (frequency response droop is between 3-5%) it makes some sense to seek a minimum standard of 5% response in 10 seconds for the LFSM-O plant.

Therefore interpreting “as much as possible” of the change in 10 seconds, National Grid has suggested a value of 50% of the steady state change is achieved in 10 seconds but noting that the requirement continues for larger frequency this should be capped at a maximum of 5% of maximum output as an acceptable level of a fast acting contribution. The proposed values of the minimum response to a frequency change in 10 second are given in the fourth column of table 1.

There is one other requirement in the Grid Code relating to LFSM-O which is in ECC6.3.7.1.2(ii) – where the response requires to be continuous and linear unless it can be reasonably demonstrated to not be technically possible.

Applying the linear and proportional principle to the proposed minimum response to frequency change in 10 seconds to active deviations of 0.2Hz, 0.5Hz and 1.6Hz for LFSM-O gives a view of minimum acceptable responses as follows in table 2:

Time	Frequency Deviation		
	ΔF = 0.2Hz (50.6Hz)	ΔF = 0.5Hz (50.9Hz)	ΔF = 1.6Hz (52Hz)
10s	2% of max output	5% of max output	5% of max output
20s	4% of max output	10% of max output	10% of max output
30s	4% of max output	10% of max output	15% of max output
40s	4% of max output	10% of max output	20% of max output
50s	4% of max output	10% of max output	25% of max output
60s	4% of max output	10% of max output	30% of max output
64s	4% of max output	10% of max output	32% of max output

Table 2 – Detailing the minimum responses against time for different frequency deviations

This is indicated graphically for an injection of a +2.0Hz step (as a 1 second ramp) in figures 1 & 2 and for an injection of a +0.6Hz ramp in figures 3 & 4. On the graphs the blue line indicates the injected frequency with the green line showing the calculated minimum steady state response position in relation to the frequency deviation. The boundary of acceptable minimum response against time calculated in line with the methodology set out above is shown by the red dashed line. The difference between the orange and red lines indicates the permitted two second delay in for the initial measureable response but it is important to note that at the end of the time period (ie at 10 seconds) both the red and orange lines converge to the same point. For the avoidance of doubt any response which is on or below the red line is acceptable.

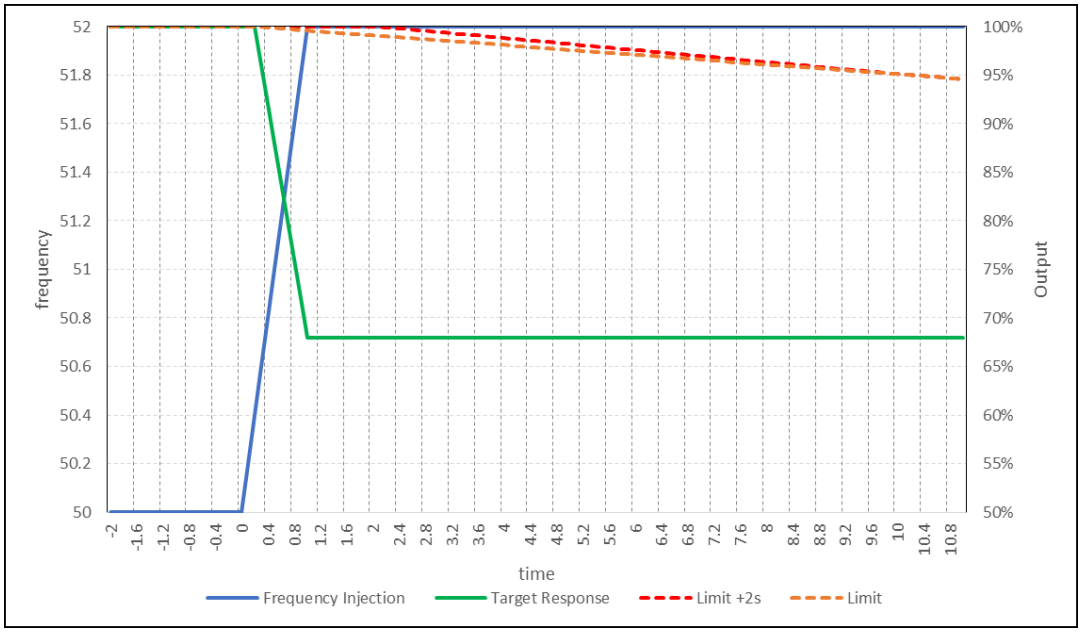

Figure 1 - +2.0Hz injection with 10% droop setting (initial response)

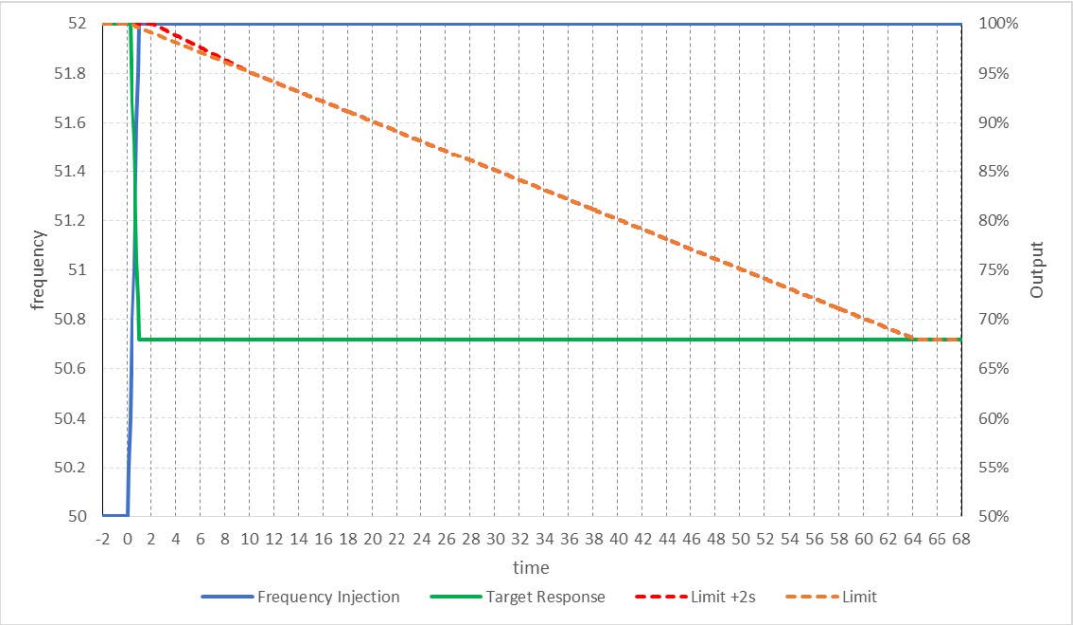

Figure 2 - +2.0Hz injection with 10% droop setting (whole response)

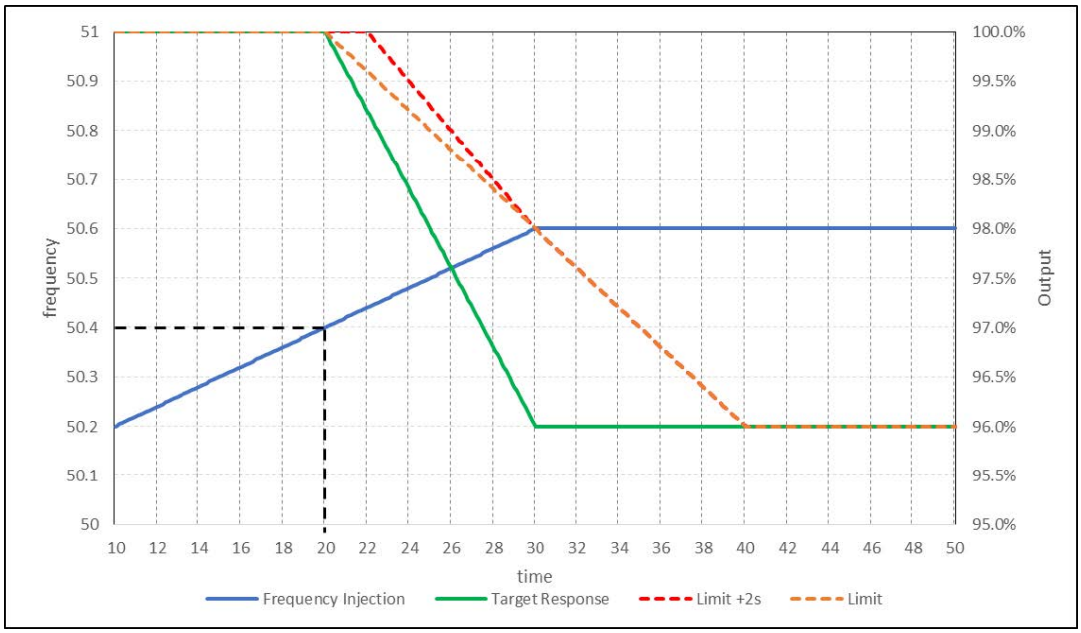

Figure 3 - +0.6Hz injection with 10% droop setting (initial response)

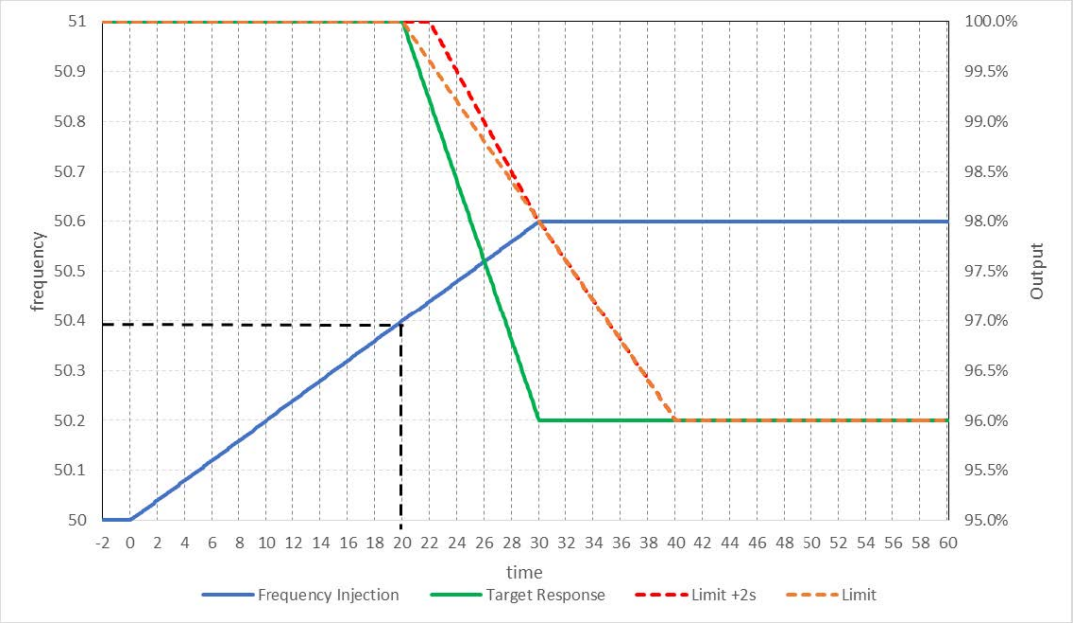

Figure 4 - +0.6Hz injection with 10% droop setting (whole response)

National Grid and the DNOs discussed the above thinking with representatives of manufacturers of smaller generation what a suitable approach might be to specifying the LFSM-O delivery requirements with more clarity. In particular National Grid's suggestion that "as much as possible" be turned into a performance cap of a ramp of 0.5% of output per second was discussed. This was seen as reasonable and proportionate in informal discussions and forms the basis of the legal text of this modification.

The legal text was drafted on this basis and comprises a revision to ECC.6.3.7.2 in the Grid Code and to 11.2.4 (Type A) and 12.2.4 (Type B) in G99. Also, to help manufacturers, Generators and DNOs understand clearly how compliance can be demonstrated, a graphical representation of the requirements has been added to A.7.2.4 (for Type A generating modules); B.5.6 (for Type B synchronous generating modules) and B.6.5 (for Type B power park modules). The draft legal text is attached as follows:

Appendix 1 Grid Code ECC 6.3.7.2

Appendix 2 G99 11.2.4 (Type A requirements)

Appendix 3 G99 2.2.4 (Type B requirements)

Appendix 4 G99 A.7.2.4 (compliance for Type A generating modules

Appendix 5 G99 B.5.6 (compliance for Type B synchronous generating modules)

Appendix 6 G99 B.6.5 (compliance for Type B power park modules)

4 Workgroup Discussions

The workgroup met on 6 June. Following discussion the WG supported the legal text (with one amendment), and supported the text being consulted on as quickly as possible.

Within the work group it was queried wither the system frequency had ever risen above the LFSM-O trigger frequency of 50.4 Hz other than in local islands and it is not believed this has occurred within

the last 20 years with the maximum frequency being 50.397Hz. Hence to date LFSM-O has never been required to deliver response in GB.

The work group also discussed wither the permitted 2 second delay in starting to respond to a frequency change should be allowed to apply after the 10 second activation period and hence change the red lines in figures 1,2,3 & 4 to be parallel to the orange line and not coincide after 10 second. After discussion it was agreed the current interpretation with the lines coinciding after 20 seconds as per the proposal is acceptable.

A discussion also took place as to whether this current proposal which is only limited to type A and B PGMs should be applied to all PGMs (ie type A, B, C and D). It was felt as type C and D response capabilities are already tested more vigorously with the FSM requirements they should easily meet the LRSM-O requirements and there was no benefit in adding this requirement to them. However, a work group member noted that some of the obligations in Article 13 of RfG, for Type A PGMs, do flow through to Type B, C and D PGMs.

It was agreed to modify the legal text of ECC 6.3.7.2(iii) to make it clear that if a generating module needed to make use of the provision in Article 13.2(e) whereby the initial response could be delayed by more than 2s, then it would be for the generator also to justify what the overall response would be and how much would be delivered in 10s, as opposed to having to ensure that the overall response was not unduly arduous in meeting the 10s requirement in 6.3.7.2(v). This modification to 6.3.7.2(iii) is included in Appendix 1.

It was also noted that there risks to overall harmonization if the drafting of the Grid Code and G99 are not word-for-word identical. Whilst accepting this point and the theoretical risk the majority of the workgroup were content that ensuring the requirements were identical, irrespective of the exact wording used, was the key objective and that the proposed drafting was adequate in this respect.

The workgroup reviewed the efforts taken by the Code Administrators to ensure that affected parties were aware of the proposed revisions. The Code Administrators explained that apart from the normal circulation lists in use, the modification had also been brought to the attention of the VSM expert group currently meeting. The G99 consultation and workshops held between October and February had also extended the Distribution Code Administrator's circulation list, picking up a number of manufacturers of smaller generation equipment who had not previously been registered on the D Code mailing list. A small number of these who make inverters for Type A and B modules had been contacted directly to appraise them of the GC0110 work. The Workgroup did not identify any obvious additional publication of GC0110 that should be undertaken outside of the normal consultation process.

The work group also discussed the materiality of the changes. It had been demonstrated in the work group by National Grid that existing larger synchronous machines, and a variety of inverter connected generation would have no trouble meeting the newly defined LFSM-O timings (largely because they also have to meet the more onerous FSM requirements too). Representatives of manufacturers of smaller synchronous generation in the work group confirmed that they thought the proposed interpretation would have no effect on their current designs, ie there is no material effect on costs etc.

5 Applicable Distribution Code Objectives

Impact of the modification on the Applicable Distribution Code Objectives:	
Relevant Objectives	Identified impact
To permit the development, maintenance and operation of an efficient, coordinated and economical system for the distribution of electricity	Positive

To facilitate competition in the generation and supply of electricity	Positive
To efficiently discharge the obligations imposed upon distribution licensees by the distribution licences and comply with the Regulation and any relevant legally binding decision of the European Commission and/or the Agency for the Co-operation of Energy Regulators;	Positive
To promote efficiency in the implementation and administration of the Distribution Code	Neutral

6 Consultation Questions

i. Do you agree that clarifying the performance requirements as proposed in the appendices 1 to 6 is helpful?

ii. Do you agree that the proposed text remains compliant with the RfG requirements?

iii. Do you have any comments on the draft legal text in Appendices 2 to 6?

iv. Do you have any other comments?

7 Next Steps

Responses to this consultation should be sent to the Distribution Code Review Panel Secretary at dcode@energynetworks.org by **17:00 27 July 2018** on the pro-forma provided expressly for the purpose, or via any other convenient means. Given the need to progress this modification to implementation to give clarity to manufacturers in advance of the RfG compliance date of 27 April 2019, responses after this date may not be considered.

For more information, please contact:

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