Frequency Changes during Large Disturbances and their Impact on the Total System

Volume 2

This document contains responses to the first industry consultation and network Licensees' replies

Document Control

Version	Date	Change Reference
1.0	14 March 2014	Consultation

Consultation Responses

Ref	Company
GC0035 - CR-01	Energy UK
GC0035 - CR-02	Northern Powergrid
GC0035 - CR-03	SSE Generation Ltd & SSE Renewable UK Ltd
GC0035 - CR-04	Deep Sea Electronics Plc
GC0035 - CR-05	Scottish Power Generation
GC0035 - CR-06	EDF Energy
GC0035 - CR-07	DNV KEMA
GC0035 - CR-08	London Underground
GC0035 - CR-09	Good Energy Ltd
GC0035 - CR-10	RES Ltd
GC0035 - CR-11	RenewableUK
GC0035 - CR-12	RWE
GC0035 - CR-13	E.ON UK
GC0035 -CR-14	UK Demand Response Association
GC0035-CR-15	Enercon
GC0035 – CR-16	Trinity Mirror Printing
GC0035 - CR-17	Confidential
GC0035 - CR-18	Wykes Engineering Ltd - Withdrawn

ENC 16/13

Energy UK's response to the Industry Consultation for Frequency Changes during Large Disturbances and their Impact on the Total System

02 October

Introduction

Energy UK is the trade association for the energy industry. Energy UK has over 80 companies as members that together cover the broad range of energy providers and suppliers and include companies of all sizes working in all forms of gas and electricity supply and energy networks. Energy UK members generate more than 90% of UK electricity, provide light and heat to some 26 million homes.

Energy UK welcomes the opportunity to respond to the Industry Consultation for Frequency Changes during Large Disturbances and their Impact on the Total System.

Energy UK Response

1. **Do you agree it is necessary to change RoCoF settings on Loss of Mains protection for new and existing distributed generators within stations of registered capacity of 5MW and above? If not, what alternative actions would you recommend and why?**

It is in the interests of the generation community that as stable a frequency as possible be maintained, and that both rate of change and maximum deviation from nominal frequency be minimised during unusual events. It is clear that under the existing standards, Distributed Generation (DG) may, due to its control software settings and not any fundamental mechanical limitations, trip during the most marked, rapid, frequency excursions. This would exacerbate the frequency excursions and could in some circumstances lead to power cuts.

We agree that there are adverse factors at work: fast-responding plant (when on frequency response mode), the oil and coal plant, are all closing. They uniquely have "drum boilers" with "governor valves" that can provide extra output (when on frequency response mode) within 2 seconds. All other large plant can only provide extra output (when on frequency response mode) within 10 seconds, but biased much more towards response at the 7,8,9 second mark. MW seconds of stored energy in large transmission connected plant used to be 250,000 in 2010 (varying by minute of course, from 210,000 to 300,000), this is now 180,000 on average. Pumped storage takes more than 10 seconds

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to start up, which is ideal for dealing with TV pickups - but much too slow to help in the most extreme frequency events.

Energy UK members would like to emphasise that they do not wish to see any deterioration in existing frequency quality (regardless of any changes to Rate of Change of Frequency (ROCOF) settings), and wish to see National Grid take every opportunity to develop new options to stabilise frequency through new forms of fast response plant; we appreciate the work that the national Balancing Services Standing Group (BSSG) and Commercial Balancing Services Group (CBSG) workgroups are undertaking in this direction, regarding a new fast frequency response premium product, entailing frequency response in less than 5 seconds. We are monitoring closely the work that has taken place via ENTSO-E to investigate possible solutions within the new demand connection code. We do however appreciate that it is vital that DG is robust against faster frequency changes than it is at present.

The implications to generators less than 5MW and transmission connected plant have not been assessed and there has not been any analysis of the other setting options considered by the working group to determine the best solution. The benefits described cannot be considered to be true without assessing the full range of impact of the change.

National Grid must thoroughly assess the costs of this proposal, particularly on parties who may not be able to pass such costs on. Those on fixed contracts, such as the longer term Short Term Operating Reserve (STOR) contracts, should be able to pass through any material costs.

The mechanical limit for GB is typically a faster ROCOF than 1 hertz per second, therefore we can support a change in ROCOF settings to 1 hertz per second for >5 MW DG. We await the proposals that are to be developed for <5 MW DG.

The standards for distributed generation, G59/2, and G83/2, are exhibits to the Distribution Code. For big generators the equivalent content is in the Grid Code, but the Distribution Code is a “shell” document which merely refers to a number of exhibits. G59 and G83 were developed by the industry. However, there is a charge to access them. This charge is £85 for G83, and £185 for G59, per single user.

The existence of the charge means that in order for any industry party, to engage fully in debate around reform of G83/2 and G59/2, it must pay to access the relevant actual documents, and then pay again whenever the standards are updated. They are national standards developed under the Distribution Code, and should, our members believe, be accessible for free.

2. Do you agree that 1Hzs-1 measured over half a second is an appropriate RoCoF setting? If not, what alternative RoCoF setting would you recommend and why?

1Hz/s may be appropriate for some sites and generation technologies, but consider that this setting is not appropriate for all sites. At some synchronous generator sites, the installed ROCOF relays are used not only for the protection of the distribution network, as required by DNOs, but also by Generators for the protection of their plant and personnel, particularly against the risk of damage caused by out of phase closing due to auto-reclose circuit breakers on the DNO’s network. As the relay is providing a plant and personnel protection function, we are strongly of the opinion that the relay settings should be agreed by both the DNO and the Generator, and this may require a site-specific assessment rather than the adoption of generic settings, particularly if the latter are so insensitive. It is important to note that a suitable setting for protection purposes depends on many site-specific factors, such as generator inertia and other generator parameters, voltage control capabilities, auto-reclose settings, and the export capacity of the generator compared to the local load.

The measurement period cannot be too short or spurious measurements may result. There is a need to clarify this as there is some confusion over what time period ROCOF should, in compliance terms, be measured (the standards are not specific). “Vector shift” entails comparing the point of transition across zero volts on two adjacent cycles of the mains (so, looking really at just one cycle) – this is like

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ROCOF, but measured across a very short period of time, namely 0.02 seconds. The Vector Shift approach is far too sensitive, leading to the possibility of inaccuracy; it could lead to erroneous indicators of non-compliance for DG that is compliant across the measurement period of 500 ms, which reflects much better the shortest time period that is relevant for the transmission system as a whole.

The vector shift approach also entails a risk of spurious tripping due to transients, and loss of generation output from DG that needn't, on the proposed 500ms measurement basis, have tripped. This risk is greater for the GB synchronous area than for the main European synchronous area, due to the inertia and system size being smaller; therefore, the GB system is a little more vulnerable to local/wider transients.

3. **Are you responsible for distributed generation which will be affected by these proposals? How much of your generating capacity is affected?**

N/A

4. **Do you agree with the Workgroup's probability and risk assessment conclusions?**

No comment

5. **Do you agree with the Workgroup's approach to the probability and risk assessment relating to the risk to individuals and the risk to equipment as a consequence of a change to RoCoF settings?**

No comment

6. **What, if any, additional features should be added to the Workgroup's probability and risk assessment relating to the risk to individuals and the risk to equipment as a consequence of a change to RoCoF settings? How can these be quantified and by whom?**

No comment

7. **Do you have specific information relating the risks to generators of out of phase re-closure which would improve upon the Workgroup's assessment?**

No comment

8. **What assessment and mitigation measures would it be appropriate for synchronous generators to take to reduce the risk of out of phase re-closures that could otherwise present a hazard?**

No comment

9. **What is your view of the costs that the Workgroup presented for implementing its proposals? Has the Workgroup over or under-estimated costs? Has the Workgroup missed some items or included costs that shouldn't be considered?**

No comment

10. **What is your view of the potential Balancing Services costs that National Grid estimates can be saved by implementing the Workgroup's proposals? Has it over or under-estimated costs? Has National Grid missed some items or included costs that shouldn't be considered?**

We consider that full details of the potential Balancing Services cost National Grid could save would not be apparent until the assessment of phase 2 (settings for generation capacity of less than 5MW).

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11. Do you believe that 18 months is an appropriate period for protection setting changes to be implemented?

Yes, a sufficient amount of time is needed for a software upgrade to become available for either existing or new >5 MW DG. We consider 18 months to be sufficient for this to be developed and implemented.

12. Do you have any comments on the Workgroup's future work plan to develop proposals for distributed generation of less than 5MW in capacity and to develop proposals for a RoCoF withstand capability?

Yes, this work will be necessary – in order to ensure we avoid the situation that has come to pass in Germany and Italy, where visits have and will continue to be made to the lofts of hundreds of thousands of households, to alter the solar PV inverter settings. This would lead to negative PR for the electricity industry as a whole – as would power cuts due to the unnecessarily small, "engineered", artificial, ROCOF software settings, that does not reflect real mechanical limitations. We look forward to some specific recommendations to consider.

13. Do you believe the proposals better facilitate the Distribution Code objectives? Please include your reasoning.

i) to permit the development, maintenance and operation of an efficient, coordinated and economical system for the transmission of electricity;

Yes, it is inefficient for plant to be forced to trip due to an engineered, artificial software limit that is mandated to be set too sensitive (to trip at too low a ROCOF). It is inefficient also in that this could cause un-necessary future power cuts, and disturb other generators through an increase of frequency swings.

ii) to facilitate competition in the generation and supply of electricity

Yes, it is inefficient for plant to be forced to trip due to an engineered, artificial software limit that is mandated to be set too sensitive (to trip at too low a ROCOF)

iii) subject to sub-paragraphs (i) and (ii), to promote the security and efficiency of the electricity generation, transmission and distribution systems in the national electricity transmission system operator area taken as a whole; and

Yes, the disturbance to other generators through exacerbation of frequency swings could even lead to them, also, tripping, or at any rate, increase wear and tear on them.

iv) to efficiently discharge the obligations imposed upon the licensee by this license and to comply with the Electricity Regulation and any relevant legally binding decisions of the European Commission and/or the Agency.

Yes; the passing of this change to ROCOF settings would be very much in line with the aims of the Load Frequency Control and Reserves (LFCR) European network code, in that it would assist the system operator here in GB in maintaining frequency to within the specifications and default values set out in tables 1, 2, and 3 included in Article 19 of the LFCR code.

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FROM THE CHAIRMAN OF THE DISTRIBUTION CODE REVIEW PANEL OF GREAT BRITAIN

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"By Email"

Mr Kyle Martin
Energy UK
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11 March 2014

Dear Kyle,

Frequency Changes during Large Disturbances and their Impact on the Total System

Thank you for your response to the consultation which took place in September 2013 on proposals to modify the Distribution Code requirements relating to Frequency changes during Large Disturbances and their Impact on the Total system.

Licensees received valuable feedback from the Industry with responses received from eighteen industry parties. The majority of responses were in favour of the proposals and recommended its implementation subject to certain concerns being addressed.

The Workgroup have helped to formulate responses to the comments you have raised in its work developing final proposals. I have summarised the Workgroup's thoughts in the points below:

- The Workgroup notes your comments on the changes to generation in Great Britain and that your members wish to see no deterioration in frequency quality. This is a desire the Workgroup shares. The Workgroup believes that its proposals reduce the risk of severe frequency deviations by minimising the likelihood of cascade generator losses due to undesired Loss of Mains protection operation.

- The Workgroup also noted your concerns on the lack of analysis on generators less than 5MW and the consideration of other setting options. The Workgroup intends to develop its view of the costs associated with changes to Loss of Mains protection requirement for generators of less than 5MW in the next phase of work. The Workgroup has also reviewed and revised its proposals for generators of greater than 5MW in the light of feedback received and believes that the cost benefit case is valid for this change when considered in isolation.

- In relation to your query on the current charges for access to G83/2 and G59/2, the Workgroup wishes to highlight that the key requirements for compliance are freely available in the Distribution Code.

- In addition, the Workgroup notes your comments regarding the need to take the characteristics of individual connection sites into account when specifying protection settings. This aligns with the Workgroup's recommendation. The Workgroup's revised recommendations give owners of existing synchronous generators added flexibility in the choice of settings.

- Your concern relating Vector Shift and the risk of spurious tripping and unnecessary loss of distribution generation output has been noted and the Workgroup fully intends to examine this in the next phase of work.

- In addition, your view on the potential Balancing Services cost was noted. As stated above, the Workgroup has also reviewed and revised its proposals in the light of feedback received and believes that the cost benefit case is valid for this change when considered in isolation.

- Finally, the Workgroup accepts your view that a specification of measurement periods is required and this has been addressed in the revised proposal. Your views on the necessity of the phase 2 work were also welcome.

There will be a further consultation on these changes during March 2014 and I anticipate the publication of the Final Report to the Authority to follow in April. If you have any queries, or outstanding issues, please contact the Workgroup via grid.code@nationalgrid.com.

Yours sincerely,

Mike Kay

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Mike Kay
Networks Strategy and Technical Support Director
Electricity North West
Chairman of the Distribution Code Review Panel of Great Britain

Industry Consultation Response Proforma

Frequency Changes during Large Disturbances and their Impact on the Total System

Industry parties are invited to respond to this consultation expressing their views and supplying the rationale for those views, particularly in respect of any specific questions detailed below.

Please send your responses by **27 September 2013** to david.spillett@energynetworks.org.

Please note that any responses received after the deadline or sent to a different email address may not receive due consideration.

Respondent:	*Alan Creighton*
Company Name:	*Northern Powergrid*

Industry Consultation Questions

(a)	Do you agree it is necessary to change RoCoF settings on Loss of Mains protection for new and existing distributed generators within stations of registered capacity of 5MW and above? If not, what alternative actions would you recommend and why?	NGET's case for the need to address the risk to the total system from increasing RoCoF events is well made. Changing the settings of RoCoF based LOM relays is a reasonable means of helping to managing this risk. At the moment the volume of generation (and its operating regime) in the >5MW category that is equipped with such relays is uncertain and hence the extent to which implementation of the recommendations will result in a reduction in NGETs Balance Service expenditure is also uncertain. In order to reduce the Balance Services procured to manage the RoCoF risk, NGET will need to understand the quantity of generation operating at any given time fitted with RoCoF protection set to the existing G59 settings.
(b)	Do you agree that 1Hzs-1 measured over half a second is an appropriate RoCoF setting? If not, what alternative RoCoF setting would you recommend and why?	The risk assessment carried out by UoS concludes that whilst the overall risk to network equipment and people associated with network equipment would increase by the adoption of the proposed setting, the resulting risk is broadly acceptable and virtually independent of which of the 'new' series of settings is deployed. On the basis that any of the proposed settings results in a level of risk that is broadly acceptable it seems reasonable to adopt the setting that will provide the most enduring solution and minimise the number of occasions when generators are asked to change protection settings.

(c)	Are you responsible for distributed generation which will be affected by these proposals? How much of your generating capacity is affected?	No
(d)	Do you agree with the Workgroup's probability and risk assessment conclusions?	The probability and risk assessment carried out by the University of Strathclyde does seem to be a reasonably robust assessment based on conservative assumptions. Their report is not too easy to read in isolation however the additional explanation provided at the industry workshops was very helpful. The analysis is based on a limited number of load profiles and generator profiles and just one protection relay. It is difficult to form a view of whether the conclusions would be different if a wider range of demand and generation profiles had been applied or if different LoM relays had been used to assess the NDZ in WP1. Whilst most of the assumptions do seem to be conservative, it would be good to clarify whether the overall conclusions are particularly sensitive to any of the assumptions. The conclusions in section 4 of the UoS report seem reasonable ones to draw from the analysis presented.
(e)	Do you agree with the Workgroup's approach to the probability and risk assessment relating to the risk to individuals and the risk to equipment as a consequence of a change to RoCoF settings?	Notwithstanding our comments in (d) the approach appears to be reasonable. The risk assessment does appear to makes some implicit assumptions including: • Auto reclose equipment on the distribution network can safely cater to an out of phase reclosure. • The probability of a fault occurring within the 3sec when an island could persist, which would not be adequately protected / cleared is negligible. • There are no risks associated with non-synchronous generation plant. Whilst these assumptions are probably reasonable it would be good to tease them out for completeness. We note that the approach does not go as far as assessing the individual risk associated with failures of generation plant nor the risks to generation plant itself – this being a task for the generators.

(f)	What, if any, additional features should be added to the Workgroup's probability and risk assessment relating to the risk to individuals and the risk to equipment as a consequence of a change to RoCoF settings? How can these be quantified and by whom?	To complete a robust risk assessment of all the potential risks for every scenario of generation / demand and protection relay would have been particularly challenging and time. Subject to the concerns raised in (d) the approach appears to be reasonable and the time taken to include additional features could have been extensive.
(g)	Do you have specific information relating the risks to generators of out of phase re-closure which would improve upon the Workgroup's assessment?	No, this is a question that would be best addressed by the generator community.
(h)	What assessment and mitigation measures would it be appropriate for synchronous generators to take to reduce the risk of out of phase re-closures that could otherwise present a hazard?	As a DNO with responsibility for agreeing the LoM protection settings this is an area of concern. There could be a temptation for a Generator to undertake a risk assessment, conclude that the risks are too high and request that the DNO agrees (under DPC7.4.3.8) that the existing settings should be retained. It would be helpful if there was guidance developed by the Workgroup that could be used by the Generator to help them complete the risk assessment (particularly where the generator is operating in PV mode) and provide guidance on the risk mitigation options available. If the risks could be materially mitigated without incurring excessive costs, then it would be reasonable for the DNO to decline a request to retain the existing settings – conversely if the mitigation costs were disproportionately expensive it would be reasonable for the DNO to agree different settings from those in DPC 7.4.3.4. Whilst it would be difficult to present prescriptive guidance, general guidance on a risk assessment approach that could be adopted (e.g. following the UoS approach and comparing the result against the ALARP framework), the range of mitigating options that a DNO would expect a Generator to have be considered (e.g. restricting access to the generation plant, utilising an alternative Loss of Mains protection) could be developed together with a range of costs that it would be reasonable for a Generator to spend mitigating the risk. The costs guidance could be given in the form of a percentage of the typical new connection cost for a generator of a similar size e.g. 5%. Such guidance could be included as a Guidance Note in the Distribution Code or Engineering Recommendation G59.

(i)	What is your view of the costs that the Workgroup presented for implementing its proposals? Has the Workgroup over or under-estimated costs? Has the Workgroup missed some items or included costs that shouldn't be considered?	The DNO will occur costs managing the change of protection process, witnessing the protection changes, pursuing those Generators who seem reluctant to make the changes and providing information and support to Generators when they undertake a risk assessment. Although these costs will be small compared to those referred to in the report, and hence wouldn't influence the decision, they should be recognised.
(j)	What is your view of the potential Balancing Services costs that National Grid estimates can be saved by implementing the Workgroup's proposals? Has it over or under-estimated costs? Has National Grid missed some items or included costs that shouldn't be considered?	The report states that in the first two months of 2013/14 £1m has been spent specifically managing the risk presented by rate of change of frequency. Given NG's licence obligations to operate an economical and efficient system it seems reasonable to conclude that this was the cheapest means of managing the risk. These historic costs tend to suggest that the annual cost is towards the lower end of the £10m-£100m range. Even if the costs were £10m pa, and the implementation costs were £7.5m, the change would be justified.
(k)	Do you believe that 18 months is an appropriate period for protection setting changes to be implemented?	Our experience of the implementation of the frequency protection changes associated with G59/2 is that the changes took longer to implement than anticipated. Whilst we recognise that there does need to be clear implementation targets we feel that allowing 12 months for the generator to assess the risks and agree the protection settings with the DNO followed by 12 months to implement them (i.e. one complete outage season) would be more achievable.

(l)	Do you have any comments on the Workgroup's future work plan to develop proposals for distributed generation of less than 5MW in capacity and to develop proposals for a RoCoF withstand capability?	The outline plan considers a wide range of activities, but could perhaps be expanded to include the following: • Whether there are other forms of LOM protection that either exist or need to be developed that could be applied to future plant. There would be merit in setting out the performance requirements of an 'ideal' RoCoF 'relay' or system and setting academia the challenge of developing a new approach that could cater for the Total System dynamics that are anticipated in the future. For example there may be opportunities to use the Smart Meter communications infrastructure to provide a dedicated 'intertripping' signal which even if slower than RoCoF relay operating times might provide sufficient risk mitigation. • The risk assessment would need to cater for the multiple points on an HV and LV network that could be 'opened' during faults or normal network operation to create an island and the potential for out of sync closing to take place at manually operated points e.g. link boxes / LV distribution board / HV disconnectors. The modelling exercise is very likely to be orders of magnitude greater than that carried out for the >5MW generators.
(m)	Do you believe the proposals better facilitate the Distribution Code objectives? Please include your reasoning.	(i) to permit the development, maintenance and operation of an efficient, coordinated and economical system for the transmission of electricity; Yes. The proposal economically addresses an increasing risk to the total system.
		(ii) to facilitate competition in the generation and supply of electricity The proposal has a negligible impact.

		(iii) subject to sub-paragraphs (i) and (ii), to promote the security and efficiency of the electricity generation, transmission and distribution systems in the national electricity transmission system operator area taken as a whole; and Yes. The proposal economically addresses an increasing risk to the total system.
		(iv) to efficiently discharge the obligations imposed upon the licensee by this license and to comply with the Electricity Regulation and any relevant legally binding decisions of the European Commission and/or the Agency. The proposal has a negligible impact.

Additional Comments

	Proposed Changes to DCode DPC7.4.3.4 & EREC G59/3 10.5.7.1	Clarity of the required setting is important and it would be worth confirming that the G59 and DCode requirement can be implemented with relays that are commercially available. The requirement is 'The desired protection requirement is 1Hz/s, but it is important that this is measured over a period of at least half of one second. The total tripping time will therefore be 0.5s plus the circuit breaker operating time. The total tripping time should not exceed 2.5s'. Presumably this means that the total 'detection and tripping time' should not exceed 2.5s. Would it be acceptable for the measurement period to be 2 seconds? It would be good to confirm that the required setting can be applied unambiguously on typical relays used to provide LoM protection.
	Proposed Changes to EREC G59/3	10.5.7.1 Note (2) heading should be changed to read LOM constant (i.e. without the 's' as the reference to K2 has been deleted.

FROM THE CHAIRMAN OF THE DISTRIBUTION CODE REVIEW PANEL OF GREAT BRITAIN

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"By Email"

Mr Alan Creighton
Northern Powergrid
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11 March 2014

Dear Alan,

Frequency Changes during Large Disturbances and their Impact on the Total System

Thank you for your response to the consultation which took place in September 2013 on proposals to modify the Distribution Code requirements relating to Frequency changes during Large Disturbances and their Impact on the Total system.

Licensees received valuable feedback from the Industry with responses received from eighteen industry parties. The majority of responses were in favour of the proposals and recommended its implementation subject to certain concerns being addressed.

The Workgroup have helped to formulate responses to the comments you have raised in its work developing final proposals. I have summarised the Workgroup's thoughts in the points below:

- In response to the specific comments you raised on the Workgroup's risk Assessment, the Workgroup believes that the profiles used were sufficiently representative for the purposes of developing generic recommendations and recognises that additional information is required under certain circumstances. The Workgroup believes that its consultation document provided a reasonable summary of the factors which influenced the outcome of the assessment, which would also apply to any site specific assessment. In particular, the consultation highlighted the effect of generator control mode. The Workgroup notes there are practical limits to modelling and the Workgroup is open to suggestions regarding how to develop this, particularly for phase 2 of the work.

- In addition, your concerns regarding the site specific risk has been noted and the Workgroup agrees that guidance on the risk assessment would be useful. Outline guidance will be available within G59. The Workgroup has also noted and agreed with your comment on the costs incurred managing the change of protection process.

- The Workgroup welcomes your interest in the risk assessment report. The consultation document describes how various factors affect the calculated risk and presents results for different generator voltage control modes because of the significance of this aspect. .

- Furthermore, the Workgroup welcomes your three suggestions regarding G59 and responds that the work underpinning G59 shows that the risk to DNO's auto reclosing circuit breakers is negligible provided there is no fast acting protection that initiates an instantaneous trip.

- The Workgroup notes your statement on implementing previous frequency protection changes and recognises that timescales may be challenging in some circumstances. However, the Workgroup is conscious of the costs triggered by delaying action.

- The Workgroup agrees that further research into other forms of LOM protection would be valuable and your suggestion on phase 2 and the risk assessment catering for multiple points on a HV and LV network has been noted by the Workgroup.

- Finally, the Workgroup agreed that there needs to be more clarity in specifying what settings need to be achieved and the legal text has been revised accordingly.

There will be a further consultation on these changes during March 2014 and I anticipate the publication of the Final Report to the Authority to follow in April. If you have any queries, or outstanding issues, please contact the Workgroup via grid.code@nationalgrid.com.

Yours sincerely,

Mike Kay

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Mike Kay
Networks Strategy and Technical Support Director
Electricity North West
Chairman of the Distribution Code Review Panel of Great Britain

Industry Consultation Response Proforma

Frequency Changes during Large Disturbances and their Impact on the Total System

Industry parties are invited to respond to this consultation expressing their views and supplying the rationale for those views, particularly in respect of any specific questions detailed below.

Please send your responses by **27 September 2013** to david.spillett@energynetworks.org.

Please note that any responses received after the deadline or sent to a different email address may not receive due consideration.

Respondent:	Campbell McDonald
Company Name:	SSE Generation Ltd & SSE Renewable UK Ltd

Industry Consultation Questions

(a)	Do you agree it is necessary to change RoCoF settings on Loss of Mains protection for new and existing distributed generators within stations of registered capacity of 5MW and above? If not, what alternative actions would you recommend and why?	We agree that it may be necessary to change the RoCoF setting on Loss of Mains protection for new and existing distribution connected generators greater than 5 MW if it reduces the impact of frequency deviation as a result of a large disturbance and delivers a cost effective solution. We are concerned however that the costs to small independent generators may now be necessary as a result of the decision to raise the grid infeed loss above 1320MW. We are concerned that the parties benefiting from this proposed change are not the parties bearing the costs and should have been considered at the time when the increase in grid infeed loss to 1800 MW was proposed.
(b)	Do you agree that 1Hzs-1 measured over half a second is an appropriate RoCoF setting? If not, what alternative RoCoF setting would you recommend and why?	We are unsure if 1Hzs-1 is an appropriate setting as it is a significant reduction in the sensitivity of the loss of mains and may significantly increase the likelihood of a power island being created. The figures presented show the worst case based around 0.6Hzs-1. The proposal to go for 1Hzs-1 gives a margin of error to avoid any further changes in future, although we welcome this as a concept; however as this less sensitive setting introduces increased risk to the generator which may not be justified. The final setting adopted has to be optional for all interested parties not just the Transmission System Operator. Where potential power islands are identified addition measures should be put in place to protect generators

		and connected customers such as check synchronising before CB closure.
(c)	Are you responsible for distributed generation which will be affected by these proposals? How much of your generating capacity is affected?	Yes, Impacted Generation greater than 5 MW and with G59 LOM protection: Thermal (England) 192 MW Hydro (Scotland) 42.5 MW Wind (Scotland) 171 MW
(d)	Do you agree with the Workgroup's probability and risk assessment conclusions?	We agree with some of the Workgroup's probability and risk assessment conclusions, however we don't agree with that it probability of sustained islanded operation is highly unlikely with any protection setting. Many Grid Supply Points in the North of Scotland export to the transmission system and are capable of sustaining a power island for a period and certainly long enough for a DAR closure to be initiated. The workgroup have still to give an estimate of the cost of a disruptive failure of generator and complete the second phase of the technical study in April 2014 to establish the exposure. It seems unfair to request these changes until everyone knows the specific risks to their equipment and employees.
(e)	Do you agree with the Workgroup's approach to the probability and risk assessment relating to the risk to individuals and the risk to equipment as a consequence of a change to RoCoF settings?	The risk assessment and probability relates to distribution network equipment and for an individual in the vicinity of the distribution network owned equipment but does not cover cost of damage to generators or customer's equipment subjected to an out of phase re-closure or an individual in the vicinity of them during a disruptive failure.

(f)	What, if any, additional features should be added to the Workgroup's probability and risk assessment relating to the risk to individuals and the risk to equipment as a consequence of a change to RoCoF settings? How can these be quantified and by whom?	We suffered an out of phase closure on a relatively small machine of 2.2 MW which resulted in direct costs of over £100k. Another out of phase closure damaged end windings where the machine suffered premature failure within two months (cost in excess of £150k). An indication of the type of equipment damage we could expect if the change of RoCoF protection settings left the plant with no Loss of Mains protection. Possible failures due to out of phase closures which create very large torques and counter torques and can cause... Coupling damage, Sheared fixings, Gearbox damage, Gear or bearing damage, Alternator frame damage, Prime mover shaft shearing Large electrical currents and voltage surges create… Rotor diode failures, Circuit breaker contact failures and flash-over damage, Damaged Alternator windings particularly to end windings & Transformer stressing
(g)	Do you have specific information relating the risks to generators of out of phase re-closure which would improve upon the Workgroup's assessment?	Older generators are operated in P-V control mode by design and don't have the facility to operate in P-Power Factor control mode and are therefore at greater risk of out of phase re-closure. The Workgroups assessment would be improved by quantifying the generators at risk.
(h)	What assessment and mitigation measures would it be appropriate for synchronous generators to take to reduce the risk of out of phase re-closures that could otherwise present a hazard?	RoCoF is an effective means of detecting Loss of Mains and if the proposed changes mean that mitigation measures are required to reduce the risk of out of phase re-closures that could present a hazard to the generator or their employees then the revised RoCoF protection setting must be inappropriate and unreasonable. In addition any move to change out the Loss of Mains from RoCoF to Vector Shift could be short lived as VS will also soon be subject of a review.
(i)	What is your view of the costs that the Workgroup presented for implementing its proposals? Has the Workgroup over or under-estimated costs? Has the Workgroup missed some items or included costs that shouldn't be considered?	The estimated cost of implementing a relay configuration change indicated by the working group appears to be within the range we would expect. If the existing relay can not be reconfigured to the new setting and a new relay is required then we estimate the implementation cost to be nearer £20K per site.

(j)	What is your view of the potential Balancing Services costs that National Grid estimates can be saved by implementing the Workgroup's proposals? Has it over or under-estimated costs? Has National Grid missed some items or included costs that shouldn't be considered?	The potential Balancing Services cost savings by implementing the workgroup proposals have not been specifically estimated by National Grid. The report implies a cost of £11m due to RoCoF but the report does not give an estimate of the savings that would be realised specifically by implementing this change. Indeed the report highlights further changes to RoCoF protection settings for <5MW are being considered. An estimate of the likely increased cost of procuring additional Balancing Services as a result of the change of infeed loss from 1320MW to1800MW should be published with an explanation of how these costs will be recovered to allow a comparison to be made. This comparison would be useful to gauge against the additional costs and plant risk associated with the move away from a RoCoF protection setting of 0.125Hzs-1.
(k)	Do you believe that 18 months is an appropriate period for protection setting changes to be implemented?	No. Generators will need longer to specify changes to their equipment, budget and then procure equipment or services to implement the change in a controlled and documented way.
(l)	Do you have any comments on the Workgroup's future work plan to develop proposals for distributed generation of less than 5MW in capacity and to develop proposals for a RoCoF withstand capability?	What will the savings be in Balancing Services costs are? How feasible is it to implement a change to the RoCoF protection setting for all distribution generation on power stations of less than 5 MW. A cut off capacity should be considered. The effectiveness of changing the RoCoF protection setting for this type of power station need to be assessed against the success of the G59/2 change.

(m)	Do you believe the proposals better facilitate the Distribution Code objectives? Please include your reasoning.	(i) to permit the development, maintenance and operation of an efficient, coordinated and economical system for the transmission of electricity; At this stage we are minded to believe that change to the RoCoF protection setting as Loss of Mains does better facilitate some Distribution Code objectives. We believe the benefits of implementing this change are to the wider industry and not to the small power station owners. The costs and operational risk to be taken on by the small power stations can be justified if the true cost savings are clearly established.
		(ii) to facilitate competition in the generation and supply of electricity
		(iii) subject to sub-paragraphs (i) and (ii), to promote the security and efficiency of the electricity generation, transmission and distribution systems in the national electricity transmission system operator area taken as a whole; and
		(iv) to efficiently discharge the obligations imposed upon the licensee by this license and to comply with the Electricity Regulation and any relevant legally binding decisions of the European Commission and/or the Agency.

FROM THE CHAIRMAN OF THE DISTRIBUTION CODE REVIEW PANEL OF GREAT BRITAIN

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"By Email"

Mr Campbell McDonald
SSE Generation Ltd & SSE Renewable UK Ltd
Inveralmond House
200 Dunkeld Road
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PH1 3AQ

11 March 2014

Dear Campbell,

Frequency Changes during Large Disturbances and their Impact on the Total System

Thank you for your response to the consultation which took place in September 2013 on proposals to modify the Distribution Code requirements relating to Frequency changes during Large Disturbances and their Impact on the Total system.

Licensees received valuable feedback from the Industry with responses received from eighteen industry parties. The majority of responses were in favour of the proposals and recommended its implementation subject to certain concerns being addressed.

The Workgroup have helped to formulate responses to the comments you have raised in its work developing final proposals. I have summarised the Workgroup's thoughts in the points below:

- Concerning RoCoF settings, the Workgroup recognises that the proposed changes have a high impact on small generators. The Workgroup notes that larger infeed loss risks are only one of the drivers for the change and that the management of these costs are generally socialized and that there is a risk that a change to this approach could have undesirable effects. The Workgroup recognises that concerns in this area are shared by a number of parties, but is unable to address the direct concern within its terms of reference. Workgroup members recognise that it may be necessary to discuss these and similar issues in other forums at a later date.

- The Workgroup has noted your concerns with the $1Hzs^{-1}$ setting however believes it provides a sufficient margin between anticipated system average behaviour and the protection setting to provide assurance that settings will not have to be revisited in unreasonably short timescales. However, the Workgroup has revised its recommendations with respect to existing synchronous generators in response to concerns raised in this consultation process.

- The Workgroup notes your valuable experience of islanded operation and your view that that islanding can be more likely than the generic risk assessment suggests. The Workgroup agrees that the risk of associated with a higher RoCoF setting for synchronous generation is highly dependent on local conditions and plant characteristics and therefore recommends that a site specific risk assessment is carried out. The Workgroup's view is that an increased risk of disruptive failure in general is not acceptable to the industry and therefore included the cost of the necessary risk assessment and mitigation in its analysis rather than the cost of a disruptive failure.

- The Workgroup thanks you for your information on an out-of-phase re-closure and where possible will to incorporate this information in further work.

- The Workgroup notes your comment on the increased risk of out of phase re-closure for generators operating in P-V control that do not have the ability to operate in P-F Power Factor Control Mode. Again, the Workgroup believes that the risk to existing synchronous generators, and the any appropriate mitigation, is best assessed on a site by site basis. Moreover, the Workgroup notes that Vector Shift may not be a suitable alternative to RoCoF for synchronous machines and the Workgroup intends to review Vector Shift in future work.

- The Workgroup thanks you for your information on the costs of implementing the Workgroup's proposals. From its research the Workgroup believes that all common RoCoF relays in use can cater for the new settings so the contingency of having to change a relay is not expected.

- In relation to the potential Balancing Services cost saving, the Workgroup confirms that the costs and savings associated with different phases of the work have been addressed in the revised Cost Benefit Analysis.

- The Workgroup notes your concern over the 18 month proposed timescale for generators to make specified changes and recognises that timescales may be challenging in some circumstances. The Workgroup is also conscious of the cost triggered by any unnecessary delay. However, the Workgroup has increased its proposed implementation period to 2 years in response to concerns raised.

- The Workgroup notes your concern on the feasibility of implementing a change to RoCoF protection setting for all distributed generation on power stations of less than 5MW. The Workgroup will consider this in the development of its proposals.

There will be a further consultation on these changes during March 2014 and I anticipate the publication of the Final Report to the Authority to follow in April. If you have any queries, or outstanding issues, please contact the Workgroup via grid.code@nationalgrid.com.

Yours sincerely,

Mike Kay

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Mike Kay
Networks Strategy and Technical Support Director
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Industry Consultation Response Proforma

Frequency Changes during Large Disturbances and their Impact on the Total System

Industry parties are invited to respond to this consultation expressing their views and supplying the rationale for those views, particularly in respect of any specific questions detailed below.

Please send your responses by **27 September 2013** to david.spillett@energynetworks.org.

Please note that any responses received after the deadline or sent to a different email address may not receive due consideration.

Respondent:	*D.W. Hartley, technical Director*
Company Name:	*Deep Sea Electronics Plc*

Industry Consultation Questions

(a)	Do you agree it is necessary to change RoCoF settings on Loss of Mains protection for new and existing distributed generators within stations of registered capacity of 5MW and above? If not, what alternative actions would you recommend and why?	Yes, given the conditions prevailing. Synthetic inertia fitted to Wind Turbines, for instance, would have possibly meant a tighter RoCoF setting could be maintained, but the costs may have been prohibitive. The issue here is that the slower the settings required on RoCoF then potentially the less useful it becomes.
(b)	Do you agree that 1Hzs-1 measured over half a second is an appropriate RoCoF setting? If not, what alternative RoCoF setting would you recommend and why?	With the information presented, it is probably acceptable at this power level in the Grid, but is likely to leave less room for manoeuvre lower down the chain, where greater fluctuations may be the case.
(c)	Are you responsible for distributed generation which will be affected by these proposals? How much of your generating capacity is affected?	No.

(d)	Do you agree with the Workgroup's probability and risk assessment conclusions?	Generally ok, but with a few concerns about initial suppositions in that it has been carried out with generally favourable conditions – eg. PF ≈ 1, Synchronous Generators. The area for most concern would be the out-of-synch re-closures and this is possibly underplayed.
(e)	Do you agree with the Workgroup's approach to the probability and risk assessment relating to the risk to individuals and the risk to equipment as a consequence of a change to RoCoF settings?	Believe that the risk to individuals is acceptable, although a little higher, but the risk to equipment does appear to be largely unknown, probably because we have had such a stable situation for so long. More information on this aspect would give more peace of mind and sources of data should be available – see below.
(f)	What, if any, additional features should be added to the Workgroup's probability and risk assessment relating to the risk to individuals and the risk to equipment as a consequence of a change to RoCoF settings? How can these be quantified and by whom?	With regard to this, I believe there should be a number of agencies who could reference some data regarding risk to individuals and machinery which would help increase confidence in the analysis. Initially, I would suggest HSE, AMPS, Insurance bodies possibly, and obviously the Generators who form part of this consultation.
(g)	Do you have specific information relating the risks to generators of out of phase re-closure which would improve upon the Workgroup's assessment?	Not at this level of the Grid, but have a number of contacts who could input such information into Stage 2. Examples would include damage to shafts, couplings, engine/Alternator mounts, windings etc.
(h)	What assessment and mitigation measures would it be appropriate for synchronous generators to take to reduce the risk of out of phase re-closures that could otherwise present a hazard?	Check-synch equipment at all points of connection would be the ideal, as highlighted in the study.

(i)	What is your view of the costs that the Workgroup presented for implementing its proposals? Has the Workgroup over or under-estimated costs? Has the Workgroup missed some items or included costs that shouldn't be considered?	Costs are probably reasonably stated for the solutions proposed. Out-of- synch closures may be under-stated at the end of the day if there are more connections than expected. These costs are not compared to the costs for carrying out modifications for synthetic inertia etc., but will presumably be lower.
(j)	What is your view of the potential Balancing Services costs that National Grid estimates can be saved by implementing the Workgroup's proposals? Has it over or under-estimated costs? Has National Grid missed some items or included costs that shouldn't be considered?	Not convinced that, with greater penetration of the market by renewables, some form of balancing may always be required and would be an offset in the cost savings put forward. The proportion is difficult to predict as it relies on the amount and mix of generators predicted to be on line at any point in time.
(k)	Do you believe that 18 months is an appropriate period for protection setting changes to be implemented?	This seems reasonable if the proposal goes ahead.
(l)	Do you have any comments on the Workgroup's future work plan to develop proposals for distributed generation of less than 5MW in capacity and to develop proposals for a RoCoF withstand capability?	Stage 2 work at lower levels in the supply chain may well affect RoCoF settings again, to the point that the technique may not be useful. The number of generators on the network will mean it is a very difficult model to predict. More valid data will be required and we welcome the intention to get more people involved.
(m)	Do you believe the proposals better facilitate the Distribution Code objectives? Please include your reasoning.	(i) to permit the development, maintenance and operation of an efficient, coordinated and economical system for the transmission of electricity; Not necessarily, because overall standards are being reduced. Lower costs for changes don't always mean the best solution. This may be justified if the conclusions of the report prove to be correct but there appear to be quite a few 'unknowns' at this stage.

		(ii) to facilitate competition in the generation and supply of electricity Yes, but different types of generation appear to be competing on different playing fields, in that some are being potentially penalised for others in the protection levels now required.
		(iii) subject to sub-paragraphs (i) and (ii), to promote the security and efficiency of the electricity generation, transmission and distribution systems in the national electricity transmission system operator area taken as a whole; and The risks still appear to be within manageable levels and therefore it is secure, given the results of the study.
		(iv) to efficiently discharge the obligations imposed upon the licensee by this license and to comply with the Electricity Regulation and any relevant legally binding decisions of the European Commission and/or the Agency. Can't really comment at this stage.

FROM THE CHAIRMAN OF THE DISTRIBUTION CODE REVIEW PANEL OF GREAT BRITAIN

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"By Email"

Mr D Hartley
Deep Sea Electronics Plc
Highfield House
Hunmanby Industrial Estate
Hunmanby
North Yorkshire
YO14 0PH

11 March 2014

Dear Mr Hartley,

Frequency Changes during Large Disturbances and their Impact on the Total System

Thank you for your response to the consultation which took place in September 2013 on proposals to modify the Distribution Code requirements relating to Frequency changes during Large Disturbances and their Impact on the Total system.

Licensees received valuable feedback from the Industry with responses received from eighteen industry parties. The majority of responses were in favour of the proposals and recommended its implementation subject to certain concerns being addressed.

The Workgroup have helped to formulate responses to the comments you have raised in its work developing final proposals. I have summarised the Workgroup's thoughts in the points below:

- In response to the specific comments you expressed concerning RoCoF settings, the Workgroup notes that synthetic inertia may have a role addressing RoCoF in the future but at the present time it is unproven. There is a risk it may never be fast enough acting to limit the potential system RoCoF sufficiently.

- The Workgroup has also noted your comments on the $1Hzs^{-1}$ proposal and understands that local faults and effects can be interpreted by RoCoF relays as a shift in system frequency. However, the Workgroup does not believe these are of specific concern in the development of the Workgroup's proposals as these are local effects. The Workgroup takes the view that the introduction of a time delay to RoCoF settings will make nuisance tripping for local events much less common.

- The Workgroup notes your comments on the Workgroup's probability and risk assessment conclusions in particular with the initial suppositions of favourable

conditions for Synchronous Generators. The Workgroup believes these have been addressed within its assessment and recommendations.

- In relation to check-synch equipment, the Workgroup acknowledges that this could be used to manage out-of-phase re-closure risks, but notes that costs would be incurred. The Cost Benefit Analysis takes this option into account in its assessment of implementation costs.

- Finally, the Workgroup note your comment that RoCoF settings may at some point no longer be useful. The Workgroup does not believe this to be the case at the present time.

There will be a further consultation on these changes during March 2014 and I anticipate the publication of the Final Report to the Authority to follow in April. If you have any queries, or outstanding issues, please contact the Workgroup via grid.code@nationalgrid.com.

Yours sincerely,

Mike Kay

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Mike Kay
Networks Strategy and Technical Support Director
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Industry Consultation Response Proforma

Frequency Changes during Large Disturbances and their Impact on the Total System

Industry parties are invited to respond to this consultation expressing their views and supplying the rationale for those views, particularly in respect of any specific questions detailed below.

Please send your responses by **27 September 2013** to david.spillett@energynetworks.org.

Please note that any responses received after the deadline or sent to a different email address may not receive due consideration.

Respondent:	*Alastair Frew*
Company Name:	*ScottishPower Generation*

Industry Consultation Questions

(a)	Do you agree it is necessary to change RoCoF settings on Loss of Mains protection for new and existing distributed generators within stations of registered capacity of 5MW and above? If not, what alternative actions would you recommend and why?	Yes
(b)	Do you agree that 1Hzs-1 measured over half a second is an appropriate RoCoF setting? If not, what alternative RoCoF setting would you recommend and why?	Yes
(c)	Are you responsible for distributed generation which will be affected by these proposals? How much of your generating capacity is affected?	Yes, 140MW

(d)	Do you agree with the Workgroup's probability and risk assessment conclusions?	In general yes, however not quite sure about the hazard from out of phase re-closure.
(e)	Do you agree with the Workgroup's approach to the probability and risk assessment relating to the risk to individuals and the risk to equipment as a consequence of a change to RoCoF settings?	The calculations of the consequential changes seem reasonable.
(f)	What, if any, additional features should be added to the Workgroup's probability and risk assessment relating to the risk to individuals and the risk to equipment as a consequence of a change to RoCoF settings? How can these be quantified and by whom?	Out of phase reconnection is mentioned and the probability of it occurring is calculated reasonably, however the actual hazard from an out of phase reconnection is described in para 4.6 as potentially causing severe damage. Is this based on fact or belief? Can actual generator failure rates be added to the calculation?
(g)	Do you have specific information relating the risks to generators of out of phase re-closure which would improve upon the Workgroup's assessment?	We have had incidents where generators have been connected out of phase. An example is:- Due to a fatigue failure of a latching pin in a circuit breaker, the breaker closed prematurely at the end of the spring charging cycle before the generator speed or phase angle had been matched. The generator was connected for approximately 1.3 seconds before the protection opened the circuit breaker. Owing to the limited nature of instrumentation and data on this type of generator it took a number of days to identify the fault and his generator was connected out of phase another two times during this period. Although there is no data logged from the generator a network fault recorder did log the voltage and current in one of the possible two11kV supply in-feeds. The traces from all 3 events were similar, initially before breaker closed there was a steady approximately 500A current flow. Once the circuit breaker closed there was a step change in voltage and current which then followed a sinusoidal trace presumably at the slip frequency

		between the grid and the generator as it pole slipped, until the circuit breaker opened. The line voltage was oscillating by approximately 2kV and the current was oscillating from 500A up to 2500A (note there may be a second parallel supply doing the same thing). This generator suffered no significant damage and has remained in-service. Similar issues are pole slipping on embedded generators can also be caused by local network faults on other circuits connected to the busbars. An example of this is when two 11kV generators were in service when a line fault occurred on a local area circuit connected to the same busbars. Again as mentioned previously there is limited instrumentation and data on this type of generator, however on this occasion although there is no 11kV fault recorder data there is 132kV data. This data shows the fault was on the system of approximately 0.7seconds during this period the 132kV system volts were suppressed by a constant 10kV, however once the fault has cleared the 132kV system voltage and current oscillate as the generators are now pole slipping. The oscillations start with a 7kV magnitude and reduce with time and have nearly stopped when the generators trip 40 seconds after the fault. This sequence of events was repeated for a second time later that day when after generators had been returned to service, network engineers believing the fault had cleared reclosed the circuit breaker back onto the original fault. These generators suffered no significant damage and have remained in-service. The main point to note in this event is the generators are pulled out of synchronism in less than 0.7 seconds and appear only to be returning to synchronism after approximately 40 seconds. This suggests that the braking torque applied to the generator by the fault currents is significantly larger than the out of phase torque being applied trying to accelerate the generator back into synchronism.

		These incidents suggest that a network fault is far worse than an out of phase synchronisation on a generator. Please note this is based on an interpretation of very limited data and should be considered accordingly with any data coming from other sources.
(h)	What assessment and mitigation measures would it be appropriate for synchronous generators to take to reduce the risk of out of phase re-closures that could otherwise present a hazard?	Currently all generators are designed to withstand a network fault at the appropriate network fault rating, it is difficult to see how these levels will be exceeded.
(i)	What is your view of the costs that the Workgroup presented for implementing its proposals? Has the Workgroup over or under-estimated costs? Has the Workgroup missed some items or included costs that shouldn't be considered?	Seem reasonable.
(j)	What is your view of the potential Balancing Services costs that National Grid estimates can be saved by implementing the Workgroup's proposals? Has it over or under-estimated costs? Has National Grid missed some items or included costs that shouldn't be considered?	Difficult to have a view on the bases that it is just given in the report as an estimated number with no real explanation.
(k)	Do you believe that 18 months is an appropriate period for protection setting changes to be implemented?	Yes

(l)	Do you have any comments on the Workgroup's future work plan to develop proposals for distributed generation of less than 5MW in capacity and to develop proposals for a RoCoF withstand capability?	It seems a logical progression to continue to lower powered generators.
(m)	Do you believe the proposals better facilitate the Distribution Code objectives? Please include your reasoning.	(i) to permit the development, maintenance and operation of an efficient, coordinated and economical system for the transmission of electricity; Yes
		(ii) to facilitate competition in the generation and supply of electricity Do not see how this has any effect on competition.
		(iii) subject to sub-paragraphs (i) and (ii), to promote the security and efficiency of the electricity generation, transmission and distribution systems in the national electricity transmission system operator area taken as a whole; and Yes should reduce the risk of simultaneous large scale disconnection of embedded generation
		(iv) to efficiently discharge the obligations imposed upon the licensee by this license and to comply with the Electricity Regulation and any relevant legally binding decisions of the European Commission and/or the Agency.

FROM THE CHAIRMAN OF THE DISTRIBUTION CODE REVIEW PANEL OF GREAT BRITAIN

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"By Email"

Mr Alastair Frew
Scottish Power Generation Ltd
Cathcart House
Spean Street
Glasgow
G44 4GP

11 March 2014

Dear Alastair,

Frequency Changes during Large Disturbances and their Impact on the Total System

Thank you for your response to the consultation which took place in September 2013 on proposals to modify the Distribution Code requirements relating to Frequency changes during Large Disturbances and their Impact on the Total system.

Licensees received valuable feedback from the Industry with responses received from eighteen industry parties. The majority of responses were in favour of the proposals and recommended its implementation subject to certain concerns being addressed.

The Workgroup have helped to formulate responses to the comments you have raised in its work developing final proposals. I have summarised the Workgroup's thoughts in the points below:

- In response to your query on whether actual generator failure rates can be added to the Cost Benefit Analysis, the Workgroup believes that a general increase in the risk of out-of-phase re-closure is not acceptable to the industry and that appropriate assessment and mitigation is required. Mitigation costs have been included in the Cost Benefit Analysis.

- The Workgroup thanks you for the information you provided outlining occasions where generators have connected out of phase or experienced pole slipping caused by local network faults. The Workgroup found this useful and corroborates the group's view that out-of-phase re-closure will have different impacts in different circumstances.

- The Workgroup has noted your comment on all generators being designed to withstand a network fault at the appropriate network fault rating, and will take this into consideration when developing withstand proposals.

- Finally, the Workgroup noted your concern that it is difficult to have a view of the potential Balancing Services cost savings. The Workgroup has reviewed its

Cost Benefit Analysis and has provided more information in its revises proposals.

There will be a further consultation on these changes during March 2014 and I anticipate the publication of the Final Report to the Authority to follow in April. If you have any queries, or outstanding issues, please contact the Workgroup via grid.code@nationalgrid.com.

Yours sincerely,

Mike Kay

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Mike Kay
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Industry Consultation Response Proforma

Frequency Changes during Large Disturbances and their Impact on the Total System

Industry parties are invited to respond to this consultation expressing their views and supplying the rationale for those views, particularly in respect of any specific questions detailed below.

Please send your responses by **27 September 2013** to david.spillett@energynetworks.org.

Please note that any responses received after the deadline or sent to a different email address may not receive due consideration.

Respondent:	John Morris
Company Name:	EDF Energy

Industry Consultation Questions

(a)	Do you agree it is necessary to change RoCoF settings on Loss of Mains protection for new and existing distributed generators within stations of registered capacity of 5MW and above? If not, what alternative actions would you recommend and why?	It is in the interests of all Users of the transmission system to have a robust system resilient to the secured loss. With the increase penetration of renewable generators over time the overall system inertia is tending to reduce. For the same secured loss the rate of change of frequency will increase and potentially encroach on the loss of mains protection used on many embedded generators. This could lead to the frequency falling to the level of automatic demand disconnection. The proposed change to ROCOF settings for embedded generators >5MW is supported and the future work to extend this to sub 5MW to obtain maximum benefit is noted. The alternative or complimentary measures to limit rate of change of frequency excursions would be to require future non-synchronous generators to employ synthetic inertia control systems and/or provide a fast frequency response service. Both of these options are being considered in other standing groups of the CUSC.
(b)	Do you agree that 1Hzs-1 measured over half a second is an appropriate RoCoF setting? If not, what alternative RoCoF setting would you recommend and why?	From the analysis provided by NGET in this paper we support the change of ROCOF settings on embedded generators to 1 Hz/sec measured over 500ms.

(c)	Are you responsible for distributed generation which will be affected by these proposals? How much of your generating capacity is affected?	EDF Energy has 370MW of embedded generation of capacity >5MW over 21 separate sites. Not all of these will have ROCOF protection and the extent of this is still being assessed.
(d)	Do you agree with the Workgroup's probability and risk assessment conclusions?	Yes.
(e)	Do you agree with the Workgroup's approach to the probability and risk assessment relating to the risk to individuals and the risk to equipment as a consequence of a change to RoCoF settings?	From the analysis provided there would appear to be an insignificant small increase in risk to synchronous embedded generators of out of phase reclosure if this change was implemented. Equally there is a low probability that an embedded synchronous generator would continue to supply an isolated part of the distribution network keeping it energised.
(f)	What, if any, additional features should be added to the Workgroup's probability and risk assessment relating to the risk to individuals and the risk to equipment as a consequence of a change to RoCoF settings? How can these be quantified and by whom?	The modelling carried out seems to be appropriate.
(g)	Do you have specific information relating the risks to generators of out of phase re-closure which would improve upon the Workgroup's assessment?	No

(h)	What assessment and mitigation measures would it be appropriate for synchronous generators to take to reduce the risk of out of phase re-closures that could otherwise present a hazard?	The risk could be reduced by requiring DNO's to use intertrip for embedded synchronous generators at risk rather than placing reliance on ROCOF.
(i)	What is your view of the costs that the Workgroup presented for implementing its proposals? Has the Workgroup over or under-estimated costs? Has the Workgroup missed some items or included costs that shouldn't be considered?	Our estimate for making a change to those sites with ROCOF protection is of the order of £1000/site providing this is done during normal planned maintenance visits.
(j)	What is your view of the potential Balancing Services costs that National Grid estimates can be saved by implementing the Workgroup's proposals? Has it over or under-estimated costs? Has National Grid missed some items or included costs that shouldn't be considered?	Analysis seems reasonable.
(k)	Do you believe that 18 months is an appropriate period for protection setting changes to be implemented?	This period of time should allow for the changes to be carried out progressively during routine maintenance visits.
(l)	Do you have any comments on the Workgroup's future work plan to develop proposals for distributed generation of less than 5MW in capacity and to develop proposals for a RoCoF withstand capability?	It would seem appropriate to consider a similar change for smaller embedded plant to gain maximum benefit of this change. It is noted there Is also the intention to introduce a rate of change of frequency withstand for all other plant. There is currently an assumption, probably valid, that existing plant will ride through a 1Hz/sec transient. If this were to be increased then some analysis of existing plant capability may be required.

(m)	Do you believe the proposals better facilitate the Distribution Code objectives? Please include your reasoning.	(i) to permit the development, maintenance and operation of an efficient, coordinated and economical system for the transmission of electricity; yes, it is inefficient for plant to trip incorrectly for a secured loss due to the arbitrary limit that is mandated to be set too sensitive
		(ii) to facilitate competition in the generation and supply of electricity neutral
		(iii) subject to sub-paragraphs (i) and (ii), to promote the security and efficiency of the electricity generation, transmission and distribution systems in the national electricity transmission system operator area taken as a whole; and Should improve the resilience of the transmission system to largest secured loss and hence maintain the security of supply.
		(iv) to efficiently discharge the obligations imposed upon the licensee by this license and to comply with the Electricity Regulation and any relevant legally binding decisions of the European Commission and/or the Agency. neutral

FROM THE CHAIRMAN OF THE DISTRIBUTION CODE REVIEW PANEL OF GREAT BRITAIN

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"By Email"

Mr John Morris
EDF Energy
40 Grosvenor Place
London
SW1X 7EN

11 March 2014

Dear John,

Frequency Changes during Large Disturbances and their Impact on the Total System

Thank you for your response to the consultation which took place in September 2013 on proposals to modify the Distribution Code requirements relating to Frequency changes during Large Disturbances and their Impact on the Total system.

Licensees received valuable feedback from the Industry with responses received from eighteen industry parties. The majority of responses were in favour of the proposals and recommended its implementation subject to certain concerns being addressed.

The Workgroup have helped to formulate responses to the comments you have raised in its work developing final proposals. I have summarised the Workgroup's thoughts in the points below:

- The Workgroup thanks you for your suggestion that it would be useful to review alternative or complimentary measures to limit RoCoF and notes that a range of options are currently under consideration. At present however, none of the proposed methods have been demonstrated to be fast enough to limit RoCoF in the required protection timescales.

- Your suggestion of reducing the risk of out of phase re-closures by requiring DNO's to use intertrip for embedded synchronous generators has been noted, This is one of the options suggested in the consultation document.

- The Workgroup thanks you for the information you provided on the estimated cost of making a change to sites with RoCoF. The Workgroup has taken this into consideration in developing its revised proposals and Cost Benefit Analysis.

- Finally, the Workgroup has noted your comment that analysis of existing plant capability may be required and will take this into consideration in its further work.

There will be a further consultation on these changes during March 2014 and I anticipate the publication of the Final Report to the Authority to follow in April. If you have any queries, or outstanding issues, please contact the Workgroup via grid.code@nationalgrid.com.

Yours sincerely,

Mike Kay

Digitally signed by Mike Kay
DN: cn=Mike Kay, o=Electricity North West, ou=Network Strategy, email=mkay@iee.org, c=GB
Date: 2014.03.12 14:06:15 Z

Mike Kay
Networks Strategy and Technical Support Director
Electricity North West
Chairman of the Distribution Code Review Panel of Great Britain

Consultation response

Subject	**:**	**Frequency Changes during Large Disturbances and their Impact on the Total System**
Date	**:**	**27-09-2013**

This document presents our response to the Industry Consultation request published on the 15th of August by National Grid. Below are the questions raised by national grid in the document GC0035IndustryConsultationv10.pdf in *Italics* followed by our responses.

7.2 Responses are invited to the following questions:

(a) Do you agree it is necessary to change RoCoF settings on Loss of Mains protection for new and existing distributed generators within stations of registered capacity of 5MW and above? If not, what alternative actions would you recommend and why?

Yes, DNV KEMA is of the opinion that to be able to facilitate a generation portfolio with a high penetration of renewable energy generation a higher RoCoF tolerance is required. Renewable energy generation consists largely of asynchronous generation which does not provide natural inertia to the system and as an effect lowers the total system inertia as synchronous generation is displaced. The reduction in the system inertia leads to faster RoCoF events. A higher RoCoF tolerance will indirectly support a resilient network because generation sources will be less likely to disconnect due to an unnecessary loss of mains protection action.

(b) Do you agree that 1Hzs^{-1} measured over half a second is an appropriate RoCoF setting? If not, what alternative RoCoF setting would you recommend and why?

Yes, considering the RoCoF events known on the system 500ms is a sufficient time window to prevent most unnecessary outages. The 1 Hz/s over a 500ms time window allows for higher RoCoF values within smaller time frames than the 500ms proposed, which is important.

(c) Are you responsible for distributed generation which will be affected by these proposals? How much of your generating capacity is affected?

No.

(d) Do you agree with the Workgroup's probability and risk assessment conclusions?

Yes.

(e) Do you agree with the Workgroup's approach to the probability and risk assessment relating to the risk to individuals and the risk to equipment as a consequence of a change to RoCoF settings?

Yes, in addition it would be useful to review present off the shelve RoCoF protection equipment setting capability to accommodate the RoCoF settings proposed and possible future changes.

(f) What, if any, additional features should be added to the Workgroup's probability and risk assessment relating to the risk to individuals and the risk to equipment as a consequence of a change to RoCoF settings? How can these be quantified and by whom?

To gather information from generator safety control experts regarding the effect of increased RoCoF settings on the safe operation of generation equipment taking account of all protection to prevent damage or unsafe operation.

(g) Do you have specific information relating the risks to generators of out of phase re-closure which would improve upon the Workgroup's assessment?

No.

(h) What assessment and mitigation measures would it be appropriate for synchronous generators to take to reduce the risk of out of phase enclosures that could otherwise present a hazard?

(i) What is your view of the costs that the Workgroup presented for implementing its proposals? Has the Workgroup over or under-estimated costs? Has the Workgroup missed some items or included costs that shouldn't be considered?

The costs look fair regarding the equipment and installation required. The timeframe proposed would make it possible to install the equipment during a planned outage. However it could be that additional studies are required to make sure all protection settings of the equipment will allow for the desired RoCoF capability looking at the complete protection system behaviour.

(j) What is your view of the potential Balancing Services costs that National Grid estimates can be saved by implementing the Workgroup's proposals? Has it over or under-estimated costs? Has National Grid missed some items or included costs that shouldn't be considered?

It is important to recognise that the dynamic change in inertia of the total electricity grid will largely influence the need of balancing services and therefore the accompanied costs. Being able to simulate and monitor the inertia behaviour of the grid in combination with understanding the key process indicators that influence the inertia power in each regional area of the grid on a second by second basis is essential to make sure mitigation costs are incurred in the most economical manner subject to system security constraints.

(k) Do you believe that 18 months is an appropriate period for protection setting changes to be implemented?

See answer (i)

(l) Do you have any comments on the Workgroup's future work plan to develop proposals for distributed generation of less than 5MW in capacity and to develop proposals for a RoCoF withstand capability?

Technical issues regarding distributed generators producing less than 5 MW are similar to larger sets. However the cost of protection replacement may be less acceptable for very small generators. The previous studies indicate that asynchronous generation in general can cope well with high RoCoF events.

(m) Do you believe the proposals better facilitate the Distribution Code objectives? Please include your reasoning.

Yes. Higher RoCoF value allowance will facilitate more renewable energy generation integration to the network and hence contribute to the government's goals to meet carbon reduction targets and facilitates a greater degree of energy independence. Although a higher RoCoF allowance does not directly contribute to a more resilient network, the effect of preventing unnecessary disconnection of generators indirectly makes the network more resilient. On the longer term however additional solutions are needed to facilitate government's goals of renewable generation where the change of RoCoF settings is only a first step and temporary as solo solution.

FROM THE CHAIRMAN OF THE DISTRIBUTION CODE REVIEW PANEL OF GREAT BRITAIN

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"By Email"

Mr Willem Uijlings
DMV KEMA
Palace House
3 Cathedral Street
London
SE1 9DE

11 March 2014

Dear Mr Uijlings,

Frequency Changes during Large Disturbances and their Impact on the Total System

Thank you for your response to the consultation which took place in September 2013 on proposals to modify the Distribution Code requirements relating to Frequency changes during Large Disturbances and their Impact on the Total system.

Licensees received valuable feedback from the Industry with responses received from eighteen industry parties. The majority of responses were in favour of the proposals and recommended its implementation subject to certain concerns being addressed.

The Workgroup have helped to formulate responses to the comments you have raised in its work developing final proposals. I have summarised the Workgroup's thoughts in the points below:

- The Workgroup thanks you for your suggestion that it would be useful to review whether "off the shelf" RoCoF protection equipment has the capability to accommodate the RoCoF settings proposed. The Workgroup has sought expert advice and has revised its recommendations to enhance clarity and provide assurance its recommendations can be implemented in practice.

- Your recommendation that the risk assessment could be improved by gathering information from generator safety control experts regarding the effect of increased RoCoF settings could be of merit and the Workgroup intends to account for this when developing the withstand proposals.

- The Workgroup agrees with your comment that the timeframe proposed would make it possible to install the equipment during a planned outage. The Workgroup also agrees that there may be a need for additional studies to ensure that the equipment will allow for the necessary RoCoF setting.

- In relation to your comment on monitoring inertia behaviour, the Workgroup acknowledges that National Grid will need to review and reassess system dynamic performance on an ongoing basis in order to ensure requirements are appropriate.

- Finally, the Workgroup has noted your comment that technical issues regarding distributed generators producing less than 5MW are similar to larger sets and responds that it is possible that all generators will need to be made less susceptible to tripping for RoCoF, irrespective of size of design, and the Workgroup acknowledges your concerns over the costs to do this.

There will be a further consultation on these changes during March 2014 and I anticipate the publication of the Final Report to the Authority to follow in April. If you have any queries, or outstanding issues, please contact the Workgroup via grid.code@nationalgrid.com.

Yours sincerely,

Mike Kay
Networks Strategy and Technical Support Director
Electricity North West
Chairman of the Distribution Code Review Panel of Great Britain

Industry Consultation Response Proforma

Frequency Changes during Large Disturbances and their Impact on the Total System

Industry parties are invited to respond to this consultation expressing their views and supplying the rationale for those views, particularly in respect of any specific questions detailed below.

Please send your responses by **27 September 2013** to david.spillett@energynetworks.org.

Please note that any responses received after the deadline or sent to a different email address may not receive due consideration.

Respondent:	*Russell Fleetwood*
Company Name:	*London Underground*

Industry Consultation Questions

(a)	Do you agree it is necessary to change RoCoF settings on Loss of Mains protection for new and existing distributed generators within stations of registered capacity of 5MW and above? If not, what alternative actions would you recommend and why?	Yes,
(b)	Do you agree that 1Hzs-1 measured over half a second is an appropriate RoCoF setting? If not, what alternative RoCoF setting would you recommend and why?	I agree with a setting of 1Hzs-1 based on the risk probability data provided as presented at the workshop on the 9th September.
(c)	Are you responsible for distributed generation which will be affected by these proposals? How much of your generating capacity is affected?	Yes, all of the capacity will be affected. Although all generation is utilised within the London Underground private network and not exported to the public network.

(d)	Do you agree with the Workgroup's probability and risk assessment conclusions?	Yes.
(e)	Do you agree with the Workgroup's approach to the probability and risk assessment relating to the risk to individuals and the risk to equipment as a consequence of a change to RoCoF settings?	Yes.
(f)	What, if any, additional features should be added to the Workgroup's probability and risk assessment relating to the risk to individuals and the risk to equipment as a consequence of a change to RoCoF settings? How can these be quantified and by whom?	The main addition which came from the workshop was to include as part of the probability and risk assessment the feasibility and affect of extending the auto-reclose time as an alternative to making RoCoF setting changes.
(g)	Do you have specific information relating the risks to generators of out of phase re-closure which would improve upon the Workgroup's assessment?	No.
(h)	What assessment and mitigation measures would it be appropriate for synchronous generators to take to reduce the risk of out of phase re-closures that could otherwise present a hazard?	Normal risk assessment process based on protection and operating times.

(i)	What is your view of the costs that the Workgroup presented for implementing its proposals? Has the Workgroup over or under-estimated costs? Has the Workgroup missed some items or included costs that shouldn't be considered?	The costs seemed to be more or less appropriate.
(j)	What is your view of the potential Balancing Services costs that National Grid estimates can be saved by implementing the Workgroup's proposals? Has it over or under-estimated costs? Has National Grid missed some items or included costs that shouldn't be considered?	No comment.
(k)	Do you believe that 18 months is an appropriate period for protection setting changes to be implemented?	I would favour 18 months to 2 years.
(l)	Do you have any comments on the Workgroup's future work plan to develop proposals for distributed generation of less than 5MW in capacity and to develop proposals for a RoCoF withstand capability?	No.
(m)	Do you believe the proposals better facilitate the Distribution Code objectives? Please include your reasoning.	(i) to permit the development, maintenance and operation of an efficient, coordinated and economical system for the transmission of electricity; Do not have an opinion on this question.

		(ii) to facilitate competition in the generation and supply of electricity Do not have an opinion on this question.
		(iii) subject to sub-paragraphs (i) and (ii), to promote the security and efficiency of the electricity generation, transmission and distribution systems in the national electricity transmission system operator area taken as a whole; and Do not have an opinion on this question.
		(iv) to efficiently discharge the obligations imposed upon the licensee by this license and to comply with the Electricity Regulation and any relevant legally binding decisions of the European Commission and/or the Agency. Do not have an opinion on this question.

FROM THE CHAIRMAN OF THE DISTRIBUTION CODE REVIEW PANEL OF GREAT BRITAIN

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"By Email"

Mr Russell Fleetwood
London Underground
55 Broadway
London
SW1H 0BD

11 March 2014

Dear Russell,

Frequency Changes during Large Disturbances and their Impact on the Total System

Thank you for your response to the consultation which took place in September 2013 on proposals to modify the Distribution Code requirements relating to Frequency changes during Large Disturbances and their Impact on the Total system.

Licensees received valuable feedback from the Industry with responses received from eighteen industry parties. The majority of responses were in favour of the proposals and recommended its implementation subject to certain concerns being addressed.

The Workgroup have helped to formulate responses to the comments you have raised in its work developing final proposals. I have summarised the Workgroup's thoughts in the points below:

- In response to your specific query on whether there will be an assessment of the feasibility and the effect of extending the auto-reclose time as an alternative to making RoCoF setting changes, The Workgroup notes that extending auto-re-closure times is one of the methods it has highlighted which can mitigate the risk of out of phase re-closures on generators.

- In relation to your comment on the timescales for implementation and a preferred period of 18 months to 2 years, the Workgroup recognises that timescales may be challenging in some circumstances but is conscious of the cost triggered by delay. However an implementation period of 2 years has been recommended in the Workgroup's revised proposals.

Industry Consultation Response Proforma

Frequency Changes during Large Disturbances and their Impact on the Total System

Industry parties are invited to respond to this consultation expressing their views and supplying the rationale for those views, particularly in respect of any specific questions detailed below.

Please send your responses by **27 September 2013** to david.spillett@energynetworks.org.

Please note that any responses received after the deadline or sent to a different email address may not receive due consideration.

Respondent:	*Hayden Scott-Dye*
Company Name:	*Good Energy Ltd*

Industry Consultation Questions

(a)	Do you agree it is necessary to change RoCoF settings on Loss of Mains protection for new and existing distributed generators within stations of registered capacity of 5MW and above? If not, what alternative actions would you recommend and why?	Yes
(b)	Do you agree that 1Hzs-1 measured over half a second is an appropriate RoCoF setting? If not, what alternative RoCoF setting would you recommend and why?	Yes
(c)	Are you responsible for distributed generation which will be affected by these proposals? How much of your generating capacity is affected?	Yes, 100% (17.4MW)

(d)	Do you agree with the Workgroup's probability and risk assessment conclusions?	No Comment
(e)	Do you agree with the Workgroup's approach to the probability and risk assessment relating to the risk to individuals and the risk to equipment as a consequence of a change to RoCoF settings?	No Comment
(f)	What, if any, additional features should be added to the Workgroup's probability and risk assessment relating to the risk to individuals and the risk to equipment as a consequence of a change to RoCoF settings? How can these be quantified and by whom?	Vector Shift could be used as main to ROCOF or backup to ROCOF for asynchronous generators under proposed changes to ROCOF.
(g)	Do you have specific information relating the risks to generators of out of phase re-closure which would improve upon the Workgroup's assessment?	No
(h)	What assessment and mitigation measures would it be appropriate for synchronous generators to take to reduce the risk of out of phase re-closures that could otherwise present a hazard?	No Comment

(i)	What is your view of the costs that the Workgroup presented for implementing its proposals? Has the Workgroup over or under-estimated costs? Has the Workgroup missed some items or included costs that shouldn't be considered?	No Comment
(j)	What is your view of the potential Balancing Services costs that National Grid estimates can be saved by implementing the Workgroup's proposals? Has it over or under-estimated costs? Has National Grid missed some items or included costs that shouldn't be considered?	No Comment
(k)	Do you believe that 18 months is an appropriate period for protection setting changes to be implemented?	Yes
(l)	Do you have any comments on the Workgroup's future work plan to develop proposals for distributed generation of less than 5MW in capacity and to develop proposals for a RoCoF withstand capability?	No
(m)	Do you believe the proposals better facilitate the Distribution Code objectives? Please include your reasoning.	(i) to permit the development, maintenance and operation of an efficient, coordinated and economical system for the transmission of electricity; Yes, it will help to eliminate spurious (false) trippings of Distributed Generation and also enhance the security of supply in cascade failures.

		(ii) to facilitate competition in the generation and supply of electricity No Comment
		(iii) subject to sub-paragraphs (i) and (ii), to promote the security and efficiency of the electricity generation, transmission and distribution systems in the national electricity transmission system operator area taken as a whole; and Yes, comment as per i)
		(iv) to efficiently discharge the obligations imposed upon the licensee by this license and to comply with the Electricity Regulation and any relevant legally binding decisions of the European Commission and/or the Agency. No comment

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"By Email"

Mr Hayden Scott-dye
Good Energy Ltd
Monkton Reach
Monkton Hill
Avon Reach
Chippenham
Wiltshire
SN15 1EE

11 March 2014

Dear Hayden,

Frequency Changes during Large Disturbances and their Impact on the Total System

Thank you for your response to the consultation which took place in September 2013 on proposals to modify the Distribution Code requirements relating to Frequency changes during Large Disturbances and their Impact on the Total system.

Licensees received valuable feedback from the Industry with responses received from eighteen industry parties. The majority of responses were in favour of the proposals and recommended its implementation subject to certain concerns being addressed.

The Workgroup have helped to formulate responses to the comments you have raised in its work developing final proposals. I

In response to your specific comment on Vector Shift and its potential use as "main" to RoCoF or "backup" to RoCoF for asynchronous generators the Workgroup would wish to emphasise that this is option is open to generators. The Workgroup recommends that careful consideration is given before changing protection.

There will be a further consultation on these changes during March 2014 and I anticipate the publication of the Final Report to the Authority to follow in April. If you have any queries, or outstanding issues, please contact the Workgroup via grid.code@nationalgrid.com.

Yours sincerely,

Mike Kay
Digitally signed by Mike Kay
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Date: 2014.03.12 14:13:58 Z

Mike Kay
Networks Strategy and Technical Support Director
Electricity North West
Chairman of the Distribution Code Review Panel of Great Britain

There will be a further consultation on these changes during March 2014 and I anticipate the publication of the Final Report to the Authority to follow in April. If you have any queries, or outstanding issues, please contact the Workgroup via grid.code@nationalgrid.com.

Yours sincerely,

Mike Kay

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Mike Kay
Networks Strategy and Technical Support Director
Electricity North West
Chairman of the Distribution Code Review Panel of Great Britain

Industry Consultation Response Proforma

Frequency Changes during Large Disturbances and their Impact on the Total System

Industry parties are invited to respond to this consultation expressing their views and supplying the rationale for those views, particularly in respect of any specific questions detailed below.

Please send your responses by **27 September 2013** to david.spillett@energynetworks.org.

Please note that any responses received after the deadline or sent to a different email address may not receive due consideration.

Respondent:	*Joe Duddy*
Company Name:	*RES Ltd.*

Industry Consultation Questions

(a)	Do you agree it is necessary to change RoCoF settings on Loss of Mains protection for new and existing distributed generators within stations of registered capacity of 5MW and above? If not, what alternative actions would you recommend and why?	*Yes*
(b)	Do you agree that 1Hzs-1 measured over half a second is an appropriate RoCoF setting? If not, what alternative RoCoF setting would you recommend and why?	*Yes*
(c)	Are you responsible for distributed generation which will be affected by these proposals? How much of your generating capacity is affected?	*Yes.* *RES owns and operates 110 MW of distributed generation >5MW in GB.* *RES operates 107 MW of distributed generation >5MW in GB on behalf of others.*

(d)	Do you agree with the Workgroup's probability and risk assessment conclusions?	*Yes*
(e)	Do you agree with the Workgroup's approach to the probability and risk assessment relating to the risk to individuals and the risk to equipment as a consequence of a change to RoCoF settings?	*Yes*
(f)	What, if any, additional features should be added to the Workgroup's probability and risk assessment relating to the risk to individuals and the risk to equipment as a consequence of a change to RoCoF settings? How can these be quantified and by whom?	
(g)	Do you have specific information relating the risks to generators of out of phase re-closure which would improve upon the Workgroup's assessment?	
(h)	What assessment and mitigation measures would it be appropriate for synchronous generators to take to reduce the risk of out of phase re-closures that could otherwise present a hazard?	

(i)	What is your view of the costs that the Workgroup presented for implementing its proposals? Has the Workgroup over or under-estimated costs? Has the Workgroup missed some items or included costs that shouldn't be considered?	I do not expect that the cost of changing ROCOF protection settings at distributed generators managed by RES will exceed the Workgroup's estimate.
(j)	What is your view of the potential Balancing Services costs that National Grid estimates can be saved by implementing the Workgroup's proposals? Has it over or under-estimated costs? Has National Grid missed some items or included costs that shouldn't be considered?	
(k)	Do you believe that 18 months is an appropriate period for protection setting changes to be implemented?	*Yes*
(l)	Do you have any comments on the Workgroup's future work plan to develop proposals for distributed generation of less than 5MW in capacity and to develop proposals for a RoCoF withstand capability?	*The Workgroup has identified risks which are only partly mitigated by the present proposals. The future work plan is necessary to fully address these risks. Failure to address the risks will result in costs, reduced network security and/or failure to achieve government legal obligations and policy objectives for renewable energy.*
(m)	Do you believe the proposals better facilitate the Distribution Code objectives? Please include your reasoning.	(i) to permit the development, maintenance and operation of an efficient, coordinated and economical system for the transmission of electricity; *Yes. The proposals prevent a growing risk to the security of the electricity (the risk and consequences of cascade ROCOF tripping of embedded generation) which would otherwise be mitigated to a limited extent by expensive Balancing actions at times of high ROCOF risk.*

		(ii) to facilitate competition in the generation and supply of electricity *Yes. The proposals prevent the need for mitigating actions such as the constraint of largest infeed and the constraint of asynchronous generators. In the absence of these proposals, such constraints would be required to control the risk and consequences of cascade ROCOF tripping of embedded generation.*
		(iii) subject to sub-paragraphs (i) and (ii), to promote the security and efficiency of the electricity generation, transmission and distribution systems in the national electricity transmission system operator area taken as a whole; and *Yes. The proposals prevent a growing risk to the security of the electricity generation, transmission and distribution systems in the national electricity transmission system operator area taken as a whole (i.e. the risk and consequences of cascade ROCOF tripping of embedded generation). This risk would otherwise be mitigated to a limited extent by expensive Balancing actions at times of high ROCOF risk.*
		(iv) to efficiently discharge the obligations imposed upon the licensee by this license and to comply with the Electricity Regulation and any relevant legally binding decisions of the European Commission and/or the Agency.

FROM THE CHAIRMAN OF THE DISTRIBUTION CODE REVIEW PANEL OF GREAT BRITAIN

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"By Email"

Mr Joe Duddy
RES Ltd
Beaufort Court
Egg Farm Lane
Kings Langley
Hertfordshire
WD4 8LR

11 March 2014

Dear Joe,

Frequency Changes during Large Disturbances and their Impact on the Total System

Thank you for your response to the consultation which took place in September 2013 on proposals to modify the Distribution Code requirements relating to Frequency changes during Large Disturbances and their Impact on the Total system.

Licensees received valuable feedback from the Industry with responses received from eighteen industry parties. The majority of responses were in favour of the proposals and recommended its implementation subject to certain concerns being addressed.

The Workgroup have helped to formulate responses to the comments you have raised in its work developing final proposals. I have summarised the Workgroup's thoughts in the points below:

- In response to your specific comment you made on the cost of changing RoCoF protection settings at distributed generators managed by yourselves, the Workgroup believes it has taken this view into consideration in its revised proposals and cost benefit analysis.

- Your concern that failure to address risks which are only partly mitigated by the present proposals been noted by the Workgroup who agree and intend to proceed with further work.

There will be a further consultation on these changes during March 2014 and I anticipate the publication of the Final Report to the Authority to follow in April. If you have any queries, or outstanding issues, please contact the Workgroup via grid.code@nationalgrid.com.

Yours sincerely,

Mike Kay

Digitally signed by Mike Kay
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Date: 2014.03.12 14:17:29 Z

Mike Kay
Networks Strategy and Technical Support Director
Electricity North West
Chairman of the Distribution Code Review Panel of Great Britain

Industry Consultation Response Proforma

Frequency Changes during Large Disturbances and their Impact on the Total System

Industry parties are invited to respond to this consultation expressing their views and supplying the rationale for those views, particularly in respect of any specific questions detailed below.

Please send your responses by **27 September 2013** to david.spillett@energynetworks.org.

Please note that any responses received after the deadline or sent to a different email address may not receive due consideration.

Respondent:	Zoltan Zavody
Company Name:	RenewableUK

Industry Consultation Questions

(a)	Do you agree it is necessary to change RoCoF settings on Loss of Mains protection for new and existing distributed generators within stations of registered capacity of 5MW and above? If not, what alternative actions would you recommend and why?	Yes
(b)	Do you agree that 1Hzs-1 measured over half a second is an appropriate RoCoF setting? If not, what alternative RoCoF setting would you recommend and why?	Yes
(c)	Are you responsible for distributed generation which will be affected by these proposals? How much of your generating capacity is affected?	No

(d)	Do you agree with the Workgroup's probability and risk assessment conclusions?	-
(e)	Do you agree with the Workgroup's approach to the probability and risk assessment relating to the risk to individuals and the risk to equipment as a consequence of a change to RoCoF settings?	-
(f)	What, if any, additional features should be added to the Workgroup's probability and risk assessment relating to the risk to individuals and the risk to equipment as a consequence of a change to RoCoF settings? How can these be quantified and by whom?	
(g)	Do you have specific information relating the risks to generators of out of phase re-closure which would improve upon the Workgroup's assessment?	-
(h)	What assessment and mitigation measures would it be appropriate for synchronous generators to take to reduce the risk of out of phase re-closures that could otherwise present a hazard?	-

(i)	What is your view of the costs that the Workgroup presented for implementing its proposals? Has the Workgroup over or under-estimated costs? Has the Workgroup missed some items or included costs that shouldn't be considered?	Costs may be lower if changes are undertaken in the context of normal planned maintenance visits.
(j)	What is your view of the potential Balancing Services costs that National Grid estimates can be saved by implementing the Workgroup's proposals? Has it over or under-estimated costs? Has National Grid missed some items or included costs that shouldn't be considered?	We note that, if cost savings accrue to the System Operator, then there is a wider question regarding the apportionment of the cost of implementation.
(k)	Do you believe that 18 months is an appropriate period for protection setting changes to be implemented?	It sounds sensible but should be determined in the context of the timescale for normal planned maintenance visits.
(l)	Do you have any comments on the Workgroup's future work plan to develop proposals for distributed generation of less than 5MW in capacity and to develop proposals for a RoCoF withstand capability?	A review of <5MW plant is needed.
(m)	Do you believe the proposals better facilitate the Distribution Code objectives? Please include your reasoning.	(i) to permit the development, maintenance and operation of an efficient, coordinated and economical system for the transmission of electricity; Yes. The cost of meeting system security would increase if generators were not able to tolerate increasing rates of change of frequency.

		(ii) to facilitate competition in the generation and supply of electricity Yes. For a relatively low cost, the wider field can be kept open for larger generators.
		(iii) subject to sub-paragraphs (i) and (ii), to promote the security and efficiency of the electricity generation, transmission and distribution systems in the national electricity transmission system operator area taken as a whole; and Yes. System security will be maintained at lower cost than if other measures were invoked.
		(iv) to efficiently discharge the obligations imposed upon the licensee by this license and to comply with the Electricity Regulation and any relevant legally binding decisions of the European Commission and/or the Agency. -

FROM THE CHAIRMAN OF THE DISTRIBUTION CODE REVIEW PANEL OF GREAT BRITAIN

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"By Email"

Mr Zolton Zavody
Renewable UK
Greencoat House
Francis Street
London
SW1P 1DH

11 March 2014

Dear Zoltan,

Frequency Changes during Large Disturbances and their Impact on the Total System

Thank you for your response to the consultation which took place in September 2013 on proposals to modify the Distribution Code requirements relating to Frequency changes during Large Disturbances and their Impact on the Total system.

Licensees received valuable feedback from the Industry with responses received from eighteen industry parties. The majority of responses were in favour of the proposals and recommended its implementation subject to certain concerns being addressed.

The Workgroup have helped to formulate responses to the comments you have raised in its work developing final proposals. I have summarised the Workgroup's thoughts in the points below:

- In response to your specific comment on the cost of implementation being potentially lower if changes are undertaken in context of normal planned maintenance visits, the Workgroup notes this point and believes the recommended implementation period provides some scope to do this.

- Your comment on cost savings has been addressed by the Workgroup in a revised Cost Benefit Analysis. The Workgroup notes that any Balancing Services cost savings are of benefit to the Industry.

- Finally, in relation to the implementation timescales and your comments on continuing the assessment to smaller than 5MW plant, the Workgroup thanks you and your members for your comments.

There will be a further consultation on these changes during March 2014 and I anticipate the publication of the Final Report to the Authority to follow in April. If you have any queries, or outstanding issues, please contact the Workgroup via grid.code@nationalgrid.com.

Yours sincerely,

Mike Kay

Digitally signed by Mike Kay
DN: cn=Mike Kay, o=Electricity North West, ou=Network Strategy, email=mjkay@ew.org, c=GB
Date: 2014.03.12 14:16:22 Z

Mike Kay
Networks Strategy and Technical Support Director
Electricity North West
Chairman of the Distribution Code Review Panel of Great Britain

Industry Consultation Response Proforma

Frequency Changes during Large Disturbances and their Impact on the Total System

Industry parties are invited to respond to this consultation expressing their views and supplying the rationale for those views, particularly in respect of any specific questions detailed below.

Please send your responses by **27 September 2013** to david.spillett@energynetworks.org.

Please note that any responses received after the deadline or sent to a different email address may not receive due consideration.

Respondent:	John Norbury Network Connections Manager RWE Supply & Trading GmbH Windmill Hill Business Park Whitehill Way Swindon SN5 6PB T +44 (0)1793 89 2667 M +44 (0)7795 354 382 mailto:john.norbury@rwe.com
Company Name:	RWE group of UK companies, including RWE Npower plc, RWE Npower Renewables Limited and RWE Supply & Trading GmbH

Industry Consultation Questions

(a)	Do you agree it is necessary to change RoCoF settings on Loss of Mains protection for new and existing distributed generators within stations of registered capacity of 5MW and above? If not, what alternative actions would you recommend and why?	We do not agree with a change to the RoCoF settings on the basis proposed. We agree that a change to the RoCoF settings would provide an effective element in establishing a wider solution to manage system inertia, subject to satisfactory resolution of the issues identified in this response.
(b)	Do you agree that 1Hzs-1 measured over half a second is an appropriate RoCoF setting? If not, what alternative RoCoF setting would you recommend and why?	At this stage the actual withstand capability of users' equipment is not fully understood and therefore it is not possible to confirm the appropriateness of a setting of 1Hz/sec. With reference to section 5.55(3) of the consultation document, the further investigation work into generation withstand capabilities is a critical piece of work that needs to be carried out before a

		realistic RoCoF setting can be established. Fully understanding the withstand capability is likely to be extremely complex. The issues are not just limited to torsional stress withstand, but also control system responses, for example gas turbine flame controls, which need to be considered. It is recommended that no change to RoCoF settings be made until the full impacts to all users are understood.
(c)	Are you responsible for distributed generation which will be affected by these proposals? How much of your generating capacity is affected?	The respondent is responsible for approximately 213MW synchronous generation that would be affected by this proposed change. In addition, the Respondent has interests in a significant amount of renewable generation, both installed and in development, that would be affected.
(d)	Do you agree with the Workgroup's probability and risk assessment conclusions?	The risk assessment conclusions do not appear to sufficiently address the very high risk of 2.98×10^{-1} probability of a mal-sync event for generators as a result of de-sensitised RoCoF settings. A greater understanding of the site specific risk assessment is required, such that generators are not put at a greater risk or exposed to increased costs as a result of a network operation issue.
(e)	Do you agree with the Workgroup's approach to the probability and risk assessment relating to the risk to individuals and the risk to equipment as a consequence of a change to RoCoF settings?	We do not object to the proposed approach to probability and risk assessment.
(f)	What, if any, additional features should be added to the Workgroup's probability and risk assessment relating to the risk to individuals and the risk to equipment as a consequence of a change to RoCoF settings? How can these be quantified and by whom?	More consideration is required to assess the impact and benefits to risk reduction through variation of auto-reclose times to improve the detection abilities of more insensitive RoCoF settings.

(g)	Do you have specific information relating the risks to generators of out of phase re-closure which would improve upon the Workgroup's assessment?	The level of risk of catastrophic failure or significant damage is high if an out of phase re-closure occurs on synchronous plant. No specific information is readily available at this stage, but such an event cannot be allowed to happen and there are extensive systems on a power plant facility to avoid it.
(h)	What assessment and mitigation measures would it be appropriate for synchronous generators to take to reduce the risk of out of phase re-closures that could otherwise present a hazard?	Reducing the risk of out-of-phase re-closures cannot be performed by synchronous generators alone. The only measure that can be taken is an improved ability to detect true LOM events. However, this ability is significantly reduced when the island is closely matched between generation and demand and the generator operates in voltage control mode. In this instance, the most technically feasible and cost affect approach would be for check-sync or auto-reclose blocking to be carried out by the DNO. Otherwise, the best mitigation is for a sync-generator to retain a lower and more sensitive ROCOF setting.
(i)	What is your view of the costs that the Workgroup presented for implementing its proposals? Has the Workgroup over or under-estimated costs? Has the Workgroup missed some items or included costs that shouldn't be considered?	The consultation paper concludes that a site specific risk assessment is carried out and that all costs and work are to be borne by the generator. On the basis that LOM is a system operator protection function (it is only required to be implemented by the generator), the proposed solution is not a fair distribution of cost and work. A generator is not bound by G59 to adopt the specified RoCoF settings (section 2.5) and is only responsible to have working LOM protection. Given the increase risk of mal-sync, increased costs, increase work and the additional need to ensure withstand capabilities of equipment (and the related need to ensure insurance cover and manufacturers acceptance) there is no clear incentive for a generator adversely affect by this change to adopt it. Furthermore, the costs for implementation and risk reduction are not very well developed and no visibility of the costs of DNO based solutions seems to have been considered.

(j)	What is your view of the potential Balancing Services costs that National Grid estimates can be saved by implementing the Workgroup's proposals? Has it over or under-estimated costs? Has National Grid missed some items or included costs that shouldn't be considered?	We remain unconvinced by the potential Balancing Services estimated by National Grid, which we assume to arise mainly from procuring reserve generating capacity. This reserve capacity may be used by the system operator for other purposes, such as frequency response and alleviating constraints, and therefore it is difficult to understand how specific level of reserve can be apportioned to RoCoF. Furthermore, National Grid has no knowledge of the total MWs of embedded generating units that are synchronised to the distribution networks at any point in time, questioning the accuracy at which it would be able to determine the level of Balancing Services and costs that could be saved. If National Grid maintains that these estimated savings would be achieved, we would propose a financial contribution from these savings be made to generators in recognition of their costs and risk premium be included with this change.
(k)	Do you believe that 18 months is an appropriate period for protection setting changes to be implemented?	We would propose that any change be implemented over a period of 4 years as opposed to 18 months. 4 years would coincide with typical protection maintenance programmes and also minimise the risk of a bottleneck of resource. Furthermore, in recognition of the significant risk of protection failure and subsequent plant damage arising from a RoCoF change, 4 years would provide a more reasonable time period to carry out the necessary testing should a change be adopted.
(l)	Do you have any comments on the Workgroup's future work plan to develop proposals for distributed generation of less than 5MW in capacity and to develop proposals for a RoCoF withstand capability?	We would suggest that work on the withstand capability, allowing for input from synchronous machine manufacturers and operators, be prioritised above other work planned in relation to this proposal.
(m)	Do you believe the proposals better facilitate the Distribution Code objectives? Please include your reasoning.	(i) to permit the development, maintenance and operation of an efficient, coordinated and economical system for the transmission of electricity; Not known.

		(ii) to facilitate competition in the generation and supply of electricity No. Imposing this change would be discriminatory in that it would impose additional costs on only one category of generator (namely embedded + 5MW)
		(iii) subject to sub-paragraphs (i) and (ii), to promote the security and efficiency of the electricity generation, transmission and distribution systems in the national electricity transmission system operator area taken as a whole; and No. Reducing the level of reserve generation, required to realise any savings from this change, would inherently make the transmission system less secure. In addition, the increased risk of plant damage incurred by generating units would further reduce the security of the transmission system.
		(iv) to efficiently discharge the obligations imposed upon the licensee by this license and to comply with the Electricity Regulation and any relevant legally binding decisions of the European Commission and/or the Agency. The new European RfG code will require all generators between 1MW and 50MW to include fault ride through capability. A joint PPA and TNEI report (CER ROCOF review – May 2013) commissioned to investigate RoCoF for the Irish grid system suggests that there is a potential for interaction between FRT events and RoCoF. TNEI studies indicate a RoCoF of up to 8Hzs^{-1} for fault-induced voltage depressions. Therefore this type of fault will have to be discriminated against true LOM events such that the generators can remain connected for FRT but disconnect for LOM. If adequate discrimination between these events is not possible there is a risk that once RfG comes into force sites using RoCoF will not be fully compliant.

Other comments: Typographical error in DPC7.4.3.4 and G59/2 1-.5.7.1 (1) : “operasting”

FROM THE CHAIRMAN OF THE DISTRIBUTION CODE REVIEW PANEL OF GREAT BRITAIN

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"By Email"

Mr John Norbury
RWE
Windmill Hill Business Park
Whitehill Way
Swindon
Wiltshire
SN5 6PB

11 March 2014

Dear John,

Frequency Changes during Large Disturbances and their Impact on the Total System

Thank you for your response to the consultation which took place in September 2013 on proposals to modify the Distribution Code requirements relating to Frequency changes during Large Disturbances and their Impact on the Total system.

Licensees received valuable feedback from the Industry with responses received from eighteen industry parties. The majority of responses were in favour of the proposals and recommended its implementation subject to certain concerns being addressed.

The Workgroup have helped to formulate responses to the comments you have raised in its work developing final proposals. I have summarised the Workgroup's thoughts in the points below:

In response to your specific comment on generators less than 5MW and transmission connected plant and the lack of assessment of such plant, the Workgroup believes that the benefit case is robust enough but acknowledges that the assessment has a number of dimensions. The implications for generators less than 5MW will need to be assessed, and, if a change is applicable to them is to be progressed in further work.

You commented that the consultation should have provided Cost Benefit Analysis of all of the setting options considered, in response, the Workgroup has reviewed its assessment and has revised its recommended settings accordingly

- In response to your specific comment that you believe the RoCoF settings should remain as they are, the Workgroup notes your general position and have provided further detailed responses to your other comments.

- Your comment on the appropriateness of a setting of 1Hzs[1] and the suggestion that further investigation work into generation withstand capabilities is needed was noted by the Workgroup. The Workgroup

believes that RoCoF protection setting requirements are not directly related to inherent withstand capability so there is not a need to conclude a withstand proposal at this stage. However, the Workgroup does note your comments on the complexity of determining a withstand capability requirement and agrees that this is a necessary piece of work.

- In relation to your concern over the risk assessment conclusions failing to sufficiently address the "very high risk" of 2.98×10^{-1}, the Workgroup recommends a site specific risk assessment to identify any actions necessary to reduce the risk. The consultation document highlights a number of factors which will have an impact on risk and therefore how the risk can be reduced.

- The Workgroup notes your comment that a greater understanding of the site specific risk assessment is required. The Workgroup's revised recommendations include additional guidance on which factors to consider.

- The Workgroup agree that consideration of auto-reclose times is worthwhile. The Workgroup's recommendation is to capture this in the site specific risk assessment. The Cost Benefit Analysis includes costs for this.

- Moreover, the Workgroup notes your suggestion that the most feasible and cost effective approach to reducing the risk of out of phase re-closures would be for check-sync or auto-reclose blocking to be carried out by DNO's. However, the Workgroup believes that the most cost effective method needs to be established on a site by site basis, which could of course necessitate modifications to the network.

- Your comment suggesting there is no clear incentive for a generator adversely affected by this change to adopt it has been noted. The Workgroup notes that the RoCoF protection requirements are mandatory in the Distribution Code, and repeated in G59. The Workgroup also recognises that there are cost implications for parties affected by the proposals. There are a number of precedents for managing the costs of such a change and generally they fall with the affected party.

- The Workgroup notes your concern that the costs for implementation and risk reduction are not developed well. The Workgroup has reviewed and revised its estimates which it believes are sufficiently robust for the cost benefit analysis presented alongside the Workgroup's revised proposals.

- You state that you are unconvinced by the potential Balancing Services savings estimated by National Grid and this has been noted. The forecast Balancing Services costs arise from either curtailing active power infeed loss risks or synchronising additional generation. These actions are required whenever the volume of distributed generation at risk exceeds a de-minimis level. Further detail of forecast Balancing Services costs has been presented to the Workgroup. Again, The Workgroup has reviewed and revised its forecast, and the uncertainties it is subject to, and believes it is sufficiently robust to support the case for adopting the Workgroup's revised proposals.

- The Workgroup notes your point on the estimated savings and proposal that a financial contribution from these savings should be made to generators. The Workgroup reiterates that any such mechanism could be developed as a separate piece of work, but that it falls outside of it current Terms of Reference.

- In addition, the Workgroup notes your suggestion to change the implementation period from 18 months to 4 years. The Workgroup recognises that timescales may be challenging in some circumstances but is conscious of the cost of the delay. An implementation period of 2 years has now been recommended. Moreover, the Workgroup thanks you for your comment that work on the withstand capability should be prioritised above other work planned in relation to this proposal and will take this into consideration when developing withstand proposals.

Finally, the Workgroup thanks you for your comments on the draft legal text, especially where you have highlighted a typographical error and thanks you for your input.

There will be a further consultation on these changes during March 2014 and I anticipate the publication of the Final Report to the Authority to follow in April. If you have any queries, or outstanding issues, please contact the Workgroup via grid.code@nationalgrid.com.

Yours sincerely,

Mike Kay

Digitally signed by Mike Kay
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Mike Kay
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Electricity North West
Chairman of the Distribution Code Review Panel of Great Britain

Industry Consultation Response Proforma

Frequency Changes during Large Disturbances and their Impact on the Total System

Industry parties are invited to respond to this consultation expressing their views and supplying the rationale for those views, particularly in respect of any specific questions detailed below.

Please send your responses by **27 September 2013** to david.spillett@energynetworks.org.

Please note that any responses received after the deadline or sent to a different email address may not receive due consideration.

Respondent:	*Guy Phillips and Paul Newton*
Company Name:	*E.ON UK*

Industry Consultation Questions

(a)	Do you agree it is necessary to change RoCoF settings on Loss of Mains protection for new and existing distributed generators within stations of registered capacity of 5MW and above? If not, what alternative actions would you recommend and why?	Before answering the specific questions in more detail we wish to be clear that we do not support the proposal in its present form. In summary this is for the following reasons: i) The implications to generators less than 5MW and transmission connected plant have not been assessed. The benefits described cannot be considered to be true without assessing the full range of impact of the change. ii) We do not believe 1Hz/s measured over half a second is the appropriate setting. iii) The consultation should have provided cost benefit analysis of all of the setting options considered by the working group to determine the best solution. iv) It is not clear that the change proposed will have any tangible benefit prior to 2020, even in the most extreme scenarios assessed, let alone whether the circumstances will come to pass. v) A stable frequency is a fundamental part of the quality of supply. The proposal will deteriorate the quality of supply and therefore current performance assumed by users of both distribution and transmission networks. It may be equally appropriate to consider an explicit obligation on network operators in this regard. Turning specifically to question a); we do not agree it is absolutely necessary to change all ROCOF settings. Actions are already being taken by National Grid to limit rate of change of frequency so this is a

		solution in itself. It does not appear that the development of ancillary service products has kept pace with the increasing penetration of non-synchronous generation. By addressing this, it should be possible to develop and purchase the necessary products more efficiently. The DRIVe tender initiative, which includes inertia, is a welcome step in this direction, as is the technical investigation of synthetic inertia from non-synchronous plant, and these should continue to be investigated and developed. We also note National Grid's development of the Rapid Frequency Response service. Nevertheless, we believe that the existing recommended setting of 0.125Hz/s is not necessary for all sites and some changes can be made with benefits to system security and system balancing costs.
(b)	Do you agree that 1Hzs-1 measured over half a second is an appropriate RoCoF setting? If not, what alternative RoCoF setting would you recommend and why?	1Hz/s may be appropriate for some sites and generation technologies, but we do not think it is appropriate for all sites. At some synchronous generator sites, the installed ROCOF relays are used not only for the protection of the distribution network, as required by DNOs, but also by Generators for the protection of their plant and personnel, particularly against the risk of damage caused by out of phase closing due to auto-reclose circuit breakers on the DNO's network. As the relay is providing a plant and personnel protection function, we are strongly of the opinion that the relay settings should be agreed by both the DNO and the Generator, and this may require a site-specific assessment rather than the adoption of generic settings, particularly if the latter are so insensitive. We therefore believe that the unamended provisions in the new DCP7.4.3.9 are insufficient and that exceptional circumstances should be amended to include safety to personnel. DNO's must also be prepared during any implementation process for the probability of exceptional circumstances to arise and offer appropriate flexibility when finalising revised settings. The consultation is also not explicit regarding the consequences to a generator if agreement cannot be reached with a DNO on revised settings to apply. Parties cannot be fully informed regarding the implications of the proposal unless this is absolutely clear.

		The setting proposed by the work group is based almost entirely upon consideration of predicted future potential system ROCOF values, with limited consideration given to whether 1Hz/s remains an effective setting for protection purposes. It is important to note that a suitable setting for protection purposes depends on many site-specific factors, such as generator inertia and other generator parameters, voltage control capabilities, auto-reclose settings, and the export capacity of the generator compared to the local load. After reviewing the University of Strathclyde (UoS) risk assessment report, and subsequent discussions, we are of the opinion that 0.5Hz/s is the maximum sensible generic setting from a protection perspective, and even then, a lower setting may be required for some sites.

(c)	Are you responsible for distributed generation which will be affected by these proposals? How much of your generating capacity is affected?	Much of E.ON's GB generating capacity will be affected by these proposals. This includes distribution connected synchronous and non-synchronous generation. As well as the out of phase reclosing risk presented to distribution connected plant, we are very concerned about the impact on our large transmission connected generating units. If it is planned to operate the system in future with system ROCOF levels up to 1Hz/s permitted, then this major change will be seen by all generating plant, transmission connected as well as distribution connected. The ability of synchronous units to withstand the additional stresses arising from such increased ROCOF levels, of unknown frequency of occurrence, is not known. It is of considerable concern to us that these present proposals have been put forward without any assessment of the impact on large transmission connected units. A proposed change of permitted system ROCOF levels from the order of 0.1-0.2Hz/s, to 1Hz/s represents a significant deterioration in frequency quality; as such, we would argue that a full and proper impact assessment on all affected plant is a necessity before such a change can be endorsed. We note that the next phase of this work includes the following item: "Development of RoCoF withstand criteria for use in GB (as will be required by the EU Network Code Requirements for all Generators (ref 8.1(b)))" We have two comments on this. Firstly the draft RfG wording permits ROCOF protection to take precedence over the withstand requirement. Secondly, our generating units are of various sizes and technologies, and date from the 1960s to the present day. Their withstand capabilities will be whatever they are and will not be able to be changed. This must be taken into account in the management of the system. Therefore, as an owner and operator of a wide portfolio of generating plant, we expect the GB system to continue to be operated to ensure that unacceptable frequency conditions do not occur, including rate of change of frequency.

(d)	Do you agree with the Workgroup's probability and risk assessment conclusions?	Clause 1.14 of the report states: "Each time an island forms there is a risk of "out of phase re-closure", where the control scheme which is designed to restore a loss of supply rapidly would switch automatically to reconnect the desynchronised island without checking that the electrical conditions were matched. This could damage generator equipment and place people at risk suggesting that a site specific risk assessment would be required for higher RoCoF settings on synchronous generators of this size." Assuming auto-reclose circuit breakers are installed, we agree with the above statement.
(e)	Do you agree with the Workgroup's approach to the probability and risk assessment relating to the risk to individuals and the risk to equipment as a consequence of a change to RoCoF settings?	We have no particular comments to make on the approach taken other than the calculations are for an average site and the report does not give much of an indication of the likely range of results when considering a range of sites.
(f)	What, if any, additional features should be added to the Workgroup's probability and risk assessment relating to the risk to individuals and the risk to equipment as a consequence of a change to RoCoF settings? How can these be quantified and by whom?	As stated earlier, a change of system ROCOF planning levels will impact all User plant, both transmission and distribution connected. We believe it is essential to get input from steam and gas turbine manufacturers to ascertain the capabilities of new and old units, and system ROCOF planning levels should be aligned with the capabilities of equipment.
(g)	Do you have specific information relating the risks to generators of out of phase re-closure which would improve upon the Workgroup's assessment?	We have no additional observations to share at this point.

(h)	What assessment and mitigation measures would it be appropriate for synchronous generators to take to reduce the risk of out of phase re-closures that could otherwise present a hazard?	Before applying ROCOF settings different to the existing recommended settings, whether for existing plant or new plant, we would expect to undertake a site-specific assessment to ascertain what, if any, alternative settings are appropriate. In the case of new plant, there is the option to use alternative protection, such as intertripping or perhaps vector shift. However, in the case of existing plant using ROCOF relays, we would seek to retain those and use them with appropriate settings, rather than change to an alternative protection scheme.
(i)	What is your view of the costs that the Workgroup presented for implementing its proposals? Has the Workgroup over or under-estimated costs? Has the Workgroup missed some items or included costs that shouldn't be considered?	The implementation costs appear to be in the right order. One cost item potentially missing is damage caused to plant, either transmission or distribution connected plant, by high system ROCOF values which may occur if the savings of balancing services costs are made. This risk has not yet been assessed and so the costs are unknown.

(j)	What is your view of the potential Balancing Services costs that National Grid estimates can be saved by implementing the Workgroup's proposals? Has it over or under-estimated costs? Has National Grid missed some items or included costs that shouldn't be considered?	We find the assessment to be not entirely transparent. For example, clause 6.28 states: "By changing protection settings for generators at stations of 5MW and above, these Balancing Services costs can be avoided. The phase 2 work the Workgroup has identified will need to be completed to provide full assurance of these benefits." However, it is noted that phase 2 includes generation capacity of less than 5MW. Are we therefore correct to assume that not all the quantified benefits will be realised unless the issues regarding generation of less than 5MW are resolved? If so, then only a portion of the stated benefits are attributable to resolving issues with the generation above 5MW, and this break down is not given. We also expected to see cost-benefit analyses for more of the setting options included in the UoS report. Hence, what, for example, is the difference between the benefits of the work group's preferred option (1Hz/s, 0.5s, setting option 4 in the UoS report) and setting option 2 in the UoS report (0.5Hz/s, 0.5s)? We assume that setting option 2 would itself yield substantial benefits as, based on Tables 1 and 2 (clause 2.27), it is not until 2020, that predicted system ROCOF levels may exceed this setting, under certain conditions. We feel the transparency of the consultation would have been better had at least one alternative option, e.g. setting option 2, as well as setting option 4, been included, with cost-benefit analyses specific to each option.
(k)	Do you believe that 18 months is an appropriate period for protection setting changes to be implemented?	For protection setting changes at distribution connected plant, yes, this seems reasonable.
(l)	Do you have any comments on the Workgroup's future work plan to develop proposals for distributed generation of less than 5MW in capacity and to develop proposals for a RoCoF withstand capability?	We believe these issues need to be investigated, particularly the actual and achievable withstand capabilities of plant, and that the outcome of this should inform decisions on system planning and operating frequency quality criteria.

(m)	Do you believe the proposals better facilitate the Distribution Code objectives? Please include your reasoning. The full impact on all generating plant needs to be further investigated before this question can be properly answered.	(i) to permit the development, maintenance and operation of an efficient, coordinated and economical system for the transmission of electricity; -
		(ii) to facilitate competition in the generation and supply of electricity -
		(iii) subject to sub-paragraphs (i) and (ii), to promote the security and efficiency of the electricity generation, transmission and distribution systems in the national electricity transmission system operator area taken as a whole; and -
		(iv) to efficiently discharge the obligations imposed upon the licensee by this license and to comply with the Electricity Regulation and any relevant legally binding decisions of the European Commission and/or the Agency. -

FROM THE CHAIRMAN OF THE DISTRIBUTION CODE REVIEW PANEL OF GREAT BRITAIN

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"By Email"

Mr Guy Phillips
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Westwood Business Park
Coventry
West Midlands
CV4 8LG

11 March 2014

Dear Guy,

Frequency Changes during Large Disturbances and their Impact on the Total System

Thank you for your response to the consultation which took place in September 2013 on proposals to modify the Distribution Code requirements relating to Frequency changes during Large Disturbances and their Impact on the Total system.

Licensees received valuable feedback from the Industry with responses received from eighteen industry parties. The majority of responses were in favour of the proposals and recommended its implementation subject to certain concerns being addressed.

The Workgroup have helped to formulate responses to the comments you have raised in its work developing final proposals. I have summarised the Workgroup's thoughts in the points below:

- In response to your specific comment on generators less than 5MW and transmission connected plant and the lack of assessment of such plant, the Workgroup believes that its benefit case, which has been reviewed in the light of consultation responses, is robust for the recommended change.

- You commented that the consultation should have provided Cost Benefit Analysis of all of the setting options considered. The Workgroup has reviewed its assessment and has revised its recommended settings accordingly, and has revised its Cost Benefit Analysis to align with its new recommendations.

- The Workgroup does not concur with your statement that the proposal will lead directly to a deterioration of quality of supply and current performance. The believes that the proposal will improve quality of supply in some aspects by ensuring that unnecessary involuntary demand control actions do not occur. The Workgroup has noted your comment that $1Hzs^{-1}$ may not be appropriate for all sites and has considered this in its revised recommendations.

- The Workgroup has noted your comment that the relay settings should be agreed by both the DNO and the Generator. The Workgroup responds that its proposal incorporates a recommendation to perform a site specific risk assessment, but that there is limited scope to apply varying settings at different sites as the minimum setting effectively sets the system limit. However, there is scope to employ appropriate mitigating measures which has been accounted for in the development of the Workgroup's proposals.

- The Workgroup notes your suggestion that exceptional circumstances should be amended to include safety to personnel and has incorporated some flexibility in its revised recommendations to provide more options to achieve this.

- The Workgroup notes your comment that the consultation is not explicit regarding the consequences to a generator if agreement cannot be reached with a DNO on revised settings to apply. The Workgroup notes that normal dispute resolution approaches would apply.

- The Workgroup notes your concern of out of phase reclosing risk and the impact on large transmission connected generating units. The Workgroup believes that the proposals under consideration do not have a direct impact on large transmission connected generating units. However, the Workgroup will take these comments into consideration when developing withstand proposals.

- The Workgroup also notes your comment that you have generating units of various size and technologies and this must be taken into account.

- In addition, the Workgroup notes your comments concerning the draft RfG wording, especially that the RfG drafting requires that the RoCoF withstand of the generator will be specified by the TSO, and that the relevant Network Operator will specify the RoCoF settings that should be used. The Workgroup agree that the system should continue to be operated to ensure that unacceptable frequency conditions do not occur, however the Workgroup do not yet have a definite view of what RoCoF withstand is required. The Workgroup will also take these comments into consideration when developing its withstand proposals.

- The Workgroup notes your comment that the calculations in the risk assessment are for an average site. Therefore the Workgroup suggests a site specific risk assessment to account for this fact in certain circumstances.

- The Workgroup welcomes your suggestion on gaining input from steam and gas turbine manufacturers to ascertain the capabilities of new and old units and will take these into account when developing proposals on withstand capability. Additionally, The Workgroup recognises EON’s desire to retain lower settings and make site specific decisions. However, a minimum setting needs to be applied in order to deliver the benefits the Workgroup has identified.

- The Workgroup notes your comments on the costs for damage caused to plant. The Workgroup did not include these costs in the Cost Benefit Analysis as it recommends that any necessary site specific works are undertaken to manage the risk of damage appropriately.

- The Workgroup notes your comment that the assessment is not entirely transparent and has reviewed its Cost Benefit Analysis and clarified its presentation to ensure that the claimed benefits match the costs incurred.

- The Workgroup notes that the Cost Benefit Analysis did not differentiate between settings to the level of detail that you recommended but is confident that its revised recommendations can be justified based on the settings options analysis already completed.

- Finally, the Workgroup agrees that further investigation needs to be done conducted into the issues of withstand capability and smaller distributed generation.

There will be a further consultation on these changes during March 2014 and I anticipate the publication of the Final Report to the Authority to follow in April. If you have any queries, or outstanding issues, please contact the Workgroup via grid.code@nationalgrid.com.

Yours sincerely,

Mike Kay

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Jenkins, Robyn

From: Alastair Martin [alastair.martin@flexitricity.com]
Sent: 24 September 2013 17:47
To: David Spillett
Cc: members@ukdra.com
Subject: Frequency changes during large system disturbances: consultation response from the UK Demand Response Association

Dear David

Thank you for the opportunity to comment on your proposals regarding frequency changes during large system disturbances. Please find below the response of the UK Demand Response Association to this consultation.

Best regards

Alastair Martin
On behalf of the UK Demand Response Association

m: 07881 908 035
e: alastair.martin@flexitricity.com

(a) Do you agree it is necessary to change RoCoF settings on Loss of Mains protection for new and existing distributed generators within stations of registered capacity of 5MW and above? If not, what alternative actions would you recommend and why?

We recognise the issue which National Grid seeks to address. However, the method proposed is not without cost. It is unlikely that a change to RoCoF settings can be made without affecting the DNO's view and/or the site's view of the residual adequacy of the thus-changed RoCoF protection. We expect that a change to these settings would cause many DNOs to revise their policies, which would require that many existing and prospective distributed generation (DG) sites install alternative protection systems. Such alternatives are likely to favour intertripping, which is significantly more expensive than RoCoF. This would prevent a number of prospective DG sites from going forward, and (to the extent that retrospective costs fall on generators) potentially make some existing DG sites uneconomic.

Furthermore, adjustment of protection settings does not in itself imply RoCoF withstand capability. This would indicate that means to maintain system inertia would be a more effective solution, because both RoCoF protection and failure to withstand can remove DG from the network in the event of a large plant loss. Failure to withstand may also imply damage.

Where there are alternatives which would not impose these costs (however the costs might be allocated) or where the risk of a failure to withstand system events would not be increased, such alternatives should be fully explored.

We would like to see more detailed consideration given of alternatives such as:

- Estimation of the inertia contribution from the population of synchronous embedded generators, such as CHP, biomass, hydro and others
- Commercial incentives to provide – and to report, in operational timescales, provision of – synchronous inertia from CHP, biomass, hydro and similar DG sites
- Simulated inertia by adding dynamic RoCoF control to existing and future providers of dynamic frequency response, including large generators, DG and load

- Rapid RoCoF commercial services, by adding fast-acting RoCoF trip settings to existing and future providers of non-dynamic frequency response

Such approaches could be investigated, and indeed demonstrated, through the Network Innovation Fund or similar mechanisms. Existing market participants would be able to respond with their views on plant capability if a clear statement of likely dynamic and non-dynamic inertia/RoCoF service parameters were provided by National Grid.

(b) Do you agree that 1Hzs-1 measured over half a second is an appropriate RoCoF setting? If not, what alternative RoCoF setting would you recommend and why?

We would like to see a clear statement explaining exactly what is meant by “measured over half a second”. The precise interpretation of this requirement could have a material impact on the ongoing viability of RoCoF protection as a means of detecting loss of mains.

(c) Are you responsible for distributed generation which will be affected by these proposals? How much of your generating capacity is affected?

Demand response participants include many DG operators who are responsible for such sites. Over 50% of active demand response capacity may be affected.

(d) Do you agree with the Workgroup's probability and risk assessment conclusions?

(e) Do you agree with the Workgroup's approach to the probability and risk assessment relating to the risk to individuals and the risk to equipment as a consequence of a change to RoCoF settings?

(f) What, if any, additional features should be added to the Workgroup's probability and risk assessment relating to the risk to individuals and the risk to equipment as a consequence of a change to RoCoF settings? How can these be quantified and by whom?

(g) Do you have specific information relating the risks to generators of out of phase re-closure which would improve upon the Workgroup's assessment?

We have no additional comments to make on points (d) to (g).

(h) What assessment and mitigation measures would it be appropriate for synchronous generators to take to reduce the risk of out of phase re-closures that could otherwise present a hazard?

We note that the out-of-phase re-closure problem is partly a consequence of the lack of check-dead systems on many re-closers. Check-dead systems would be an appropriate response to this hazard. Given the importance of DG to the UK’s economic and energy future, we suggest that such systems should be standard on all new or retrofitted installations, and should be deployed on networks affected by the present proposals.

(i) What is your view of the costs that the Workgroup presented for implementing its proposals? Has the Workgroup over or under-estimated costs? Has the Workgroup missed some items or included costs that shouldn't be considered?

The workgroup does not appear to have considered the open-ended cost that would result from abandonment of RoCoF as an acceptable form of loss-of-mains protection by DNOs. This cost would comprise higher capital costs for site development, retrospective costs on existing sites, and the potentially very large opportunity cost of DG sites closed or not developed as a result.

(j) What is your view of the potential Balancing Services costs that National Grid estimates can be saved by implementing the Workgroup's proposals? Has it over or under-estimated costs? Has National Grid missed some items or included costs that shouldn't be considered?

National Grid has recently purchased inertia services on the open market, but has tended to do this in conjunction with localised voltage support services. The latter service would still be required if the former were delivered using the proposed setting change. Therefore it is not clear that all of the costs identified would actually be saved.

(k) Do you believe that 18 months is an appropriate period for protection setting changes to be implemented?

No. The interventions required at sites are unknown because the impact on the adequacy of RoCoF loss-of-mains protection is unclear. However, it is very unlikely that even basic setting changes – assuming no collateral impact on protection effectiveness – can be executed and verified in the timescale proposed.

(l) Do you have any comments on the Workgroup's future work plan to develop proposals for distributed generation of less than 5MW in capacity and to develop proposals for a RoCoF withstand capability?

The per-site cost of RoCoF setting changes, upgrading to intertripping, or other measures, are typically invariant in respect of DG unit size. The number of affected sites will be one or two orders of magnitude greater. There will be significantly greater difficulties in obtaining withstand information concerning a large population of smaller sites. For these reasons, we expect that inclusion of smaller sites would be very substantially more expensive.

(m) Do you believe the proposals better facilitate the Distribution Code objectives? Please include your reasoning.

We have no additional comments to make on point (m).

FROM THE CHAIRMAN OF THE DISTRIBUTION CODE REVIEW PANEL OF GREAT BRITAIN

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"By Email"

Mr Alastair Martin
UK Demand Response Association
2-6 Cannon Street
London
EC4M 6YH

11 March 2014

Dear Alastair,

Frequency Changes during Large Disturbances and their Impact on the Total

Thank you for your response to the consultation which took place in September 2013 on proposals to modify the Distribution Code requirements relating to Frequency changes during Large Disturbances and their Impact on the Total system.

Licensees received valuable feedback from the Industry with responses received from eighteen industry parties. The majority of responses were in favour of the proposals and recommended its implementation subject to certain concerns being addressed.

The Workgroup have helped to formulate responses to the comments you have raised in its work developing final proposals. I have summarised the Workgroup's thoughts in the points below:

- The Workgroup notes your statement concerning a change to RoCoF settings and potential consequential change in DNO policy. The Workgroup comments that it is unlikely that DNO's would revise policies, and there could be significant challenge to any DNO that moved beyond the requirements of the Distribution Code. Accepted practice is for the generator to determine how to protect against Out Of Phase re-closures and to determine if intertripping would be a cost effective solution. The Workgroup believe costs incurred in doing this are accounted for in the Cost Benefit Analysis.

- The Workgroup notes your comment on the adjustment for protection settings does not imply withstand. The Workgroup intends to develop proposals to deal with withstand capability in its further work.

- The Workgroup agrees with your recommendation to fully explore alternatives to making protection setting changes. The Workgroup believe it has accounted for a range of alternatives in its Cost Benefit Analysis.

- The Workgroup thanks you for your helpful suggestions on inertia and the Workgroup believes these suggestions will help National Grid develop its thinking in this area (as it falls under National Grid's responsibility). Moreover,

National Grid notes its experiences of investigating “synthetic inertia”, where potential providers could provide a fast acting capability, but not currently fast enough to beat RoCoF protection.

- In addition, your comment on requiring a clearer explanation on what is meant by “measured over half a second” has been noted and the Workgroup agree that a level of precision is needed on the specification of measuring periods and this is addressed in its revised recommendations.

- Furthermore, your statement that the out-of-phase re-closure problem could be a consequence of the lack of check-dead systems. The Workgroup agrees that this option could be applied where it is efficient to do so.

- In response to your suggestion that the Workgroup has not considered the open-ended cost that would result from abandonment of RoCoF, and members would wish to highlight that there is no proposal to abandon RoCoF as a loss of mains protection.

- The Workgroup thanks you for pointing out that actions taken to resolve system issues can help resolution of others. The Balancing Services cost forecast used by the Workgroup takes this into account by starting from a baseline where other system issues have been addressed. The Workgroup believes that its revised forecast takes appropriate account of future uncertainties and the interaction with other issues.

- Furthermore, your comment on timescales has been noted and the Workgroup recognises that timescales may be challenging in some circumstances but is conscious of the cost triggered by delay. Consequently, an implementation period of two years has been recommended.

- Finally, the Workgroup notes your comment on the per site cost of RoCoF Setting.

There will be a further consultation on these changes during March 2014 and I anticipate the publication of the Final Report to the Authority to follow in April. If you have any queries, or outstanding issues, please contact the Workgroup via grid.code@nationalgrid.com.

Yours sincerely,

Mike Kay

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Chairman of the Distribution Code Review Panel of Great Britain

Jenkins, Robyn

From: Konstantinos Pierros [konstantinos.pierros@enercon.de]

Sent: 25 September 2013 13:12

To: David Spillett

Subject: Frequency Changes during Large Disturbances and their Impact on the Total System Industry Consultation

Dear David,

I am writing to you with regard to the consultation about the new proposed RoCoF settings in the UK.

ENERCON, as a manufacturer of Wind Energy Converters (WECs) with a long history in the UK and worldwide, are in favor of every change that facilitates the integration of renewable generation to the challenging current network environment and that taps the capabilities of our technology to a greater extent. Therefore, we do support the new proposed settings and we feel that these are to the right direction.

Our WECs, already since the beginning of the 2000s can withstand a RoCoF of more than 4Hz/s, while their limits for normal frequency operation are 43Hz and 57Hz. This means that the WECs are practically immune to frequency deviations and, as they are considered controlled current sources (given our inverter control system), they cannot operate an island with purely loads and WECs, as they need an installation to produce the voltage for them to take as reference and inject the current; that's captured in the report as well. However, in many projects we have experienced nuisance tripping due to the RoCoF settings, despite our capabilities and the absence of the risk of forming an island!

Clearly, there has been no common line across the industry of how this K2x0.125Hz/s of the G59/2 was to be interpreted (any delay in measurement? what is the frequency measurement resolution? what is the frequency measurement window? is the latter floating or constant? to name but a few open issues). There is the chance with the present change to promote a standardization of the current practice and you need to take it. Only in this way you will be able in the future to confidently model the system behavior and avoid assumptions around the RoCoF behavior of DGs. Are the DNOs considering to accepting type testing…?

Furthermore, the document is proposing changes to the RoCoF, but what about vector shift…? It appears neglected, although there are again different voices in the industry, favoring vector shift over RoCoF. We have been suggested the use of vector shift to avoid nuisance tripping! I believe the values of the vector shift in Annex 2 should be updated as well to correspond to the proposed RoCoF settings. If not, there should be clear reasoning why it is not proposed/considered any more.

Moreover, the study from Strathclyde concerned only synchronous generators. If it is accepted that only in the case that there is a number of synchronous generators in the electrical vicinity, there is the risk of an island being created, then why do our customers have to procure relays and have supervised, paid tests..? I believe the interference of synchronous machines and inverter based technology should have been studied as well, and perhaps different protection arrangements (for instance what if the synchronous machines had the RoCoF protection but the eg WECs had only OF/UF/OV/UV protection…?) and FRT capabilities to be introduced soon by the Rfg down to Type B power generating modules.

What is more, we would expect a clear signal to the DNOs that the implementation of any new proposed setting would be acceptable even for power stations below 5MW; we would not want in our new sub-5MW installations to have settings only to be changed in a couple of years, not to mention our already superior performance. We have experienced DNOs sticking to the letter of the G59 and in this case, this should be avoided.

I chose to reply in this way, as ENERCON is a WEC manufacturer and cannot meaningfully

comment on the majority of the questions raised (primarily concerning DNOs/developers/synchronous generators), for instance on whether the 1Hz/s is adequate for the UK system or not [question (b)] or if the Balancing Services cost savings are reasonably estimated [question (j)]. What we can tell, however, is that RoCoF tends to become an anti-islanding solution gradually less favored by international DNOs apart from those in the British Isles. We would welcome an analysis of whether the RoCoF is really necessary or not, and for which type of generation in specific.

Please let me know if you would like me to fill the questionnaire, although our contribution will be limited to a few points only, and I shall do it.

Kind Regards,
Konstantinos Pierros

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"By Email"

Mr Konstantinos Pierros
Enercon
Teerhof 59
D-28199
Bremen
Germany

11 March 2014

Dear Konstantinos,

Frequency Changes during Large Disturbances and their Impact on the Total System

Thank you for your response to the consultation which took place in September 2013 on proposals to modify the Distribution Code requirements relating to Frequency changes during Large Disturbances and their Impact on the Total system.

Licensees received valuable feedback from the Industry with responses received from eighteen industry parties. The majority of responses were in favour of the proposals and recommended its implementation subject to certain concerns being addressed.

The Workgroup have helped to formulate responses to the comments you have raised in its work developing final proposals. I have summarised the Workgroup's thoughts in the points below:

- The Workgroup thanks you for the information you provided on your Wind Energy Converters and how they can withstand a RoCoF of more than 4Hzs^{-1}.

- In relation to your comment on G59/2, the Workgroup agree that the requirements of the Distribution Code need to be readily applicable to protection equipment and has taken expert advice in finalising its recommendations.

- Your observation of whether Vector Shift is being considered has been noted and the Workgroup can confirm it intends to examine issues relating to Vector Shift in future work.

- Also, your comment that the study from Strathclyde only focused on synchronous generators has been noted and the Workgroup would like to highlight that Phase 2 of the work will consider the interaction of a range of generators technologies. However, it has concluded that this was not

necessary for the type of plant considered under the proposals in this phase of work.

- Your statement that you would like a clear signal to DNO's that the implementation of new proposed settings are acceptable has been noted and the Workgroup agree that requirements need to be expressed clearly.

- Finally, the Workgroup notes your comment that you would welcome further analysis of whether RoCoF is really necessary.

There will be a further consultation on these changes during March 2014 and I anticipate the publication of the Final Report to the Authority to follow in April. If you have any queries, or outstanding issues, please contact the Workgroup via grid.code@nationalgrid.com.

Yours sincerely,

Mike Kay

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Jenkins, Robyn

From: Robert Frames [rob.frames@trinitymirror.com]
Sent: 24 September 2013 13:48
To: David Spillett
Subject: Frequency (ROCOF) Protection settings

Re: Future Rate of Change of Frequency (RoCoF) Protection Settings

Further to your letter of 22 August 2013, Trinity Mirror Printing (TMP) Oldham have reviewed both the proposed RoCoF protection settings changes against existing settings for the Generators.

In summary we recognise the challenges faced by National Grid and DNO's in managing both system inertia and potential for Low Frequency Demand Disconnection to customers but obviously changing the current 0.125 Hz RoCoF settings to 0.5 Hz over 0.5 second will require modifications the Generator Controls. This said the proposals come at a time when the site is looking to modify existing generator operation to enable Long Term Parallel operation with up to 5 MW of export to the Grid.

Taking this into account and the timescales for RoCoF Protection setting Proposed Changes Response by 27th September we look forward to working with Electricity North West in identifying whether the proposed change of operation at TMP Oldham can be accommodated in terms of network fault current contribution and alignment with both current and future G59/2 Engineering Recommendation requirements. Hopefully this will also enable capital investment justification for changes as a consequence of potential new RoCoF protection settings.

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Regards,

R. Frames
Projects, SHE and Services Manager

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Tel : **0161 683 6174**
Email : **rob.frames@trinitymirror.com**

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"By Email"

Mr Robert Frames
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11 March 2014

Dear Robert,

Frequency Changes during Large Disturbances and their Impact on the Total System

Thank you for your response to the consultation which took place in September 2013 on proposals to modify the Distribution Code requirements relating to Frequency changes during Large Disturbances and their Impact on the Total system.

The licensees received valuable feedback from the Industry with responses received from eighteen industry parties. The majority of responses were in favour of the proposals and recommended its implementation.

The Workgroup would like to thank you for your response to the original consultation.

There will be a further consultation on these changes during March 2014 and I anticipate the publication of the Final Report to the Authority to follow in April. If you have any queries, or outstanding issues, please contact the Workgroup via grid.code@nationalgrid.com.

Yours sincerely,

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