

# Distribution Code Consultation Response Proforma Working Group Responses

DCRP/PC/18/01: Engineering Recommendation P28

Voltage fluctuations and the connection of disturbing equipment to transmission systems and distribution networks in the United Kingdom.

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Stakeholders were invited to respond to the above consultation, expressing their views or providing any further evidence on any of the matters contained within the consultation document together with the rationale for their responses to the set questions.

The deadline for responses and comments was **17:00 on Wednesday 31 January 2018** with emails sent to [dcode@energynetworks.org](mailto:dcode@energynetworks.org) - noting that any responses received after the deadline may not receive due consideration by the Working Group.

This document collates the responses received from stakeholders by the stated deadline together with the associated responses of the P28 Working Group – shown in **blue** font below each stakeholder response.

Any queries on the content of the consultation pro-forma and Working Group responses should be addressed to DCode Administrator on 020 7706 5124, or to [dcode@energynetworks.org](mailto:dcode@energynetworks.org)

## Distribution Code Consultation Response Proforma Working Group Responses

<b>Respondent</b>	Dr. Isaac Gutierrez
<b>Company Name</b>	ScottishPower Renewables Ltd
<b>No. of DCode Stakeholders Represented</b>	1
<b>Stakeholders represented</b>	ScottishPower Renewables Ltd.
<b>Role of Respondent</b>	Generator
<b>We intend to publish the consultation responses on the DCode website. Do you agree to this response being published on the DCode website? [Y/N]</b>	Y

	Question	Response
Q1	Do you agree with the proposed requirements and planning levels for RVCs in EREC P28 Issue 2 (as provided in Figure 5, Figure 6, Figure 7 and Table 4 of EREC P28 Issue 2)?	Although after further clarification from ENA, SPR understands that as per Note 7 in table 4, SPR is allowed to meet any of the categories in table 4 for any given windfarm, the requirements in Table 4 as they stand for category 2 and category 3 still more onerous than Grid Code CC 6.1.7 under certain circumstances. As a windfarm developer, SPR would always try to procure wind turbine transformers that allow auto-reclose schemes to meet the requirements in Table 4 Category 1 (or Figure 4 of the current P28 engineering recommendations) but this is not always the case as some turbines transformer produce rapid voltage fluctuations outside the $\pm 3\%$ range. Taking as an example a wind farm consisting of 10 wind turbines when after carrying out the P28 studies it comes to light that any single wind turbine transformer cannot meet Table 4 Category 1 then the obvious choice for SPR will be to meet category 2 in Table 4. If one event consists of 4 RVCs and each RVC must be separated by at least 10 minutes then this will represent a massive loss of revenue for SPR as in the cited example only 4 turbines would be

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		<p>allow to auto reclose in one day after a trip in the grid is cleared /reset in line with the requirement in Category 2. It could be argued that pre-insertion resistors could be installed but that has cost implications (the bigger the resistor the more expensive) and always there is the risk of the pre-insertion resistor failure leaving the windfarm in the situation described above. The worst case scenario could be for a 10 wind turbine windfarm under Table 4 Category 2 requirement to take 3 days for energising all turbines which SPR cannot accept. SPR is of the opinion that as per above explanation the requirements in Table 4 shall be relaxed mainly for category 2 and category 3. Please note that the above example does not include potential effects of cable energisation within the windfarm which could make things worse.</p>
		<p>Response from the P28 Working Group:</p> <p>Category 2 of Grid Code CC.6.1.7 allows a maximum <math> \%V_{\text{steadystate}}  \leq 3\%</math> and <math>1\% &lt;  \%V_{\text{max}}  \leq 3\%</math> not more than 4.76 occurrences per hour with events evenly distributed. Category 1 of EREC P28 Issue 2 (which is analogous to Category 2 of Grid Code CC.6.1.7) also allows a maximum <math> \%V_{\text{steadystate}}  \leq 3\%</math> and <math>1\% &lt;  \%V_{\text{max}}  \leq 3\%</math> not more than 7.8 occurrences per hour for flicker assessment under Stage 2 against the limit of <math>P_{\text{st}} \leq 0.5</math> [Figure B.1.2 of EREC P28 Issue 2]. Under these circumstances the P28 Working Group do not believe the requirements in EREC P28 Issue 2 are more onerous than Category 2 of Grid Code CC.6.1.7.</p> <p>The time and voltage magnitude limits for Category 3 RVCs shown in Figure CC.6.1.7 of the Grid Code when compared with Figure 7 of EREC P28 Issue 2 confirm that both the time and voltage limits in EREC P28 Issue 2 for Category 3 very infrequent events (not more than 4 RVCs in 1 day providing less frequent than once every 3 calendar months) are less onerous than those for Category 3 RVCs in the Grid Code, where a maximum of 4 RVCs per day are permitted typically not planned more than once per year on average over the lifetime of a connection. Under these circumstances the P28 Working Group do not believe the requirements in EREC P28 Issue 2 are more onerous than Category 3 of Grid Code CC.6.1.7.</p> <p>In terms of the wind farm example provided above, the P28 Working Group would comment as follows. The requirement for <math> \%V_{\text{steadystate}}  \leq 3\%</math> in EREC P28 Issue 2 Table 4 Category 1 is comparable to the general limit of 3% for voltage step changes in the current EREC P28 Issue 1. In terms of energising wind turbine transformers, the resultant voltage change can be assessed against either Category 1, Category 2 or Category 3 of Table 4 of EREC P28 Issue 2 depending upon the maximum no. of occurrences. For very infrequent events, less than 1 RVC event (consisting of up to 4 RVCs per day) in 3 calendar months, the connectee may choose to assess against Category 3 in Table 4, where each RVC is permitted to have a <math> \%V_{\text{max}}  \leq 12\%</math>. The</p>

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		<p>above example presumes that only one wind turbine transformer can be energised at a time. However, the intention of the limits in Category 3 is to allow several transformers to be energised at any one time whilst complying with the limit. Category 3 allows 4 such energisations in a day.</p> <p>The P28 Working Group would like to point out that the limits in Table 4 of EREC P28 Issue 2 and the associated amendments to the Distribution Code have been carefully chosen to allow a greater number and magnitude of RVC type voltage fluctuations than is currently permitted whilst not posing an unacceptable risk of voltage complaints from other customers connected to the system. It would not be acceptable to increase the RVC limits proposed for Category 2 and Category 3 events in EREC P28 Issue 2 simply to avoid the need for disturbing equipment connectees to mitigate unacceptable voltage fluctuations caused by the energisation of their equipment, where these fluctuations could cause an unacceptable risk of interference to other customers.</p> <p>The P28 Working Group would also point out that the changes in EREC P28 Issue 2 are a significant relaxation compared with the current requirements in DPC4.2.3.3 of the Distribution Code, which only permits a voltage depression of -10% not more frequently than once per year for energisation of transformers, as a result of post fault switching, post maintenance switching, or carrying out commissioning tests.</p> <p>On this basis, the P28 Working Group is of the opinion that the requirements in Table 4 of EREC P28 Issue 2 should not be relaxed for Category 2 and Category 3.</p>
Q2	Do you agree with the proposal for providing improved clarity of what constitutes 'worst case normal operating conditions' for the assessment of voltage fluctuations under EREC P28?	Yes
Q3	Do you agree with the proposals for an intermediate planning level to assist with co-ordination of the transfer of flicker severity from higher voltage to lower voltage supply systems?	Yes
Q4	Do you have any objections to the proposed amendments in EREC P28 Issue 2 as they currently stand? If so, please describe your concerns and if possible propose any alternatives.	See answer to Q1
		Response from the P28 Working Group:

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		See response to Q1
Q5	Do you agree that the proposed modification proposal better facilitates the Distribution Code objectives?	Yes
Q6	Recognising that any consequential changes to the Grid Code will need to be progressed via the Grid Code governance process, the Working Group would welcome any concerns you have at this stage if the EREC P28 Issue 2 proposal was to be considered for adoption in the Grid Code?	SPR is concerned that assets could be sitting for long periods of time without generating power as indicated in answer to Q1 representing a major loss of revenue for a windfarm owner/developer
		<p>Response from the P28 Working Group:</p> <p>The P28 Working Group believes that the limits and maximum number of occurrences for rapid voltages changes permitted in EREC P28 Issue 2 are less onerous than those in the Grid Code. The intention of the planning levels for rapid voltage changes in EREC P28 Issue 2 are to provide more flexibility for generators, who need to energise large numbers of wind turbine transformers, than currently exists in the Grid Code. The EREC P28 Working Group trusts that their response to Q1 allays these concerns and that there would be no objection to ultimately adopting the relevant limits and requirements from EREC P28 Issue 2 in the Grid Code.</p>
Q7	Do you have any other comments to make on the proposed changes?	No

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<b>Respondent</b>	Alastair Frew
<b>Company Name</b>	ScottishPower Generation
<b>No. of DCode Stakeholders Represented</b>	
<b>Stakeholders represented</b>	
<b>Role of Respondent</b>	Generator
<b>We intend to publish the consultation responses on the DCode website. Do you agree to this response being published on the DCode website? [Y/N]</b>	Y

	Question	Response
Q1	Do you agree with the proposed requirements and planning levels for RVCs in EREC P28 Issue 2 (as provided in Figure 5, Figure 6, Figure 7 and Table 4 of EREC P28 Issue 2)?	For the higher categories of RVCs P28 appears to set the planning level for RVC the same as operating levels which could result in equipment be constrained off for long periods due to external events causing them to trip off. It uses the description in category 3 of "Commissioning, maintenance & post fault switching" and then limits it to 1 event every 3 months all these events can be troublesome and may require repeat switching and at a rate of once per 3 month is impractical. The numbers being used for design proposes and planned normal operation is fine in that when the network is working properly equipment will remain connected for long periods with no issues.
		<p>Response from the P28 Working Group:</p> <p>Regarding the setting of RVC planning levels and operating levels, the planning limit for Category 3 RVCs (very infrequent events) in EREC P28 Issue 2 does allow an RVC with <math>V_{max}</math> -</p>

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		<p>10% for up to 2 s after the start of the RVC event (<math>t=0</math>). If the initial voltage <math>V_0</math> was at the lower statutory limit of -10% for systems with a nominal voltage <math>\geq 132</math> kV then the resultant voltage of <math>V_n</math> -20% would coincide with the G59 undervoltage stage 1 setting of -20%. However, in practice, the characteristic of any RVC, means the <math>V_{max}</math> of -10% would only be present for typically <math>&lt; 100</math> ms. Consequently, the P28 Working Group believes there would be no realistic prospect of operation of the G59 undervoltage stage 1 protection for external RVC events that conform with the limits and requirements of EREC P28 Issue 2.</p> <p>The reference to "Commissioning, maintenance and post fault switching" in Table 4 of EREC P28 Issue 2 is an example of applicability. NOTE 7 in Table 4 states that these are examples only and that customers may opt to conform to the limits of another category providing the expected frequency of the events do not exceed the maximum frequency permitted for the chosen category. Commissioning, maintenance or post fault switching activities could be classed as Category 1, Category 2 or Category 3 events depending upon the maximum number of occurrences foreseen for those events. For example: Where post fault switching events are expected to be carried out more frequent than once every 3 calendar months then conformance with Category 2 could be chosen, where 4 events (each consisting of 4 RVCs) in 1 calendar month are allowed providing the voltage remains within the limits shown in Figure 6 for Category 2 infrequent events. Notwithstanding, the P28 Working Group would consider rewording of Note 7 where the examples of applicability could be also used as criteria to justify the selection of the category.</p> <p>The P28 Working Group agree that the planning levels for RVC should mean that equipment and installations designed to conform with these levels should not cause interference with other equipment/installations connected to the system.</p>
Q2	Do you agree with the proposal for providing improved clarity of what constitutes 'worst case normal operating conditions' for the assessment of voltage fluctuations under EREC P28?	Yes
Q3	Do you agree with the proposals for an intermediate planning level to assist with co-ordination of the transfer of flicker severity from higher voltage to lower voltage supply systems?	Yes
Q4	Do you have any objections to the proposed amendments in EREC P28 Issue 2 as they currently stand? If so, please describe your concerns and if possible propose any alternatives.	See answer to Q1

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		<p>Response from the P28 Working Group:</p> <p>See response to Q1</p>
Q5	Do you agree that the proposed modification proposal better facilitates the Distribution Code objectives?	Yes
Q6	Recognising that any consequential changes to the Grid Code will need to be progressed via the Grid Code governance process, the Working Group would welcome any concerns you have at this stage if the EREC P28 Issue 2 proposal was to be considered for adoption in the Grid Code?	<p>Initial concern is the Categories in P28 table 4 are different from the current Grid Code Categories in the Grid Code Connection Conditions table CC.6.1.7 which causes confusion.</p> <p>In general the proposed P28 Category 1 matches the current Grid Code Category 2 and does not create an issue. The problem appears to occur with the higher categories where currently the Grid Code allows up to 4 events per <b>day</b> “No more than 4 per day for Commissioning, Maintenance and Fault Restoration” whereas the new proposal only allows 1 event per <b>3 months</b> for “Commissioning, maintenance &amp; post fault switching”. These event numbers are significantly different and this appears to result from the fact that the Grid Code uses typical planning levels but then the allowed operating levels are different depending on events, whereas P28 appears to be stringently applying the planning levels to the operating levels. Currently the Grid Code CC.6.1.7 (viii) specifies “Voltage changes in category 3 only occur infrequently, typically not planned more than once per year on average over the lifetime of a connection, and in circumstances notified to NGET, such as for example commissioning in accordance with a commissioning programme, implementation of a planned outage notified in accordance with OC2 or an Operation or Event notified in accordance with OC7; and” but the use of the word “typically” still allows up to 4 events a day to allow for operational problems. The new P28 proposal seems a lot more stringent by in 5.3.3 by just referring to the P28 table stating that the planning levels, i.e. 1 event per 3 months, should not be exceed which could result of items which trip off being left disconnected for months.</p> <p>At the time of the GC0076 work there was concern that if the Grid Code changes were not carefully worded rules could be implemented which could result in customers being left disconnected whilst waiting for the next available switching window to occur, which in the P28 case could be months. With the current P28 proposal for Grid Code it is not clear that this situation will not occur.</p>
		<p>Response from the P28 Working Group:</p> <p>Although the categories of RVC events in EREC P28 Issue 2 and the Grid Code have similar numbers, e.g. ‘Category 3’, the titles, maximum number of occurrences and limits are different. This reflects the further work carried out by the P28 Working Group and the experience of</p>



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		<p>National Grid in applying RVC limits since the GC0076 modification was implemented in the Grid Code. Notwithstanding, the intention is to align the categories in the Grid Code with those in EREC P28 Issue 2, which would avoid confusion.</p> <p>With respect to Category 2 and Category 3 events in EREC P28 Issue 2: Under both Category 2 &amp; Category 3, one event is permitted in a given day, where one event can consist of up to 4 separate RVCs (see NOTE 2). Therefore, up to 4 RVCs in a given day are allowed under both Category 2 &amp; Category 3 of Table 4 [EREC P28 Issue 2], which is similar to the maximum of 4 RVCs per day permitted in Category 3 of the Grid Code. The difference being that the permitted occurrence of RVC events in EREC P28 Issue 2 is more frequent than Category 3 of the Grid Code. Category 3 of the Grid Code permits a maximum of 4 RVCs per day typically not planned more than once per year on average over the lifetime of a connection compared with 4 events (each event consisting of up to 4 RVCs) per calendar month for Category 2 events in EREC P28 Issue 2 and 1 event (consisting of up to 4 RVCs) every 3 calendar months for Category 3 events in EREC P28 Issue 2. On this basis the P28 Working Group believes that EREC P28 Issue 2 provides for a greater number of RVCs in any given time period than is currently permitted in the Grid Code. The intention is to provide users, including generators, with more flexibility for energising transformers than currently exists in the Grid Code.</p> <p>With respect to the application of the wording "...typically not planned more than once per year on average over the lifetime of a connection..." in CC.6.1.7 (a) (viii) of the Grid Code. The P28 Working Group believes the limits and maximum number of occurrences for RVCs in the Grid Code apply to both design and operation of the system. Although the requirements in EREC P28 Issue 2 primarily relate to the design and assessment of connections, the P28 Working Group does not intend for any particular difference in the <u>application</u> of associated aspects of EREC P28 Issue 2 and the Grid Code. The P28 Working Group would point out that EREC P28 Issue 2 acknowledges that the final decision as to whether or not disturbing equipment exceeding the limits in EREC P28 Issue 2 may be connected to the system is at the discretion of the relevant system/network operator (see Lines 276-280) in EREC P28 Issue 2.</p>
Q7	Do you have any other comments to make on the proposed changes?	<p>It is surprising after the description in the introduction of the importance for restricting flicker to stop customer annoyance and complaints to then not apply this standard to all equipment by exempting licenced Distribution and Transmission Operators, given their equipment will be very similar.</p> <p>It is noted there is a reference to current version P28 figure 4 in the SQSS and P28 rev replaces the original figure 4 with figure B.1.2 are these the same and will it be corrected?</p>

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## Working Group Responses

		<p>Response from the P28 Working Group:</p> <p>The scope of EREC P28 Issue 1 applies to voltage fluctuations caused by industrial, commercial and domestic equipment connected to the system. The terms of reference for the revision of EREC P28 Issue 1, as set by the Joint Distribution Code and Grid Code Review Panels, was for EREC P28 Issue 2 to remain a 'customer facing' document and for any overarching application of requirements and limits in EREC P28 to be contained within the Distribution Code. Notwithstanding, the P28 Working Group, as part of their Terms of Reference, has sought to be fair and even-handed in the application of requirements taking into account the different operating context and objectives of users and network operators.</p> <p>The P28 Working Group note the acknowledgment in the SQSS that ER P28 Issue 1 Figure 4 was used in the derivation of Figure 6.1 'Maximum Voltage Step Changes Permitted for Operational Switching'. Figure B.1.2 in EREC P28 Issue 2 is intended to replace Figure 4 in EREC P28 Issue 1 but has been aligned with the current flicker severity curve in Figure A.1 of PD IEC/TR 61000-3-7 – except that the curve has been deliberately capped at a maximum symmetrical step voltage change of 3% once every 475 s. Consequently, the curve in Figure B.1.2 in EREC P28 Issue 2 differs from that in Figure 4 of EREC P28 Issue 1 and Figure 6.1 of the SQSS. The P28 Working Group would recommend that Figure 6.1 in the SQSS is reviewed in light of the current flicker severity curve in Figure A.1 of PD IEC/TR 61000-3-7 and the aligned Figure B.1.2 in EREC P28 Issue 2.</p>
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<b>Respondent</b>	<i>Jan Muller</i>
<b>Company Name</b>	Solarcentury
<b>No. of DCode Stakeholders Represented</b>	O+M of ~500MW of solar PV farms
<b>Stakeholders represented</b>	<i>Solarcentury</i>
<b>Role of Respondent</b>	<i>Solar PV Generator developer builder and operator</i>
<b>We intend to publish the consultation responses on the DCode website. Do you agree to this response being published on the DCode website? [Y/N]</b>	Y

	Question	Response
Q1	Do you agree with the proposed requirements and planning levels for RVCs in EREC P28 Issue 2 (as provided in Figure 5, Figure 6, Figure 7 and Table 4 of EREC P28 Issue 2)?	YES
Q2	Do you agree with the proposal for providing improved clarity of what constitutes 'worst case normal operating conditions' for the assessment of voltage fluctuations under EREC P28?	YES
Q3	Do you agree with the proposals for an intermediate planning level to assist with co-ordination of the transfer of flicker severity from higher voltage to lower voltage supply systems?	YES

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Q4	Do you have any objections to the proposed amendments in EREC P28 Issue 2 as they currently stand? If so, please describe your concerns and if possible propose any alternatives.	NO, an improvement with good clarity of G59 RVC events For clarity in stable locations a G59 event can be classed in Stage 3 of Table 4 line 774?
		<p>Response from the P28 Working Group:</p> <p>The reference to 'G59 re-energisation' in Table 4 of EREC P28 Issue 2 is an example of applicability. NOTE 7 in Table 4 states that these are examples only and that customers may opt to conform to the limits of another category providing the expected frequency of the events do not exceed the maximum frequency permitted for the chosen category. On this basis, G59 RVC events could be classed as Category 2 or Category 3 events depending upon the maximum number of occurrences that are foreseen for those events. For example: Where G59 events are expected to be carried out less frequently than once every 3 months then conformance with Category 3 could be chosen, providing the voltage remains within the limits shown in Figure 7 for Category 3 very infrequent events. If G59 RVC events are expected to occur more frequently than once in every 3 calendar months then conformance with Category 2 would be expected.</p>
Q5	Do you agree that the proposed modification proposal better facilitates the Distribution Code objectives?	YES
Q6	Recognising that any consequential changes to the Grid Code will need to be progressed via the Grid Code governance process, the Working Group would welcome any concerns you have at this stage if the EREC P28 Issue 2 proposal was to be considered for adoption in the Grid Code?	
Q7	Do you have any other comments to make on the proposed changes?	NO

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Please provide comments relating to the specific technical content of the EREC<sup>1</sup>

Page No	Line No	Clause/ Subclause	Paragraph Figure/ Table	Type of comment (General/ Technical/Editorial)	COMMENTS	Proposed change	OBSERVATIONS OF THE SECRETARIAT on each comment submitted
27	774		Table 4	General	<p>Please clarify that G59 events can be classed as Stage 3 very infrequent events in some locations.</p> <p>Important that this is described clearly so that DNO planners and Generators have common understanding for G59 and RVC thresholds</p>	'may include G59 events'	Please see the response to Q4 above, where G59 RVC events may be classed as Category 3 very infrequent events subject to the expected maximum number of occurrences being compatible with those stated for the chosen category. The P28 Working Group believes that the title of the end column and associated NOTE 7 in Table 4 of EREC P28 Issue 2 make the applicability of Category 2 and Category 3 clear, including the applicability to G59 RVC events.

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<sup>1</sup> Add more rows if required

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<b>Respondent</b>	<i>Steve Cox</i>
<b>Company Name</b>	Electricity North West
<b>No. of DCode Stakeholders Represented</b>	1
<b>Stakeholders represented</b>	<i>Electricity North West</i>
<b>Role of Respondent</b>	<i>Distribution Network Operator</i>
<b>We intend to publish the consultation responses on the DCode website. Do you agree to this response being published on the DCode website? [Y/N]</b>	Yes

	Question	Response
Q1	Do you agree with the proposed requirements and planning levels for RVCs in EREC P28 Issue 2 (as provided in Figure 5, Figure 6, Figure 7 and Table 4 of EREC P28 Issue 2)?	Yes
Q2	Do you agree with the proposal for providing improved clarity of what constitutes 'worst case normal operating conditions' for the assessment of voltage fluctuations under EREC P28?	Yes
Q3	Do you agree with the proposals for an intermediate planning level to assist with co-ordination of the transfer of flicker severity from higher voltage to lower voltage supply	Yes

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	systems?	
Q4	Do you have any objections to the proposed amendments in EREC P28 Issue 2 as they currently stand? If so, please describe your concerns and if possible propose any alternatives.	No objections
Q5	Do you agree that the proposed modification proposal better facilitates the Distribution Code objectives?	Yes
Q6	Recognising that any consequential changes to the Grid Code will need to be progressed via the Grid Code governance process, the Working Group would welcome any concerns you have at this stage if the EREC P28 Issue 2 proposal was to be considered for adoption in the Grid Code?	No concerns
Q7	Do you have any other comments to make on the proposed changes?	No further comments. Electricity North West was represented on the working group which drafted the revision and has therefore been closely involved in preparing the text.