Draft Minutes of the Inaugural Meeting of the ER P28 Joint GCRP and DCRP Working Group

9th December 2014

Held at the ENA, Dean Bradley House, 52 Horseferry Road, London, SW1P 2AF

1. Welcome, Introductions

DC welcomed everybody to the inaugural meeting of the ER P28 Joint GCRP and DCRP Working Group to review the case and proposed scope of review of ENA Engineering Recommendation P28 Planning Limits for Voltage Fluctuations caused by Industrial, Commercial and Domestic Equipment in the UK.

Attendance, apologies and absences were noted (see Appendix A for Attendance List).

Round the table introductions were made.

ACTION 1.0: Email MJC a list of other Groups that sitting members are a member of (All)

2. Address by the Chair (Designate)

In his role as Chair (Designate) GE gave an overview of the meeting Agenda (see Appendix B) including the background to the establishment of the Working Group (WG), the purpose of the WG, its obligations and the purpose of this inaugural meeting.

ENA Engineering Recommendation P28 Planning Limits for Voltage Fluctuations caused by Industrial, Commercial and Domestic Equipment in the UK (P28) was first issued in 1989 and has not been subsequently revised, making it some 25 years old and reflects the high quality of the document.

The purpose of the WG is to review the adequacy of P28 in light of all the changing technologies that have occurred in recent years which have affected the scope and recommendations of P28. The output of the WG will be a set of recommendations to the joint GCRP (Grid Code Review Panel) and DCRP (Distribution Code Review Panel) on the nature and extent of changes required and, ultimately, the publication of a revised P28.

The WG was referred to Briefing Paper 1 which outlines the case and proposed scope of review of P28 (see Appendix C).
(Document reference: Briefing Paper 1 P28 WG Meeting 1 091214 v1.pdf)

The WG consists of a broad and diverse set of stakeholders and GE reiterated that it is important the work carried out by the WG is done in an open and transparent way. The WG falls under the governance of the GCRP and DCRP with the latter taking the lead in this review process.

The WG were made aware it has a clearly defined set of obligations – each member represents their own organisation but also a broader stakeholder, whose interests should be placed ahead of personal company interest. Under Ofgem's CACoP (Code Administration Code of Practice) there will be a full and fair debate with all minority stakeholders represented including consumers, where WG members agreed not stifle or dominate any debate and will operate in a transparent way in the public domain.

The WG members representing broader stakeholders agreed to engage with all those organisations and individuals they represent.

The purpose of this inaugural meeting, being the formal constitution of the WG, to agree the scope and Terms of Reference (ToR) and to agree the project plan for progression of P28 were stated.

There were no comments on the background or context of the WG.

3. Formal Constitution of the Working Group

GE gave an overview of the formal constitution of the WG as follows.

3.1 Membership

Membership includes representatives from DNOs (Distribution Network Operators), National Grid (representing the GCRP), ENA (representing the DCRP), Generators (represented by Energy UK), Heat Pump Trade Association (HPA), Manufacturers Trade Association (represented by BEAMA), Renewable Energy Trade Associations (represented by the Solar Trade Association and Renewable Energy Association), Disturbing Load Connectees (represented by Tata Steel), Independent Technical Experts, Government (DECC) and the Regulator (Ofgem).

It was noted there are currently no representatives from IDNOs (Independent Distribution Network Operators) or consumer groups, which would need to be reviewed. GE reiterated the WG must disseminate and communicate back its findings to all relevant parties.

It was agreed that all key stakeholders had been identified other than the exceptions noted above.

It was pointed out that SS is fulfilling both a 'sitting member' role on behalf of Energy UK as well as a 'corresponding role' on behalf of Dong Energy.

There were no objections to the membership of the WG.

3.2 Secretariat

The facilitation and secretariat support for the WG is provided by the ENA and their nominated representatives, namely:

- David Crawley (ENA Representative)
- Gary Eastwood (Facilitator and Chair (Designate) of the WG)
- Michelle Chambers (Administrator)

The Secretariat has been appointed by the joint GCRP and DCRP.

The Secretariat's remit is to:

- provide project management and secretariat services for the WG
- liaise with the GCRP and DCRP and other ENA WGs
- ensure that all work carried out by the WG is technically correct, governance rules set out by the GCRP and DCRP are met and the work is carried out in a timely manner
- produce reports for both the GCRP and DCRP (it was noted that this function is independent to that of the WG)

DC explained this WG is the first to follow a new stakeholder consultation process ahead of final public consultation. The Secretariat comprises of suitably qualified and experienced individuals that will drive the review forward.

There were no objections to these appointments by the WG.

3.3 Nominations for Deputy Chair

GE stated the Deputy Chair is an elected role, preferably held by a non DNO member, who will support the Chair, generally with the need for minimal commitment outside of meetings. The Deputy Chair will ensure that all stakeholder views are heard and there is a fair and balanced debate.

GE asked for nominations to which JD registered his interest. The nomination of JD as Deputy Chair was proposed by GE and seconded by DC.

GE accepted the appointment of Deputy Chair on behalf of the WG subject to final agreement by the GCRP and DCRP.

3.4 Terms of Reference (ToR)

GE presented a brief overview of the draft ToR noting the Scope of Review would be discussed in more detail in item 4 of the agenda (see Appendix D).
(Document reference: ER P28 ToR v0.2 Draft)

There was a round the table discussion about the objectives of the WG and the content of the draft ToR, summarised as follows.

The question was asked whether there was an Engineering Technical Report associated with P28 (AH); it was thought to be ETR 117 (KL).

The benefit of an implementation plan similar to that produced for the revision of ER G5/4 was highlighted.

ACTION 1.1: Review the scope of ETR 117 and consider if it should be added to the ToR (GE)

Where the ToR states changes to P28 should “reflect current practices” it would be better to state: “reflect good practices” (JD).

ACTION 1.2: In ToR section 2 ‘Objectives’ replace “reflect current practices” with “reflect good practices” (GE)

There was a discussion around the timeframes for future review/amendment of P28 in light of new and emerging technologies and whether P28 should be time bound, for example every 5 years? (MH).

ACTION 1.3: Amend the ToR to include a recommended future review date of P28 by the GCRP and DCRP, which is mindful of changing technologies and the impact these may have on its recommendations (GE)

The WG agreed to be bound by the GCRP and DCRP governance procedures and the CACOP, where appropriate, and to ensure appropriate public consultation takes place before publication of P28.

GE proposed that three initial P28 meetings be arranged at 2-3 month intervals; adequate notice would be given and the dates should be noted by the members. In the intervening periods discussions will take place in sub-groups and any outcomes will be tabled at WG meetings. It is intended that all sitting members will attend meetings on a regular basis. Where this is not possible, the WG agreed it would be advisable for all apologies to be sent in advance together with details of any substitute representative, which would be considered for acceptability by the Secretariat on behalf of the WG.

ACTION 1.4: Amend ToR section 6 to state there is an obligation on representatives to attend all meetings and that apologies and details of substitute representatives should be notified in advance of all meetings (GE)

The WG agreed that substitute representatives nominated by sitting members can attend P28 meetings as long as they are appropriately qualified and experienced.

ACTION 1.5: Amend ToR section 6 to state that substitute representatives must be appropriately qualified and experienced and be able to contribute to the WG (GE)

It was agreed to consider the current performance of P28 (any reported problems or flicker complaints) so WG members could understand priorities and better focus attention; the intention being a clear unambiguous prescriptive route for improvement.

ACTION 1.6: Amend ToR to consider the current performance of P28 to identify issues and to prioritise areas for improvement (GE)

As P28 is referenced by other WGs. the WG agreed it is important to consult with these other WGs and, therefore, these minutes would be circulated to stakeholders and would document the decisions and the actions of the WG.

4. Proposed Scope of ER P28 Review

GJE presented ToR section 4 ‘Scope of review’ (See Appendix D).
(Document reference as attached: (ER P28 ToR v0.2 Draft.pdf)

Six proposed areas have been identified:

- General
- Standards
- Limits
- Evaluation of background levels
- ‘First-come, first-served’ versus allocation of rights
- Other technical issues

A summary of the discussion is detailed below:

4.1 General

- Technical issues – the WG could benefit from outside specialist technical expertise in terms of research and support; the WG would need to be mindful of the possible need for confidentiality agreements.

ACTION 1.7: Amend ToR to allow the WG the opportunity to invite technical experts to P28 WG meetings, if required (GE)

ACTION 1.8: Include in the draft Agenda, issued 1 month ahead of meetings, any invitation to include a technical guest (GE)

4.2 Standards

- Not all Standards may have been considered but it may add value to review, for example, IEEE Standards (JD) and wind farm related Standard (AH).
- The P_{st} characteristic is important and will be difficult to move away from as it is embodied in Standards.

ACTION 1.9: Widen the review of Standards, focussing on European Standards, giving some consideration to IEEE Standards, where there is no IEC or National Standards (GE)

4.3 Limits

- Models produced are based on data from DNOs – there needs to be a rethink on data accuracy and guidance from DNOs on interpreting data particularly for inverters (MH)
- Need to look at the process by which a connectee liaises with a DNO – the point of connection as distinct from "point of common coupling" is a grey area (MH)
- New guidance notes on the application of P28 may be required
- Consider moving from a deterministic approach to a probabilistic approach for P28 (JD) to allow for randomness of events
- Given the new range of lighting technologies the randomness of disturbances rather than singular events and frequency of switching are factors to consider
- Need to consider EN 50160 Voltage Characteristics of Electricity Supplied by Public Distribution Systems (AH)
- The way multiple installations are treated is not an easy task but needs to be addressed (DC)
- Should this review reflect that IEC has moved on from the original principles in P28 or should additional questions be put to IEC?

ACTION 1.10: Review the Grid Code including GC0076 Grid Code Limits on Rapid Voltage Changes - will P28 be governed by the code condition or constrained by it? (GE)

4.4 Evaluation of Background Levels

- No further comment

4.5 'First-come, First-served' versus Allocation of Rights

- No comment other than the WG agreed with point 4.5c noting it would be useful to look at the wider practices in other countries and if appropriate to consider following the same process
- What can be learnt from harmonics related work in the revision of G5/4 on allocation of rights? Are the issues similar to P28? (AH)

4.6 Other Technical Issues

- No further comment

ACTION 1.11: Issue second draft of ToR for approval ahead of next meeting (GE)

5. Stakeholder Response and Viewpoints

GE opened the discussion by reiterating the importance of members providing and documenting feedback on Briefing Papers.

A summary of points noted during the round the table discussion follows:

- P28 provides guidance around connections for different loads. Should it provide prescriptive guidance on individual types of equipment or keep to higher level principles? (GE) Guidance on individual types of equipment is not required (AH)
- Examples for specific applications would provide clarity (AH)
- Clarification would be helpful on how the calculations of flicker severity should be approached regardless of software being used (AH)
- Any recommendations should consider the wide number of software systems and provide guidance as to what input parameters and factors are appropriate for simulation (MH/JD/RB)
- There are issues around limits for connection of wind turbines and there is a lack of guidance on evaluation of flicker for solar power installations. It was noted that wind curves may be different from those for solar power (JD)
- Need guidance on energy storage devices (MH)
- Based on empirical evidence there is minimal flicker from wind power but it may be different for PV (Photovoltaics) (KL)
- Need to consider how we treat uncontrolled inputs – new technologies need assumptions made about conditions they are exposed to (GE)
- For renewable energies we must consider guidance on these technologies for input into P28 (KL)

ACTION 1.12: Obtain flicker measurements from solar power installations report and circulate it to the WG for repository (MH)

6. Summary of Responses and Actions

GE presented a summary of responses/viewpoints on Briefing Paper 1 (see Appendix E). (Document reference: ER P28 BP1 Summary of Responses 03.12.14 Anonymous.pdf)

Responses are anonymous but the WG agreed that all the contributors could be identified, if necessary.

As part of role with the PQ & EMC WG, DC covers Eurelectric SWP which involves some coverage of Standards. There was a discussion on the applicability of Standards and work across various Standards WGs.

ACTION 1.13: Cross reference current standards across all technologies using a mind map diagram (DC)

A summary of points noted during the round the table discussion follows:

- There is a common theme involving voltage step change issues which could affect the DCode (AH)
- Pages 2-7 reflects an independent technical expert's view (TNEI) including how to study loads (RB)

- The Electricity Council software program referenced in P28 section 6.2.1 is out of date. Due to the proliferation of software and flicker programs the WG do not believe the Electricity Council software program needs to be reviewed or replaced. DC noted that ENA does not hold a copy

ACTION 1.14: If available send DC a copy of the Electricity Council software program that converts a voltage change pattern into P_{ST} as referenced in P28 section 6.2.1 (KL)

- With regards to transient disturbances consideration should be given to which fault levels apply and the time frame of a transient disturbance; clearer guidelines are required
- Need to separate continuous voltage change (less than or equal to 3% change in P_{st} / $P_{lt)}$, and large step voltage change (more than 3%) which is a result of magnetising inrush or a rare or single event. Clear guidelines on the categorisation of the frequency of an event is required (KL/JD)
- Discussed PCC (Point of Common Coupling) and whether the network is sterilised. A clearer definition of PCC is required in P28, which takes into account Grid Code and Distribution Code requirements (MH/AH/RB/JD)
- It was agreed limits should be applied to tripping of loads
- AH commented that BS EN 61000-3-3 relates to unconditional connections whereas BS EN 61000-3-11 relates to conditional connection; therefore a further test is required for the latter. In terms of defining flicker severity, there may be very little the WG can do under the current P28 framework unless the committee overseeing BS EN 61000-3-3 can be influenced. The WG would need to see significant problems to deviate from the current recommendations for unconditional connections
- Limits for Stage 1 assessment do not comply with BS EN 61000-3-3 because these are unconditional connections (AH). Do we need to worry about multiple installations - are hands tied?
- When planning for emergencies P28 needs to define frequency of events and emergency conditions (large scale tripping events) and incorporate these into recommendations
- Are P_{st} levels of 0.5 adequate? The WG was referred to the studies being carried out by PB Power as part of the Smart Grid Forum WS7
- Harmonics and voltage step changes have common important aspects and the review should look at the learnings points from revision of ER G5/4 when considering flicker
- The review should also look at voltage sensitivity limits on equipment if there is found to be a problem and starting of motors
- There are some similarities between IEC/TR 61000-3-7 and P28 but it is noted the former is a Technical Report not a Standard. The WG should be mindful of aligning with IEC Standards, where appropriate
- Review should consider voltage step limits for energising transformers (MH) and the economic implications (JD)
- It would be useful to engage with transformer experts at Doble Engineering about impact of voltage waveforms from energising transformers in light of changes to transformer designs and types
- How should point-on-wave switching be treated in P28 and what guidance on initial conditions and remenance is required for studies?
- Electric Vehicles (EV) is covered in BE EN 61000-3-11 (AH) but will probably not impact on P28 as will be classed as unconditional connections

Additional considerations not currently in P28 are:

- Compatibility of under and over settings for other types of connections, for example ER G59 (AH)
- Compatibility with ITIC curve used for power quality evaluation (KL)
- Need to consider whether statutory voltage changes will impact on P28 (KL)

7. Project Plan

GE circulated a paper copy of the proposed Project Plan (see Appendix F).
(Document Reference: PowerPoint Presentation P28 WG Meeting 1 091214 v0.3 slide 13)

This proposes a 4-Phase Plan for the review/revision of P28 spread over an estimated two years:

- Phase 1 Planning Phase
  - Timescale 6 months (Sept 2014 - Feb 2015)
  - Output Project Plan

- Phase 2 Review Phase
  - Timescale 6 months (Feb 2015 – July 2015)
  - Output Report of recommended changes to the GCRP and DCRP

- Phase 3 Revision Phase
  - Timescale 12 months (Jul 2015 – Jul 2016)
  - Outputs Draft Revision of P28
    Final Revision P28

- Phase 4 Acceptance & Adoption Phase*
  - Timescale 2 months (Aug 2016 – Sept 2016)
  - Output Publication of P28

  *This is the public consultation phase

The WG agreed with the outline project plan and that timescales and deliverables are reasonable.

ACTION 1.15: Produce a detailed project plan based on the draft project plan (GE)

8. General Management/Administration

8.1 On-line Repository Requirements

GE explained an on-line repository would be developed maintained for storing all relevant documents, folders and files reviewed by the WG. It is proposed to be hosted by ENA on a dedicated area of the DCRP website and administered on behalf of the WG by the ENA Secretariat.

Access will be given to all stakeholders.

It was agreed there would be a publically accessible area containing the output of the WG including minutes of meetings, reports etc and a password protected area for WG members only containing confidential information and working documents not appropriate or suitable to be distributed outside of the WG.

The WG agreed the content should include:

- Standards
- ENA documents
- Measurement data
- Models
- Sample documents of P28 reports
- Position statement on P28 (subject to agreement)
- Tabular templates
- Process for commenting on reports

The process for commenting on reports was agreed to be reports submitted in a .pdf format with a tabular comment form in a .doc format for individual responses, which would be consolidated for WG response. This would make it easier to summarise points rather than using tracked changes. All responses would be compiled and reissued by the Secretariat

The repository should preferably allow use of an email link and have the facility to upload completed forms.

8.2 Consultation Process

GE presented the Code Administration Code of Practice which it was agreed would be issued to the WG.
(Document reference: https://www.ofgem.gov.uk/licences-codes-and-standards/codes/industry-codes-work/code-administration-code-practice-cacop)

The CACoP sets out the principles and processes that apply to Code Panels and associated Working Groups. It is the intention for this WG to follow CACoP, where possible. The WG noted it should be conscious of any deviations from the CACoP.

It was agreed that the consultation process should include the following requirements:

- Documented procedure
- Facilitate convergence and transparency of code modifications
- Include all parties affected by any proposed changes
- Ensure the interests of consumers are taken into account and protected
- Ensure viewpoints are articulated and debated (not stifled)

8.3 Support Requirements

GE outlined the following support requirements provided by the ENA Secretariat and the WG members:

Provided by ENA Secretariat:

- Organisation and facilitation of WG meetings
- Preparation of meeting agendas
- Taking and distributing meeting minutes/actions
- Preparation of briefing papers and documents
- Preparation and distribution of WG reports and documentation
- Collation of incoming data and responses

Provided by Working Group Members:

- Preparation of papers
- Response to papers

- Specialist technical support
- Incoming/field data

ACTION 1.16: Email the WG members asking for confirmation of their areas of technical expertise (GE)
The WG members need to be party to all the same information (KL)

ACTION 1.17: Email relevant documentation and circulation list to the Secretariat (GE cc MJC) who will act as coordinator to disseminate information to WG members (All)

9. AOB

No other business tabled.

10. Date for Future Meetings

The following dates were agreed for the next three meetings:

- 10th February 2015 in London
- 23rd April 2015 in London
- 18th June 2015 in London

(Post Meeting Note: The above meetings will be held at the EIC Offices in London SE1 7TP)

ACTION 1.18: Set up WG electronic appointments for future P28 meetings (GE)

ACTION 1.19: Send power point presentation with meeting minutes (GE)

ACTION 1.20: Issue minutes to WG for comment to be signed off at next meeting (GE)

Summary of Actions from Current Meeting

Item	Action	Responsibility	Due by
1.0	Email MJC a list of other Groups that sitting members are a member of	(All)	
1.1	Review the scope of ETR 117 and consider if it should be added to the ToR	(GE)	
1.2	In ToR section 2 'Objectives' replace "reflect current practices" with "reflect good practices"	(GE)	
1.3	Amend the ToR to include a recommended future review date of P28 by the GCRP and DCRP, which is mindful of changing technologies and the impact these may have on its recommendations	(GE)	
1.4	Amend ToR section 6 to state there is an obligation on representatives to attend all meetings and that apologies and details of substitute representatives should be notified in advance of all meetings	(GE)	
1.5	Amend ToR section 6 to state that substitute representatives must be appropriately qualified and experienced and be able to contribute to the WG	(GE)	
1.6	Amend ToR to include consider the current performance of P28 to identify issues and to prioritise areas for improvement	(GE)	
1.7	Amend ToR to allow the WG the opportunity to invite technical experts to P28 WG meetings, if required	(GE)	
1.8	Include in the draft Agenda, issued 1 month ahead of the meetings, any invitation to include a technical guest	(GE)	
1.9	Widen the review of Standards, focussing on European Standards, giving some consideration to IEEE Standards, where there is no IEC or National guidance Standards	(GE)	
1.10	Review the Grid Codes including GC0076 Grid Code Limits on Rapid Voltage Changes - will P28 be governed by the code condition or constrained by it?	(GE)	
1.11	Issue second draft of ToR for approval ahead of next meeting	(GE)	
1.12	Obtain flicker measurements from solar power installations report and circulate it to the WG for repository later	(MH)	

Item	Action	Responsibility	Due by
1.13	Cross reference current standards across all technologies using a mind map diagram	(DC)	
1.14	If available send DC a copy of the Electricity Council software program that converts a voltage change patterns into P_{st} as referenced in P28 section 6.2.1	(KL)	
1.15	Produce a detailed project plan based on the draft project plan	(GE)	
1.16	Email the WG members asking for confirmation of their areas of technical expertise	(GE)	
1.17	Email relevant documentation and circulation list to the Secretariat (GE cc MJC) who will act as coordinator to disseminate information to WG members	(All)	
1.18	Set up WG electronic appointments for future P28 meetings	(GE)	
1.19	Send power point presentation with meeting minutes	(GE)	Complete
1.20	Issue minutes to WG for comment to be signed off at next meeting	(GE)	

Summary of Outstanding Actions from Previous Meetings

	NONE		

Appendix A

ER P28 Joint GCRP & DCRP Working Group Inaugural Meeting

Attendance List
9th December 2014 ENA Office, London

Attendees:

Name	Initials	Company
Geraldine Bryson	GB	ENW
Peter Johnston	PJ	NIE
Roshan Bhattarai	RB	Northern Powergrid
Ken Lennon	KL	SP Energy Networks
Steve Mould	SM	UKPN
Andrew Hood	AH	WPD
Sridhar Sahukari	SS	Energy UK
Mark Horrocks	MH	Lightsource
James Hoare	JH	Renewable Energy Association
Mark Thomas	MT	TataSteel
Joe Duddy	JD	RES Group
Mark Kilcullen	MK	Department of Energy & Climate Change
Matthew Ball	MB	OFGEM
David Crawley	DC	ENA
Gary Eastwood	GE	Threepwood Consulting Ltd
Michelle Chambers	MJC	Threepwood Consulting Ltd

Apologies:

Peter Thomas	Nordex
Davor Vujatovic	Vanda Engineering Services
Gareth Evans	OFGEM
Forooz Ghassemi	National Grid

Absences:

Tony Headley	BEAMA
Tony Sweet	Heat Pump Association

Appendix B

ER P28 Joint GCRP & DCRP Working Group

Meeting No.1

To be held at ENA, 6th Floor, Dean Bradley House, 52 Horseferry Road, London, SW1P 2AF

on Tuesday, 9th December 2013, 10:30 – 15:30

Agenda

Fire Procedure

1.	Welcome, introductions	**DC/GJE**	**10:30**
2.	Address by the Chair (Designate)	**GJE**	
3.	Formal constitution of the Working Group • Membership • Secretariat • Nominations for Deputy Chair • Terms of Reference (ToR)	**DC/GJE**	
4.	Proposed scope of ER P28 Review	**DC/GJE**	
5.	Stakeholder response and viewpoints	**ALL**	
6.	Summary of responses and actions	**DC/GJE**	
7.	Project plan • Timescales • Deliverables	**DC/GJE**	
8.	General management/administration • On-line repository requirements • Consultation process • Support requirements	**GJE**	
9.	AOB	**ALL**	
10.	Dates for future meetings		**15:30**

Appendix C

ER P28 Joint GCRP & DCRP Working Group **Paper 1**

Case and proposed scope of review of ENA Engineering Recommendation P28
(Briefing paper submitted on behalf of the ENA Power Quality and EMC Co-ordination Group)

1. Summary

The purpose of this paper is to brief members of the joint Working Group regarding the case and proposed scope of review of ENA Engineering Recommendation P28 (subsequently referred to as P28). The intention is to solicit responses from members, preferably in writing ahead of the inaugural meeting.

2. Background

The Energy Networks Association (ENA) is responsible for maintenance of Engineering Recommendation (ER) P28, *Planning Limits for Voltage Fluctuations Caused by Industrial, Commercial and Domestic Equipment in the United Kingdom*. P28 deals with the assessment of voltage fluctuations and associated light flicker produced by potentially disturbing equipment. P28 is referenced in both the Grid and Distribution Codes of Great Britain and is an 'industry standard' in this technical area.

As P28 Issue 1 was last published in 1989, the Grid Code Review Panel (GCRP) and the Distribution Code Review Panel (DCRP) of Great Britain (GB) have sanctioned the review of P28 by a joint Working Group of various key stakeholders and third parties that will be materially affected by any revision of the document.

3. Case for review

P28 Issue 1 was first published in 1989 and has not been subsequently revised. Although P28 has proven to be a valuable technical document that has served the industry well, many important changes affecting its scope and recommendations have taken place in the intervening period. These changes are summarised below.

3.1 Changes to standards, limits and allocation of rights

a) P28 does not align with the following aspects of current legislation and standards, which needs to be addressed.
   i) Standards used in Stage 1 assessments (i.e. BS 5406) are now withdrawn.
   ii) The EMC Directive and subsequent EMC Regulations have introduced new standards that now apply to LV equipment (i.e. BS EN 61000-3-3 [1] and BS EN 61000-3-11 [2]).
   iii) BS EN 61400-21 [3] used in disturbance assessment of large wind turbines is not referenced.
   iv) The formulae provided for estimating voltage change for welders are incomplete. Phase-phase AC welders are covered but not the more common 1-phase AC welder and nor 3-phase AC welders or 3-ph DC welders. There are also newer types that are not covered (i.e. single-phase DC welders and plasma cutters).
   v) Stage 3 of P28 involves taking background measurements of flicker but no guidance is provided on whether to use maximum values or those based on a level not exceeded for a specified percentage of time. Engineering Recommendation G5/4-1 concerning harmonics accounts for this using the 95% of time concept and a similar approach may be justified for flicker.
   vi) PD IEC/TR 61000-3-7 [4] has been published and introduces new concepts that are worthy of consideration; namely:

I. margins between ‘Planning Levels’ and ‘Compatibility Levels’ to allow co-ordination of flicker between voltage levels.
II. NOTE: P28 currently sets the planning levels for flicker at the compatibility level with no margin.
III. planning limits for rapid voltage changes occurring less frequently than once every 10 minutes with the limits varying with how often the changes occur. This includes indicative limits with the highest reaching 6% for rapid voltage changes occurring up to two times a day at medium voltage.
NOTE: P28 currently provides a single limit of 3% and allows discretionary approval of higher limits. Thus a less restrictive regime may be possible if the IEC approach were considered.
IV. apportionment according to agreed supply capacity.
NOTE: P28 allows a first-comer to utilise the whole margin; consideration could be given, in cases of multiple connection applications, to use some form of apportionment according to agreed supply capacity. A similar issue is being considered for harmonics in the G5/4-1 working group.

a) Changes in networks and codes
Discussions are in progress with European Transmission Network Operators (ENTSO-E) concerning harmonised EU Network Codes. Documents such as PD IEC/TR 61000-3-7 [4] may be referenced and so the impact on P28 needs to be considered.

b) The Distribution Code now includes limitation on voltage fluctuations due to transformer magnetising inrush current. A review could consider whether inrush should be included within the scope of P28 and what the appropriate limit would be.
NOTE 1: This could also be linked to consideration of the PD IEC/TR 61000-3-7 [4] rapid voltage change indicative planning limits and associated CIGRE work [5].
NOTE 2: A separate paper - PP11/51 [6] - related to this was presented to the GCRP by National Grid on 22/09/2011.

c) P28 provides somewhat contradictory statements with regards to which fault level – normal or abnormal – should be used in Stage 2 and 3 assessments. This conflict needs to be resolved.

3.2 Changes in connections and lighting technology

a) Lighting technology is changing and modern lights have a different flicker performance than the 60 W tungsten filament lamp upon which the flicker limits in P28 are based. Work in this area is underway at IEC level and P28 will need to reflect this in due course.

b) LV equipment subject to restricted connection falling within the scope of BS EN 61000-3-11 [2] is supposed to be connected only after the customer checks that the network has sufficiently low impedance. The manufacturer is supposed to make a statement to this effect where it applies. However, in reality the manufacturer statement is often not provided or only on request and customers/installers fail to make the relevant checks. Furthermore, with the widespread adoption of heat pumps and electric boilers, which can operate at similar times in large numbers, and the fact that BS EN 61000-3-11 [2] allows higher levels of flicker than the P28 Stage 2 limit, this situation needs to be reviewed and guidance provided.

c) LV equipment subject to BS EN 61000-3-3 [1] is intended for unconditional connection. However, this standard allows higher flicker levels than the P28 Stage 2 limit at the supply terminals and it may be possible to exceed compatibility levels with multiple installations (i.e. when a whole housing estate has such equipment operating at similar times). This situation needs to be reviewed and guidance provided, if necessary.

4. Proposed scope of review

4.1 General

a) Update references and associated recommendations in P28, including standards.
b) Consider whether it is appropriate to employ different standards and/or processes for transmission compared with distribution connections.
c) Consider issues where P28 is unclear and provide guidance on interpretation (e.g. which fault level to consider).

4.2 Standards

a) Consider whether there are standards that could be adopted/referenced (e.g. PD IEC/TR 61000-3-7) in anticipation of the implementation of EU Network Codes.
b) Consider whether BS EN 61000-3-3 and BS EN 61000-3-11 are effective at controlling flicker for multiple LV installations.
c) Consider whether other technical standards or recommendations would need to change as a result of any change to P28.

4.3 Limits

a) Consider whether the planning limits for voltage fluctuations and flicker are adequate or acceptable.
b) Consider whether changes are necessary because of the new range of lighting technologies.
c) Consider whether transformer magnetising inrush should be within the scope of P28.

4.4 Evaluation of background levels

a) Clarify the interpretation of measured background values and what duration of measurement is appropriate.
b) Consider how to progress with flicker measurements where a new substation is not yet built (i.e. how is the background level at a new substation best estimated?)

4.5 'First-come, first-served' versus allocation of rights

a) Consider the process used to allocate the limits described in P28 between different users in similar areas including whether 'first-come, first-served' is the appropriate way of allocating limits or whether there are alternative methods (e.g. equal rights as per PD IEC/TR 61000-3-7) that can be justified.
b) Consider how 'competing' applications are dealt with and how changes to customers' requirements may impact on their right to produce voltage fluctuations and flicker.
c) Research whether other countries have moved from 'first-come, first served' to 'equal rights' and consider whether any lessons can be learned.

4.6 Other technical issues

a) Develop proposals to update P28 to fully cover the variety of equipment now commonly encountered.
b) Consider the best approach to co-ordinate 'outages' between transmission and distribution systems under fault level consideration (e.g. one transmission Supergrid transformer out at the same time as one distribution 132 kV feeder).
c) Consider how to treat situations where Planning Levels are exceeded.

Members of the joint Working Group are invited to submit their written response to the contents of this paper and viewpoints on the:

a) adequacy of the scope and technical content of the existing P28 document; and
b) additional requirements that need to be considered going forward for the revised P28 document.

References

[1]	BS EN 61000-3-3	Electromagnetic compatibility (EMC). Limits. Limitation of voltage changes, voltage fluctuations and flicker in public low-voltage supply systems, for equipment with rated current ≤ 16 A per phase and not subject to conditional connection
[2]	BS EN 61000-3-11	Electromagnetic compatibility (EMC). Limits. Limitation of voltage changes, voltage fluctuations and flicker in public low-voltage supply systems. Equipment with rated voltage current ≤ 75 A and subject to conditional connection
[3]	BS EN 61400-21	Wind turbines. Measurement and assessment of power quality characteristics of grid connected wind turbines
[4]	PD IEC/TR 61000-3-7	Electromagnetic compatibility (EMC). Limits. Assessment of emission limits for the connection of fluctuating installations to MV, HV and EHV power systems
[5]	CIGRE Working Group C4.108 report	Review of Flicker Objectives for LV, MV and HV Systems
[6]	GCRP Paper PP11/51	Voltage fluctuations

Attachments

None

Appendix D

ER P28 Joint GCRP & DCRP Working Group

Terms of Reference

1 Introduction

The Energy Networks Association (ENA) is responsible for maintenance of Engineering Recommendation (ER) P28, *Planning Limits for Voltage Fluctuations Caused by Industrial, Commercial and Domestic Equipment in the United Kingdom*. P28 deals with the assessment of voltage fluctuations and associated light flicker produced by potentially disturbing equipment. P28 is referenced in both the Grid and Distribution Codes of Great Britain and is an 'industry standard' in this technical area.

As P28 Issue 1 was last published in 1989, the Grid Code Review Panel (GCRP) and the Distribution Code Review Panel (DCRP) of Great Britain (GB) have sanctioned the review of P28 by a joint Working Group of various key stakeholders and third parties that will be materially affected by any revision of the document.

This documents sets out the Terms of Reference for the ER P28 Joint GCRP & DCRP Working Group (subsequently referred to as the 'Working Group').

2 Objective

The objective of the P28 Working Group is to review the standards and processes employed by Distribution Network Operators (DNOs) and Transmission System Operators (TSOs) in GB to assess voltage fluctuations and associated light flicker produced by potentially disturbing equipment.

The initial output from the Working Group will be a report describing the changes to Engineering Recommendation P28 that are considered necessary.

The Working Group will be responsible for ensuring that changes considered necessary to ER P28:

- support the codes in the Grid and Distribution Codes;
- align with national and international Standards, as far as possible;
- reflect current practices;
- conform with legal and regulatory frameworks;
- are technically correct;
- are usable with confidence by industry stakeholders.

In developing its proposals the Working Group will consider both the economic and technical case for change.

3 Membership

Membership will be open to nominated representatives from key stakeholders including DNOs, TSOs, Independent Distribution Network Operators (IDNOs), ENA, generators, equipment manufacturer trade associations, disturbing load connectees, independent technical experts, government, regulators and other third parties.

Membership will take the form of 'Sitting Members' and/or 'Corresponding Members'.

Changes to Membership of the Working Group will be sanctioned jointly by the GCRP and DCRP.

4 Scope of Review

The scope of review of P28 will cover the following aspects.

4.1 General

a) Update references and associated recommendations in P28, including standards.

b) Consider whether it is appropriate to employ different standards and/or processes for transmission compared with distribution connections.

c) Consider issues where P28 is unclear and provide guidance on interpretation (e.g. which fault level to consider).

4.2 Standards

a) Consider whether there are standards that could be adopted/referenced (e.g. PD IEC/TR 61000-3-7) in anticipation of the implementation of EU Network Codes.

b) Consider whether BS EN 61000-3-3 and BS EN 61000-3-11 are effective at controlling flicker for multiple LV installations.

c) Consider whether other technical standards or recommendations would need to change as a result of any change to P28.

4.3 Limits

a) Consider whether the planning limits for voltage fluctuations and flicker are adequate or acceptable.

b) Consider whether changes are necessary because of the new range of lighting technologies.

c) Consider whether transformer magnetising inrush should be within the scope of P28.

4.4 Evaluation of background levels

a) Clarify the interpretation of measured background values and what duration of measurement is appropriate.

b) Consider how to progress with flicker measurements where a new substation is not yet built (i.e. how is the background level at a new substation best estimated?)

4.5 'First-come, first-served' versus allocation of rights

a) Consider the process used to allocate the limits described in P28 between different users in similar areas including whether 'first-come, first-served' is the appropriate way of allocating limits or whether there are alternative methods (e.g. equal rights as per PD IEC/TR 61000-3-7) that can be justified.

b) Consider how 'competing' applications are dealt with and how changes to customers' requirements may impact on their right to produce voltage fluctuations and flicker.

c) Research whether other countries have moved from 'first-come, first served' to 'equal rights' and consider whether any lessons can be learned.

4.6 Other technical issues

a) Develop proposals to update P28 to fully cover the variety of equipment now commonly encountered.

b) Consider the best approach to co-ordinate 'outages' between transmission and distribution systems under fault level consideration (e.g. one transmission Supergrid transformer out at the same time as one distribution 132 kV feeder).

c) Consider how to treat situations where Planning Levels are exceeded.

5 Facilitation

Facilitation and secretariat support for the Working Group will be provided by the ENA and their nominated representative.

The Facilitator will ensure that the Working Group follows governance procedures as set down by the GCRP and DCRP. This includes general compliance with the principles set out in the Code Administrators Code of Practice (CACOP) to facilitate transparency in Code Modification processes and help protect the interests of small market participants and consumers.

6 Meetings

Meetings of the Working Group will be chaired by a joint GCRP and DCRP appointed representative. The Chair shall liaise closely with the Facilitator to ensure the Working Group operates effectively and efficiently.

Nominations for the position of Deputy Chair will be sought from Sitting Members of the Working Group. If appropriate, nominations for Deputy Chair will be reviewed by the GCRP and DCRP prior to appointment.

Sitting Members will be invited to attend meetings of the Working Group; Corresponding Members will not normally be invited to attend meetings but will be invited to comment on all other aspects under consideration by the Working Group.

A stakeholder, who has 'Sitting Membership' of the Working Group will be allowed to send a substitute representative to meetings of the Working Group, where the nominated representative is unable to attend.

Regular meetings of the Working Group will be held, not less than once every three months. An agenda and arrangements for each meeting will be notified generally one month in advance by the Facilitator of the Working Group. Additional meetings may be held when the majority of Members agree there is an essential requirement.

7 Liaison with Other Panels and ENA Working Groups

It is essential that the review of ER P28 is coordinated with the work of the GCRP and DCRP and other ENA Working Groups. Minutes from meetings and regular updates on the progress of the Working Group will be prepared and circulated by the Working Group Facilitator to other Panels and ENA Working Groups, as appropriate.

Appendix E

Stakeholder	Organisation	Response / viewpoints on Briefing Paper 1	Comment
Independent Technical Expert	1	I have a particular interest in an aspect highlighted in the briefing paper i.e. planning limits for voltage changes occurring less frequently than once every 10 minutes. The discretionary approval of higher limits has caused some difficulty in the wind industry in that some DNO's will allow (and some will not allow) a higher limit for infrequent energisation of wind farm collection circuits which cause a voltage dip due to transformer inrush current. Application of a 3% limit often requires wind farm owners to invest in mitigation measures which DNOs do not themselves use when energising their own circuits with multiple transformers. I am pleased to see that the briefing document considers this [3.1(a)(iv)(II), 3.2(b) and 4.3(c)]	Limits for infrequent voltage changes to be reviewed in light of energisation of wind farm collection circuits.
		P28 should refer appropriately to relevant power quality standards for new types of connected equipment which were not anticipated in the 1989 issue 1 of P28 e.g. (but not limited to) wind farms (IEC 61400-21) and PV inverters at various scales.	New types of connected equipment to be identified and considered from a voltage fluctuation perspective.

Stakeholder	Organisation	Response / viewpoints on Briefing Paper 1	Comment
Independent Technical Expert	2	General:	
		c) (i) Page 8 of the P28 mentioned that all limits in the P28 recommendation are based on Tungsten filament lamps. Low energy bulbs (such as compact fluorescent lamps and LED technology) are becoming more common. The limits may have to be revised considering common use of new light bulbs. There are studies available (a good study from Netherlands) which have assessed the flicker for different lamp types.	Need to assess flicker severity for modern lamp types (prevalence) commencing with literature survey.
		(ii) Section 6.2.1 discusses that Electricity Council has a computer programs that allow conversion of a voltage change pattern into Pst. Perhaps this program can be uploaded onto a website and a link provided in the P28 standard. So that it is more easily accessible.	Electricity Council computer program needs to be reviewed and need for replacement software to accompany P28 identified.
		TNEI has Matlab, Simulink model to convert a voltage trace into Pst value. We can share it if my company allows.	
		(iii) In general, P28 should be clearer on the definition (especially the period of interest, 30ms, 1sec, 10min??) for voltage step change, transient voltage dip and flicker. Depending on that definition, the appropriate fault level must be used, for example, if the period of interest is <30ms use sub-transient, if it is 30-50ms use transient fault current, if it is >100ms use steady-state.	Review applicability of fault levels used for voltage change periods.
		(iv) We must acknowledge the fact that the ultimate aim of P28 is to contain the network voltage flicker. Therefore recommendation of any voltage step change or voltage ramp limits must be in accordance with this.	Review the need to consider two aspects separately: i) Continuous voltage change ii) Large step voltage change
		However, if the P28 should cover Large voltage step changes as well as Continuous change in voltage (flicker) then for clarity, the P28 should be separated into two sections, one that deals with continuous change in voltage (flicker) and the other that deals with large change in voltages such as Voltage Step Change or Transient Voltage Dip.	
		If P28 is to cover the Large voltage step change, then a section should be added for tripping of circuits inside the wind farm/solar farm and its impact on PCC voltage.	Review the need for separate requirements for tripping of circuits and its impact on PCC. Should limits apply to tripping of loads?

Stakeholder	Organisation	Response / viewpoints on Briefing Paper 1	Comment
		Standards: a) - b) BS EN 61000-3-3 and BS EN 61000-3-11 are applicable for electronic devices with current input of less than or equal to 16A and 75A respectively. The LV equipment (220V to 250V) is normally made compliant with these standards. The existing equipment will therefore be compliant with these standards and there should not normally be a flicker problem inside the households. Therefore, it can be said that these standards are effective in controlling the flicker for multiple LV installations. c) The GB Distribution code (section DPC 4.2.3.3 on Voltage Step Changes) relies on limits specified in the P28 standard. P28 is also referenced in ER G81 in Section 7.4: Voltage Unbalance and fluctuating loads. However, a modification in the P28 standard will not affect this standard.	Review whether BS EN 61000-3-3 and BS EN 61000-3-11 are effective in controlling flicker for multiple LV installations. Consider the impact of changes on the GB DCODE and other DCODE documents.

		Limits: The P28 should have a clear section or a table with limits for voltage change due to a transients (motor starting or transformer inrush) and voltage fluctuation (flicker) due to continuous operation of machines such as welding equipment, arc furnaces etc. In the existing P28, the limits are not very clearly defined.	Review need for separate limits for transients and continuous operation.
		a) We will have to accept the existing limits on flicker are adequate as it appears there have been no experiments carried out on the human perception of flicker, plus human eye+memory could not have evolved much over the past 25 years.	Review the need for additional work required on the perception of flicker
		b) It is proposed that in Stage 1 assessment, the impact of small scale domestic wind turbines/PV panels on voltage fluctuation should be considered if they are connected directly to the grid (without a storage system). A sudden rise and fall in power due to a wind gust (for wind turbines) or cloud transient (due to PV panels) may cause a voltage fluctuation that can reflect in the string of houses connected to the same transformer. The effect on voltage can be more noticeable if several units are connected in a row. For this reason, voltage limits may have to be introduced for connection of domestic generators (in this case wind turbines and PV) during transients as they can lead to flicker.	Review the impact of SSEG transients on voltage fluctuation where common factors (e.g. wind gust, cloud transient etc) may effect multiple connections connected to the same PCC at the same time.
		c) Transient voltage dip due to transformer inrush current should be considered within the scope of P28. Since now there are several installations of onshore wind farms and onshore solar farms. Energisation of transformers inside onshore wind farms and onshore solar farms during site energisation or re-connection after maintenance can cause a sudden voltage dip. The section on electric motor starting (Section 6.3a) in P28 can be extended to include the impact of transformer energisation on voltage dips at the PCC.	Review the impact of transformer inrush current in scope of ER P28 specifically for multiple transformer installations at wind farms.
		a. The existing P28, Appendum 1 – Electric Motors (Section 3. Special cases of very infrequent starting) states that where a motor is only started at intervals of several months, regarding as an	Review definitions/requirements for ‘frequent’ and ‘infrequent events’ and align with GB DCODE

Stakeholder	Organisation	Response / viewpoints on Briefing Paper 1	Comment
		infrequent event, a voltage depression of more than 3% during special conditions may be agreed. In no case should the voltage depression at the PCC on starting exceed 6%. The P28 can be made more clear by defining frequent or infrequent events, as intervals of several months does not provide a clear time scale. Perhaps, a similar example to GB distribution code can be used. The Distribution code describes that a voltage dip of 3% can be allowed for frequent switching events, whereas a limit of 10% can be allowed for infrequent switching events. The frequent events are the ones that occur more than once per year, implying that infrequent events occur only once per year. Perhaps, a clear time scale in months between the events can also be defined. For instance, an infrequent event would be followed by another infrequent event after about 12 months. The definition of frequent and infrequent events should be given at the start of the P28 in 'Definitions'. Regarding transformer inrush, the voltage step change limits applied by the DNO must reflect the fact that DNOs themselves are also bound by these limits when energising primary or Bulk Supply Point (BSP) transformers. Whatever limit DNOs use for themselves for energising transformers should be allowed for all other connectees to the distribution network.	Review the voltage fluctuation limits for infrequent switching events and need for further guidance. Review the application of common limits related to voltage step changes for energisation of transformers (DNO and other).

Stakeholder	Organisation	Response / viewpoints on Briefing Paper 1	Comment
		Other technical issues	
		a) At present, P28 suggests no measurements are needed in Stage 2 at the PCC unless the device connecting injects flicker that exceeds Pst of 0.5. Measurements are suggested only in Stage 3 if limits are exceeded in Stage 2. However, since devices with inverters (wind turbines/solar inverters/variable speed drives) have become very common in the past few years and they all introduce some level of flicker, therefore it may be useful to do flicker measurements in the network prior connecting new inverter devices.	Review need for flicker measurements in Stage 2 assessment given devices with inverters introduce some level of flicker.
		It may be useful to do a few site measurements in a weak network with lots of wind farms/solar farms to determine the impact on flicker injected on neighbouring busbars. If the flicker levels exceed the limits, then the P28 should specify that prior connecting devices with inverters in a weak network flicker measurements should be performed.	Review need for field trial data to assess impact on flicker from DG in networks with high source impedance.
		c) (i) If planning levels are exceeded by a small amount, the utility (distribution network operator) should be contacted to discuss if they would allow, if its caused by an event that is very infrequent.	Review the need for different planning limits in remote rural networks with high source impedance, where exceedance from 3% is highly likely.
		It should be noted that when renewable generation such as Small Hydro is to be connected in rural areas, the DNO may allow more than 3% voltage limit as the network is generally weak in the region (and exceedance from 3% is highly likely). Since the frequency of switching is less hence this may support the argument of allowing more than 3% voltage limit for rural areas.	
		Similarly, for wind farms, the WTG transformers are energised very rarely, once when the site is energised and second time if they have to be taken out for maintenance. Therefore, the limit on voltage dip (currently 3%) should be based on the frequency of the event happening.	Review the application of frequency to energisation of wind turbine generator transformers.

Stakeholder	Organisation	Response / viewpoints on Briefing Paper 1	Comment
		'First come, first served' versus allocation of rights	
		a) Alternative methods such as 'equal rights' may be fairer to the load connectors and it will be also easier to manage for the distribution company. However, as mentioned in 'Other technical issues (a)' site measurement tests should be performed as a test if addition of new inverter based devices have lead to exceedance of flicker in the network.	Review the need to carry out site measurement tests to determine remaining flicker limit in the network.
		If it has, then an approach similar to used by the Western Power Distribution (WPD) to limit the harmonic injection into their network can be proposed as an example. According to that approach, the background harmonic injections are measured at a Bulk Supply Point (near to the PCC of the new generation) and a wind farm/solar farm is allowed to raise the harmonic voltages by a certain percentage at each harmonic order.	Consider whether WPD approach for harmonics can be applied, where connectees are allowed to raise flicker by a certain percentage.
		Similarly, for P28, a flicker measurement would have to be performed on an existing network near the PCC by the utility and certain percentage of the remaining limit would have to be allocated to the new devices connecting. At present, a majority of wind farms pass flicker measurements in Stage 2 and they never reach Stage 3 because background measurements are ignored.	Review whether there are problems with flicker limits being exceeded under the existing Stage 2 assessment for wind farms.
Generator	3	Will scope of review include CC.6.1.7 (Voltage Fluctuations) in the Grid Code	Review how P28 requirements impact on requirements for voltage fluctuation in the Grid Code.

Stakeholder	Organisation	Response / viewpoints on Briefing Paper 1	Comment
DNO	4	1 Only comment is a request to make sure the group covers infrequent events which give rise to step changes >3%. This comes up a lot with generator connection studies. There are no defined limits other than the 10% in D Code so some guidance in P28 would be useful. It looks like this is covered under 3.1 a)iii. And also explicitly covered in 3.2(b) of the briefing note.	Review the voltage fluctuation limits for infrequent switching events and need for further guidance.
		2. Good to see P28 will be aligned with 61000-3-1 / 11.	Review list of normative Standards that apply to P28.
		3. From a measurement perspective I have no issues with the current issue of P28 or the briefing paper which appears fairly comprehensive. My only concern is that the instruments we use to measure flicker (per IEC 61000-4-15 & IEEE 1453) will be compatible with any proposed changes.	Review measuring instruments suitable for flicker measurements (i.e. what Standard applies).
		Buried in this implicitly is the impact on DNO network design... and the effect on existing network designs. For example, following a loss of supply, the DNO may need to restore supplies in a way that could give rise to a more than 10% dip on adjacent networks in order to reduce restoration delays.	Review how limits apply to restoration of supplies by DNOs given the interests of the DNO and consumers of prompt restoration.
Independent Technical Expert	5	Having reviewed the briefing paper, I would like to state that I agree with the scope presented within it and believe it adequate and as far as I can tell, complete.	No comment.

Manufacturer	6	Do we need P28 when there is IEC/TR 61000-3-7?. Perhaps all we need is a Guidance Note to interpret the document in terms of the UK network which includes UK specific technical requirements. That would be my approach Failing that P28/1 will have to lean heavily on the IEC document, much as G5/4-1 does with IEC/TR 61000-3-6 OK So to the two topics:- 1. adequacy of the scope and technical content of the existing P28 document; The scope :- needs to refer to the IEC document(s) . I don't think any of the ER's listed are in print (except G5/4 & P16?). The Technical Content:- It's all in the IEC Document, except for those specific to the UK network And 2. requirements that need to be considered going forward for the revised P28 document Flicker:-One thing not in the IEC (I think) is an acceptance that the LV flicker emission levels are based on Incandescent lamps. Which are becoming a rarity in the EU due to legislation. Indeed the original work on this was done at EA Technology, whilst part of the EA, back in the 1980's (Using Liverpool Uni students in a room with single incandescent lamp). Still it's a fact that no one has Incandescent lamps now as their main source of light, and the low voltage spot lighting down at 12V is practically impervious to voltage fluctuations. (see IEC 61000-3-7 Annex A). I don't know if	Consider whether the scope of IEC/TR 61000-3-7 covers all aspects of P28. It is understood that LV installations are not covered by IEC/TR 61000-3-7. The fact that this document is a Technical Report and not a 'full' Standard needs to be considered. Consider the need for the structure of P28 to align with normative IEC Standards. Consider reference to applicable IEC Standards and ENA engineering documents. Review the relationship of scope and technical content between IEC 61000 documents and P28. Consider new work in IEC on flicker severity for new lighting technology as opposed to incandescent lamps.

Stakeholder	Organisation	Response / viewpoints on Briefing Paper 1	Comment
		there is a revision to IEC 61000-3-7 in the pipeline to take this into account. Voltage Steps:- This is a particular issue for DNO's and Generators / Large load Customers, where the energisation of transformers is concerned. With the move to 'Dry Type' transformers for environmental reasons, the problem is exacerbated in that the peak inrush can be 7-11 x the transformer rating (but time constant is much shorter). This issue was not properly addressed in P28 nor in the IEC. I would guess is that no DNO is compliant in this respect (If P28 applied to them). This is why a 10% figure appears in the DCode and G59/3. This needs addressing so that it is fair to all who have to occasionally energise transformers in sequence.(Usually at MV/HV). One may consider that Table 6 in IEC6100-3-7 is appropriate for this switching activity. And replace Figure 4 in P28 for MV/HV connections. You can always include a get-out for emergency re-energisation after a fault.	Review voltage step change limits for energising transformers in light of changes to transformer designs and types (i.e. dry type transformers). Consider whether Table 6 in IEC/TR 61000-3-7 can replace Figure 4 in P28.
Renewable Energy	7	Definition of a generation unit needs to be clear – wind turbines, inverters and rotating plant? The various levels of inrush needs to be clear ie some DNO's use 3%, 6% and 10% and to correspond with frequency of switching Point on wave switching with percentages that are acceptable to be above the various boundaries of 3%, 6%, 10% at voltage levels of 11kV, 33kV, 66kV and 132kV Being prescriptive on how detailed we expect studies to be and what is to be expected of the transmission/Distribution networks – ie provision of a network model or do we still stick to the LTDS	Review changes to types of generation (e.g. SSEG) and impact on voltage fluctuation compared with traditional generation plant. Review voltage step change limits for energising transformers. Consider whether higher voltage step change limits are permissible for point on wave switching Consider what network information/data is used by users for assessment and whether information/data in LTDS is acceptable.

Renewable Energy	8	Section a & b I think the document needs modernising to accommodate / reference emerging technologies and associate standards that have gown rapidly over last few years, and will continue to do so . The major issues in the significant growth in the Distributed generation Sector that are / will cause issues and where the existing P28 should reference :-	Review changes to types of generation (e.g. SSEG) and impact on voltage fluctuation compared with traditional generation plant.
		Heat pumps (AC motor or inverter driven compressors) are a preferred mass market technology for DECC for both domestic and larger buildings. There is a discussion regarding a self certification regime for small installations that would not require DNO prior approval. This would be on similar lines similar to G83/2 for electricity generating equipment. The Heat pump industry is calling for easier process , and currently the regulations are probably not being followed.	Consider the acceptability of connecting smaller heat pumps without assessment for flicker.
		Load Control / export limiting Devices – to prevent / reduce grid export from localised energy generating schemes by diverting energy to immersion heaters/ cylinders etc . This is a new renewables created issue, and reference to this technology is required as there are flicker issues.	Review flicker issues associated with export limiting devices.
		PV park / wind farm transformers on weak grid areas. The EU directive on transformer losses may help, but I think needs inclusion in some way, as transformer energisation on PV parks is potentially causing flicker issues due to large transformers in a rural network area	Review voltage step change limits for energising transformers in light of changes to transformer designs and types (i.e. dry type transformers).
		Energy Storage – This could have a similar affect to Load control where large batteries are turned on/off	Review whether new load switching technologies should be included in P28.
		EVs – will be an aspect of future	Review how EVs can impact on voltage fluctuation and flicker.

Stakeholder	Organisation	Response / viewpoints on Briefing Paper 1	Comment
		DNO/NGC controlled PV Inverter Constraining – this happens in mainland Europe, and will happen in UK in next few years	

Appendix F

Project plan

Timelines & Deliverables