

# EURELECTRIC views and recommendations on Voltage Quality Monitoring

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A EURELECTRIC position paper



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▶ Growth, added-value, efficiency

Environmental Leadership

▶ Commitment, innovation, pro-activeness

Social Responsibility

▶ Transparency, ethics, accountability

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## WG Standardisation

Giovanni VALTORTA (IT) Chair

Janusz BAK (PL); Martins BUDAHS (LV); David F. CRAWLEY (GB); Miroslav DUBOVSKY (SK); Michel GOLDBERG (FR); Olivier GOURLAY (FR); Tassos GREGORIOU (CY); Jens Zoëga HANSEN (DK); Hansjörg HOLENSTEIN (CH); Ignacio ISLA (ES); Johan JANSSEN (NL); Tuomas MAASALO (FI); Francisco MIRA (PT); Stanislav MOTEJZIK (CZ); Per NORBERG (SE); Gert PASCOLI (AT); Joachim PESTKA (DE); Mirko RISTEVSKI (); Hervé ROCHEREAU (FR); Jose Maria ROMERO GORDON (ES); Maurice ROOVERS (NL); Kjell SAND (NO); Mark SCHOCKE (DE); Dan STANCULESCU (RO); Marijana SUCEVIC-TASIC (RS); Konrad TYRAJSKI (PL); Eric VAN ASSCHE (BE); Wouter VANCOETSEM (BE); Annousa VENIERI (GR); Anthony WALSH (IE); Jozsef ZERENYI (HU); Mareks ZVIEDRITIS (LV);

## Contact:

Sophie Tielemans, Advisor Networks Unit - [stielemans@eurelectric.org](mailto:stielemans@eurelectric.org)

Gunnar Lorenz, Head of Networks Unit – [glorenz@eurelectric.org](mailto:glorenz@eurelectric.org)

### *Introductory remarks on voltage quality*

The quality of voltage is influenced by network characteristics and structure, by faults and how those faults are detected and selected, as well as by the equipment of the network users and how that equipment is used. Equipment and network users can either act as a demand (load) or a production unit (producer).

In this complex context, determining the party responsible for the voltage disturbance (network operator, a neighbouring network, or one (or all) of the connected end-users) is a difficult task. **A clear procedure for responsibility sharing between the involved stakeholders (TSOs, DSOs, equipment manufacturers and users) is therefore crucial.** A correct balance must be struck between network performance and immunity requirements for customer equipment, to ensure that extra costs are paid by those who benefit and that the overall benefits to society are greater than overall costs.

Voltage quality differs between countries, types of network (e.g. cable, overhead line, grounding) and rural/urban areas. A regulatory obligation to fulfil the same high voltage quality requirements across the whole of Europe is therefore unrealistic. **Voltage quality regulation should be tailored in such a way as to take the specific characteristics of an individual network and local network conditions into account.**

**EURELECTRIC DSOs believe that the EN50160 standard represents a solid basis for guaranteeing a reasonable level of voltage quality** under normal network conditions.

### *Voltage quality management is a shared responsibility: strike a balance between network improvements and clean/resilient equipment<sup>1</sup>*

Voltage quality is not determined by the network operator alone. Rather, voltage disturbances are often caused by accidental faults and by the network users themselves, both upstream and downstream. Indeed, the electrical installations of connected network users locally affect the voltage quality by how they draw current from the system (harmonic distortion, transient behaviour and the use over time).

Voltage quality also depends on the characteristics of electrical and electronic home appliances and of network interfaces for distributed generation. Product standards with appropriate requirements (e.g. emission limits) and connection requirements linked to a reliable conformity assessment system are necessary to ensure quality of supply. Additionally, voltage quality is becoming ever more challenging due to an increased susceptibility of end-user equipment and industrial installations to voltage disturbances.

The considerations above make it quite obvious that the network operator cannot be held solely responsible for voltage quality management. **There should be a clear process in place that defines the responsibility in case of voltage disturbances.** Controlling emission from network end-users is necessary. It can be performed if:

- For mass-market products, emission requirements in product standards are appropriate,
- For large installations, emission levels are effectively controlled, e.g. through connection agreements,
- Appropriate methodologies and engineering practices are used, e.g. based on planning levels and IEC/TR 61000-3-6, 3-7, 3-13 and/or 3-14.

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<sup>1</sup> This covers mainly large industrial end-users on the MV or HV networks

Significant improvements in voltage quality can only occur together with major immunity requirements for equipment and industrial processes. **Improvements to equipment are necessary to effectively and economically safeguard system performance against voltage dips.** In this regard, EURELECTRIC welcomes the cooperation with manufacturers reviewing electromagnetic compatibility requirements. TSOs have understood that the only way to effectively improve the ride-through capability is to correctly immunise generators. A similar approach should be applied to equipment on the consumer side.

**In sum, maintaining and/or achieving an appropriate voltage quality in distribution networks is a shared responsibility between TSOs, DSOs, equipment manufacturers and connected end-users.** Ensuring voltage quality at reasonable cost requires, on the one hand, imposing preventative measures, i.e. appropriate emission and immunity limits for customer equipment and/or installations, and on the other hand, improving and strengthening the network.

The cost of mitigating the impact of voltage disturbances on equipment and the network should also be examined. **EURELECTRIC therefore recommends conducting a study on voltage disturbances to assess the actual impact of various voltage disturbances on equipment in order to evaluate the need for and feasibility of establishing (an) immunity curve(s).** It should be noted that the immunity curve approach may not be appropriate for all types of disturbance and customer.

### *Voltage quality in evolving distribution networks*

Voltage quality will increasingly be affected by developments such as the proliferation of distributed generation, charging of electric cars, and increased use of energy-efficient equipment and appliances (usually non-linear loads). New loads and units connected to the network (e.g. photovoltaic installations, electric cars, inverters) must comply with standards and grid codes. History shows that voltage quality comes under pressure when the majority of customers suddenly ‘move in the same direction’ (e.g. by installing photovoltaic in their homes). In these cases voltage quality may suddenly become a significant problem. A continuous dialogue among DSOs – and to some extent with CEER/national regulators – must be held to foster cooperation on voltage quality measurement programmes. The resulting data can be used in the standardisation process and in national regulation.

Voltage quality standards are currently one of the greatest impediments to dispersed renewable generation: they limit the size and connection method of wind farms and other renewables and will also apply to solar panels, electric cars and heat pumps. Real problems might arise if voltage quality requirements are excessively severe. For example, maintaining voltage variations that are too low might make it impossible to install distributed generation. Certain national regulation – like the  $\pm 7\%$  in Spain or the 1-minute average in Norway – may reduce the hosting capacity of LV lines for distributed generators and fast (high power) electric vehicle chargers. Regulators should take this into careful consideration.

Generally, **EURELECTRIC believes that demands for stricter national regulation should be driven by a technical-economic analysis that justifies those stricter demands.** Such a cost-benefit analysis should include network issues such as pre-ageing of assets and effects on reactive balances.

### *Monitoring voltage quality: considerations and recommendations*

DSOs measure voltage quality<sup>2</sup> on a regular basis. The monitoring programmes provide data that may enable smoother network operation, avoid possible faults, ensure better network planning, and detect faults and disturbances.

Regulators must take two aspects of voltage monitoring into account:

- The interpretation of such data is not yet harmonised on a European scale; **a harmonised format is needed to ensure a uniform data interpretation across Europe**. A standard template for reporting data to national regulators would provide added-value to all stakeholders. This standard report could include the duration of monitoring campaigns, measurement methods, phase and time aggregation methods for voltage quality events, flagging and data exclusion criteria. The template would result in a uniform report that is independent of recording devices and could serve as a reference for developers of voltage quality management systems looking to improve reporting tools. The broad adoption of a standard report would also facilitate voltage quality benchmarking between European regions. A first step has already been taken with EN 50160:2010, e.g. for a standardised classification of voltage dips.
- In several EU member states the cost of voltage monitoring is not recognised as a distribution cost. As a result the DSOs in those countries lack resources to set up proper monitoring schemes.

EURELECTRIC DSOs question the necessity of introducing additional voltage quality requirements that are stricter than the current standard, as this may lead to higher and possibly unnecessary costs for society, especially because only few customers suffer from voltage quality problems. Moreover, ‘local’ solutions to voltage variations prove to be much more technically and economically effective. Therefore **EURELECTRIC promotes a wide voltage quality measurement campaign based on EN50160**.

### *Monitoring voltage quality in the LV network: the role of smart meters*

Rolling out smart meters opens up the possibility of collecting crude indicators on voltage variations, interruptions and sometimes dips and swells at end customers’ connection points. Such indicators could, for example, show sustained over-voltage and under-voltage due to electric cars and distributed generation.

However, such crude data should not be used as a basis for regulatory action. Instead, **EURELECTRIC believes that decisions on possible regulatory action should be taken based on the actual impact of voltage disturbances on customers**, as measured by cross-checking voltage disturbances against customer complaints and referenced to the original cause in order to avoid multiple counts or customer-made disturbances. **To thoroughly understand and handle voltage disturbances, the smart metering monitoring must be complemented by dedicated and sophisticated voltage monitoring devices at MV/LV substations**. It must also be recognised that not all voltage disturbances necessarily result in negative effects for end-users.

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<sup>2</sup> Voltage Quality (VQ) covers a wide range of voltage disturbances and deviations in voltage magnitude or the voltage waveform. Examples of voltage disturbances include supply voltage variations, harmonic voltage, voltage dips, and other voltage transients. Generally the MV and HV networks are mostly affected by voltage dips whereas the LV networks are mainly affected by voltage variations, harmonics and flicker.



Union of the Electricity Industry - EURELECTRIC aisbl  
Boulevard de l'Impératrice, 66 - bte 2  
B - 1000 Brussels • Belgium  
Tel: + 32 2 515 10 00 • Fax: + 32 2 515 10 10  
VAT: BE 0462 679 112 • [www.eurelectric.org](http://www.eurelectric.org)