

a. General questions on the recommendations to CENELEC for revising EN 50160:

Do you agree with the general messages of the 7 recommendations given in chapter 4?

Yes, we do agree. Regulation of voltage quality in European countries is needed for several reasons (increased load susceptibility and emission, needs of increased industrial process efficiency and productivity, absence of competitive markets especially in distribution sectors, deep changes in last 10 years of electrical system structure and operation- from pure passive network to also active network thanks to distributed generation, and so on). Actual version of EN50160 describes the average (somewhere minimum) voltage quality levels in European electrical systems rather than furnishes a framework of reference for voltage regulation.

Considering electricity as a homogeneous product, as was the philosophy behind EN 50160 based on the European Directive on the common market, should result in the same requirements throughout Europe. To have the same requirements for all customers throughout Europe is unrealistic; it would either lead to unacceptable levels of quality for most customers or to unacceptably high costs for most network operators. However, the revision of EN50160 can give a general framework for Europe regulation, it can state unambiguous way disturbances definition, and general limits for sharing responsibility among various parties, it can reflect new challenges of privatized and liberalized markets.

Are there any other major voltage quality issues missing from those that have been considered in this document?

Further issues are:

the acknowledgement that the majority of voltage events (dips and/or swells) are unbalanced;
coordination between voltage and current requirements;
consistency with international standards;
choice of suitable global and local objectives.

Do you have any evidence, based on survey on both networks conditions and customers' needs in given countries, about costs and benefits related to the implementation of recommendations?

Can you help us in qualifying and quantifying these costs and benefits?

The economical value of voltage quality needs more studies and, overall, common methodologies for its assessment. International working groups around the world, like inside CIGRE JWGC4.107, are studying the problem. The results of these studies will hugely help to ascertain costs and benefits comparable in different sectors and/or different countries.

b. Specific questions on the recommendations to CENELEC for revising EN 50160:

- What is an appropriate responsibility-sharing curve between equipments and grid in the voltage-duration plan (both for voltage dips and swells)?

The concept of responsibility sharing curve is very important. The proposed curve (see Fig. 6 on page 31) has to be extended to all the values of RMS voltage. It must cover also overvoltage (swells and fundamental voltage amplitude).

The limit curves have to account for specific disturbances (undervoltage, overvoltage). Actual international standards, as in the case of undervoltages, have to be considered in discussion with all the interested parties.

- *What is an appropriate way of protecting equipment against damage or failure due to short-duration overvoltages (voltage swells): limits for voltage swells (as events) or a shorter time interval (than the today's 10-min in EN 50160) for averaging continuously measured values (related to supply voltage variations)?*

More discussion is needed. Actually, the only curves that can be considered are the CBEMA curve and the more recent ITIC curve. From these curves, aggregated plots linked to several equipment's should be derived.

- *Are there benefits, further than customer protection (for instance: reduction of losses), important enough to give reasons for reducing the range of voltage variations from $Un \pm 10\%$ to a narrower band?*

Narrower voltage variation range can give benefits also for long term effects on insulated equipment. The useful life of insulated equipment of solid type strongly depends on actual value of voltage in respect to electro-thermal life model.

- *How to consider random year-by-year variations in setting limits especially for voltage dips and other events correlated to weather influence?*

Annual variation of some phenomena, like voltage dips, is a real problem. It can be unrealistic to account for it in setting limits, given the actual state of knowledge.

However, a way to consider year-by-year variations could be to consider a periodic revision of the limits in function of the actual network operation obtained by a large scale measurements in different European countries. For example, starting from the results of annual reports on the actual Voltage Quality (VQ), the limits of disturbances could be refreshed every fixed interval time (for example every five years)

- *For some topics (as for instance voltage steadiness within the tolerance band) the research made already available aggregate voltage quality indexes; should those aggregate indexes be used for regulatory purposes? Why or why not?*

Aggregate indexes can be very useful for global regulation. Indices that quantify the overall loss of VQ with only one or at least two figures could be more appropriate in respect to the use of a lot of indices in order to simplify the VQ regulation.

Moreover the use of aggregate indices can be useful especially, if the VQ regulation would include incentive/penalty schemes.

The reasons are: simplicity, data amount reduction, dimension reduction of the problem. Such a simpler application should be compensated by local regulation effected on not aggregated indexes.

c. Questions on the future of voltage quality regulation:

As discussed in chapter 5, setting minimum limits for every parameter of voltage quality (especially voltage events, for which only indicative values are given in EN 50160) still remains an open issue.

Which are pros and cons of introducing national VQ limits and requirements by the national regulators?

Main advantage is: proxy of competition among distributors in modern systems that are more and more complex and in evolution. All the consequent advantages of this are the advantages of VQ national regulation.

Do you believe that a “two level” option (definitions and measurement rules set homogeneously at EU level; limits set country by country by relevant authorities) can be a more effective way for improving or at least not deteriorating voltage quality?

Yes, surely.

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