OBSERVATIONS

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Towards Voltage Quality Regulation In Europe

An ERGEG Public Consultation Paper

We have some comments and observations to the following reflections:

➔ **4.1.** [Executive summary p.3-5.] „1. There are some voltage quality parameters whose measurement rules and definitions should be better defined, searching for the widest international consensus as possible. Unique definitions are necessary in order to calculate or measure different parameters in a uniformly way. Definitions should be improved especially for rapid voltage changes, supply voltage dips and swells (temporary power frequency overvoltages). The threshold between rapid voltage changes, voltage dips and interruptions should be equally defined internationally, which is not the case today."

- Indeed, it should be defined precisely in measuring **rapid voltage change** that how much should be
  - the averaging time of measuring before the „single rapid change" (see EN50160),
  - the length (time interval) of change (between two succeeding levels) and
  - the averaging time of measuring after change.

After our measuring and practical professional experience the procedures of single rapid voltage change caused by general electrical devices commonly pass off during 40 ms, therefore it should be expedient to lay down the period of change as 40 ms. Scilicet it is an „adequately rapid" change, and in most cases during this time the transient causing change passes off, so the two voltage levels of rapid change can be measured accurately, and never occurs that we "halve" the procedure of change by our measurement rule, distorting by this the rate of change .

A 40 ms period is also proposable for measuring period of the succeeding „determinable (measurably durable)" (see EN50160) levels (before and after change); because: in longer time intervals there can be changes distorting measuring of levels, but not a shorter averaging cycle would be good, because a „determinable (measurably durable)" level cannot be measured by a single sinus wave. The 40 ms appears an appropriate value when examining the diagrams of EN 61000-3-3 wrote about examination of voltage fluctuations. For a steady state it won't be expedient to abide the 1 second, because during a 1 second time interval it is not sure that voltage won't change more than 0,5 %, and in this way such rapid voltage changes cannot be measured, when continuous fluctuation (unsteadiness) can be experienced in voltage diagram.

Chapter 4.1 suggests to consider the proposal of NVE. These suggestions are acceptable building upon their technical experiences and arguments, but e.g. determination of cycle period of steady-state change requires further agreements, precise specification and besides exact determination of daily or weekly frequency of other parameters (maximum and steady-state changes) — using classification(!) by changing percents (e.g.: 1,5…2,5% → max. … pcs./day or max. … pcs./week; 2,5…5,0% → max. … pcs./day or max. … pcs./week; 5,0…7,5% → max. … pcs./day or max. … pcs./week; 7,5…10% → max. … pcs./day or max. … pcs./week). The base of percentage is the nominal voltage!

Experiences of NVE (that e.g. during little P_{st}, P_{lt} flicker rates there can be disturbing visual circumstances → on account of it flicker measure seems actually not a practic quality property) and occurent introduction of the two

new parameters mentioned above (maximum and steady-state changes) strongly query the raison d'ętre and practicability, efficiency of standard flicker measure! Because: if the two new parameters comply some (time distribution and frequency) limits, it will probably holds the flicker (P_{st}, P_{lt}) under accepted level.

Firstly it would be enough measuring and examining only the very rapid changes. Our arguments: (1) by this latter measurement rule any fast passed over rapid change can be registered; (2) after our measuring experience the examination of measuring these changes displays the whole flicker disturbance of the given connection point very well; (3) the steady-state changes are such slower changes, to which consumers' appliances can better adjust oneself (better bearing); besides (4) it must be written, that while there are technical solutions for consumers to compensate rapid changes (→ by NVE: maximum changes), eliminating steady-state changes is a much more harder to handle technical problem for consumers, and that is why the solution of problem would much more *weightily* load onto the Grid Company (→ „weak grid" → too big rear impedance).

- In the definition of measuring of **voltage-dip** it must be precisely and to technical experiences regulatedly determined that
  - how much the cycle period of measuring of effective value should be in the case of measuring a dip,
  - how much the lower limit to be raised — after ERGEG and us — should be (voltage dropped under this level is assumed as outage), and
  - how much voltage-hysteresis should be used for determining the end of the dip-event.

After chapter 4.1 and also after our measuring and practical professional experiences a 10 ms long (see EN50160) measure of effective value measures dips with an unnecessarily / vainly large sensitivity, since after professional ITIC curve (see chapter 2.1) 10 ms long dips are not harmful for consumers' equipments. For (after mentioned things) a dip longer than 20 ms is harmful in the only case if voltage drops under 70 %, it would be expedient to enlarge measuring cycle of dips to 40 ms, and also in this way we will measure many-many dips that do not cause consumer disturbances;

this is clearly confirmed by our many-years long measuring experiences and examinations of many voltage complaints.

We agree the statement written in chapter 4.1, after which the lower limit of voltage dip has to be raised from 1 %. This chapter suggests an increase to 10 % because of the capability of measuring tools and occurent induced voltages — we think it is acceptable and adequate (although in our opinion increasing the lower limit to 5 % would be enough).

Voltage-hysteresis: fundamental problem of almost all present-day measuring tools, that a voltage fluctuating around the lower limit (90 %) causes a lot of (even several hundred-thousand !) voltage-dip registrations or overflow in the meters, while using an adequate hysteresis these states (around limit) can be voted as a single or some *long term* dips. So dip event will only come to an end when voltage increases above 90 % in some degree. Standard EN61000-4-30 suggests 2 % hysteresis for typical cases (→ 92 %), which is an acceptable value in our opinion. This should be used by meter-manufacturers in after years.

➔ **4.2.** [Executive summary p.3-5.] „2. Limits for voltage variations – Avoid "95%-of-time" clause and avoid long time intervals for averaging measured values: We suggest… A too-wide averaging may hide some important slow supply voltage variations."

From the point of view of consumers the best possible quality is desirable of course, but it is followed by serious costs (→ tariff), too. Assuring 100% (although it would be advantageous for consumers) would load Grid Company with a serious responsibility even in normal operating circumstances. Because after our MV measurements there is almost no consumer connecting point where voltage exceeds the +/- 10% limits in normal (!) operating states, in LV there are several villages (far from 120 kV substations), where *there is* such problem. Most of these cases concern such public consumer groups, where temporary low voltage being not lower than 85 % in worst case does not cause damage (see chapter 2.3 in EN50160). In turn, most of more sensitive consumers at us have general such mode of supply, where almost never occure such voltage events (→ MV supply). As an

occurent middle course solution the 95 % limit could be raised up to e.g. 97 % introducing it by a few years timing. OR: in our opinion it would also serve the real satisfaction of consumers, if we use a duration-condition (after the 95 % clause for the 5 % of time), that 10 minutes averages can keep in the 85…90 % range consecutively at most 2 (maybe 1) hours long, and maximum 2 times a day. Using this condition probably does not put serious plus-load onto Grid Companies, in turn assures consumers' satisfaction in a real manner.

Although measuring instruments used by us can be programmed to 1 minutes average and also so can memorize a few days' data, we do not assume expedient to introduce a shorter (measure) averaging time, since measuring of rapid voltage changes, dips and swells are generally enough to confine (keep) shorter time voltage fluctuations and events between limits. Individual consumers' demands for extra quality must be handle *by themselves* (→ extra voltage quality contracts).

➔ **4.3.** [Executive summary p.3-5.] „3. Limits are needed for every voltage level: high voltage and extra-high voltage levels should be considered in the renewed standard. HV and EHV networks are by nature meshed whilst MV and LV networks are radial or radially operated; this difference must be taken into account, as well as the contribution of HV and EHV to disturbances in MV and LV networks."

These statements are fully reasonable, such a standard expansion is necessary!

➔ **4.4.** [Executive summary p.3-5.] „4. Indicative values given in EN 50160 for voltage events (especially dips and swells) are often too vague and no longer acceptable. As a preliminary step, dips and swells could be classified by severity, in order to distinguish events according to the typical causes that provoke them and the consequences they may lead to. Especially for dips and interruptions the rather vague ranges given for informative purposes (e.g. "up to several hundreds") are not useful for customers, neither for claiming damages when these occur nor even for designing their own protection

systems in an economically sound manner or for taking appropriate countermeasures."

These statements are also fully relevant and reasonable, it is necessary to (1) classify voltage events, and (2) to introduce concretized limits classes by classes!

➔ **4.5.** [Executive summary p.3-5.] „5. Duties and rights of all the parties should be taken into account…. Further, characteristics of withdrawal (e.g. harmonic currents) should be explored, as well as minimum level of short-circuit power provided by operators, in order to clearly identify responsibilities for voltage quality disturbances. Measurement procedures and tools as well should be considered in order to simply obtain a non controversial measure of disturbances, and as far as possible, a meaningful one for detecting responsibilities."

Continuing the extract from chapter 4.5:

„Duties and rights of all the parties should be taken into account. Characteristics of withdrawal (e.g. harmonics currents) should be explored, as well as minimum level of short-circuit power provided by operators, in order to clearly identify responsibilities for voltage quality disturbances. To this aim, also the presence of "disturbing" customers has to be accounted for. The level of disturbance that customers are allowed to inject has to be compliant with the short circuit power at the connection point to achieve the prescribed voltage quality. If special network features are needed (e.g. high values of short circuit power) they should be arranged for by suitable contracts.

Measurements should be considered as well in order to simply obtain a non controversial measure of disturbances, and as far as possible, a meaningful one for detecting responsibilities."

We also agrees with all this chapter; in connection with our measurements we often have the problem, we were in dilemma, when e.g. there was high flicker or also consumer made dips with its normal operating: to what extent responsible now the consumer and the Grid Company? How can we write to the consumer?! This

dilemma is not solved by our Business Regulation, it does not give a solution, only lists the things, what consumer and Grid Company *could* do.

We emphasize, that realizing things written in this chapter would be very important to have the possibility to handle voltage complaints of consumers of Grid Companies in a legal way!

It also would be important to prescribe in a standard or in an other manner that how much (how many the available power) rear short-circuit power *has to* be assured by Grid Company to a consumer having a given available power. And in case Grid Company provides (assures) this prescribed short-circuit power, it has done the network action that was "*legally required*" from it.

It is important to advantage in the future such measuring tools, which are adaptable for **disturbance-source identification** in some measure (→ minimum waveform-disturbance-registration option, besides examination of time-distribution of classified rapid voltage changes (at simple meters); in case of special measuring instrument: harmonic-contribution and flicker-contribution measuring).

➔ **4.6.** [Executive summary p.3-5.] „6. Realistic and even differentiated voltage quality levels should be defined according to network characteristics, taking into account different factors (overhead/underground, operational earthing, etc.)…"

We agree with this thought, it is necessary also for a newly appearing consumer to realize clearly that different standard concerns for supply of aerial line and different standard concerns for supply of earth cable, and different for supply of bus-bar. So it probably has a positive effect on customer contacts, too.

➔ **4.7.** [Executive summary p.3-5.] „7. The concept of "power quality contracts" should be developed in order to clarify in which situations it's applicable, as in many cases the improvement of quality of service requires interventions in the network that are to be made by the network operator. In those situations, a group of customers could benefit from the improvement and the power quality contracts might not be adequate for all."

The thought is legitimate, our opinion has already been written above in connection with chapter 4.5.

7 Issues for Consultation

The ERGEG invites stakeholders to comment on issues raised in the text.
Specifically ERGEG would like responses to the following questions:

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! see details above.

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

Is it necessary to measure steady-state harmonics continuously, or also a sampling (e.g. per 1...10 minutes) could be expedient? see EN61000-4-7. In our opinion with a large number of meters we have to control the general level of harmonic disturbance (→ more simple and cheaper meter), since special cases, problems require special measuring instruments anyhow.

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?

We have some surveying in the group of bigger consumers that can give some information to this theme…

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)?
Dips shorter than 40 ms should be borne by all equipments, besides the disturbance tolerance of current made equipments should be after the ITIC curve.

- 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)?
Problem should be handled in theme of swell events, and not with shorter averaging time.

- 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 ± 10 % to a narrower band?
We don't know such advantage.

- How to consider random year-by-year variations in setting limits especially for voltage dips and other events correlated to weather influence?
E.g. by using 3 years averages.

- 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?
For orientation yes, but one have to be very careful, because indicative values of single countries can be different through their different local properties.

- How can power quality contracts be defined in order to focus improvements in voltage quality levels according to customers' preferences?

Grid Company can guarantee a determined extra quality against some well calculated extra tariff or yearly fee.

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?*
National determination of VQ limits are more reasonable, since the situation of single countries can be different because of local conditions.

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.

Annex 1 – Technical overview

„ As for VQ parameters, voltage dips, swells and rapid voltage changes are given a major attention in this paper. **These are among the most annoying deviations for customers.**"

It is important to try to use such measuring instruments, which are adaptable to acceptably measure firstly **these three parameters**, and have **disturbance-source identifying functions** already mentioned before.

The ascertainment of „Technical overview" is confirmed also by our measuring praxis and experiences in voltage problem examining, since beside average voltage, dip, swell and flicker problems there were only rarely considerable harmonic problem or unbalance problem. (If there were some troubles with harmonics, there problem had to be analyzed further with a very special measuring instrument.) To our mind it would be enough to measure these two latter parameters in a way of sampling (sampling measurement) in the many-point power quality control measuring system.

Voltage unbalance

"It's strongly recommended that the definition for voltage unbalance in EN 50160 is to be changed towards line voltages instead of phase voltages."

Actually, in LV networks phase voltages should be measured, and in MV networks line voltages should be measured while measuring voltage unbalance, because standards concern *nominal* voltages, which are phase voltages in LV networks, and line voltages in MV networks.