



MILAN VIDMAR ELECTRIC POWER RESEARCH INSTITUTE

Institute for Electricity Supply Economy and Electrical Industry
Ljubljana, Slovenia

The Milan Vidmar Electric Power Research Institute is and has been the leading power engineering and scientific-research organisation acting in the field of electric power engineering and general energy in Slovenia and former Yugoslavia. After the World War II, when the Institute was founded, until now acknowledgments of the Institute range from the after-war electrification of the entire country and completion and connection of the 400 kV network with the European interconnection to the modernisation of procedures and adoption of new technologies into the Slovenian electric power system.

We have been doing power quality (PQ) campaigns according to SIST EN 50160 ever since it has been adopted as a "SIST" in 1999 and after the first reliable PQ instruments according to EN 50160 became available. We were doing PQ surveys before also, but not according to EN 50160.

The main reasons for our PQ campaigns were problems regarding the voltage quality at the end-user. Out of all the PQ campaigns we made, the following conclusions can be drawn:

- The **"5 % discount" is just too much!** EN 50160 gives the 5 % discount on all of the defined voltage parameters. 5 % of time makes 8,4 hours per week. That means that one could have problems reading the newspaper or watching TV or studying or doing the laundry EVERY DAY, but according to the standard, there would be no problem. Or the other way around: a company that produces some products could have ONE WHOLE WORKING DAY (8,5 h) in a week so bad power quality, that they could not produce anything, but the standard would see no problems. We must not forget, that this 5 % discount does not even apply at some extraordinary events. So, when the situation in the network is bad because of some natural catastrophe or some other event which can not be handled by the DSO in the normal way, the standard does not even apply! So the 5 % discount is used at the times, when the network should be doing OK.
- The **10-minute averaging is too long!** A lot of real PQ problems, that are present at the end-user can be hidden in that relatively long interval of 10 minutes.
- The **+/- 10 % voltage limits are too wide!** If one combines +/- 10 % limits with the 10 minute averaging and a 5 % discount, there is a lot of poor PQ, which can be hidden in that package. The distribution network in Slovenia has been and still is developed for a much narrower limits (nearly half of that, prescribed in the standard), and for the 100 % of time!
- The **P_{lt} indicator alone can not give enough information about the flicker!** The usage of only the P_{lt} indicator is not enough, to determine the PQ condition in the network. There could be a lot of disturbing events in that 2 hour interval, that would be obscured by the 2 h averaging.
- The **standardized classification of voltage dips is needed ASAP!** Voltage dips are a big problem. Especially when talking about the industry consumers. There are some standardized curves (ITIC, SEMI,...) but there is still the problem of impact of the



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dips to the electrical appliance. When one measures the PQ at the PCC of the consumer, the DIP recorded there could have much different course than one recorded at the appliance, because of the other appliances in the vicinity. The duration of the dip is also an essential information, when talking about the dips.

- The **supply interruption limit at 1 % is absurd!** What is an interruption? It is the condition in the network, when appliances can not operate (in any way). We know, that appliances can operate (do not shut down) when the voltage is 0 %, as long as this lasts only a very short time. But on the other hand a voltage dip to 80 % of the remain voltage can cause a shutdown, if it persists for a longer time. So the limit should be set dynamically and the time parameter should be also used when dealing with the dip/interruption classification.
- The **lack of experiences and example cases on closing the PQ contracts.** Our experiences show, that the consumers do not really know, what level of voltage quality would be good enough for them considering the costs it would provoke. Some consumers even expect the quality of voltage to be at its best, but with no extra costs for them. The distribution companies on the other hand do not want to close any of the PQ contracts, because they are afraid of what consequences they would bring. The problem is also the contents of such a contract. There are simply not enough experiences published about that and people do not know what to expect. There is also a problem of bad PQ being delivered from the TSO to the DSO's in some areas (regarding short interruptions and flicker). There is practically nothing a DSO can do to improve the PQ in those cases. How should the PQ treat such cases?

We suggest following:

- Abandon the "5 % discount" for it only obscures the problems and can be misleading when analyzing the PQ campaign results.
- Instead (or perhaps along with) the 10-minute averaging a much shorter averaging period should be used (e.g. 1-minute) for the same reasons as in the previous bullet.
- Voltage limits should be narrowed. Or when using the 1-minute averaging those limits could stay, but for the 10-minutes averaging narrower limits should be set.
- Besides the P_{lt} indicator, the P_{st} indicator (based on the 10-minutes flicker level average) should be used also! Its limits could be set a bit higher than for the P_{lt} indicator, but it should be used too.
- The dynamic dip/interruption classification is needed! It could be based on some existent curve (SEMI, ITIC,...) with some modification or not. The main point is, to add to the dip and the interruption classification the TIME parameter. So every event that lies below the nominal voltage and is still inside the so-called "cone" of that curve is treated as a DIP. When this dip lasts long enough (with the same amplitude) it becomes an INTERRUPTION. So the limit for the dip and interruption is no longer 1 %, but is dynamically set according to the duration of the event. The index SARFI



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could be used together with the indexes SAIDI and SAIFI as the indicator of the condition of the network.

- The PQ contracts should be adopted more widely. A sample PQ contract (like the Emerald Contract in France) should be adopted for all consumers connected to the medium voltage level. Guidelines for composing individual PQ contracts should be published including the setting of limits in reference to the PQ statistics at the PCC of the consumer.

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Best Regards,

mag. Dejan Matvoz

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