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Power Quality measurements near DER and disturbing loads

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Abstract. This paper describes the results of a four years (2006-2010) Power Quality (PQ) monitoring campaign conducted in the Dutch networks. Purpose is to get insight in the PQ at the point of connection (POC) of some connected customers with typical characteristics as for example distributed energy resources (DER) and to compare these results with the limits given in the EN50160. The results show however no specific problems near a large amount of photo voltaic (PV) panels. There was no correlation found between the harmonic distortion of the grid voltage and the production of solar energy. P_{st} levels are slightly higher on semi-cloudy days, but due to the low grid impedance never exceed the standard limits. Also near wind turbines no problems with the PQ are visible. The PQ near disturbing loads, like variable speed drives (VSDs), shows higher 5th and 7th order harmonics on MV level.
Overall, because of the usually strong Dutch grids, no PQ problems were measured at the specific locations.

Key words

Keywords- Power Quality (PQ); distributed energy resources generation (DER); point of connection (POC); EN50160; PQ monitoring.

1. Introduction

The paper describes the results of the PQ monitoring campaign within the EOS-LT 'Voltage Quality of the Future Infrastructure' (KTI) project [1]. A four-year measurement campaign is being carried out, acquiring Power Quality (PQ) data at 20 different locations in the Dutch LV, MV and HV grids. Purpose is to get insight in the PQ at the Point Of Connection (POC) of some connected customers with typical characteristics as for example distributed energy resources (DER) and to compare these results with the limits given in the EN50160 [2] and Dutch 'Grid Code' [3]. The requirements in the Dutch Grid Code, at some points, are different from the requirements in the EN50160. The most important differences are the requirements on flicker (P_{lt} <5 for 100% of the time), THD(U) and 5th order harmonic voltages. All differences between the EN50160 standard and the Dutch 'Grid Code' are given in Table 1.

Table 1 Main differences between the EN50160 standard [2] and the Dutch 'Grid Code' [3]

Parameter	Dutch Grid Code	EN50160
Flicker severity	Plt ≤ 5 during 100% of the time	Plt ≤ 1 during 95% of the time
Voltage unbalance	Negative sequence voltage<3% of the positive sequence during 100% of time	Negative sequence voltage<2% of the positive sequence during 95% of time
Total harmonic voltage distortion	THD(U)≤12% during 99.9% of the time	THD(U)≤8% during 95% of the time
5th harmonic voltage	9% for the 99.9% of the measurement period	6% for 95% of the measurement period
Fast voltage variations	≤10% Un; it is ≤3% Un in situations without loss of production.	As per IEC 61000-3-3 limits, relative steady state voltage change ≤3.3% Un

2. Details measurement equipment

The equipment used in the monitoring program measures according to the EN 61000-4-30. A UPS (12V/1,2 Ah) is integrated to have an average autonomy of 30 minutes. All devices are equipped with a GSM/GPRS modem for communication with the central database. Downloading of the measurement data is performed every day, while the internal memory is 512 MB (enough for 2 month measuring when recording 10 minutes RMS data). The data is analyzed following the standard EN 50160 and the influence of the connected load on the voltage is analyzed.

3. Measurement locations

The measurements locations were chosen in the neighborhood of DER, household loads or disturbing