# MEASUREMENT APPROACH FOR MONITORING VOLTAGE DIPS IN HV AND MV NETWORKS

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## *ABSTRACT*

*Voltage dip is one of the power quality (PQ) problems that is causing major financial losses to industrial and commercial customers. To improve the quality of the network and to provide a supply voltage of sufficient quality, PQ monitors have been installed in the HV and MV networks. As the end-users are usually connected to the MV networks through Dyn transformers, measuring and then reporting dips based on the phase-to-ground measurement could result in unreliable information. In this paper, the transfer of voltage dips from the HV to the MV network, and then to the LV network is studied first. For phase voltage (field) measurements, improved ways of reporting dips are discussed. Then, better approaches of measuring and reporting dips are discussed, which bring a number of merits for the DSOs. The most appropriate measurement approaches are then proposed for monitoring dips in the HV and MV networks.*

## INTRODUCTION

Voltage dip is one of the PQ problems which is causing major financial losses and inconveniences to industrial and commercial customers [1]-[4]. This phenomenon is defined as the temporary reduction of the rms voltage below a specified start threshold followed by its quick recovery [5]. Voltage dip can be caused by the temporary rise of current during re-connection of big transformers and/or heavy loads (e.g. motors) at the customers' installations, but mostly by short-circuit faults which occur mainly in the HV- and MV networks [6], [7]. Customers are highly interested in high quality of the supply as their processes are directly affected by the disturbances in the networks. Besides, there is an interest from the regulatory bodies to set a limit for voltage dips. In order to provide supply voltage with sufficient quality, it is important that the grid operators measure more data continuously for long periods; know more about the quality of the supply voltage and get insight into the performance of the customers' equipment; and report the quality to the users. In the Dutch HV- and MV networks PQ monitors have been introduced and installed since 2006/07 [2], [8]; and more monitors will be installed in 2015 for dip measurements in the MV-networks.

The issue of measurement is one of the important challenges for the monitoring and regulation of voltage dips. The PQ monitors that are installed in the HV and MV networks are meant to measure phase-to-ground (or phase-to-neutral) voltages; and then phase voltage dips are directly reported [8]-[10]. However, there is a critical difference between measured dips and their impacts to the end-users. There is substantial literature on the characteristics of different types of voltage dips [10]-[14]. Different methods of reporting voltage dip indices in terms of a two-dimension (magnitude and duration) characterization are discussed in [15], [16]. Representing voltage dips of different characteristics at a POC [17] in the same way and by only two-dimensions makes the reporting even less trustworthy.

The measured data recorded by the monitoring devices which are installed at the most optimal locations of the HV- and MV [18] networks are far away from the terminals where the sensitive equipment are connected. Moreover, the propagation of voltage dips from the networks of high voltage-levels to the end-users is highly influenced by the types of HV/MV and MV/LV transformers [14], [19], [20]. In the Netherlands, the end-users are usually connected to the MV networks through Dyn transformers; and they are hardly affected by phase voltage dips in the MV networks. Hence, reporting phase dips of monitors in the HV- and MV networks can result in misleading conclusions. It is also hardly possible to distinguish the contributions of the HV- and MV networks to the overall voltage dips at the distribution network affecting the end-users. Additionally, it is difficult for the grid operators to identify the weakest part(s) of the network in order to improve the quality of the supply voltage and the performance for the end-users.

This paper firstly discusses the transfer of voltage dips from the HV to the MV, and then to the LV network. It relates the propagation of dips and the characteristics of voltages that affect the performance for the end-users. Improved ways of reporting dips are discussed and recommended for monitors which are meant to measure phase voltage dips. Besides that the paper concentrates on other approaches of measuring and reporting dips which can bring a number of merits for the DSOs. The merits and demerits of the different approaches are compared; and then the most appropriate approach is proposed for monitoring dips in the HV and MV networks.

## METHODLOGY

The results presented in this paper are based on computer simulations and filed measurements.

### Computer Simulations

To understand how dips are transferred from a HV to a LV network and to choose appropriate data of monitors for the HV and MV networks, an electrical system whose simplified network is shown in Figure 1 is modelled using DIgSILENT PowerFactory.

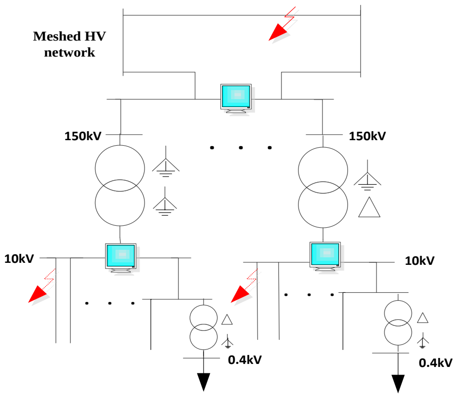


Figure 1: Simplified schematic for monitoring and transfer of dips

As it can be seen in Figure 1, MV networks can be connected to the HV networks through YNyn or YNd transformers; whereas end-users at LV level are mostly connected to the MV network through Dyn transformers. Single phase-to-ground (LG), double phase-to-ground (LLG), phase-to-phase (LL) and three phase (3L) faults are considered in the HV network; and the transfer of the dips through different types of transformers to the MV and LV networks are studied with the help of simulation results. To select the most appropriate measurements of monitors, three scenarios are discussed in this paper.

**Scenario I**

This is the case when all MV substations that are connected to the same HV monitoring point are star/delta substations (i.e. all DSOs connected to a TSO are with YNd transformers). The transfer of dips with this situation are explained in the *Results and Discussion* section; and the contribution of the MV network to the line dips at the monitoring point can be obtained using:

$$LD_{MV} = TLD_{MV} - PD_{HV} \tag{1}$$

where $LD_{MV}$, $TLD_{MV}$ and $PD_{HV}$ in (1) are the line dips originating only from the MV network, total line dips monitored in the MV network, and phase dips monitored in the HV network respectively.

**Scenario II**

In contrast with scenario I, only star/star substations are assumed, with this scenario, to be connected to the same HV measurement point (i.e. all DSOs connected to a TSO are with YNyn transformers). The transfers of dips with this type of configuration are explained in the *Results and Discussion* section; and the contribution of the MV network to the line voltage dips at the monitoring point can be estimated by:

$$LD_{MV} = TLD_{MV} - LD_{HV} \tag{2}$$

**Scenario III**

This case takes into an account that a combination of star/delta and star/star substations could possibly be connected to the same HV monitoring point (i.e. DSOs connected to a TSO could be with YNd and YNyn transformers). The transfer of dips to the end-users can be as in Scenario I or Scenario II; and the contribution of the MV network to the line voltage dips at the monitoring point of the MV network can be estimated as:

$$LD_{MV} = \begin{cases} TLD_{MV} - PD_{HV}, \ if \ HV/MV = YNd \\ \\ TLD_{MV} - LD_{HV}, \ if \ HV/MV = YNyn \end{cases} \tag{3}$$

## Filed Measurements

In this paper, a four-year field measurement data set is used for reporting voltage dips in different ways. The data set is from a monitor that is installed at one of the 10kV networks in the Netherlands; and its simplified schematic is shown in Figure 2.

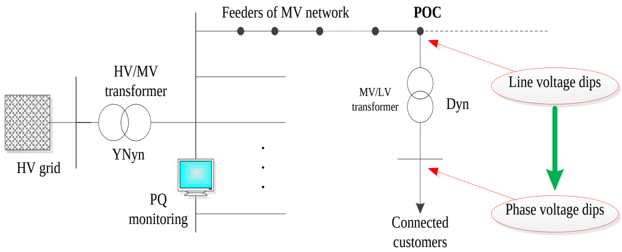


Figure 2: Simplified schematic for a10kV (Nijkerk) network

Figure 2 shows that measurements are taken from the main substation, which is the most appropriate location for monitoring dips [18]. The data set of the PQ monitor includes a four-year measurement of phase voltage dips originating from the HV and MV networks.

## RESULTS AND DISCUSSION

In this section the transfer of dips, different approaches of measuring and reporting voltage dips and their consequences are discussed with the help of simulation results and field measurement data.

## Transfer of Voltage Dips to End-users

Figure 3 and Figure 4 demonstrate the transfer of two-phase and single-phase dips in the HV network to the MV network through YNyn and YNd transformers, and then to the LV network through a Dyn transformer. Table I and Table II show the general insight into the transfer of dips, because of different faults, to the end-users.

As it can be seen in Figure 3 and Table I, the phase dips ($U_a$, $U_b$, $U_c$) and line dips ($U_{ab}$, $U_{bc}$, $U_{ca}$) in the HV network are transferred to the corresponding phase and line dips in the MV network through a YNyn transformer. Then, line dips in the MV network are transferred to phase dips in the LV network through a Dyn transformer.

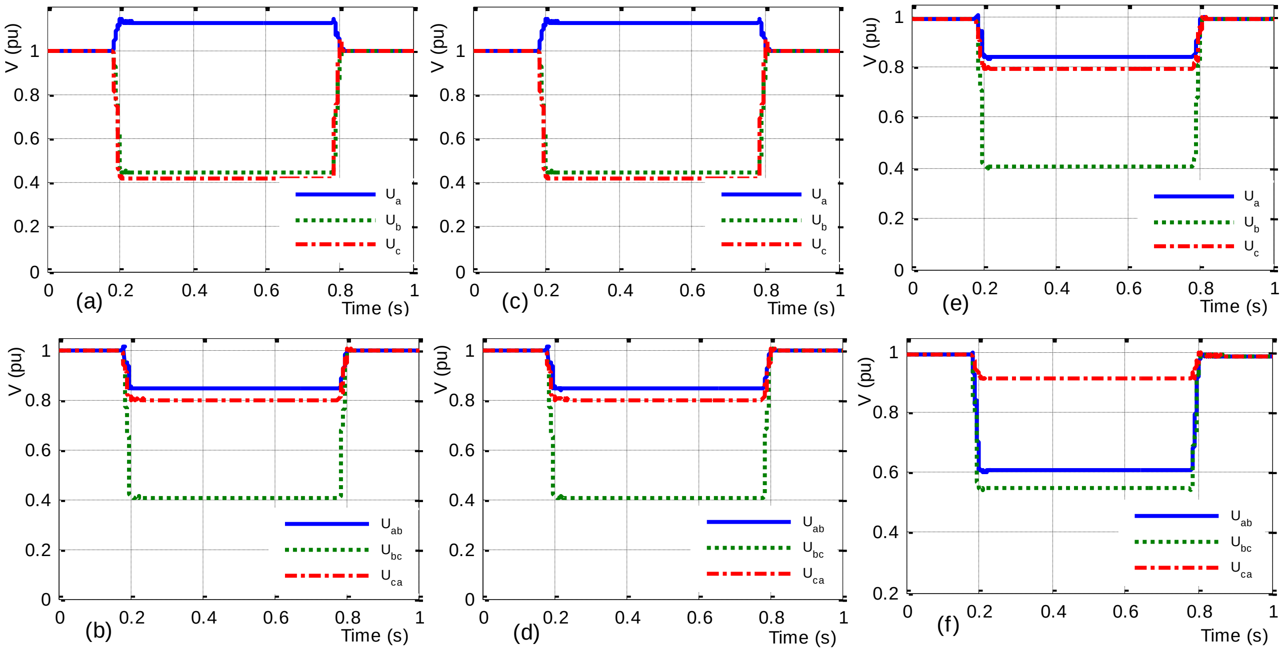


Figure 3: Propagation of dips due to two phase-to-ground faults in the HV network through YNyn and Dyn transformers - (a) phase voltages at HV, (b) line voltages at HV, (c) phase voltages at MV, (d) line voltages at MV, (e) phase voltages at LV, (f) line voltages at LV

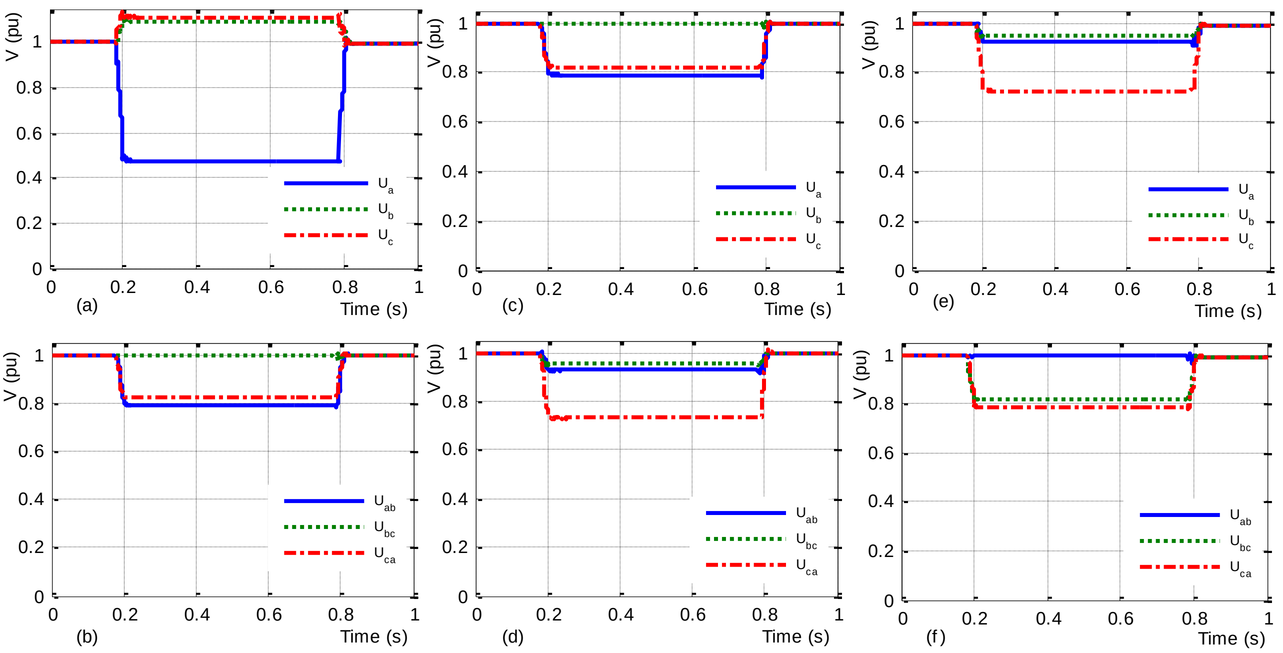


Figure 4: Propagation of dips due to single phase-to-ground faults in the HV network through YNd and Dyn transformers - (a) phase voltages at HV, (b) line voltages at HV, (c) phase voltages at MV, (d) line voltages at MV, (e) phase voltages at LV, (f) line voltages at LV

Table I: Transfer of different types of dips through YNyn and Dyn transformers

| **Fault** | **Monitor at HV** | | | | | | **Monitor at MV** | | | | | | **POC at LV** | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| ***at HV*** | $V_a$ | $V_b$ | $V_c$ | $V_{ab}$ | $V_{bc}$ | $V_{ca}$ | $V_a$ | $V_b$ | $V_c$ | $V_{ab}$ | $V_{bc}$ | $V_{ca}$ | $V_a$ | $V_b$ | $V_c$ |
| *LG* | 0.5 | 1.2 | 1.2 | 0.9 | 1.1 | 0.9 | 0.5 | 1.2 | 1.2 | 0.9 | 1.1 | 0.9 | 0.9 | 1.1 | 0.9 |
| *LL* | 1.1 | 0.7 | 0.6 | 1 | 0.4 | 0.9 | 1.1 | 0.7 | 0.6 | 1 | 0.4 | 0.9 | 1 | 0.4 | 0.9 |
| *LLG* | *1.3* | *0.4* | *0.4* | *0.9* | *0.4* | *0.9* | *1.3* | *0.4* | *0.4* | *0.9* | *0.4* | *0.9* | *0.9* | *0.4* | *0.9* |
| *3L* | 0.4 | 0.4 | 0.4 | 0.4 | 0.4 | 0.4 | 0.4 | 0.4 | 0.4 | 0.4 | 0.4 | 0.4 | 0.4 | 0.4 | 0.4 |

Table II: Transfer of different types of voltage dips through YNd and Dyn transformers

| **Fault** | **Monitor at HV** | | | | | | **Monitor at MV** | | | | | | **POC at LV** | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| ***at HV*** | $V_a$ | $V_b$ | $V_c$ | $V_{ab}$ | $V_{bc}$ | $V_{ca}$ | $V_a$ | $V_b$ | $V_c$ | $V_{ab}$ | $V_{bc}$ | $V_{ca}$ | $V_a$ | $V_b$ | $V_c$ |
| *LG* | 0.5 | 1.1 | 1.1 | 0.8 | 1.1 | 0.9 | 0.8 | 1.1 | 0.9 | 1 | 1 | 0.8 | 1 | 1 | 0.8 |
| *LL* | 1.1 | 0.7 | 0.6 | 1 | 0.4 | 0.9 | 1 | 0.4 | 0.9 | 0.7 | 0.6 | 1.1 | 0.7 | 0.6 | 1.1 |
| *LLG* | 1.1 | 0.5 | 0.4 | 0.9 | 0.4 | 0.8 | 0.9 | 0.4 | 0.8 | 0.6 | 0.6 | 1 | 0.6 | 0.6 | 1 |
| *3L* | 0.4 | 0.4 | 0.4 | 0.4 | 0.4 | 0.4 | 0.4 | 0.4 | 0.4 | 0.4 | 0.4 | 0.4 | 0.4 | 0.4 | 0.4 |

With YNd and Dyn transformers, simulation results in Figure 4 and Table II show that phase dips in the HV network become line dips in the MV network, except for single-phase faults, and then turn out to be phase dips in the LV network. For end-users connected to the MV network through Dyn transformers, which usually is the case in the Netherlands, the results show that the type of transformers affect the transfer of dips; and line dips in the MV network are very significant in analyzing the quality of supply voltage at their points of connections.

## Classical Approach of Measuring and Reporting Voltage Dips

Reporting the phase voltage dips directly from the monitors of the HV- and MV networks can significantly overestimate the number of voltage dips seen by the end-users. In Table III, a four-year dip profile that is measured at the Nijkerk 10kV substation is presented using the EN 50160 standard table.

Table III: Phase voltage dips based on a four-year measurement data at the Nijkerk 10kV network

| Residual voltage (pu) | Duration (s) | | | | |
|---|---|---|---|---|---|
| | $0.01 \le t \le 0.2$ | $0.2 < t \le 0.5$ | $0.5 < t \le 1$ | $1 < t \le 5$ | $5 < t \le 60$ |
| $0.9 > u \ge 0.8$ | 8 | 1 | 1 | 0 | 0 |
| $0.8 > u \ge 0.7$ | 2 | 2 | 1 | 2 | 0 |
| $0.7 > u \ge 0.4$ | 25 | 1 | 1 | 7 | 0 |
| $0.4 > u \ge 0.05$ | 6 | 1 | 0 | 1 | 0 |
| $u < 0.05$ | 0 | 0 | 0 | 0 | 0 |
| Total | 59 | | | | |

In Table III, all dips are added up and reported without any indication how significant the dips are to the grid operator and to the customers. One-phase faults are dominant in the HV- and MV networks [4]; but they are not perceived as dips in the LV networks. Thus, reporting all the phase voltage dips, in this way, may not give reliable information about the quality of the network and the impacts to the end-users. Moreover, the grid operator cannot easily identify the weakest part(s) of the network as it is not easy to distinguish the dips coming from the HV and MV networks affecting the end-users.

## Improved Ways of Reporting for Classically Measured Voltage Dips

For monitors intended to measure phase voltages dips, two methods of reporting dips are recommended in this paper, which will deliver better information about the quality of the supply voltage and network performance for end-users than the classical approach.

The first approach is by indicating the type of dips (1ph, 2ph and 3ph for dips caused by single-phase, two-phase and three-phase faults respectively), in the standard dip table, while reporting phase voltage dips. Reporting dips in this way helps us obtain better insight into the occurrence of each dip type, the quality of the network and impact of the dips to the customers. With this approach, the four-year voltage dips recorded at the Nijkerk MV network are presented in Table IV.

Table IV: Phase voltage dips recorded during 2010-2013 at the Nijkerk 10kV network by indicating their source

| Residual voltage (pu) | Duration (s) | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | $0.01 \le t \le 0.2$ | | | $0.2 < t \le 0.5$ | | | $0.5 < t \le 1$ | | | $1 < t \le 5$ | | | $5 < t \le 60$ | | |
| | 1ph | 2ph | 3ph | 1ph | 2ph | 3ph | 1ph | 2ph | 3ph | 1ph | 2ph | 3ph | 1ph | 2ph | 3ph |
| $0.9 > u \ge 0.8$ | 6 | 2 | 1 | 1 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| $0.8 > u \ge 0.7$ | 2 | 0 | 0 | 2 | 0 | 0 | 0 | 0 | 1 | 2 | 0 | 0 | 0 | 0 | 0 |
| $0.7 > u \ge 0.4$ | 20 | 4 | 0 | 1 | 0 | 0 | 0 | 1 | 0 | 7 | 0 | 0 | 0 | 0 | 0 |
| $0.4 > u \ge 0.05$ | 4 | 2 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 0 |
| $u < 0.05$ | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Total | 46 | 11 | 2 | | | | | | | | | | | | |

As it can be seen from Table IV, most of the dips (~78%) stem from single-phase faults which do not affect the end-users. Thus, the grid operator and end-users should only consider the number of dips that affect to the quality of the network and the performance of the loads.

The second approach is reporting the line voltage dips that can be obtained from the phase voltages recorded by the monitors of the MV substations. Table V presents the line dips which are attained from the phase dips of the Nijkerk MV network recorded in the period 2010-2013. It is very clear that only 12 dips (~20%) of the total phase dips in the MV network affect the end-users.

Table V: Line dips at the Nijkerk 10kV network during 2010-2013

| Residual voltage (pu) | Duration (s) | | | | |
|---|---|---|---|---|---|
| | $0.01 \le t \le 0.2$ | $0.2 < t \le 0.5$ | $0.5 < t \le 1$ | $1 < t \le 5$ | $5 < t \le 60$ |
| $0.9 > u \ge 0.8$ | 4 | 0 | 1 | 0 | 0 |
| $0.8 > u \ge 0.7$ | 0 | 1 | 0 | 0 | 0 |
| $0.7 > u \ge 0.4$ | 5 | 0 | 0 | 0 | 0 |
| $0.4 > u \ge 0.05$ | 0 | 1 | 0 | 0 | 0 |
| $u < 0.05$ | 0 | 0 | 0 | 0 | 0 |
| Total | 12 | | | | |

Both approaches give better insights into the dips that influence the quality of supply voltage and performance for end-users. All of the ‘2ph’ dips, in the first approach, may not always be experienced by the customers. The second approach requires extra task of extracting line dips externally from the monitoring system if phase dips are only recorded. From such data of only the distribution networks, it also remains difficult (in both approaches) to distinguish the contributions of the HV and MV networks to the total dips; and to identify the weakest network(s).

## Proposed Approach of Measuring and Reporting Voltage Dips

The simulation results, about transfer of dips, prove that line voltage dips in the MV network affect the quality of the supply voltage and performance for the end-users. However, the phase or line dips in the HV network may become line dips in the MV network depending on the configuration type of HV/MV transformers. Considering the three scenarios that are discussed in this paper, Table VI gives a summary of the most appropriate approaches of measuring and reporting voltage dips that are proposed in this paper for adoption. Based on this approach, it is recommended that monitors of the MV networks record line dips. Then, the dips can be directly reported without losing information and without misleading conclusions.

Table VI: Proposed measuring and reporting approaches of PQ monitors in the HV- and MV networks

| Scenario | Monitoring dips at the HV network | Monitoring dips at the MV network |
|---|---|---|
| **Scenario I** | Phase voltages | Line voltages |
| **Scenario II** | Line voltages | Line voltages |
| **Scenario III** | Phase and line voltages | Line voltages |

If the dips originating from the HV network are also properly monitored (in the HV), the contributions of the HV- and MV networks to the total dips affecting the end-users of the distribution network can be estimated using (1)-(3). This approach solves the limitations that emanate from the classical and improved approaches of reporting dips. Besides that this approach is very useful as it avoids overestimated numbers of dips seen by end-users and evades further calculations of dip data externally from the monitor. Moreover, this approach can undoubtedly help in the efforts of setting limits to voltage dips.

## CONCLUSION

Statistics of voltage dips can lead to misleading conclusions if the specific dips are not monitored and reported properly. With the PQ monitor settings, where monitors in the HV- and MV networks are meant to measure phase voltage dips, better information of voltage dips in the MV substations can be gathered by including the source of the dips (1ph, 2ph or 3ph faults) while reporting. The fact that one-phase dips of the HV and MV networks hardly affect the end-users paves the way to paying more attention to the (two-phase and three-phase) dips which significantly affect the customers. By recalculating the line voltage dips in the MV network, in which one-phase dips from the HV and MV networks are not seen by end-users, it is also possible to focus on the dips that ultimately affect the end-users. With more reliable information, line dips of the MV networks can then be reported using the standard dip table in EN 50160. With these approaches, it still remains difficult to determine the contributions of the HV- and MV networks to the total voltage dips in the distribution networks.

By relating the transfer of dips to the characteristics of voltages that affect the end-users, it is recommended that line voltage dips should be monitored and reported in the MV networks. To distinguish the contributions of the HV- and MV networks to the total number of dips monitored in the MV networks, the monitors of the HV networks are recommended to measure phase and/or line voltage dips. This approach can assist the grid operators to gain better insight into the quality of the networks; and the end-users can receive reports of voltage dips with more reliable information than the classical approach.

The impact of dips to the customers greatly depend on the design and robustness of process equipment. Immunity of process equipment to dips, possible mitigation techniques and costs involved with dips are part of future study.

## REFERENCES


[1] J. Manson and R. Targosz, 2008, "Leonardo PQ initiative team-European Power Quality Survey Report".

[2] CEER Report, 20111, "5th Council of European Energy Regulators Benchmarking Report on the Quality of Electricity Supply".

[3] J.F.G. Cobben, 2012, *Power quality Problems and Solutions*, Arnhem, The Netherlands.

[4] S. Bhattacharaya, J.F.G. Cobben and W.L. Kling, 2010, "Assessment of Impacts of Voltage Dips for MV Customer", *IEEE Proc. of 14th International Conference on Harmonics and Quality of Power (ICHQP)*, Bergamo, Italy.

[5] "Voltage characteristics of electricity supplied by public electricity networks", European standard, EN 50160 (2010), 2010.

[6] "Voltage dips and short interruptions on public electric power supply systems with statistical measurement results", International standard, IEC 61000-2-8 (2002), 2002.

[7] P. Heine and M. Lehtonen, 2003, "Voltage Sag Distributions Caused by Power System Faults", *IEEE Transaction on Power Systems*, vol. 18, pp. 1367–1373, Nov. 2003

[8] T. Bogaert and L. Derksen, 2014, "Spanningskwaliteit in Nederland, resultaten2013", Netbeheer Nederland, Tech. Rep. RM-ME-RM131261-01/Versie1.0, April 2014.

[9] CIGRE report, 2010, "Voltage Dip Immunity of Equipment and Installations", Tech.Rep. *CIGRE/CIRED/UIE Joint Working Group C4.110*, April 2010.

[10] "IEEE Guide for Voltage Sag Indices", IEEE Std. 1564 (2014), March 2014.

[11] R. Chiumeo, M. de Nigris, C. Gandolfi, L. Garbero, and L. Tenti, 2010, "Voltage Dips Performance Characterization by PQ Indices at National and Macro Area Level," *14th IEEE Proc. of International Conference on Harmonics and Quality of Power (ICHQP)*, Bergamo, Italy.

[12] M. Piumetto and J.G. Targarona, 2013, "Characterization of Voltage Sags and its Impact on Sensitive Loads in a MV System with Distributed Generation for Single-phase Fault", *IEEE Latin America Transaction*, vol. 11, pp. 439–446, February 2013.

[13] M. Madrigal and B. Rocha, 2007, "A Contribution for Characterizing Measured Three-phase Unbalanced Voltage Sags Algorithm," *IEEE Transaction on Power Delivery*, vol. 22, pp. 1885–1890, July 2007.

[14] M.H.J. Bollen, 2000, *Understanding power quality problems: voltage sags and interruptions*, IEEE Press, New York.

[15] G. Matusz, T. Maj, Z. Hanzelka, and W.L. Agh, 2004, "Voltage Dips and Short Circuit Interruptions- Different Strategies in Contract for the Electric Power Supply", *Proc. of the CIGRE2004 General Session*, Paris, France, 29 August-3 September 2004.

[16] M. Bollen, P. Goossens, and A. Robert, 2004, "Assessment of Voltage Dips in HV-Networks- Deduction of Complex Voltages from the Measured RMS Voltages", *IEEE Transaction on Power Delivery*, vol. 19, pp. 783–790, April 2004.

[17] L.E. Weldemariam, V. Cuk, J.F.G. Cobben, and W.L. Kling, 2014, "The Influence of Critical Distance on Monitoring Dips in the MV Network", *IEEE proc. of 49th International Universities' Power Engineering Conference (UPEC)*, Culij-Napoca, Romania, 2-5 September 2014.

[18] L. E. Weldemariam, V. Cuk, J. F. G. Cobben, and W.L. Kling, 2014, "Monitoring of Dips in the MV Network for Regulation- A Case Study", *IEEE Proc. of 16th International Conference on Harmonics and Quality of Power (ICHQP)*, Bucharest, Romania, 25-28 May 2014.

[19] R. Mustapa, M. Serwan, N. Hamhah, and Z. Zakaria, 2010, "The Propagation of Voltage Sag through Transformer Connections in a Power System Network", *IEEE Proc. of 4th International Power Engineering and Optimization Conf.(PEOCO2010)*, pp. 424–429, Malaysia, 23-24 June 2010.

[20] L. Tenti, R. Chiumeo, and C. Gandolfithe, 2013, "Origin of Voltage Dips Monitored in MV Network and its Effect on the Evaluation of MV Voltage Dip Performances Indices", *22nd Proc. of International Conference and Exhibition on Electricity Distribution (CIRED 2013)*, Stockholm, 10-13 June 2013.