Reliability and Voltage Sags

The Process of Regulating Voltage Sags

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Some Projects
Definition: 3-phase dips

- The maximum difference between the RMS-value of the voltage and the nominal voltage.
- The time period during the first phase drops below 90% and the last phase recovers to normal level.
Sags responsible for high costs in industry

Voltage sags can trip sensitive equipment, causing disruption in industrial processes.
Regulation process of Voltage Sags

- Involvement of all stakeholders
- Measuring the “state of the network”
- Classification of voltage sags
- Defining the future goal
- Defining the limits
The stakeholders

- Industries, Network Operators, Producers, Regulator
Measurement Campaign

• Short-circuits in HV or MV-network
• Sags propagate from HV- to MV-network
• Fault in same feeder: interruption
• Fault in other feeder: sag

• Measuring at MV-busbar is good indication of number of sags and its duration and residual voltage
Measurement Campaign

• Current limiting coil: more shallow sags
• Secondary protection: few more severe sags
• DG in MV-network will result in a bit higher residual voltage
• Measuring at MV-busbar is still good indication of number of sags and its duration and residual voltage
Propagation to LV-network

• Single phase fault in MV will not result in sag in LV-network
Immunity curves

• Red line in table: class III, IEC 6100-4-11
• Class A: Could be defined as “No Severe Sag”
• Class B, C and D depending on protection settings
Defining the future goals

- Starting with the “state of the Network”?
- What are reasonable investments in the network?
- How could network configuration and protection be enhanced?
- Is local mitigation of Voltage Sags possible?
- What should be the improvements in future decennia?
- Questions to be answered by the stakeholders!
Defining the limits

- Class A: No limits required, No severe Sags
- Class B, C and D should get some numbers
- Start could be the 95%-limit of the measured dips

Measuring the amount of sags at many locations and calculating the average and 95 percentile of the occurring sags
Additional consideration: multiple sags

- Several possibilities
- Count as separate sags
- Count as 1 event and classify it with lowest residual voltage and longest duration
- Count it as 1 event, analyse every sag separately, classify every sag and classify the event as 1 in the most severe class

Advised!
Additional consideration

• When there are big differences in several years: use 3 or 5 year-average limits (2020-2025 and 2021-2026,...)

• Abnormal situations (galloping lines) should be excluded for regulation
Conclusions

• Voltage Sag Regulation will help to improve Reliability and Power Quality on the Point of Connection

• Responsibilities of Network Operator and Connected Parties should be well described and understood

• Connected Parties should get more insight into occurring sags and know about their tasks in mitigating sags
Questions?
Thank you