



# Norwegian Water Resources and Energy Directorate (NVE)

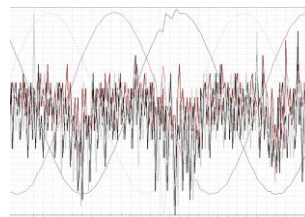


CEER-ECRB-EURELECTRIC Joint Workshop  
on Voltage Quality Monitoring,

Monday 1 October 2012, Brussels

## Norwegian legislation and regulations evolving beyond the EN 50160

Hege Sveaas Fadum  
Senior Engineer,  
Energy and Regulation Department  
Grid Section  
E-mail: [hsf@nve.no](mailto:hsf@nve.no)  
Ph: + 47 22 95 98 43



# Outline

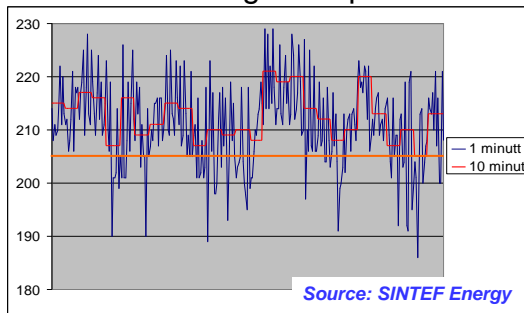
- Voltage quality parameters: Which requirements are beyond EN 50160?
- Continuously voltage quality monitoring
- Miscellaneous subjects regarding the Norwegian regulation

3

Norwegian Water Resources and Energy Directorate

## Supply voltage variations

- $V_{RMS}$  shall equal  $V_N \pm 10\%$ , measured in customer's connection point in the LV grid
- One- minute integration period:



4

- 100% of the time

Norwegian Water Resources and Energy Directorate

# Single rapid voltage changes, RVC

- Specified limits for number of RVC occurrences at connection point:
  - RVCs can result in reduced illumination-quality, hence people's annoyance and less efficiency whilst reading and writing

RVC	Maximum number permitted per day	
	$0,23 \leq U_N \leq 35$	$35 < U_N$
$\Delta U_{\text{steady state}} \geq 3\%$	24	12
$\Delta U_{\text{max}} \geq 5\%$	24	12

- If one RVC exceeds the limits for voltage variation ( $U_N \pm 10\%$ ) it is no longer an RVC, but shall still be included in the amount of permitted RVCs
- Exclusionary provisions: RVCs that occur because of...:
  - earth-faults, short-circuits, coupling of transformers, re-coupling after faults and necessary operational couplings
 ...are excepted from the required maximum number

5

# Supply voltage dips

- Maximum number of dips are included in the requirements to RVCs as shown in the previous slide.
- Aside from this, Norway has not yet found it adequate to set limits to amplitude or duration of dips.
- But NVE can order those covered by the regulation to reduce the scope or consequences of voltage dips.

6

## Flicker severity

- Requirements to long time flicker  $P_{lt}$ , applies to 100% of the time
- In addition, Norway has set requirements to short term flicker  $P_{st}$ , which applies to 95% of the week

$U_N$	$0,23 \text{ [kV]} \leq U_N \leq 35 \text{ [kV]}$	$35 \text{ [kV]} \leq U_N < \infty$	Time interval
Short time flicker severity, $P_{st} \text{ [pu]}$	1,2	1,0	95% of the week
Longtime flicker severity, $P_{lt} \text{ [pu]}$	1,0	0,8	100% of the time

Norwegian Water Resources and Energy Directorate

## Voltage harmonics and voltage unbalance

- THD:
  - Limits for all voltages (THD = 8%, 5%, 3%, 2%)
  - Ten min mean and week mean values
  - Calculated for the 40 first individual harmonics
- Individual harmonics:
  - As in EN 50160 (0,23-35 kV) up until 25<sup>th</sup> harmonic.
  - In addition, limits above 25<sup>th</sup>.
  - Limits for all voltage levels above 35 kV.
- Unbalance
  - Not exceed 2 %, 100 % of the time –all voltage levels

8

Norwegian Water Resources and Energy Directorate

# Voltage Quality Monitoring

## - Continuous monitoring

- Network companies are obliged to continuously register dips, swells and RVCs within their own power system above 1 kV.
  - These voltage parameters appear randomly in time, hence continuously monitoring is necessary in order to get a good picture of the situation.
  - No solid requirements for voltage dips and swells exist yet, even though large costs for end-users and the society are involved.
    - in Norway, between 170-330 MNOK (approx. 20-39 M€) annually for end-users.
  - Customers (end-users), need realistic reference values to be able to perform sound cost-benefit analysis for possible countermeasures within their own installations.
- The number of instruments and choice of voltage levels:
  - Balance the number of instruments and related costs
  - Trustworthy statistic
  - Characteristically networks
- Costs related are covered by each company.

9

Norwegian Water Resources and Energy Directorate

## Miscellaneous subjects regarding the Norwegian regulation of power quality

- Regulations applies to everyone that is connected to the power system:
  - Network companies, customers and power producers.
- Customer complaints:
  - Requirements on how the network companies shall handle disputes.
- Rectification without undue delay:
  - The one that is found responsible for generating disturbances exceeding the limits set in the regulation is obliged to rectify the problem without undue delay.
- Audits
  - Control how the network companies' routines and systems are handling the requirements in the regulation.
- Responsibility to give information on request
  - From existing and possible future customers (see 5th BR page 70)
- Hearing document:
  - Revision of some of the requirements is suggested from 2013.

10

Norwegian Water Resources and Energy Directorate



**Thank you for your attention!**

*Evening sky in the forest  
Photo: Hege Sveaas Fadum*