National grid power quality - today and tomorrow

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SWEDISH NATIONAL GRID

Outline

> Power quality in this presentation

> How Svenska kraftnät works with power quality

> Power quality today and tomorrow

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Power quality in this presentation

- Power quality as defined in
  - Svenska kraftnät Technical guidelines TR06 – Power quality
  - **NOT** SvKFS 2005:2 – Driftsäkerhetsteknisk utformning av produktionsanläggningar

How Svenska kraftnät works with power quality

- Technical guideline TR06 – Power Quality
  - TR06-01 – Voltage characteristics in the national grid
    - Svenska kraftnät is responsible for the voltage in the national grid. This document defines and specifies the main characteristics of the voltage in the national grid under normal conditions.
    - An appendix discuss and define the power quality disturbances
      - In an ideal power system every customers receive a voltage as follows:
        - Always clean sinusoidal, with a stable frequency, amplitude and with full symmetry. Any deviation, both long term and short term, from this can be described and characterized using various so-called power quality disturbances.

- Power quality disturbances are often divided into the following three groups:
  - Stationary disturbances
    - Stationary disturbances are permanent or slowly varying deviations. These phenomena are often well defined and can be relatively easily measured, described and quantified.
    - Long-term voltage variations, harmonics, flicker, unbalance, …
  - Event-driven disturbances
    - Event-driven disturbances are deviations, or disturbances, that occur sporadically, often caused by external events, such as thunderstorms. Incremental voltage changes associated with normal voltage control equipment such as capacitor banks and shunt reactors can be considered as an event-driven disturbances.
  - Interruptions – short and long

- TR06-02 - Planning and emission levels, measurement methods and responsibilities regarding power quality in the national grid
  - This document deals with planning levels and (very little) methods for the determination of appropriate emission levels related to power quality in the grid. It also discusses appropriate sharing of responsibilities.
  - Planning and emission levels primarily used for stationary power quality disturbances.
    - All new connections to the national grid is (should be) given emission levels and shall show finger-print measurements before and after connection
- For event-driven disturbances Svenska kraftnät try to limit these as much as possible by means of e.g.:
  - Careful selection of size of capacitor banks and shunt reactors
  - Careful design of groundings and shield wires
  - Insulation coordination

Power Quality today

- Power quality in the national grid monitored with a permanent monitoring system
  - Control meters used for permanent energy measurement system
    - Power quality meter Class A according to SS-EN 61000-4-30
  - In short – Yearly analysis show
    - Stationary – long-term voltage variations, harmonics, flicker, … - levels below the values as given in TR06-01.
    - Event-driven – Voltage dips/swells, transients, …. – levels vary depending mainly on frequency of lightning and other weather related events.

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Power quality tomorrow – Nuclear replaced with renewable

- Stationary disturbances
  - Power in-feed through converters – possible increase of disturbances, e.g. harmonics
    - It depends ……
    - Converter power in-feed may increase disturbances
      - Low- and high frequency harmonics, flicker etc.
    - Planning and emission limits important

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Cont.

- Event-driven disturbances
  - It depends ….
  - More devices for voltage control and reactive power compensation
    - capacitor banks and shunt reactors – possible more incremental voltage variations
  - More overhead lines and more meshed network – larger “antenna”
    - Possible more faults and possible more disturbances – voltage dips
  - Decreased short-circuit power
    - Deeper voltage dips in areas with decreased short circuit power
    - DFIG (contribute) contra full power converters (do not contribute)
    - Remaining nuclear power plants in areas with reduced short circuit power likely to experience deeper voltage dips

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