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Voltage quality regulation in Sweden

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Voltage quality in Sweden

- Responsibility of the network operator
- VQ monitoring only for internal use, no publication
- The regulatory process is triggered by a complaint
  - Step 1: try to reach agreement
  - Step 2: the regulator investigates the case
  - Step 3: the regulator can enforce measures on the network operator (measurements, remedying actions)

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What is acceptable voltage quality?

- Situation before
  - EN 50160
  - Reasonable number of events (dips, swells)
- A new set of limits
  - 100% of the time values for most of the EN 50160 levels
  - EN 50160 for flicker
  - New requirements for dips and swells
- No complaints = acceptable quality

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Voltage-quality variations

- Harmonics
  - EN 50160 levels hold 100% of time
  - MV levels for HV harmonics 17 – 25
- Unbalance
  - At most 2%, 100% of time
- Flicker
  - 95% of Plt during one week less than 1.0
- Slow voltage variations
  - All 10-minute values between 90 and 110%

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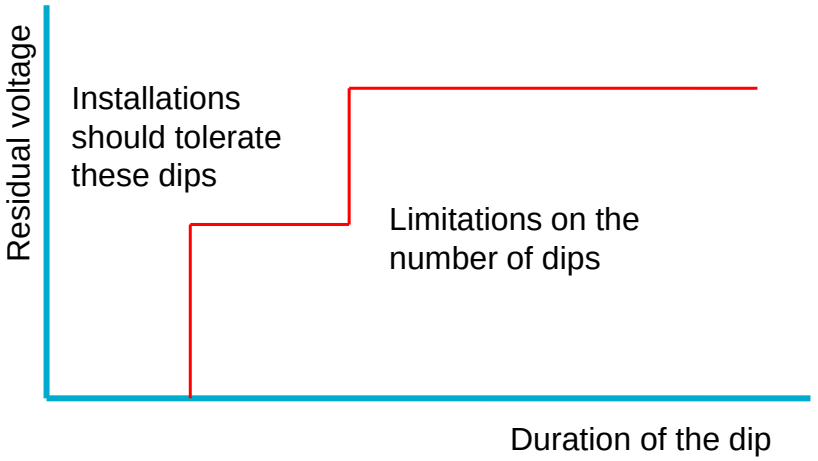
Responsibility sharing curve



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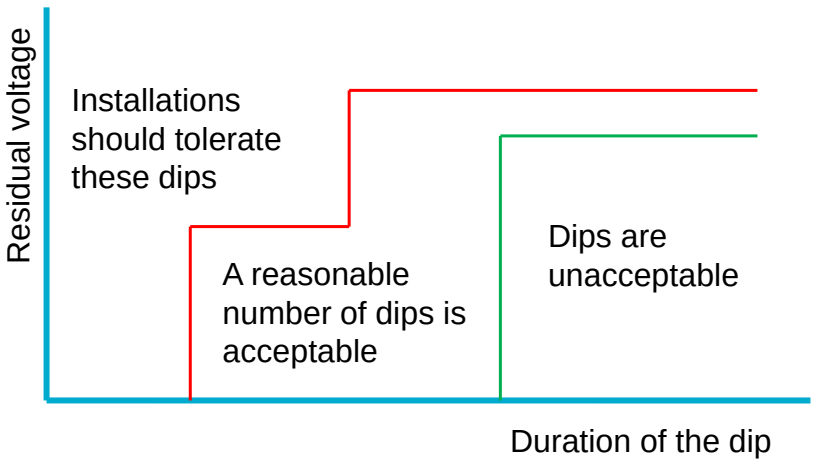
Voltage dips: Swedish regulation



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How to choose the curves?

- Dips, up to 45 kV
  - CIGRE/CIRED/UIE working group C4.110
- Dips, above 45 kV
  - Discussion between the stakeholders
- Swells, up to 1 kV
  - Protection requirements microgeneration
  - Highest overvoltages during earthfaults
  - Experiments on equipment damage

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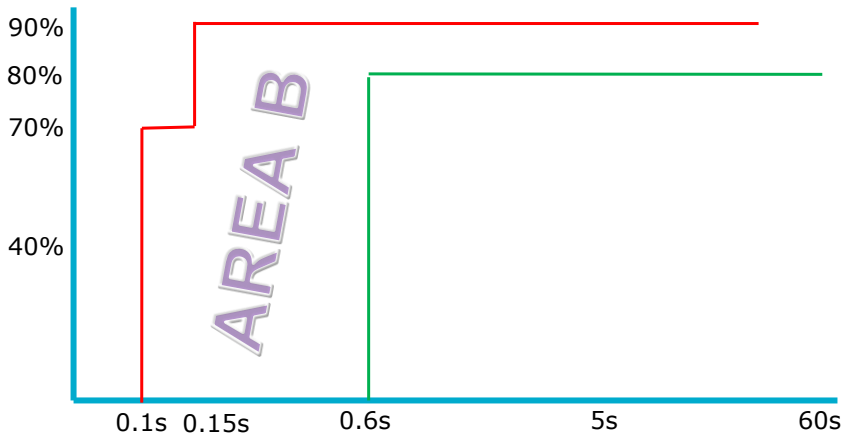
Dips nominal voltage above 45 kV



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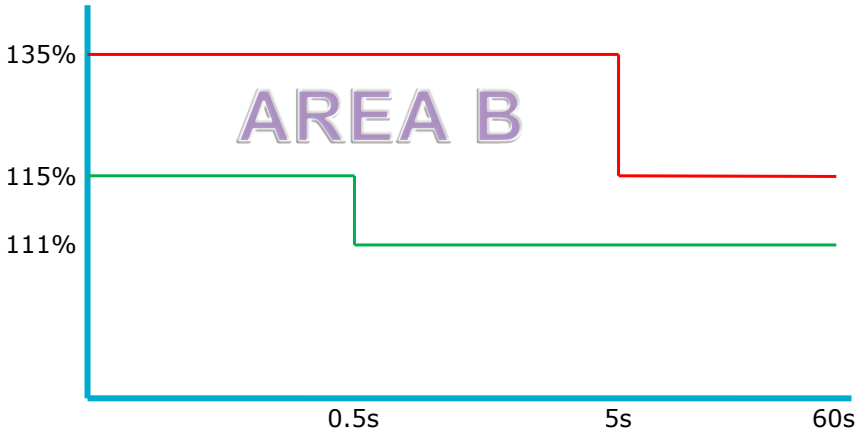
Voltage swells, up to 1 kV



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Conclusions

- New specification on what is considered acceptable voltage quality
- Variations: 100% of time
- Dips and swells: responsibility sharing

- Experience to be gained
  - on what are reasonable numbers of dips and swells
  - on whether adjustments need to be made on the responsibility sharing curves. Ideally only one curve