



Grid management with an eye to fleet charging

Oslo 23.10.2019

Background – Charging of electrical ferries

- The norwegian government has decided to change all ferries in Norway to low-emmission-connections during a period out of 12 years from 2018
- All ferry-contracts in Norway last approx. 10 years
- 2019-2020 approx. 30 contracts will be signed and the new ferries will be put into operation
- Up to now, all new contracts are signed with electric ferries

Topology and other issues representative for the situation

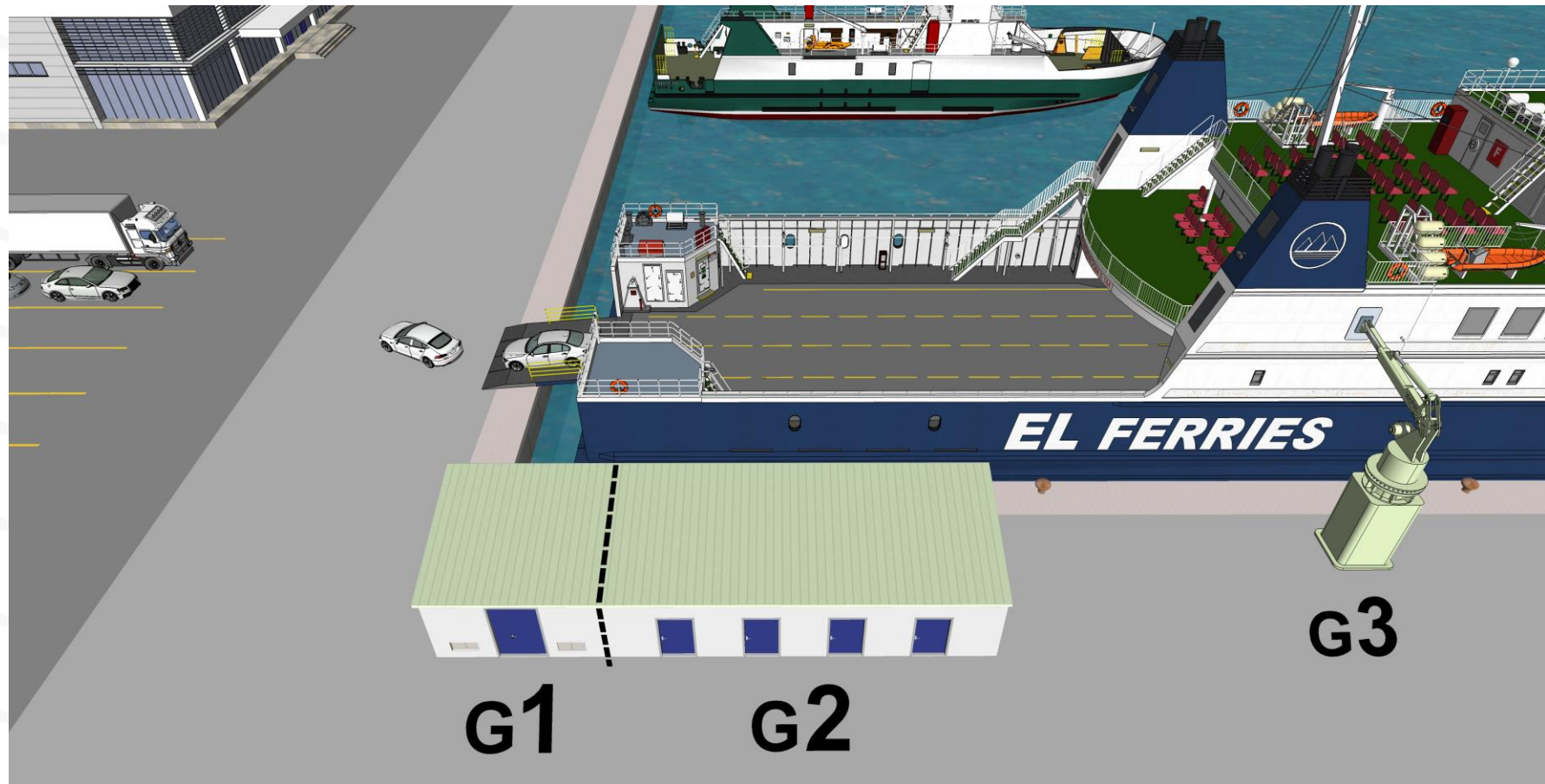
Many ferry perth's are situated at the far end of the grid

- The grid is often very weak
- The demand of power is high
- The use of electricity is short, 10 minutes charging
- The charging is done by AC/DC converting

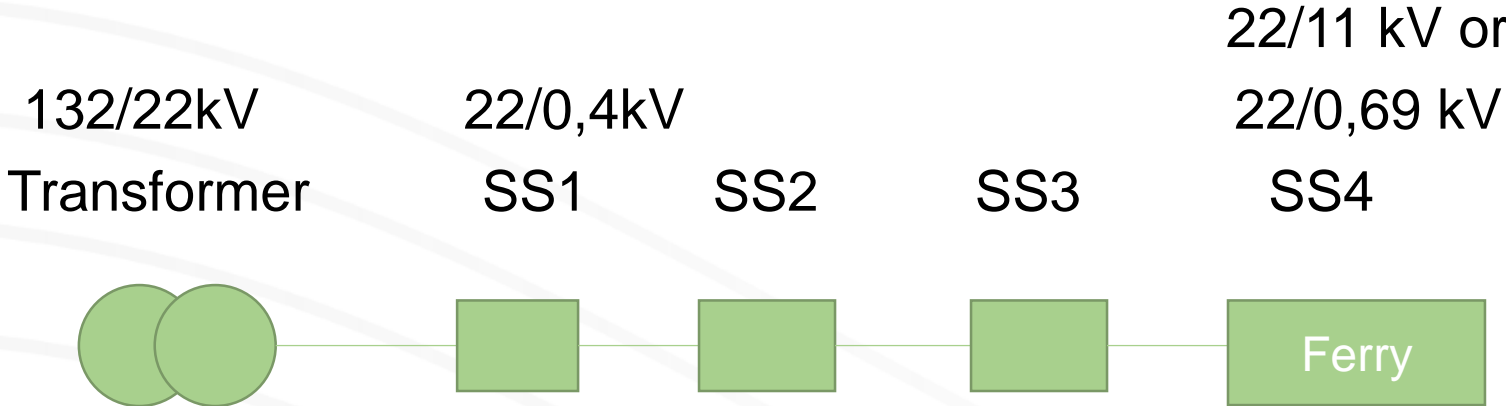
Connection point

Normal voltage delivered by the utility due to international standards:

- 690 V
- 11 kV



Typical grid



Planning and design

Main transformer(f.eks. 132/22 kV), capacity

MV-network(11kV eller 22 kV), capacity

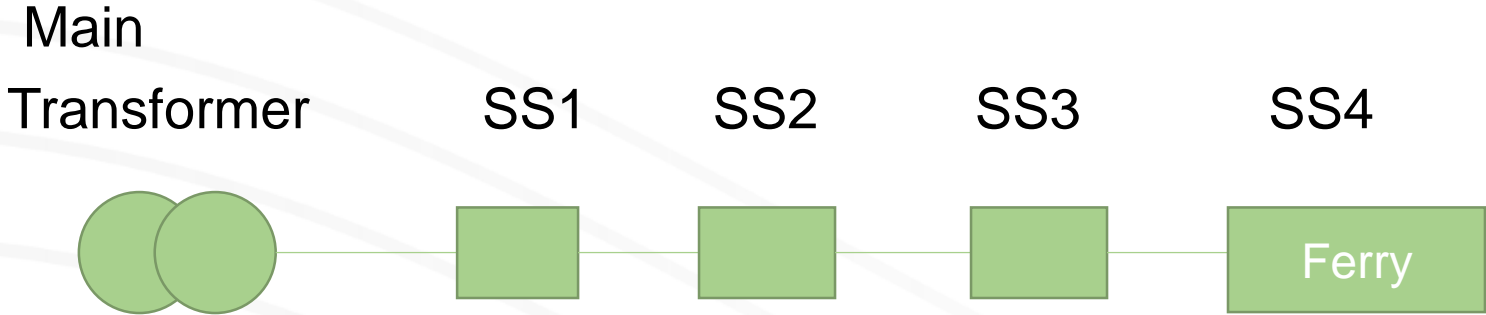
MV/LV substation – voltage and capacity

LV-network – voltage, capacity, short circuit conditions and voltage variations

Power Quality

Based on IEC61000-3-6 it is possible to sett emission-limits for the equipment the customer is planning to install.

Typical grid



Power quality regulations - demands

Demands at every single point in the grid due to

- Frequency – 50 Hz +/- 2%
- **Slow variation of the voltage – U_n +/- 10%**
- **Short-time overvoltage, Short-time undervoltage and voltage drop**
- Flicker
- Non-symmetric load
- **Harmonic Distortion**
 - THD allowed up to 8% during 10 minutes
 - THD allowed up to 5% during 1 week
 - **Single Harmonic Distortion needs to be examined**

Back to start - almost

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The combination give often problems during operation on/off – voltage variation and voltage drop.

- The use of electricity is short, 10 minutes charging – **will give many on/off during the day**
- The charging is done by AC/DC converting – **the equipment give problems with several single harmonic distortion.**
- **The chosen equipment is therefore important to the power quality**

Conclusion: recommendation to our customers

- **Start early to prepare a new customer's connection to the grid – not only for ferries and charging:**
 - *If possible, find the current distortion level in the actual grid*
 - *Use experts if necessary*
 - *Set limits for the customer's equipment*
 - *During the pre-connection period, keep a tight dialogue with the customer*