



Hubbell Industrial Controls

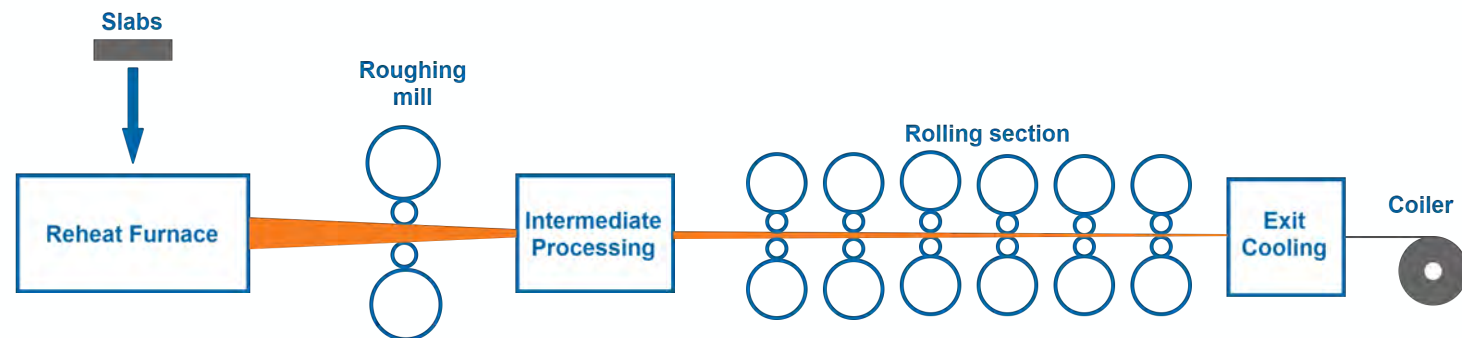
Steel Industry – Rolling mill

Steel industry training – Rolling mill

Rolling mill - overview

Rolling mill

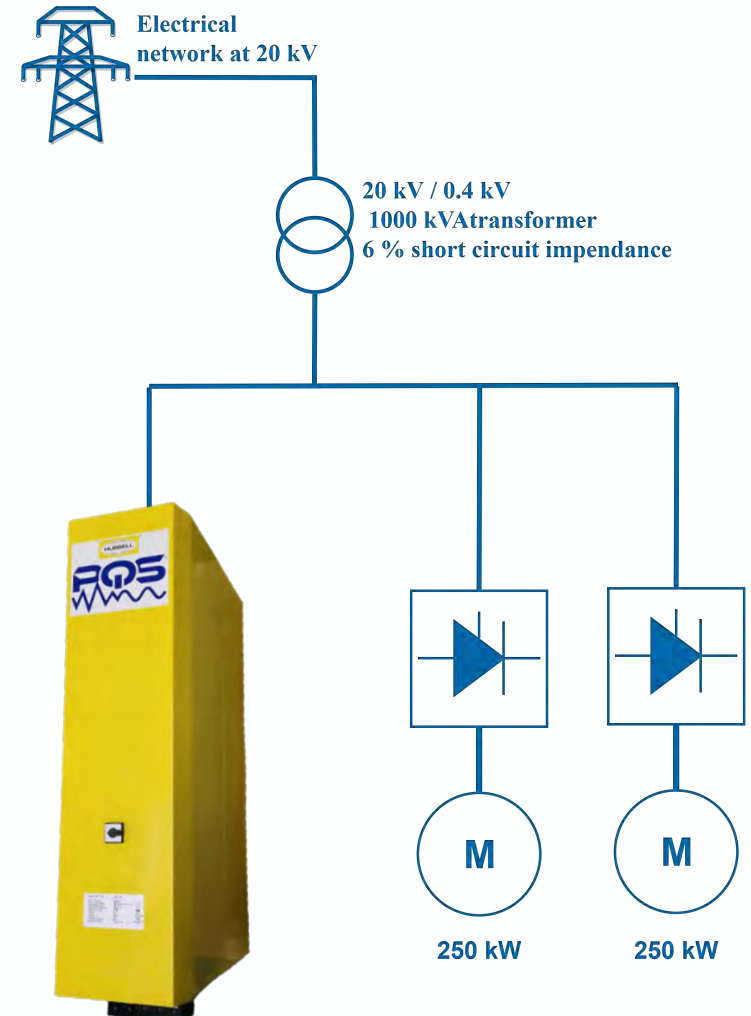
- Processing plant where steel slabs are processed into different forms
 - Bars
 - I-beams
 - Rails
 - Sheets
- Can be categorized to hot and cold rolling depending on the metal temperature
- Rolls are driven by electric motors
 - Voltage affects to the torque available from the motor
 - Motor drives create undesired effect in power grid



DC drive motor case study



- System is fed from 20 kV grid
- Two DC drives
 - Each drive connected to a 250kW motor
- PQS APEX solution connected in parallel with the loads



DC drive operation– Harmonics and commutation

- DC Drives create harmonic currents

where:

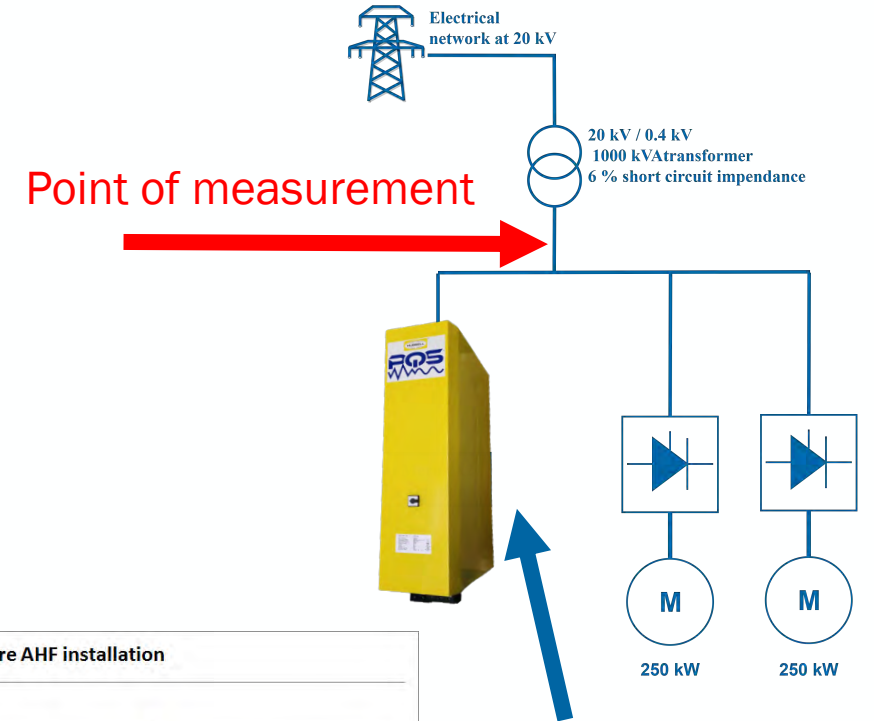
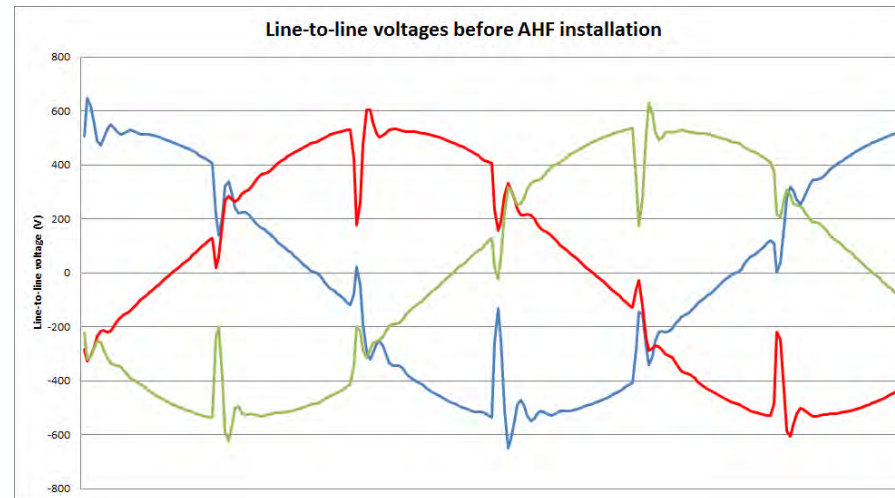
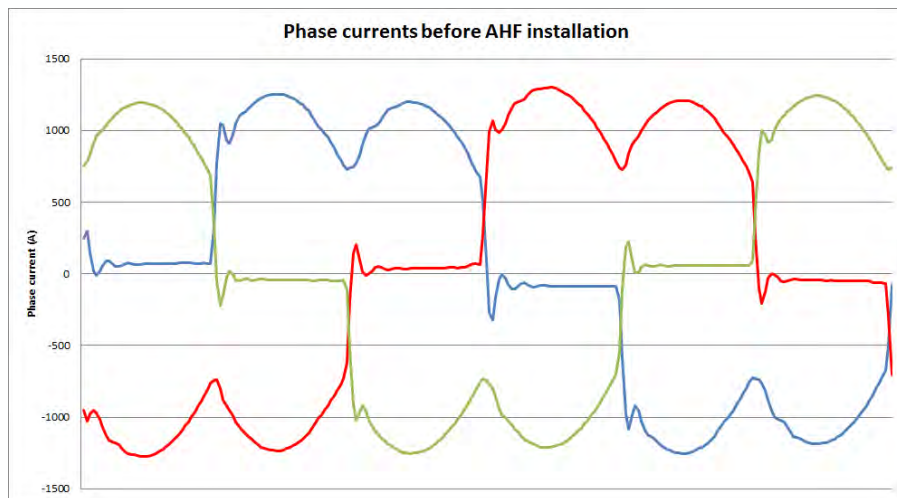
$$h_n = k * p_n \mp 1$$

p_n = pulse number

h_n = harmonic order

$k = 1, 2, 3, 4, \dots$ (integer)

- DC Drive commutation causes voltage notching



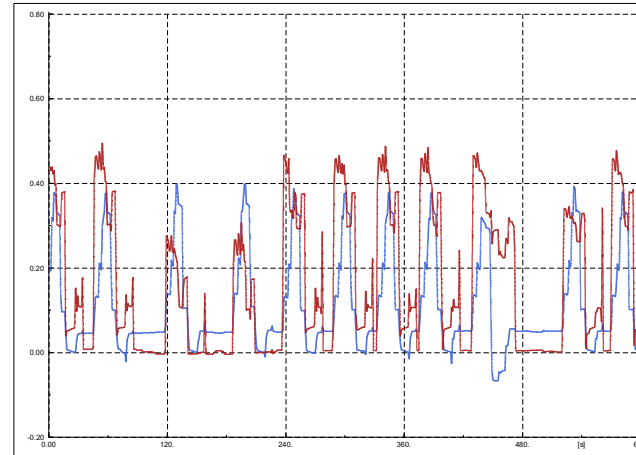
The active filter is filtering current harmonics and compensating reactive power locally

Results – Reactive power and voltage



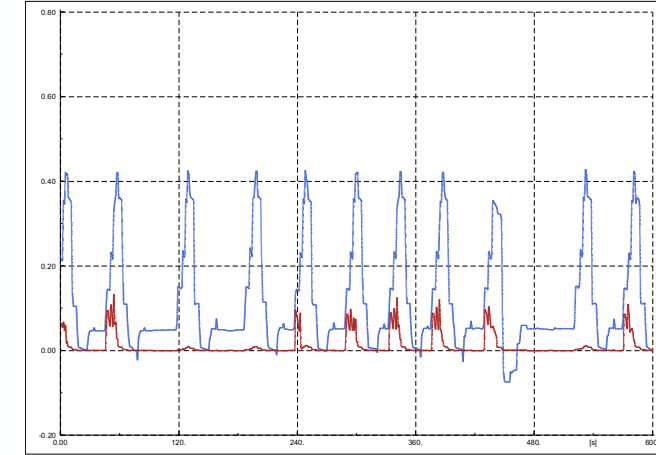
- Reactive power demand from the grid significantly reduced
- Voltage drop significantly reduced

Without Hubbell

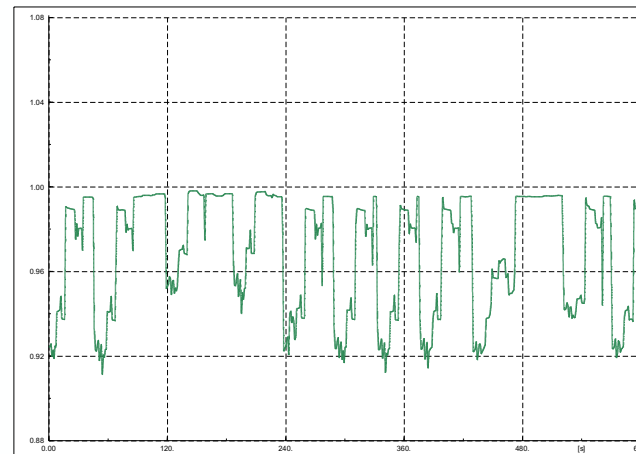


$Q_{(max)}=550\text{kvar}$ and $P_{(max)} 400\text{kW}$ at PCC

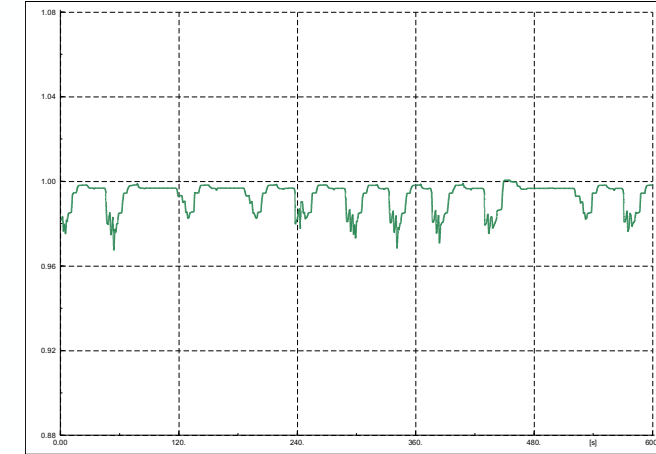
With Hubbell



$Q_{(max)} = 90\text{kvar}$ at PCC



$\Delta U = -10\%$ at 400V bus



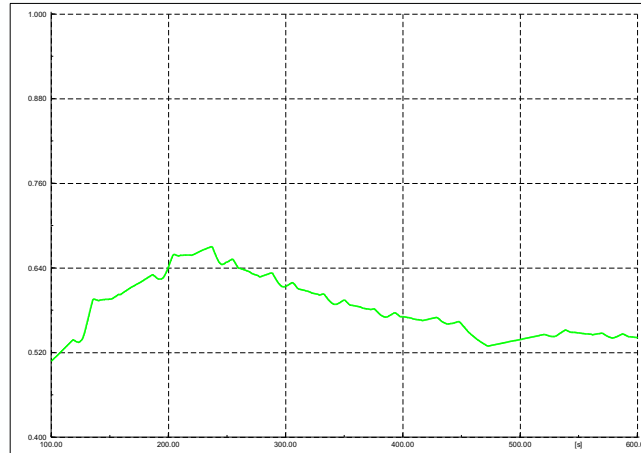
$\Delta U = -3\%$ at 400V bus

Results – Harmonics and power factor



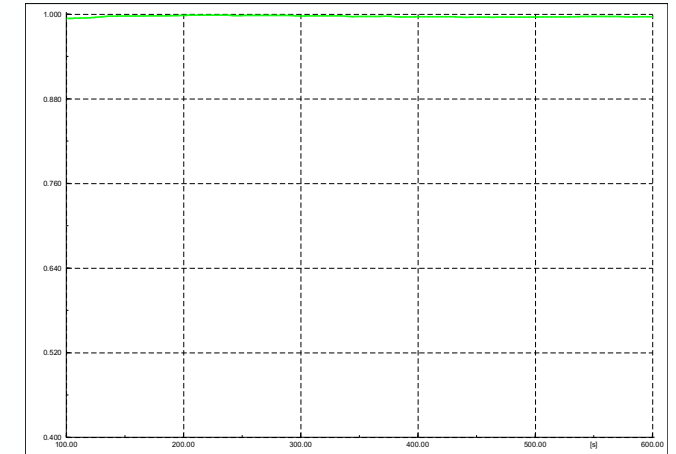
- Power factor maintained at the desired level
- Harmonic currents significantly reduced
- Commutation notch depth and area reduced

Without Hubbell

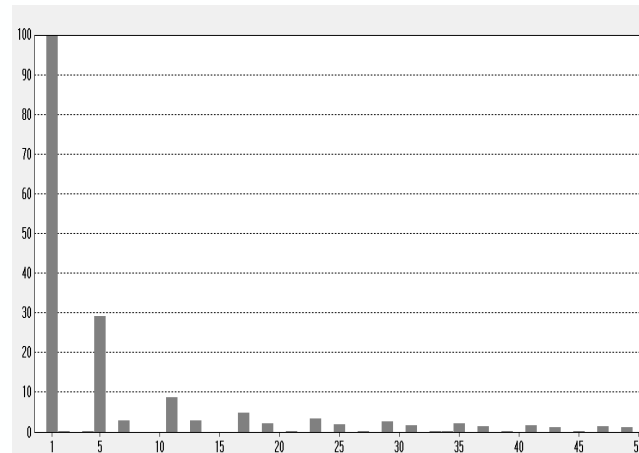
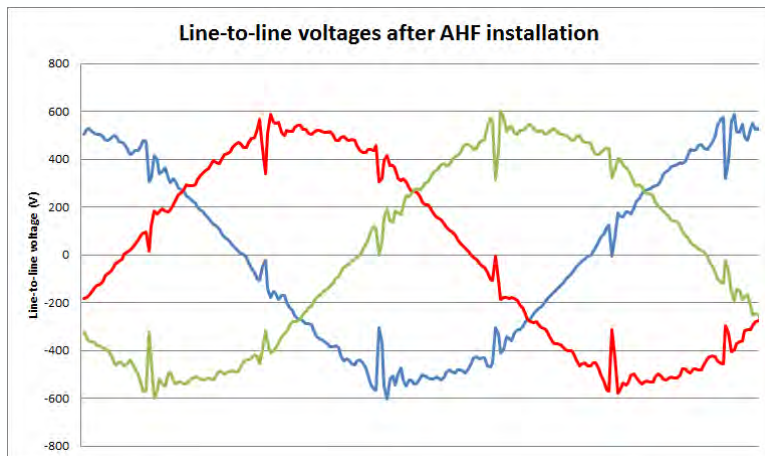


PF(10min average) = 0.678pu

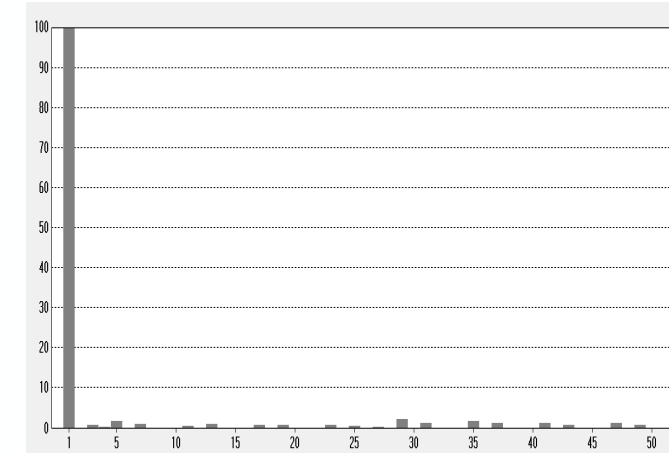
With Hubbell



PF(10min average) = 0.996pu



lthd = 32% at PCC



lthd = 4.6% at PCC

- **Higher voltage means higher torque**
 - Benefits depend on the process
 - Bigger slab → more production
 - Higher first pass reduction → higher steel grade
- **Smaller power losses: less power losses in transformer and in other network impedances because of smaller currents and harmonic compensation**
- **Improved power quality: voltage THD is improved and other equipment is protected**



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