



- Christer Liljegren, är elkraftskonsult specialiserad på el-generering som vindkraft samt elkraftsystem.
- Elkvalité och selektivplaner
- Elsystemanalys på Gotland, stora och små projekt inom vind och vattenkraft samt HVDC teknologi.
- Cleps AB startades år 2001 och basen för företaget ligger på Gotland men arbetar inom hela Sverige samt även med utlandsprojekt





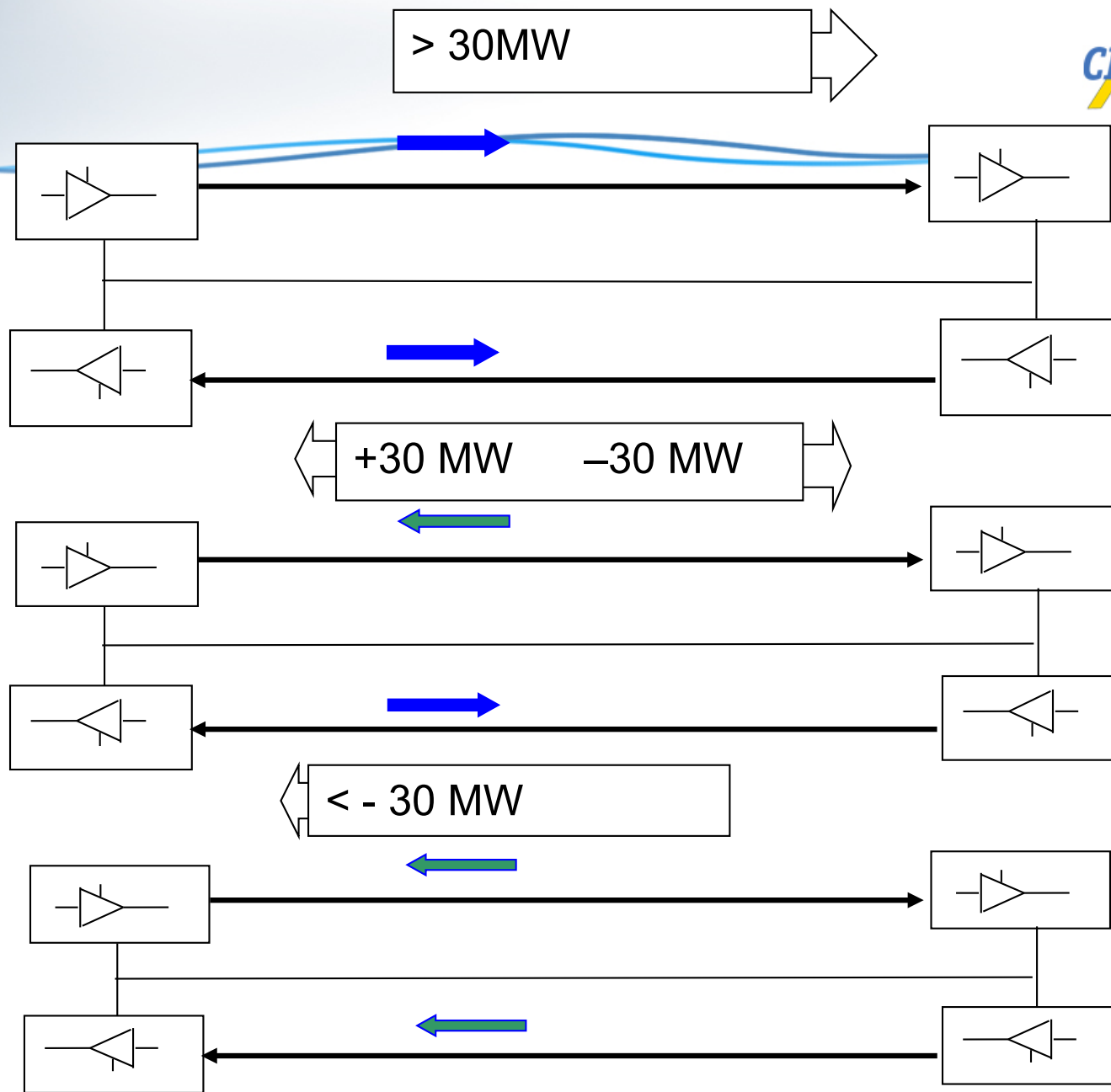
Gotlands Elsystem

- Maximal last 175 MW
- Minlast ca 40 MW
- 900 GWH i elkonsumtion
- HVDC-länkar från Västervik på 2*150 MW
- 3 st Gasturbiner på totalt ca 120 MW
- 35 Mil 70 kV ledningar
- 2 Mil 30 kV ledningar
- 210 Mil 10 kV ledningar
- 250 Mil lågspänningsledningar
- 2300 transformatorer





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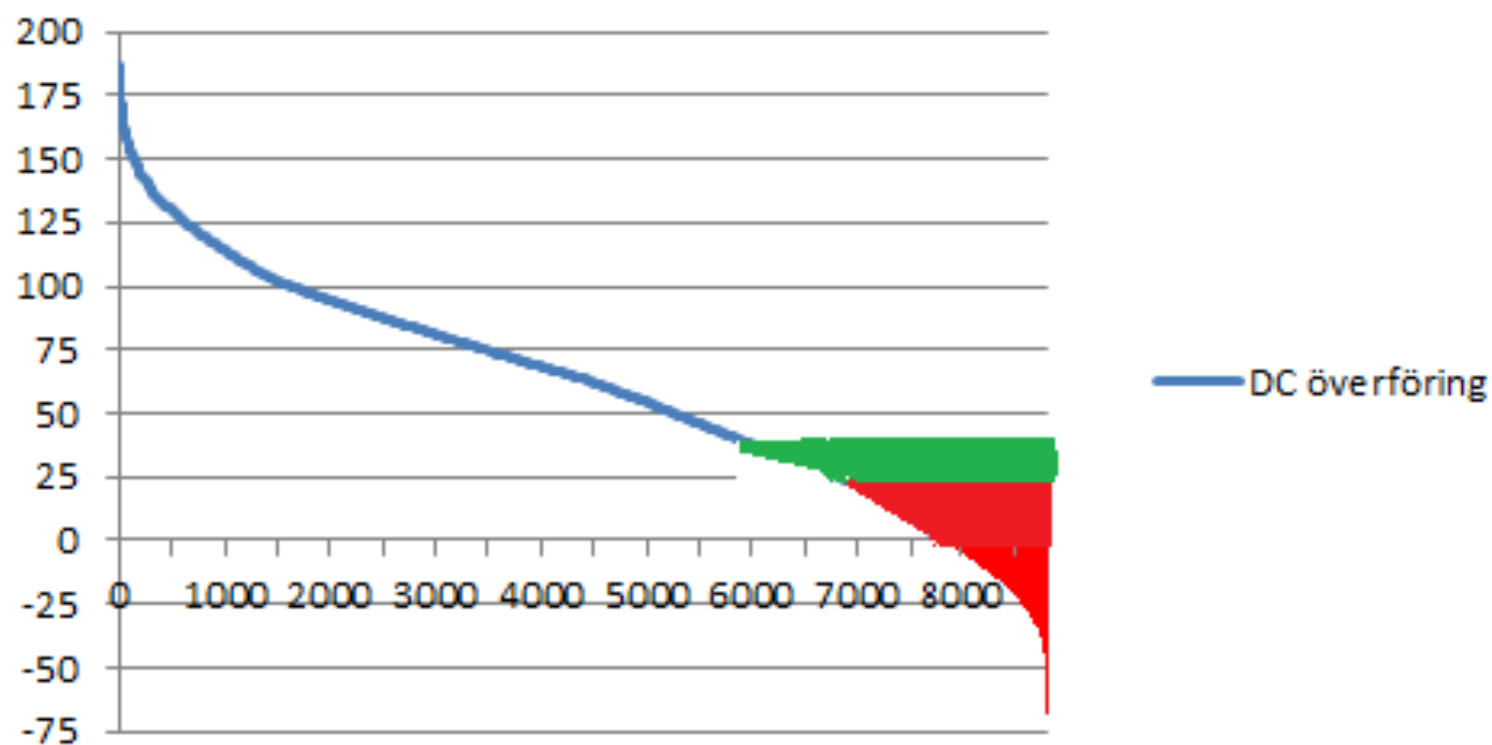


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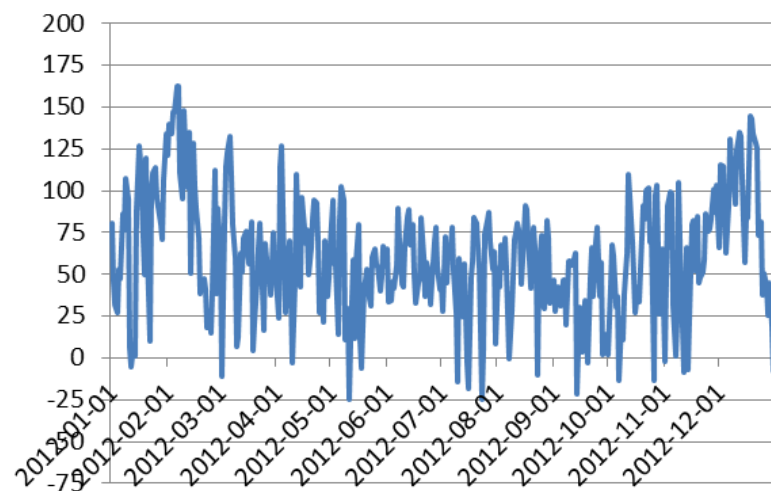
	Till Fastlandet	gräns 40 MW	Gränds 30 MW	Gränds 20 MW	Gränds 15 MW
GWH/år	25,0	106,5	76,6	53,3	43,9
Timmar	1164	3293	2664	2064	1752
		254	206	159	135
Beräknad bortstyrd energi		8,2	5,9	4,1	3,4

DC överföring

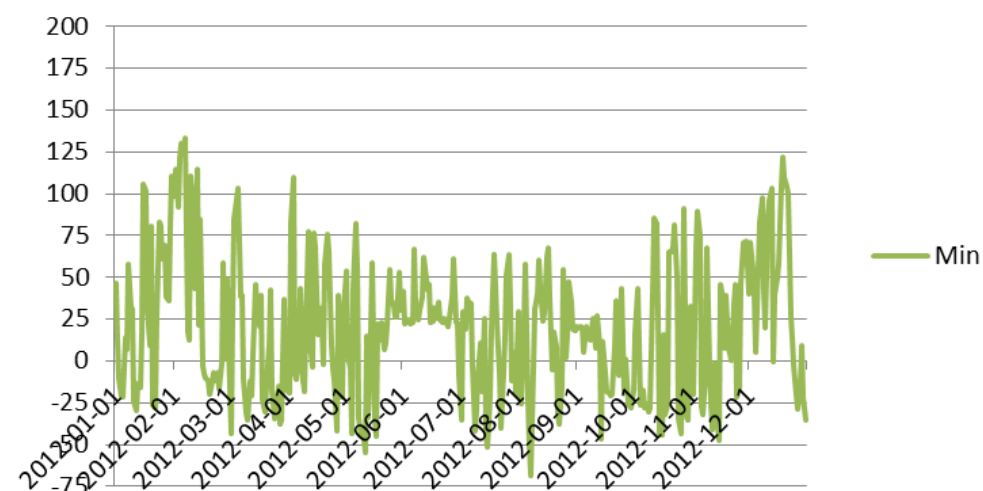




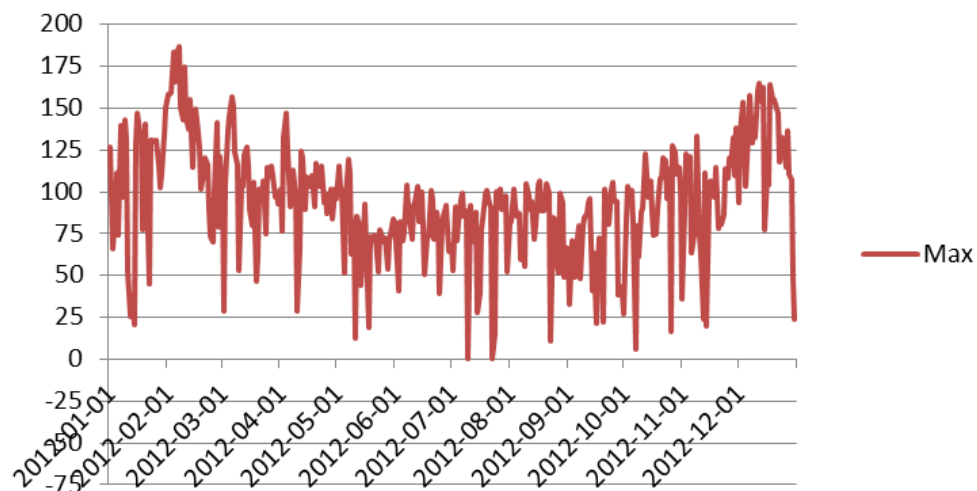
Medel



Min

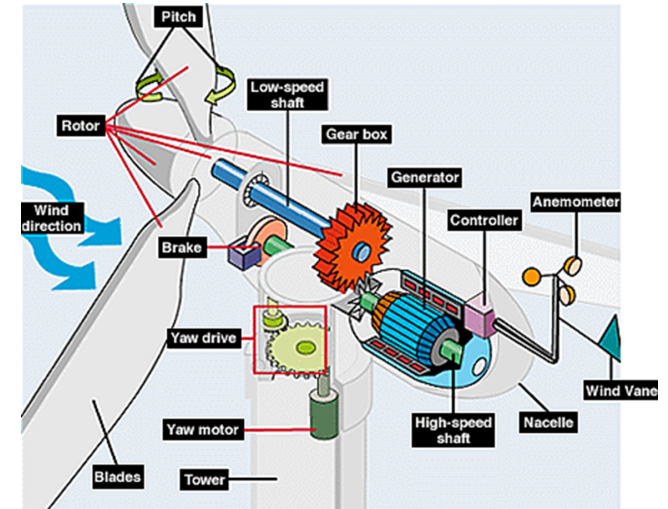
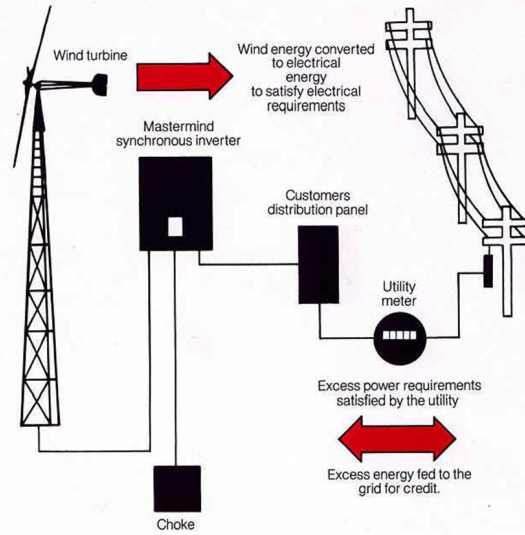


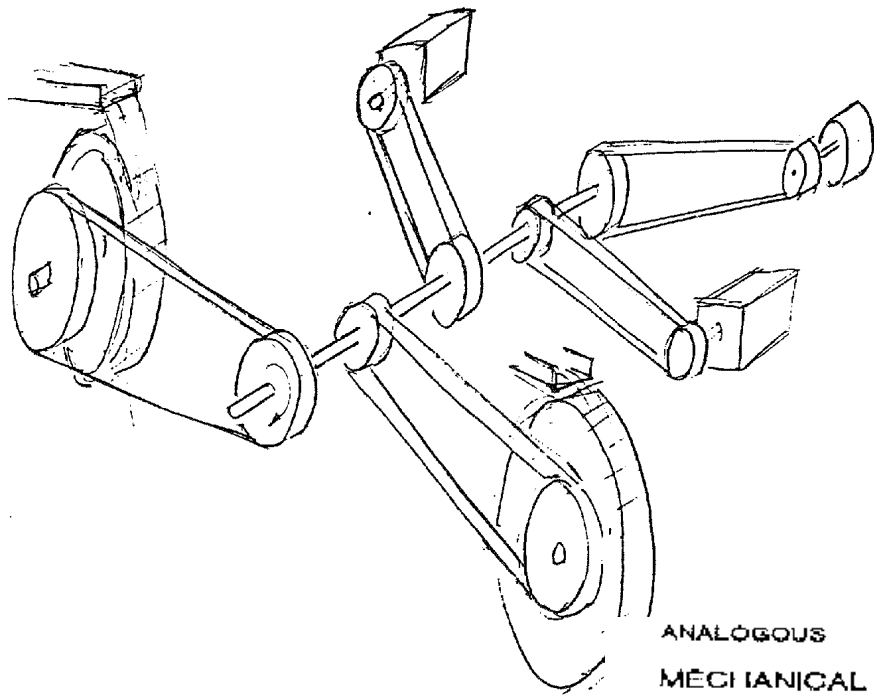
Max



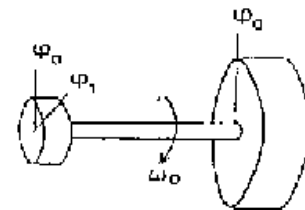


SYSTEMS CONFIGURATION





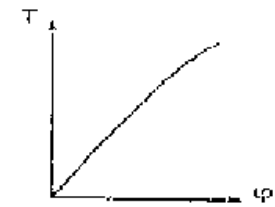
ANALOGOUS
MECHANICAL
SYSTEM



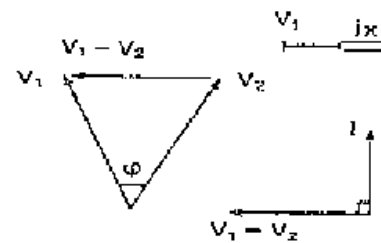
$$\varphi = \varphi_1 - \varphi_2$$

Assume

$$\frac{d\varphi}{dt} \ll \omega_0$$

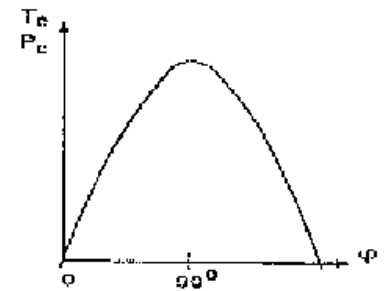


ELECTRICAL
SYSTEM



$$P_e = \frac{V_1 V_2}{X} \sin \phi$$

$$P_e = T_e \omega = T_e \omega_0$$





STATIC SYNCHRONOUS COMPENSATOR (STATCOM)



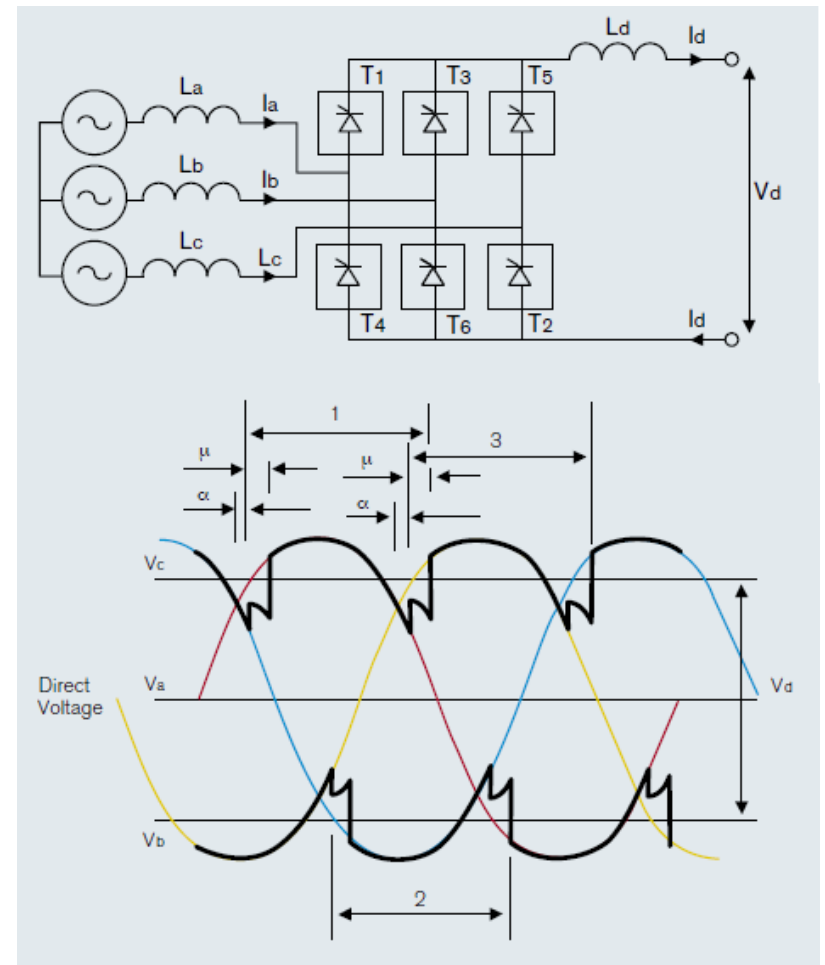
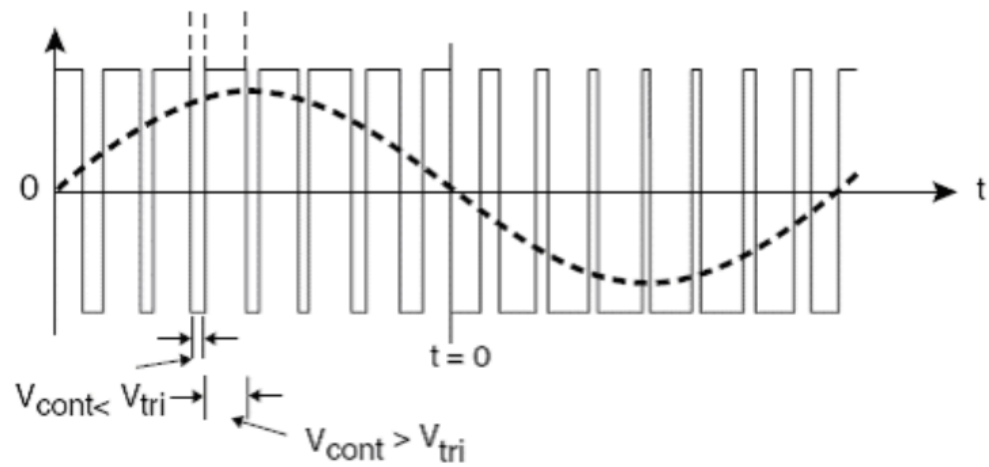
STATIC VAR COMPENSATOR (SVC)

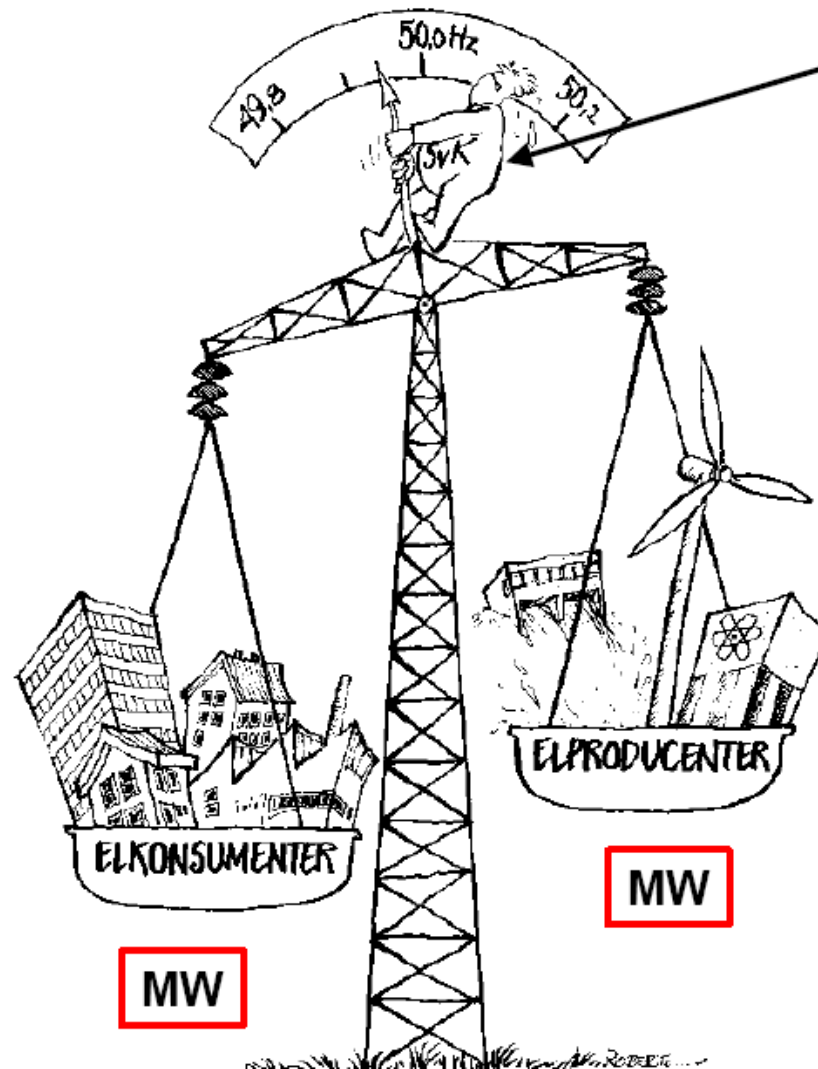


SERIES COMPENSATION SYSTEM



SYNCHRONOUS CONDENSER



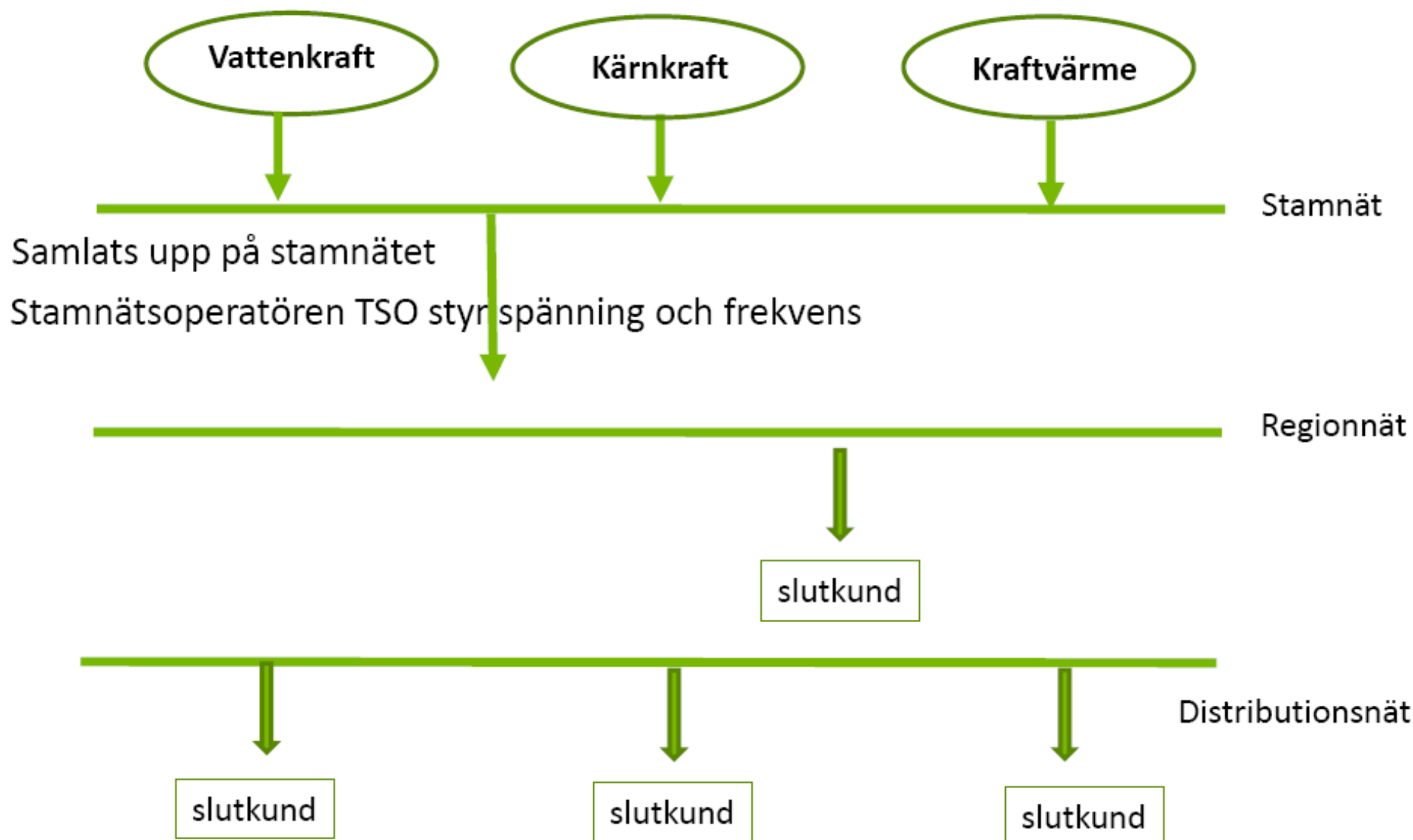


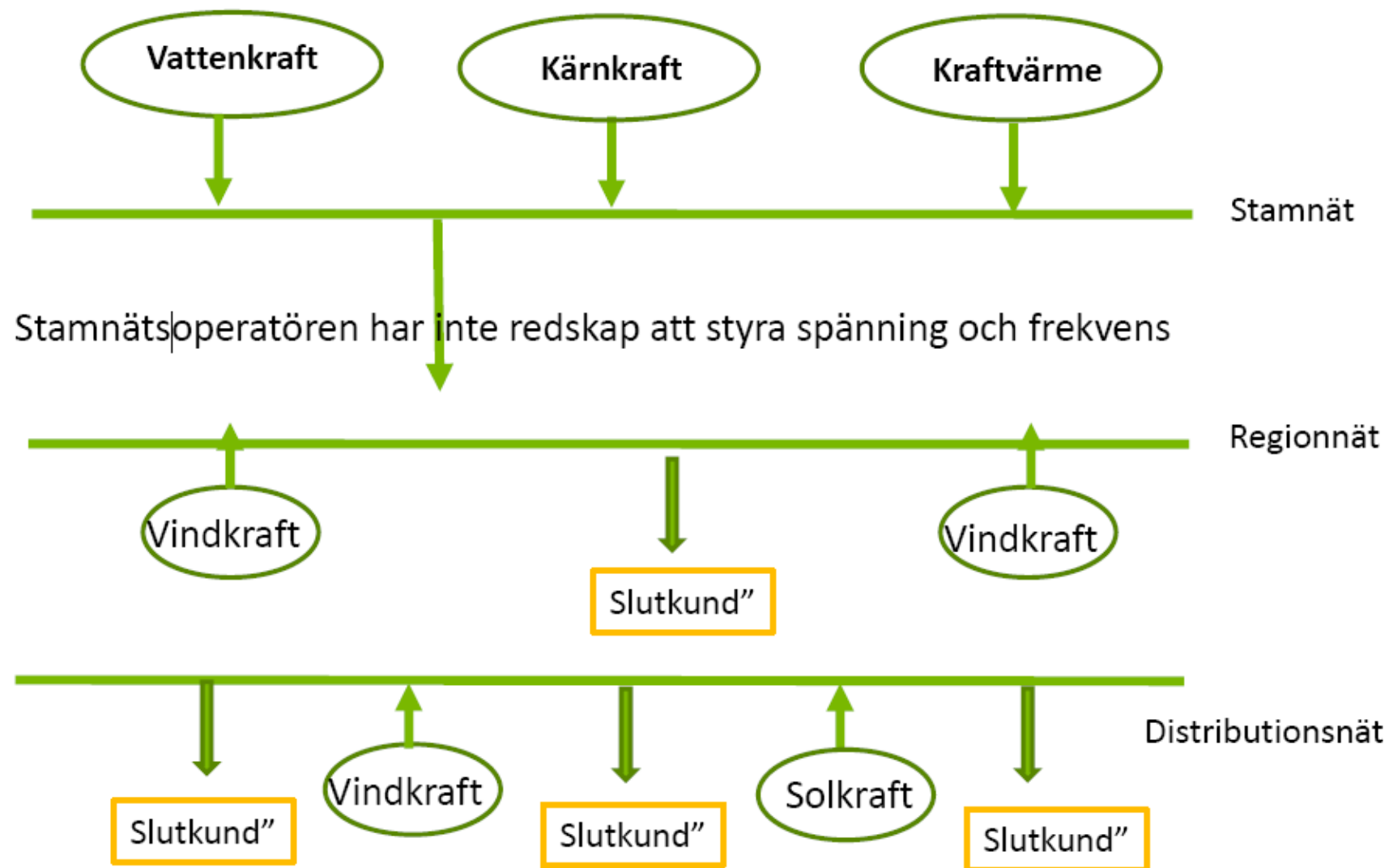
Svenska Kraftnät

MW

MW

Effekt $\neq$ Energi





Kräver högre grad av "automatstyrning"/ Aktiv kund ("smart grid")

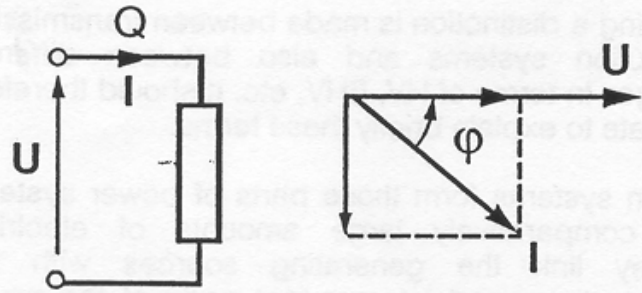


Fig. 1. Basic circuit.

$$\Delta U = |U_1| - |U_2| \quad (2.3)$$

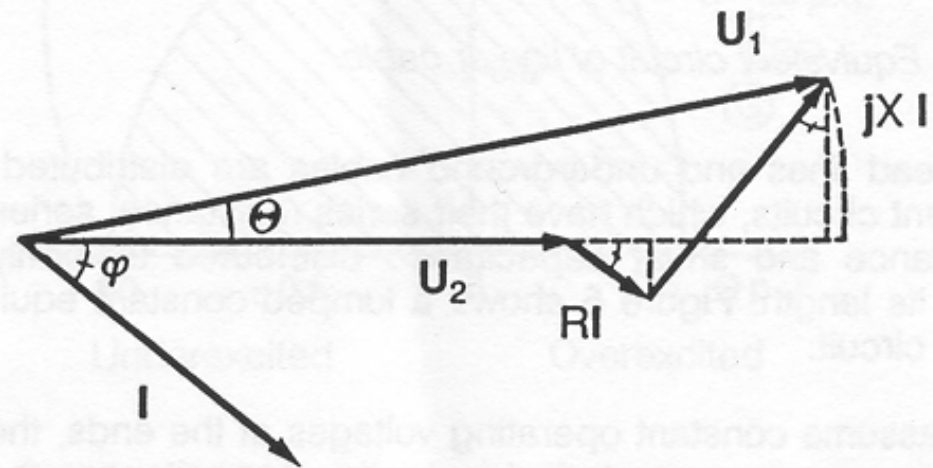
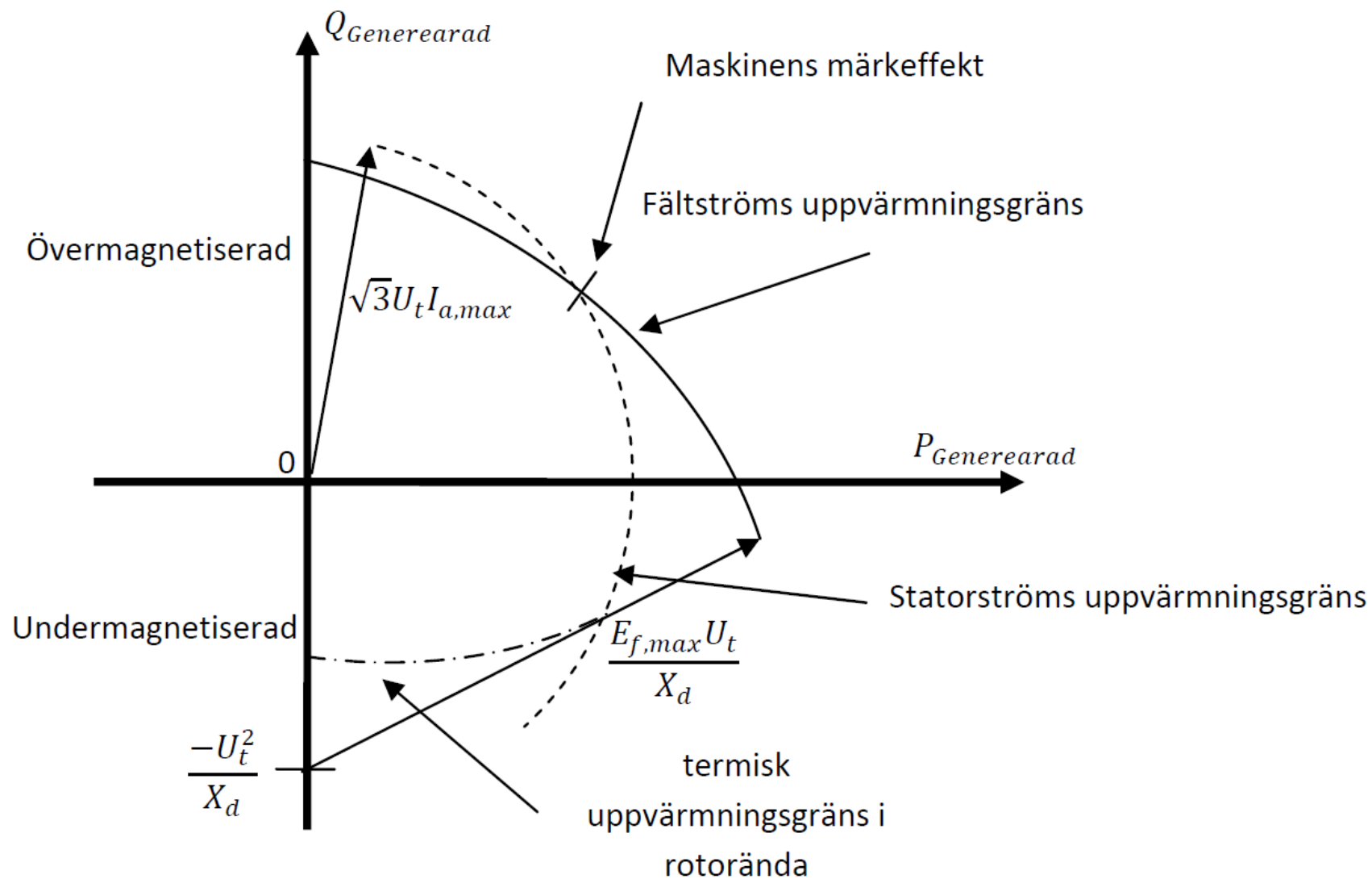
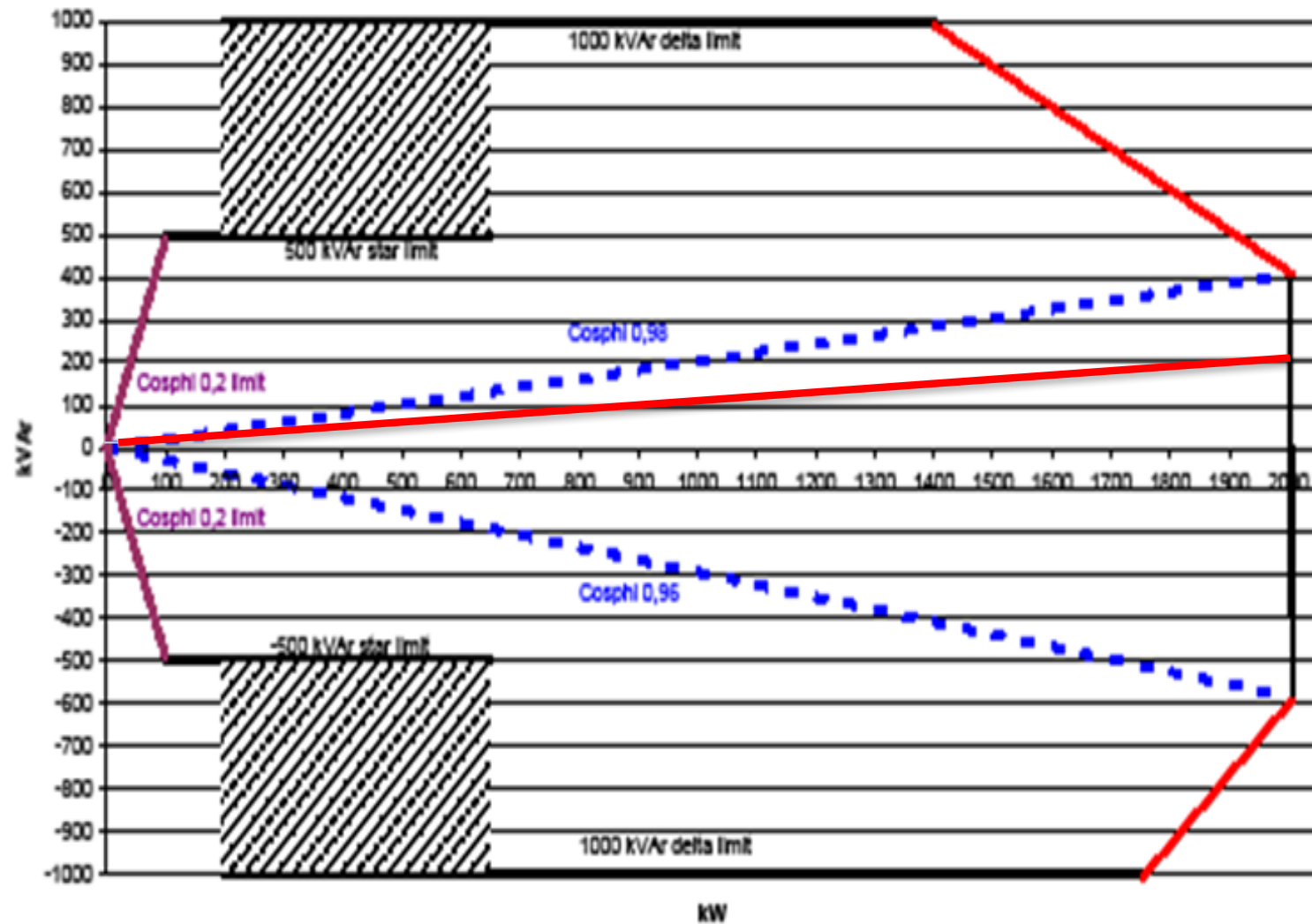


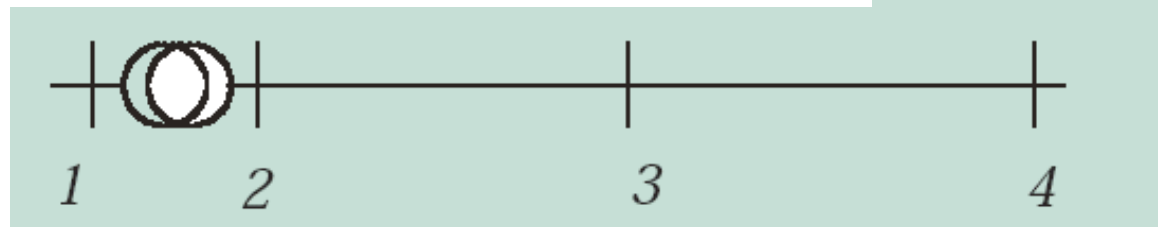
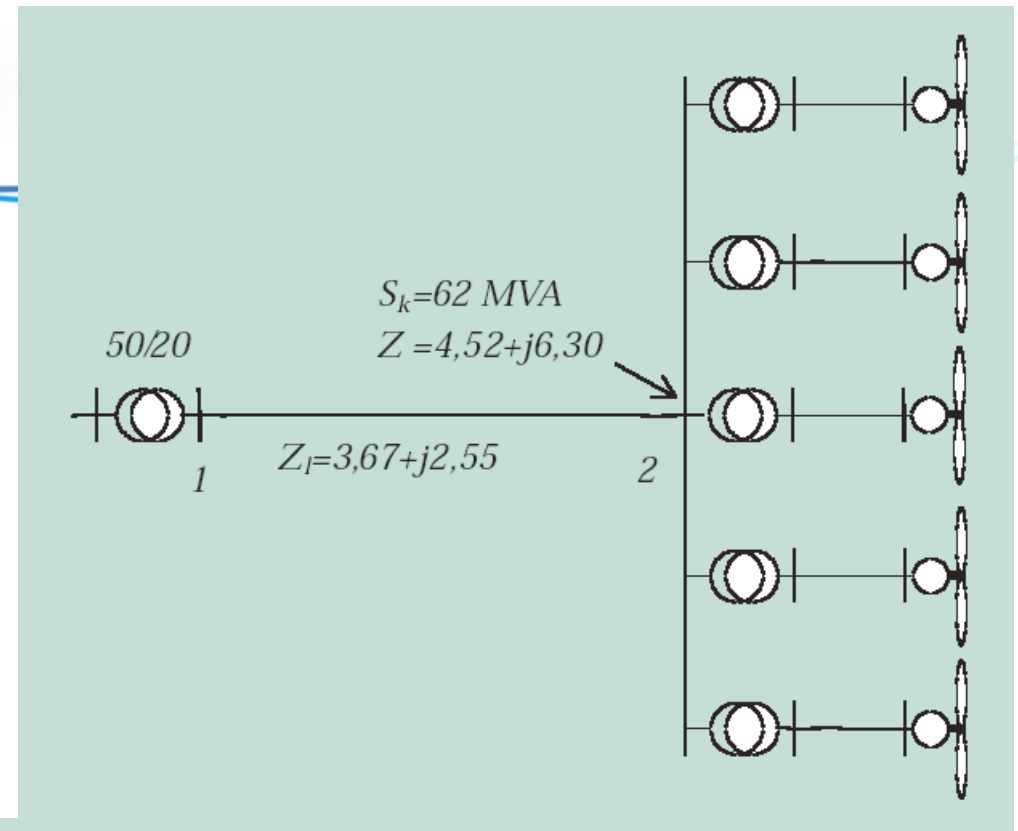
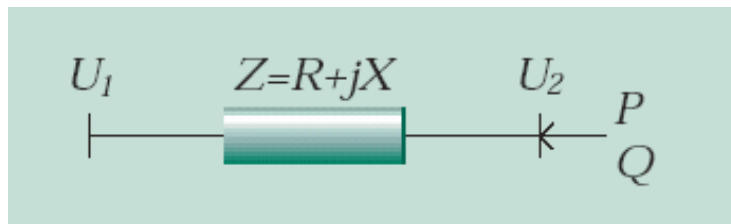
Fig. 7. Voltage drop of series impedance.



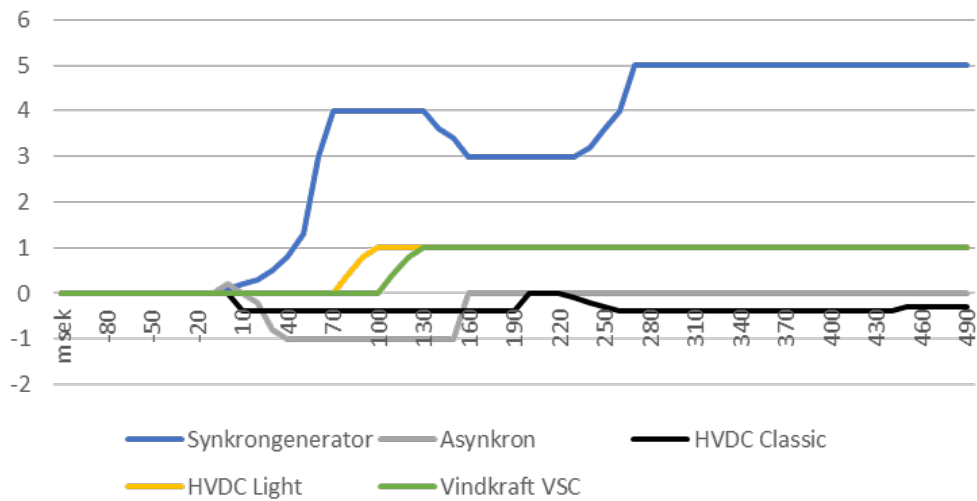


V80-2,0 MW/V90-2,0 MW reactive capability chart

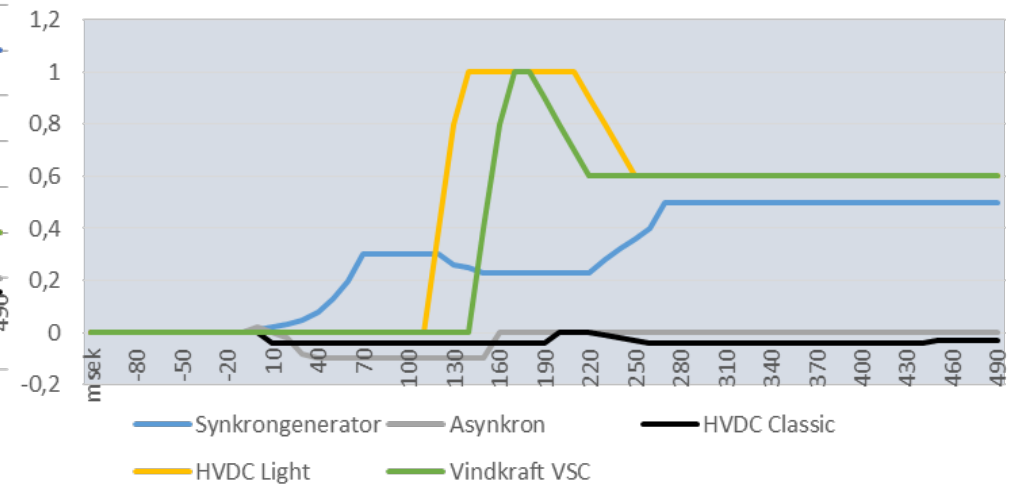




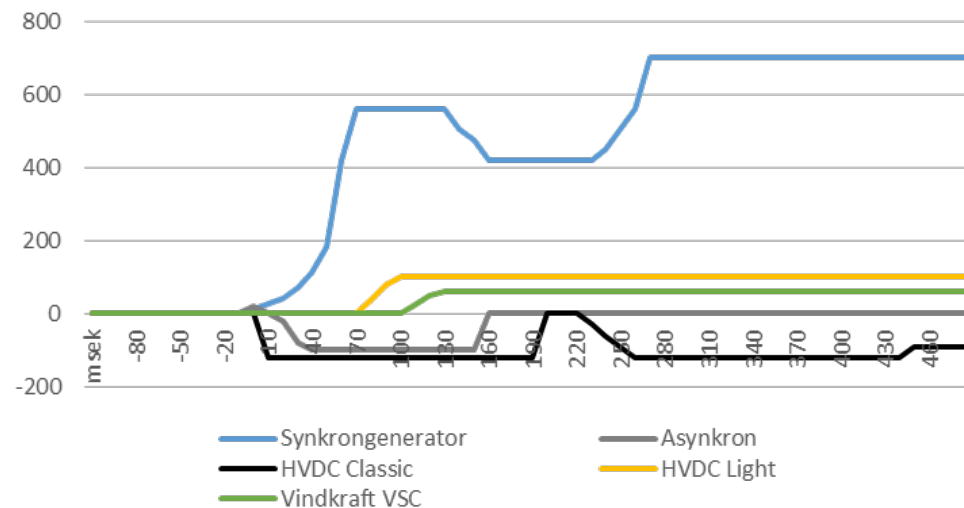
Full kortslutning, Nära 0 på 70 kV pu



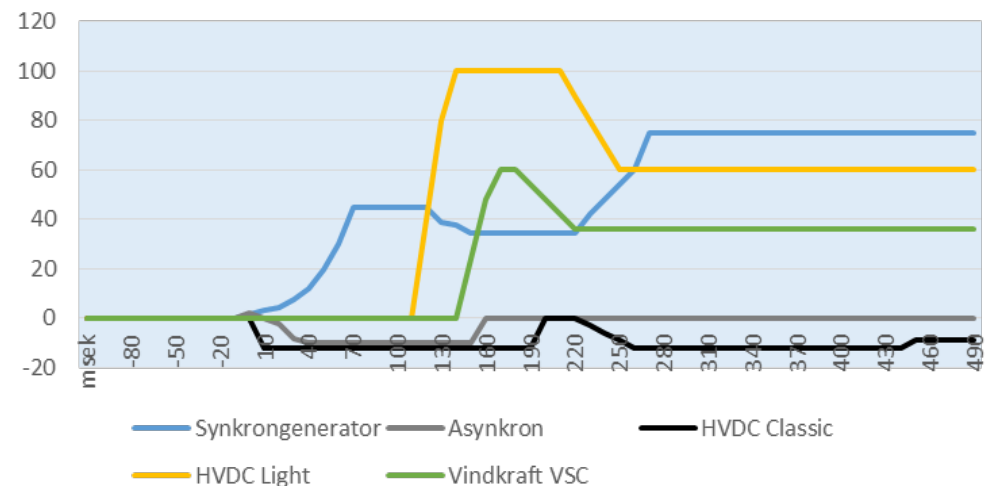
10 % sp sänkning pu

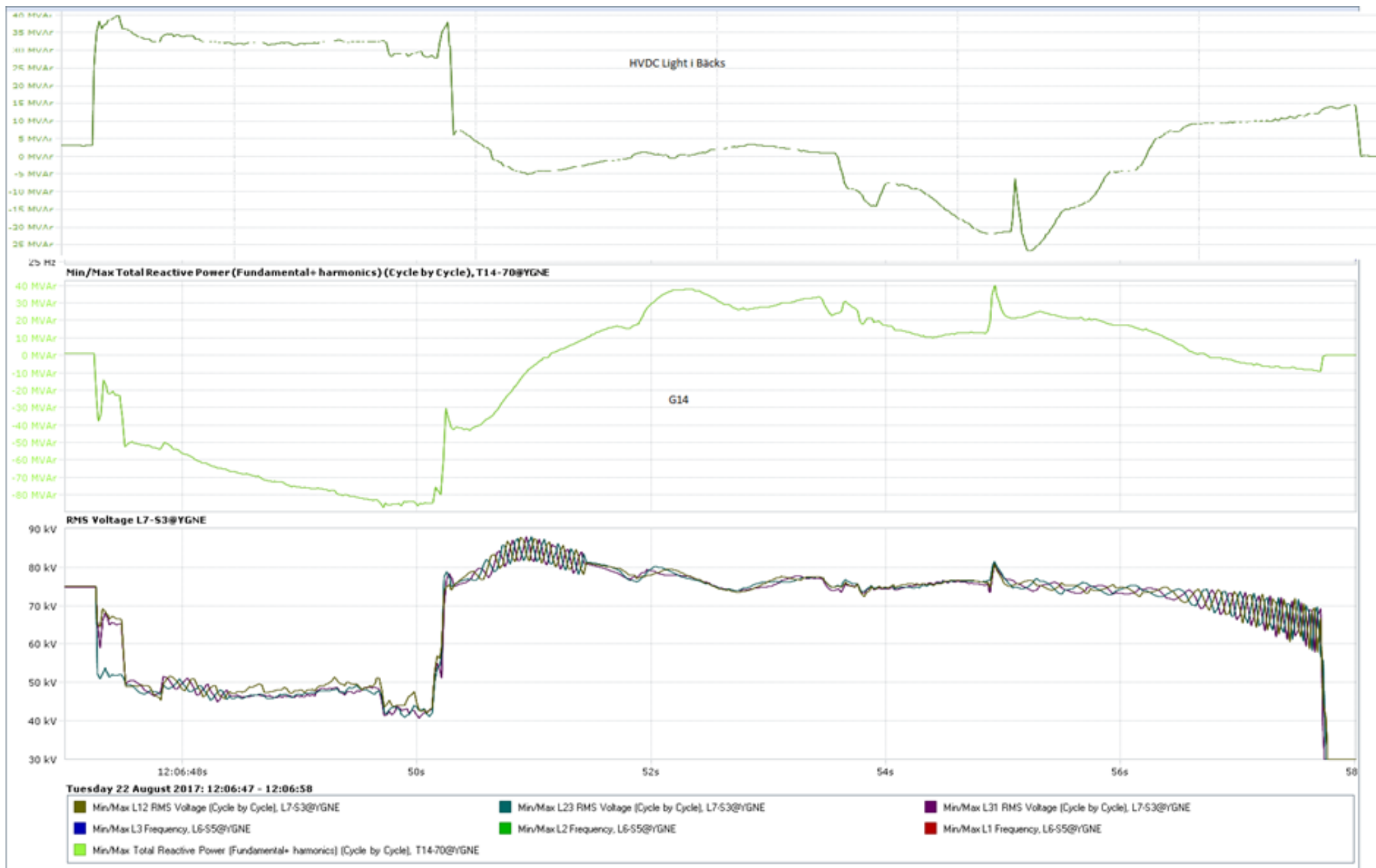


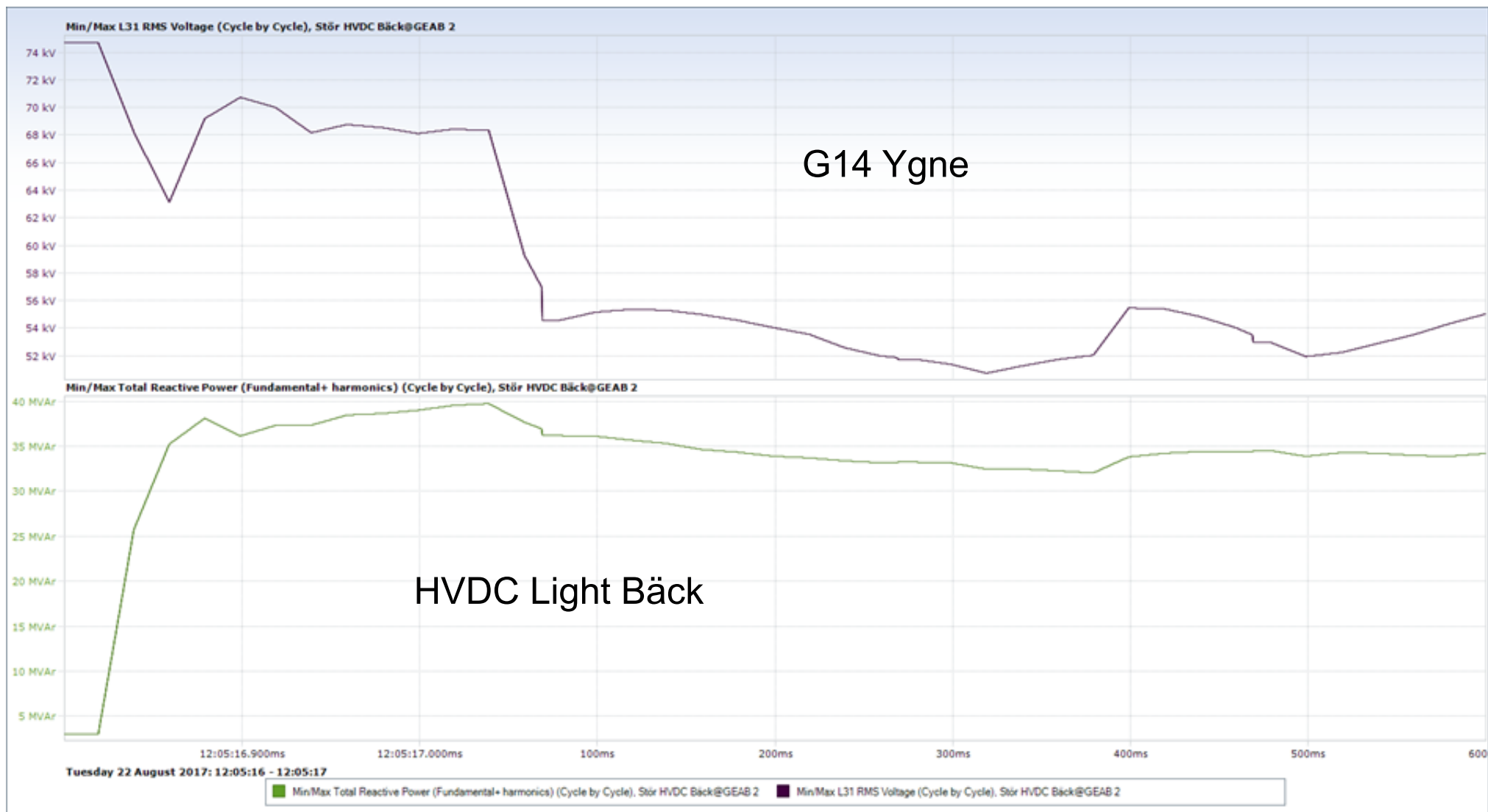
Full kortslutning, Nära 0 på 70 kV MVA



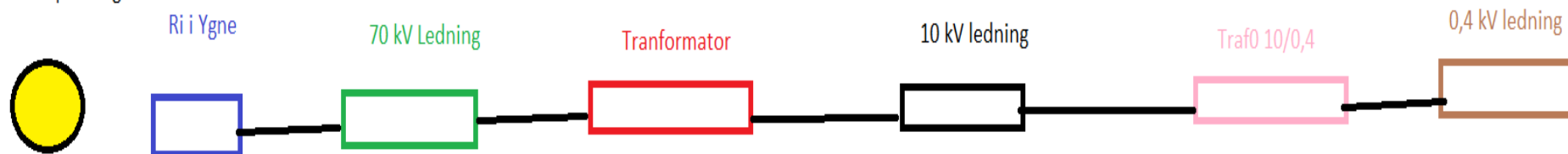
10 % sp sänkning MVA



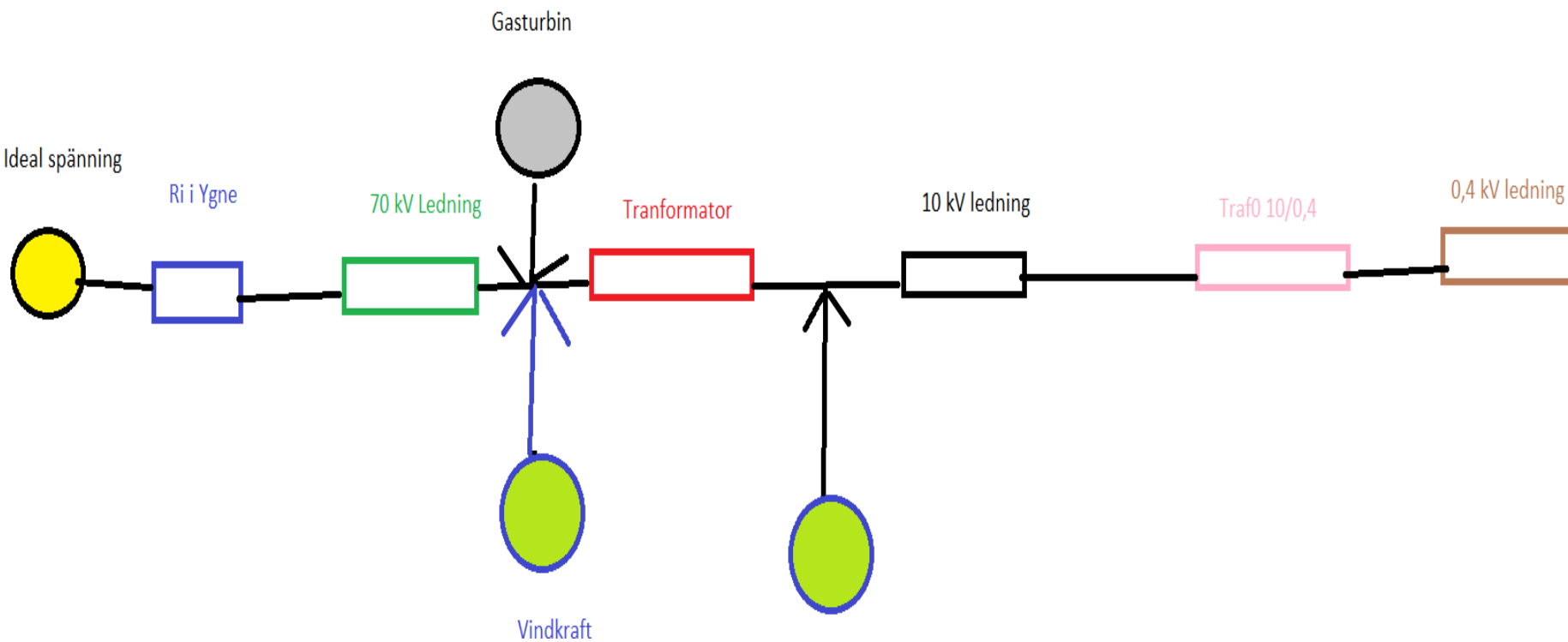


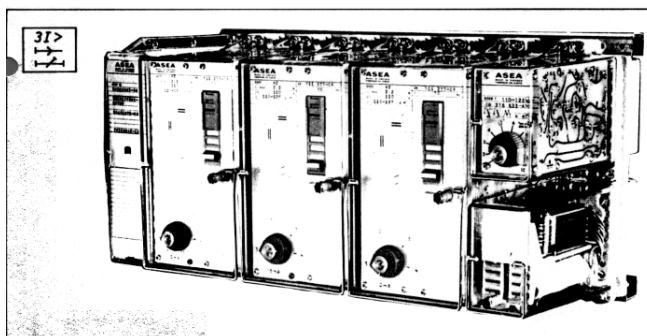


Ideal spänning



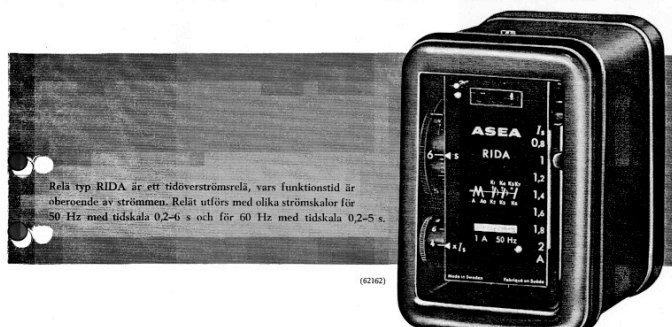
Ideal spänning





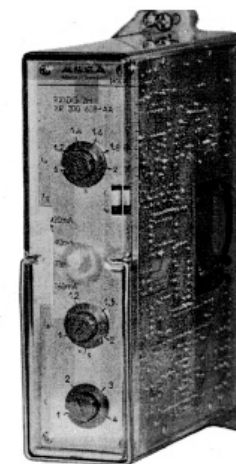
RIDA

TIDÖVERSTRÖMSRELÄ MED KONSTANTTID

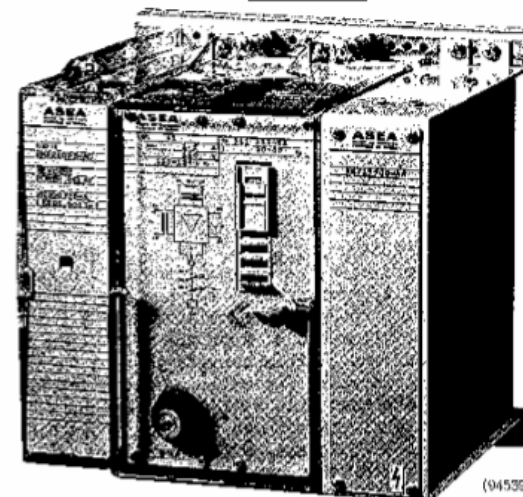


Typ RXIDG 2H

Tidöverströmsrelä



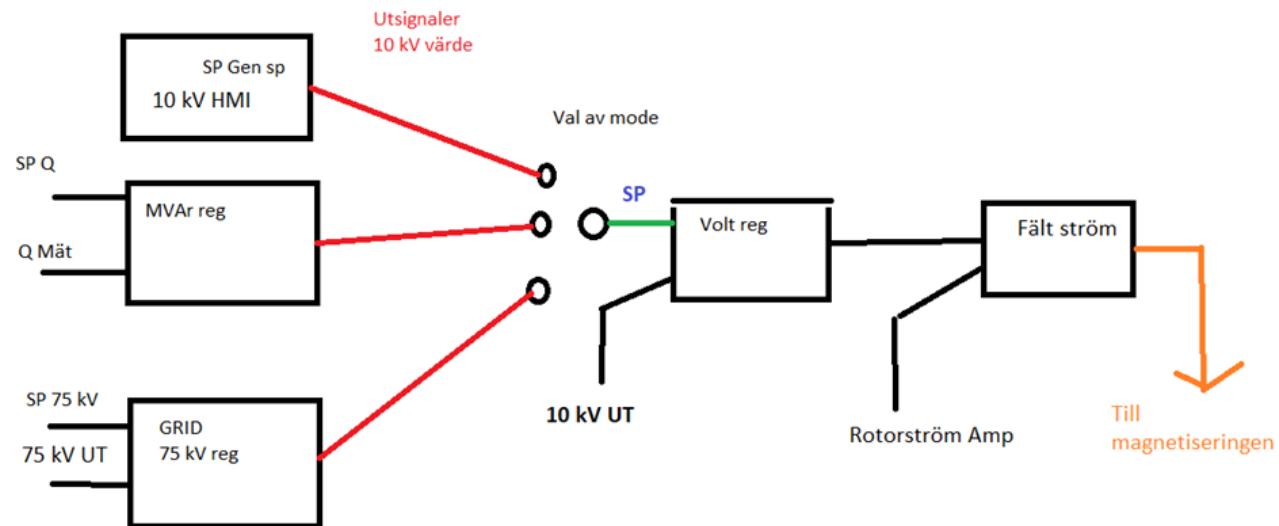
RXPE Relay



- Reaktiva kompensering
- Spänningskvalité
- System inertia svängmassa
- Kortslutningseffekt

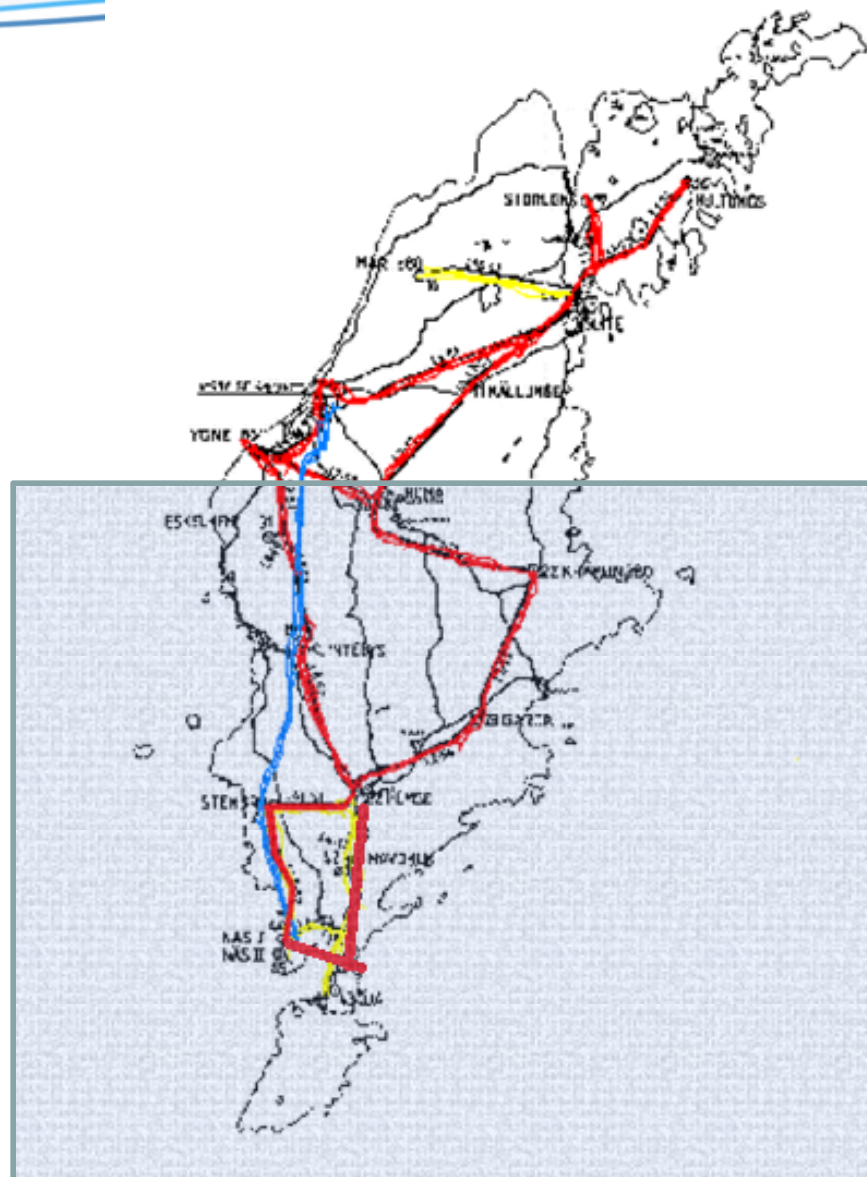
Reaktorer och kondensator bankar

- SVC Statcom
- Frekvensreglering från annat system





Nätkarta



Simplified Grid on Gotland

