ETRANS

Monitoring of Power System Dynamic Performance

Tutorial Part 2, Section 3:

Dynamic Modelling and Stability Calculations Approach

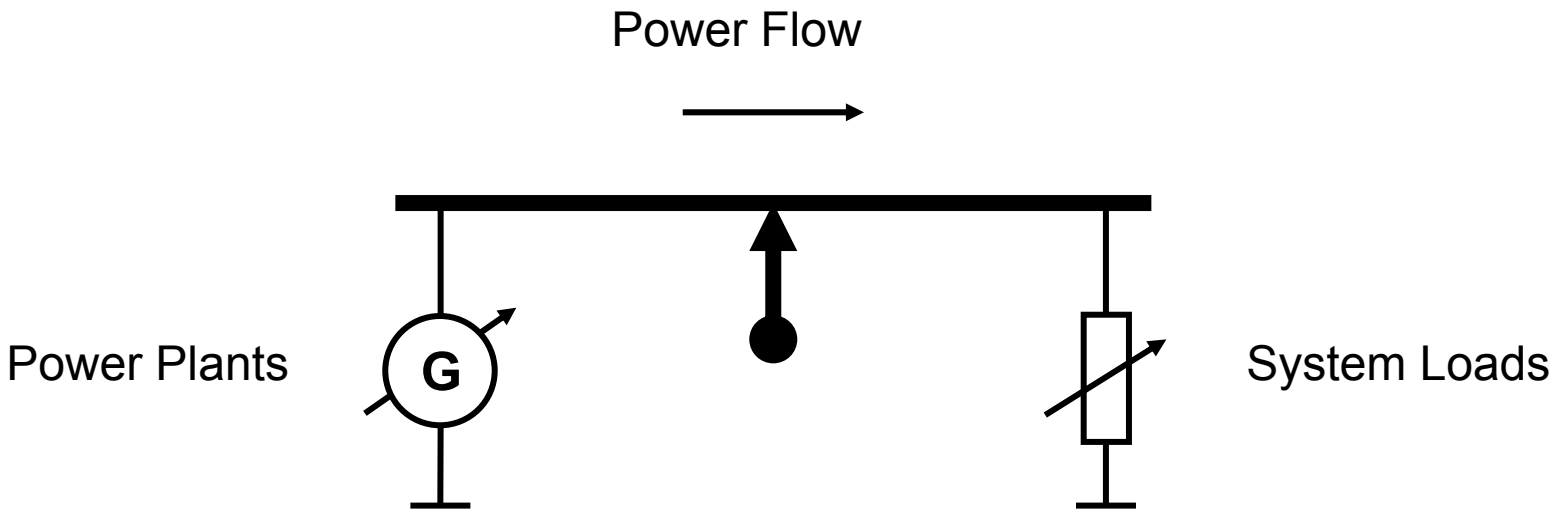
ETRANS, Laufenburg, Switzerland

Walter Sattinger
System Planning and Studies Dept.

Content

- System power balance indices and control
- Time ranges and control schemes
- Dynamic system modelling
- Dynamic system parameter identification
- Application of dynamic system calculations

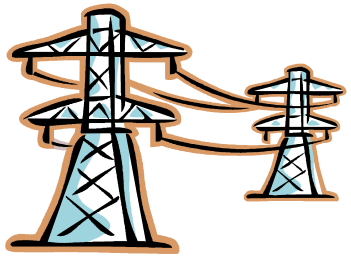
System Frequency = Balance between Generation and Consumption

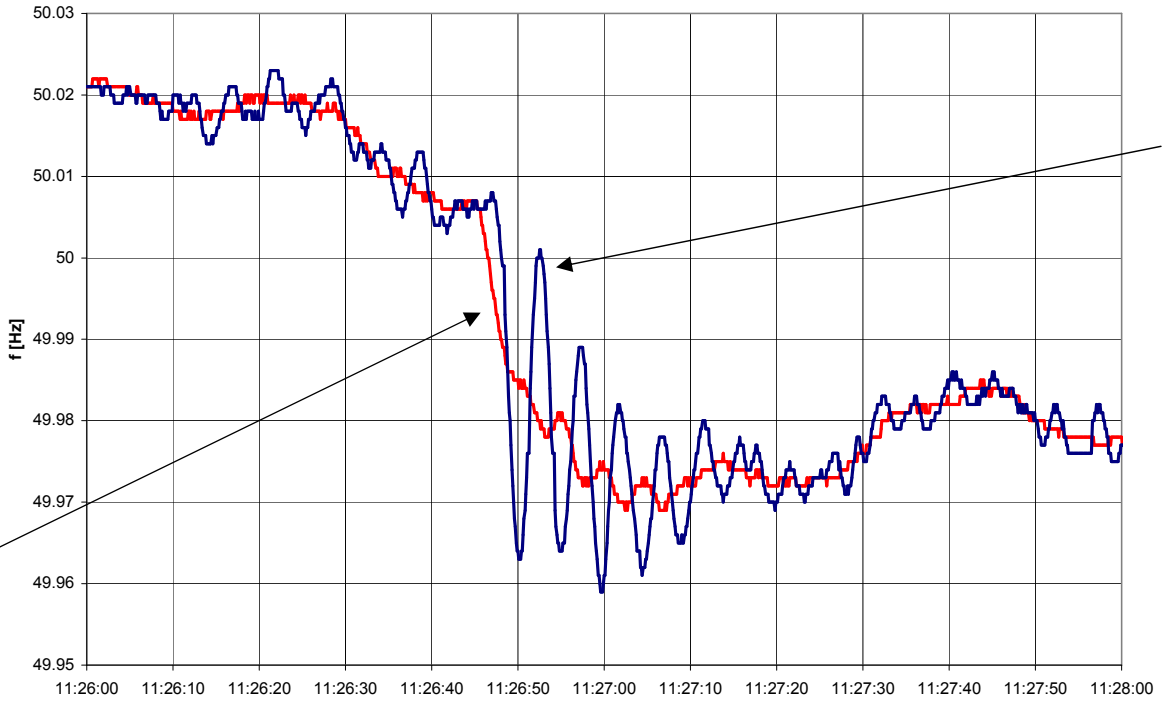


Aktuelle Frequenzabweichung (mHz)	
-250 -200 -150 -100 -50 0 50 100 150 200 250	
Aktuelle Netzfrequenz	50.002 Hz
Aktuelle Zeitabweichung	12.010 Sec

http://www.etrans.ch/services/online/frequency/

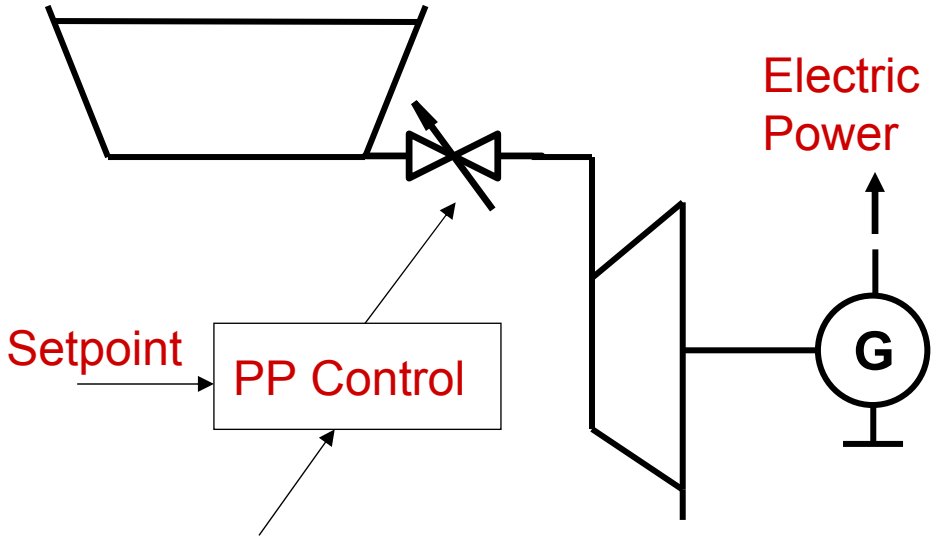
Transmission System = Elastic Shaft between Areas

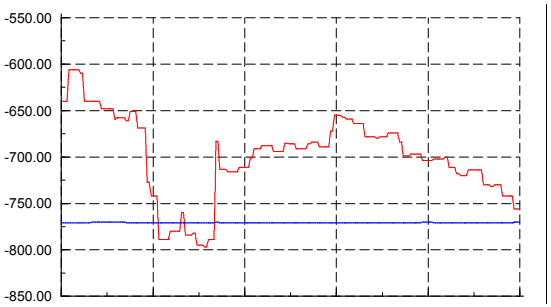




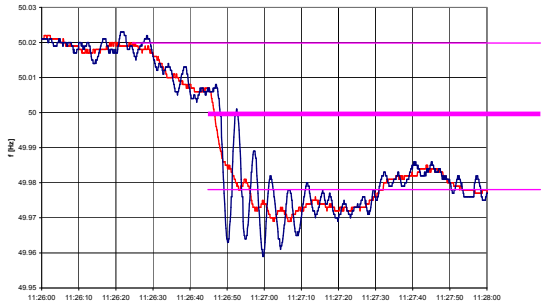
1200 MW PP Outage 09.02.06 in Spain

System Control = Automatic Speed Control

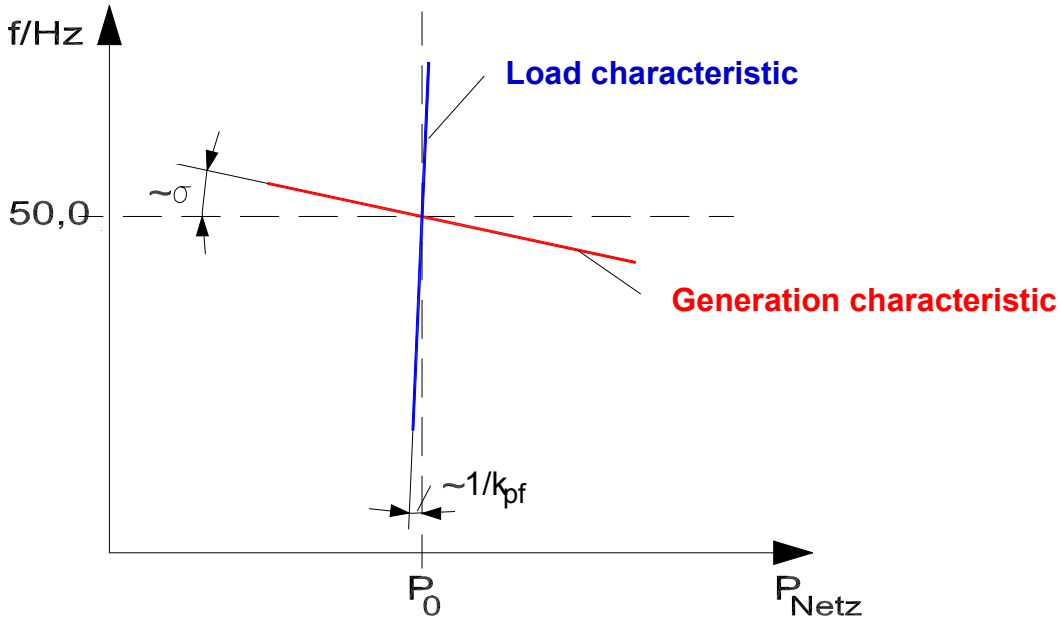




CH- Power Exchange



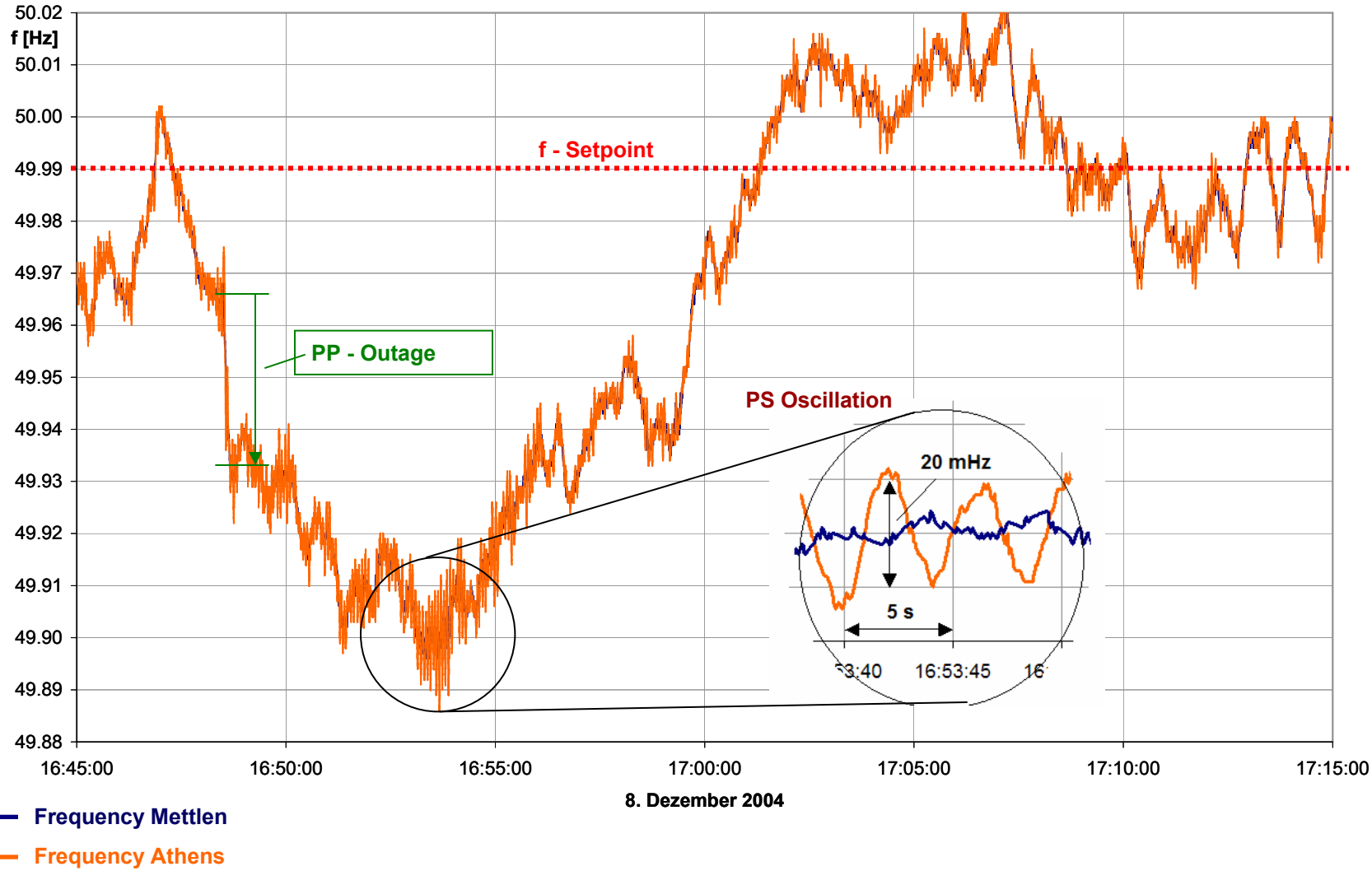
Generation and Load Characteristic



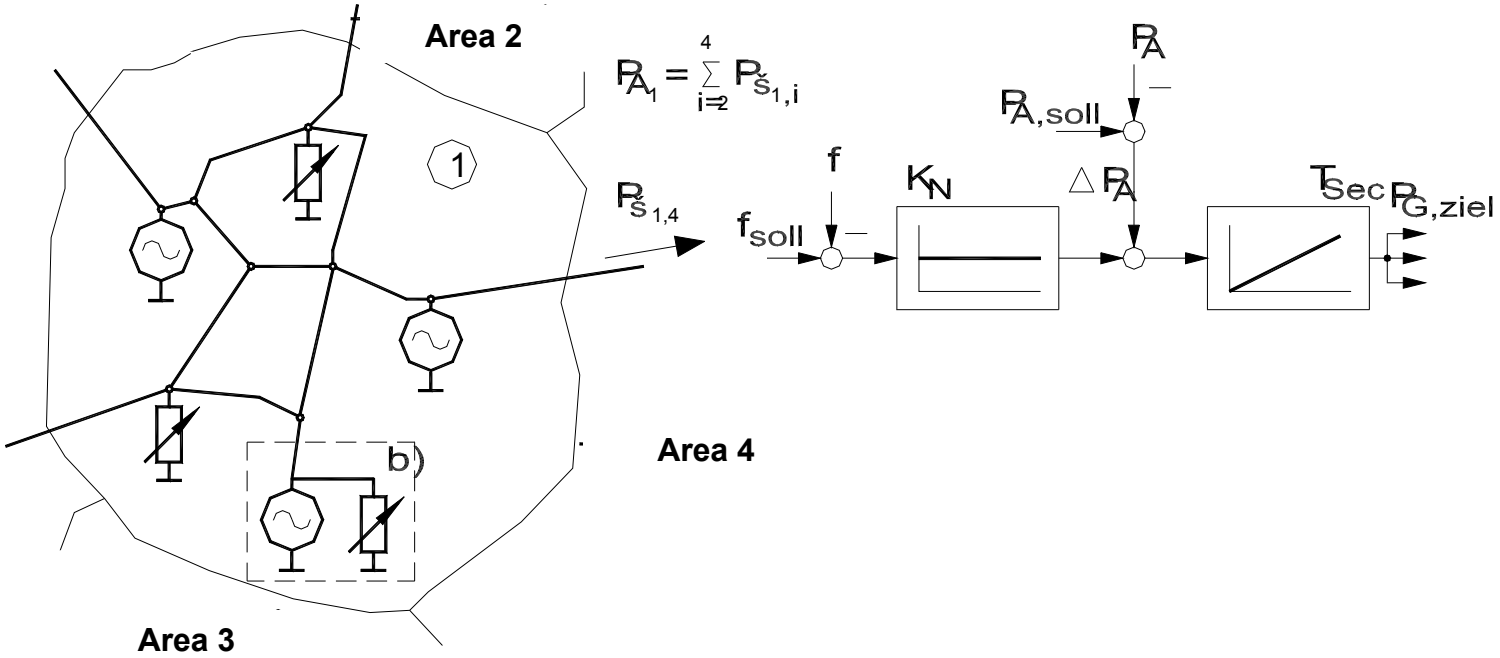
Time Ranges with Respect to System Stability

	Short-term	Mid-term	Long-term
Range	1 ms – 2 s	1 s – 2 min	1 min – 1h
Events	Faults Switching	Load shedding PP outage	Schedule change PP dynamics
Impact	Electromagnetic transients near the event location Voltage controller (AVR)	Primary control Dynamic load behaviour	Secondary control (AGC)

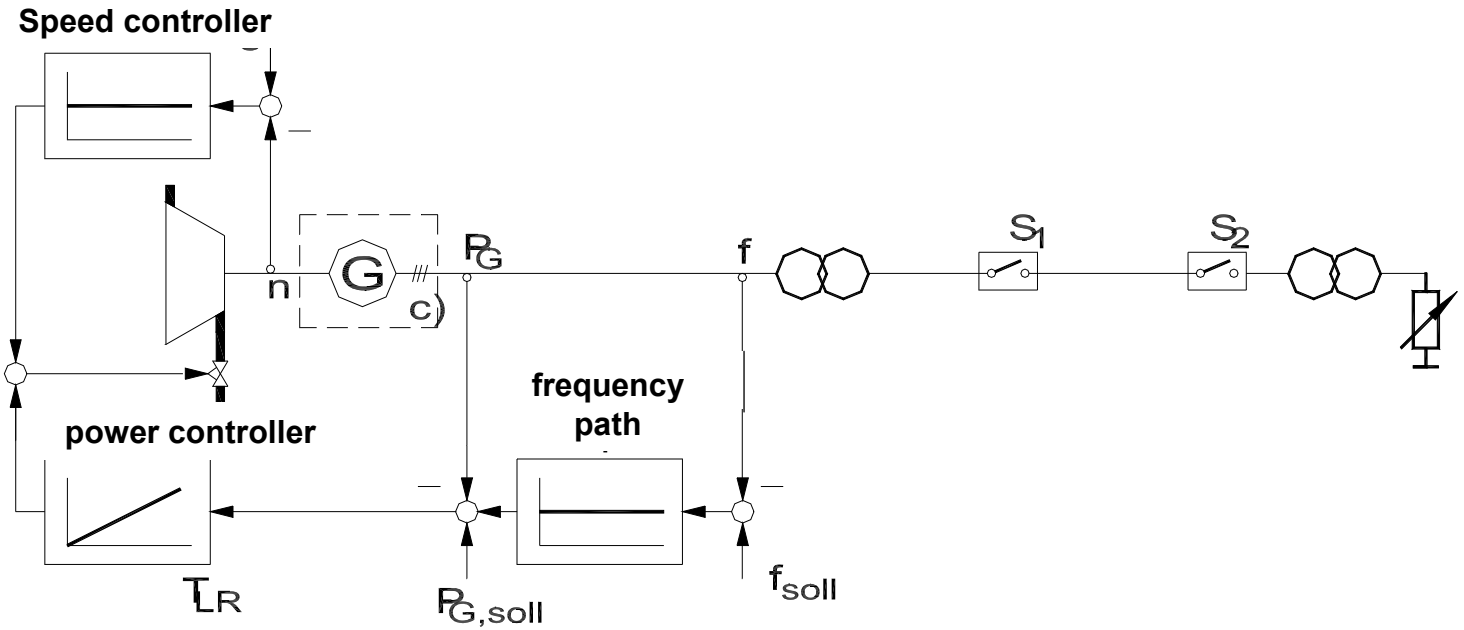
Frequency – Mirror of System Behaviour



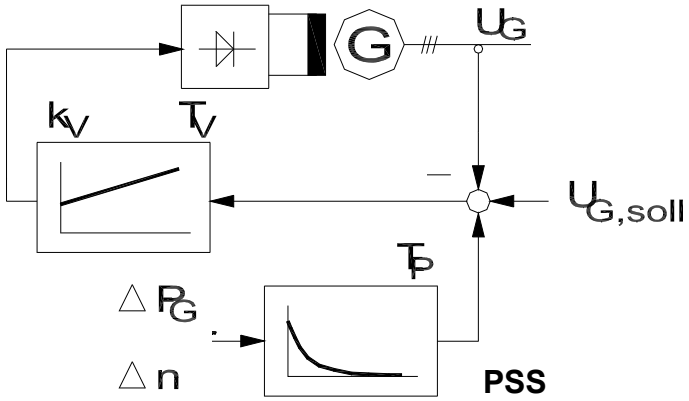
Secondary Control (AGC)



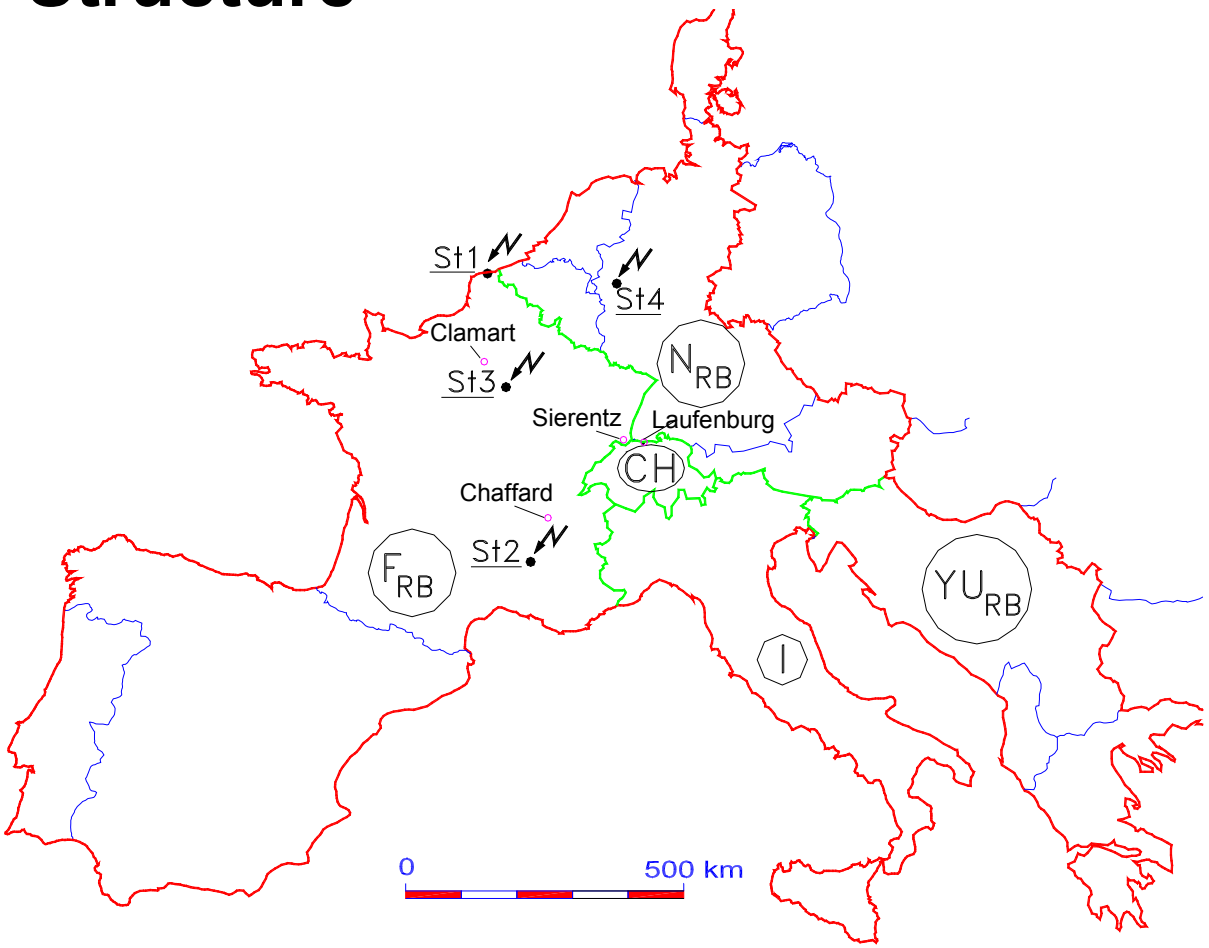
Primary Control / Governor / Turbine Control



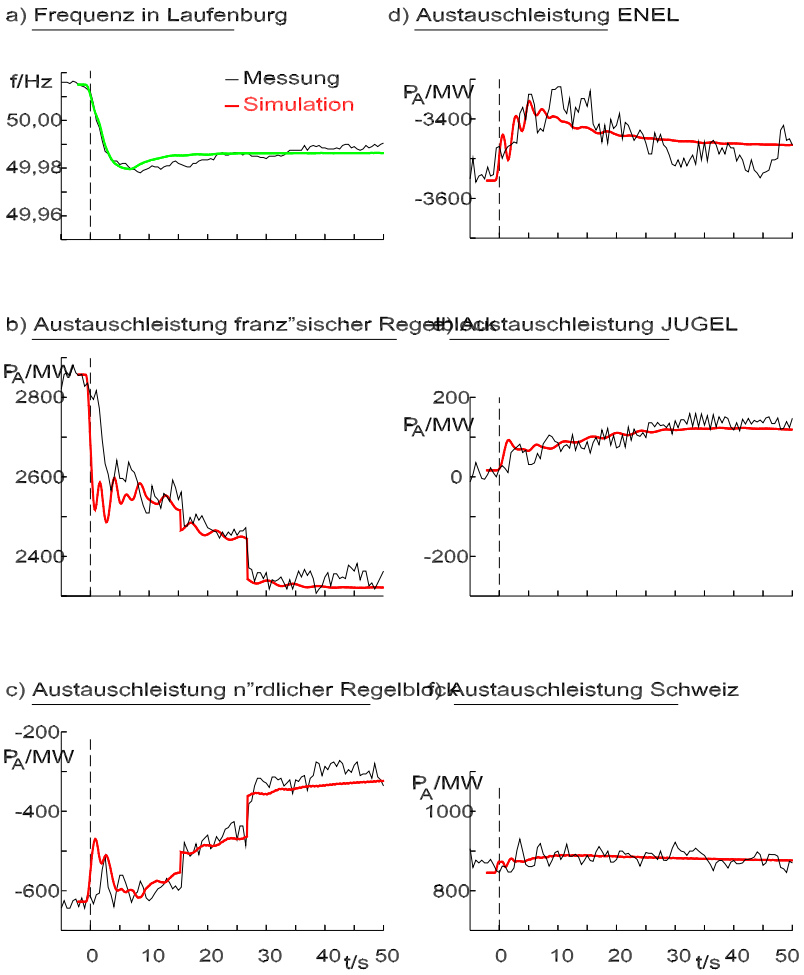
Automatic Voltage Controller (AVR)



Model Structure



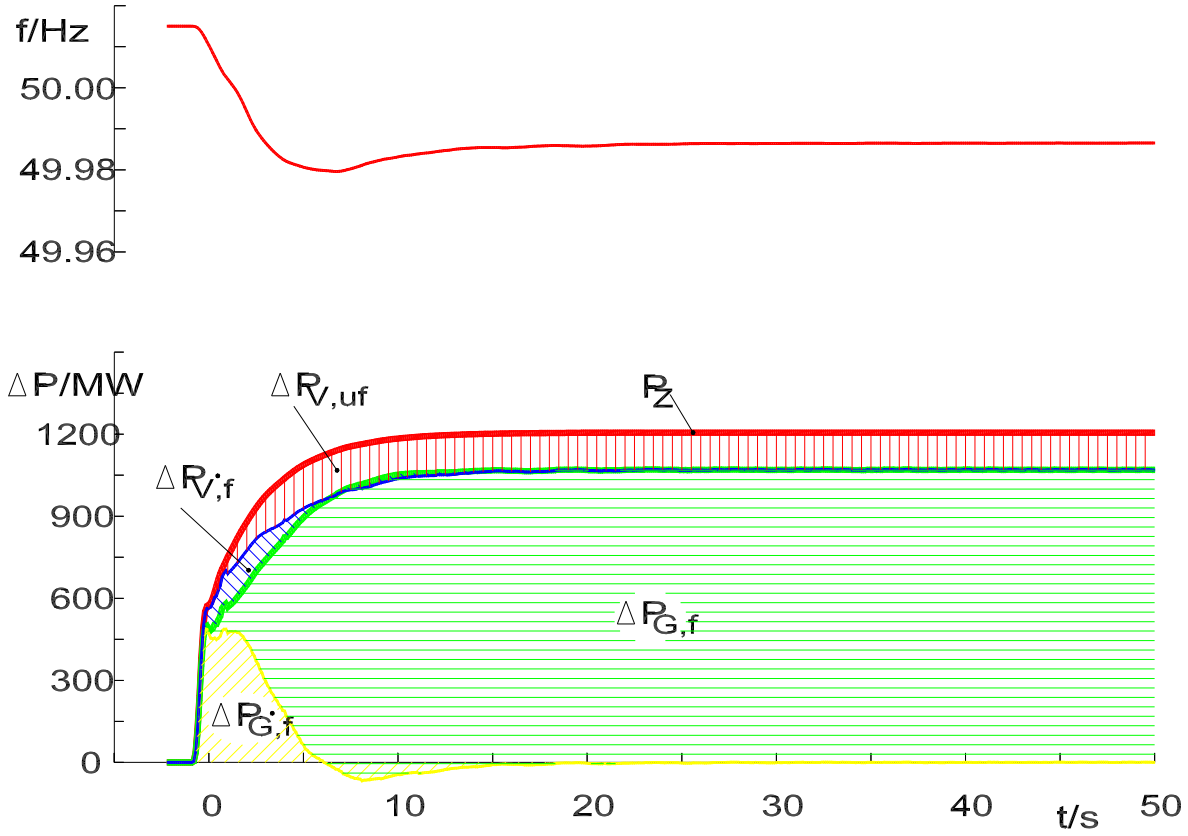
Model Calibration – Time Domain Calculations



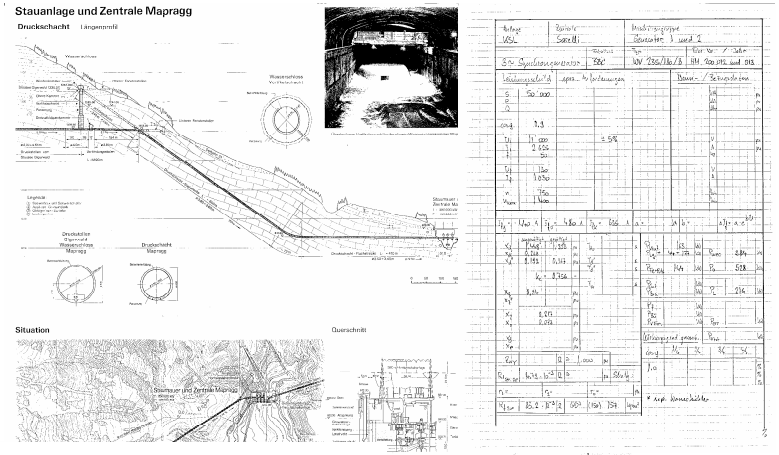
Simulation of Outage of Nogent PP 1200 MW 6.02.1991, 21:49

Comparison Measurement – Dynamic Model Calculation

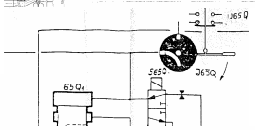
Phenomena Description / Active Power Components

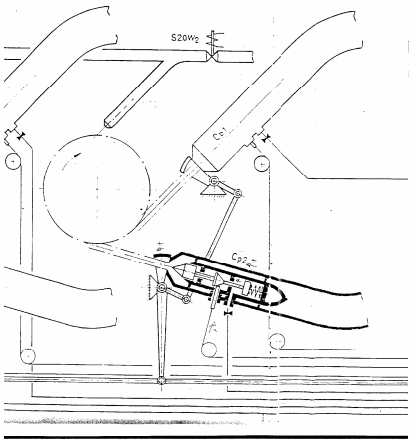


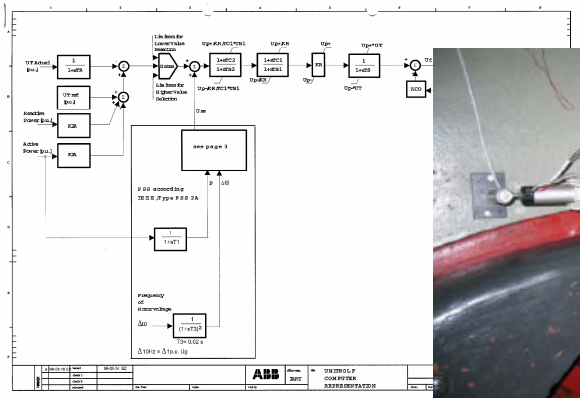
Documents + Measurement = Dynamic Model



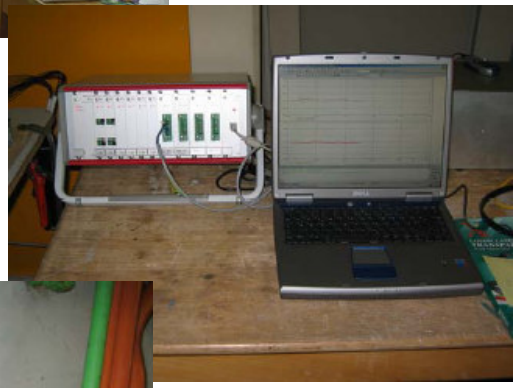
Document Review







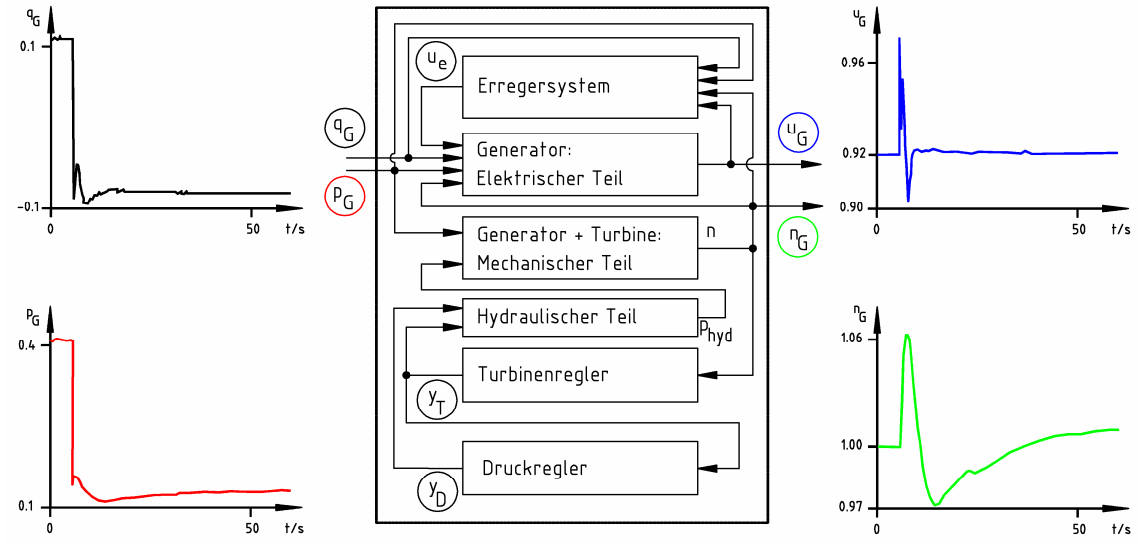
Record

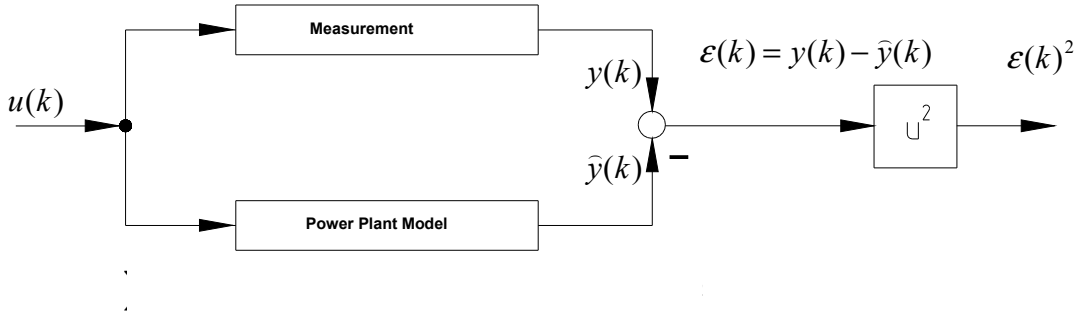


Evaluate

Measure

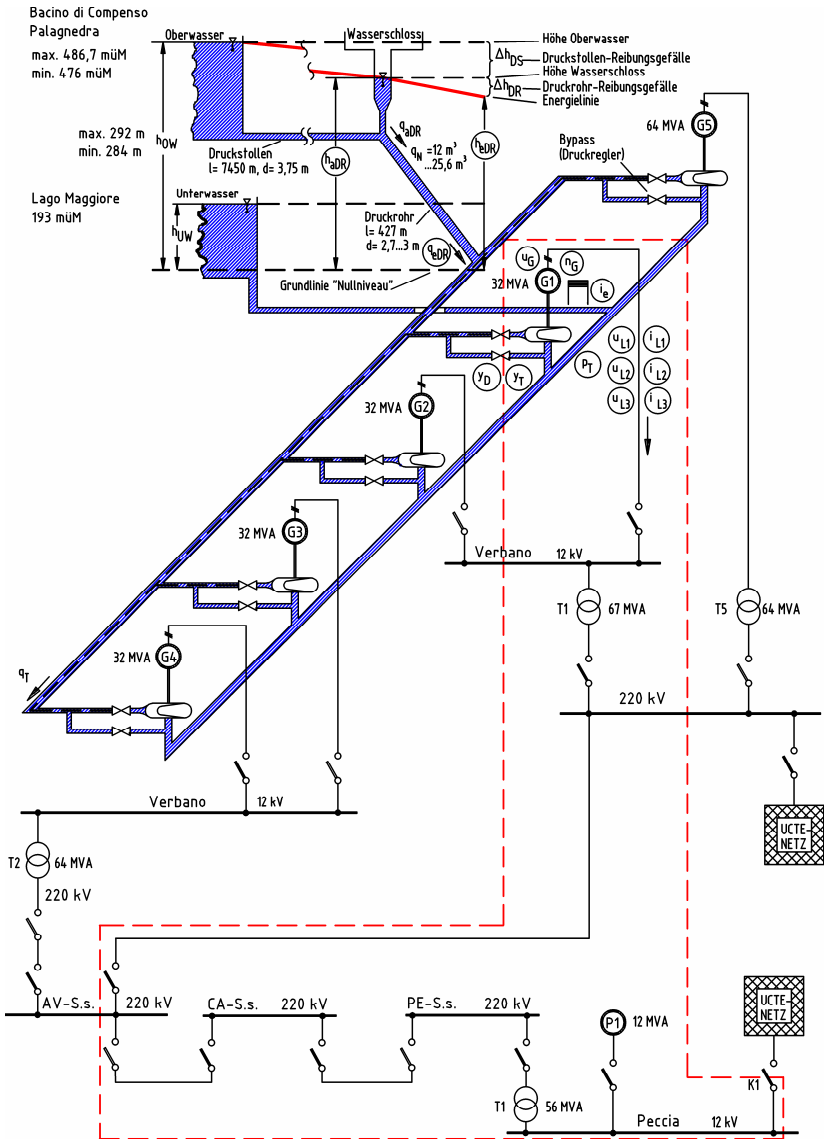
Dynamic Identification Principle

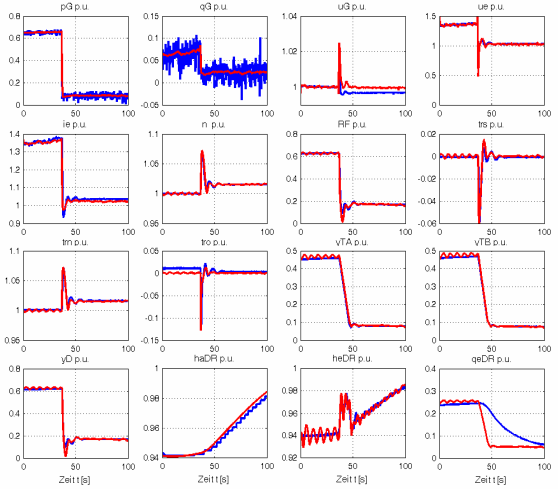


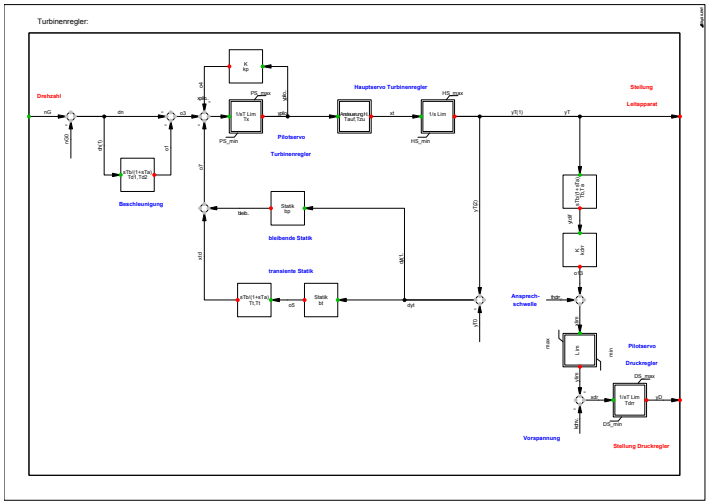


Detailed Identified Power Plants

Model Setup and Parameter Identification

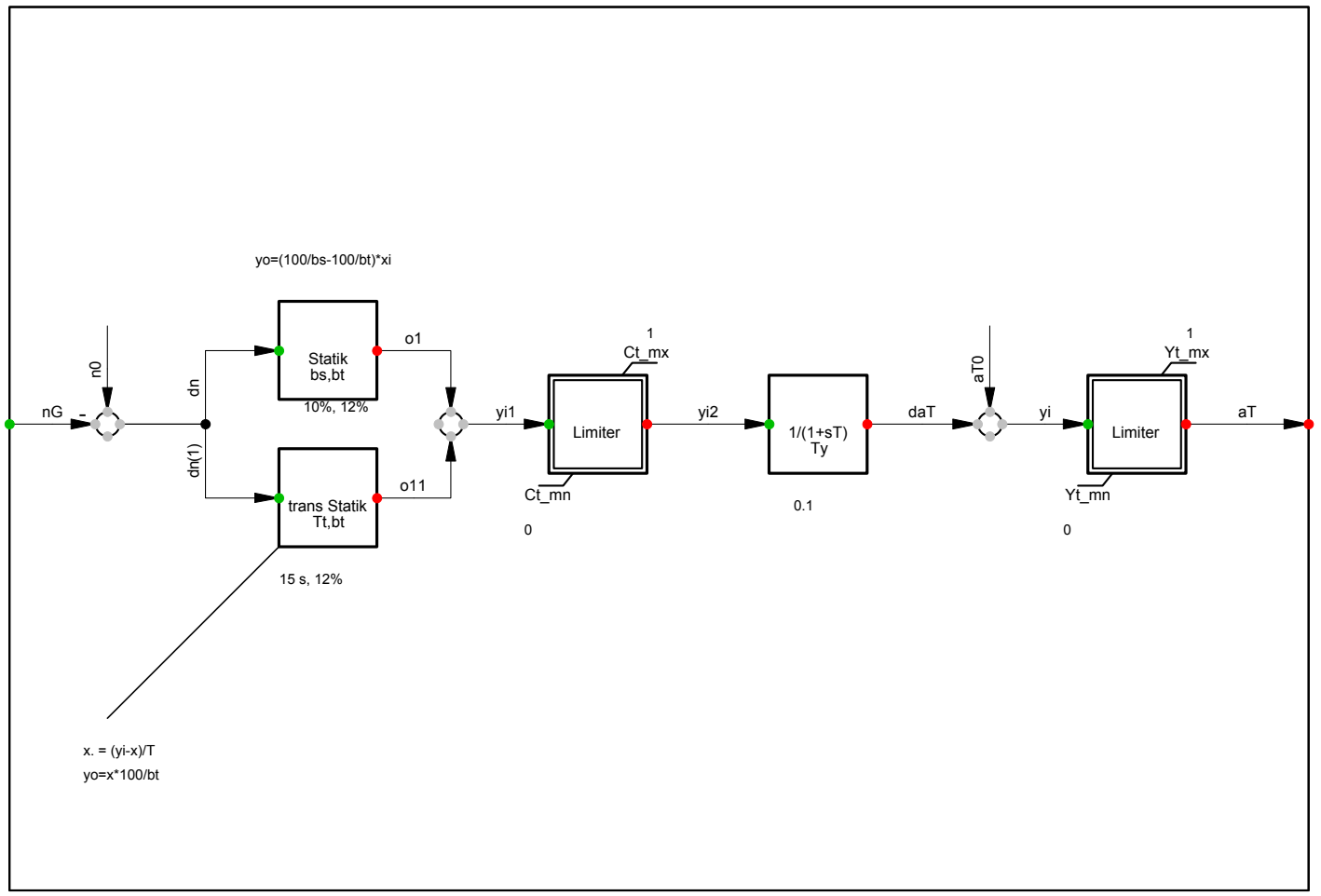






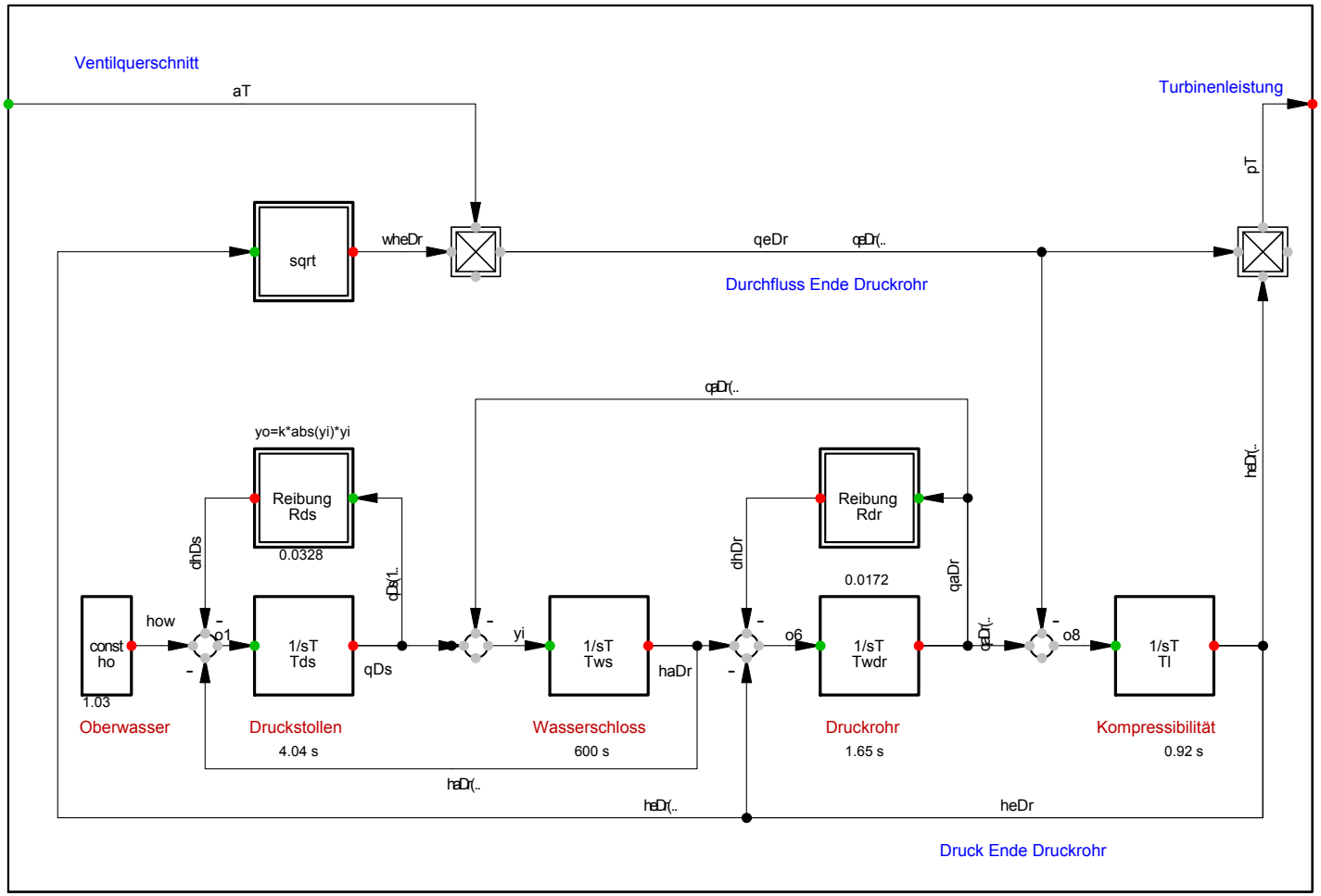
Hydro PP – Turbine Controller

PCO 8: Drehzahlregler mit transienter Statik

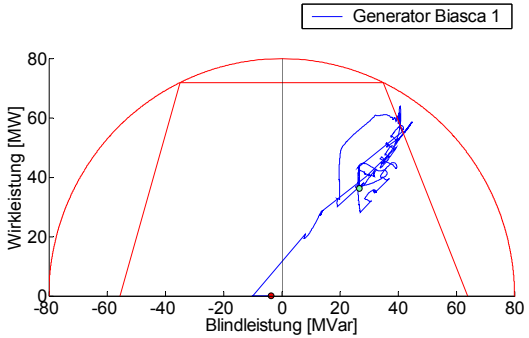


Hydro PP Turbine & Penstock

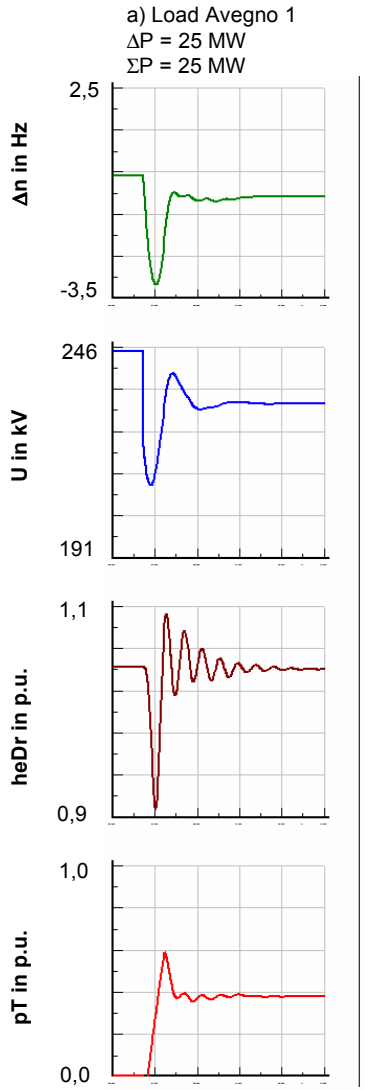
PGS 12: Wasserkraftwerk



Analysis of Simulation Results



- Possible protection triggering
  - Delay of system restoration
- Discover potential instabilities
- Define investments for PP upgrades
- Adapt restoration plans



Thank you for your attention