

Design of Variable Speed Generators for Hydropower Applications



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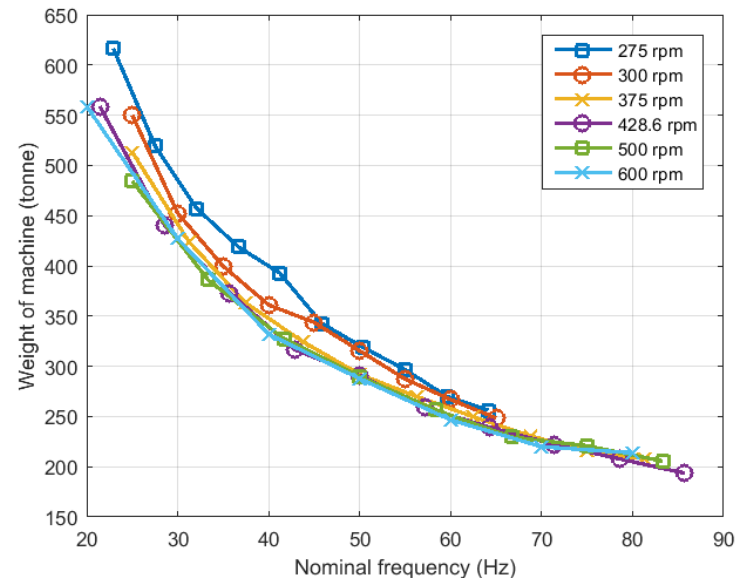
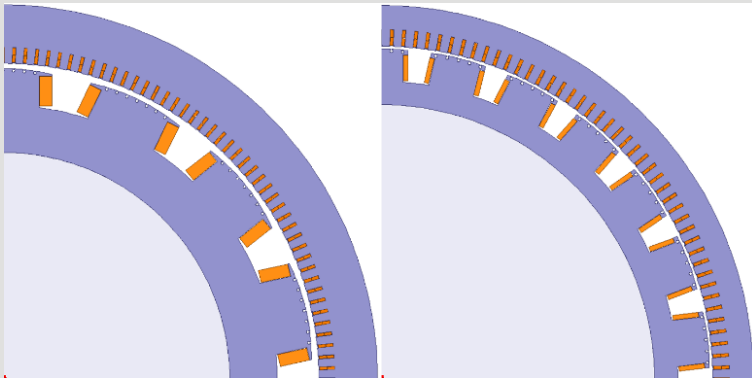
About me

- PhD Candidate at the Department of Electric Power Engineering
- Main research interests:
 - design and analysis of electrical machines
- 26 years old



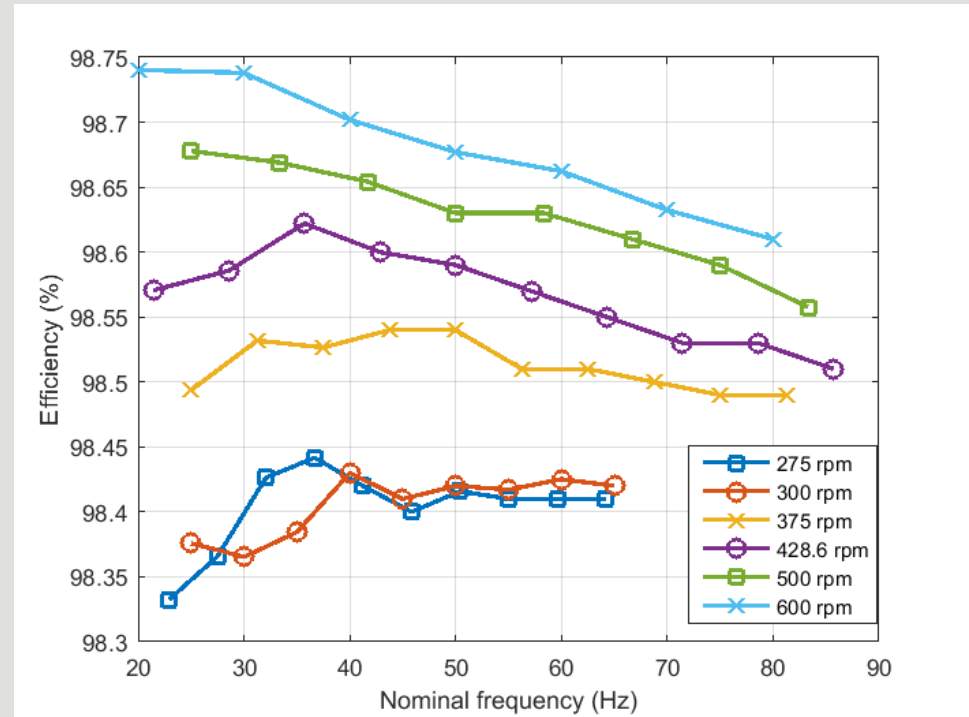
The aim of my PhD-work

- Explore the design implications of using converter-fed synchronous generators
- Investigate the effects of changing the nominal frequency of the generator

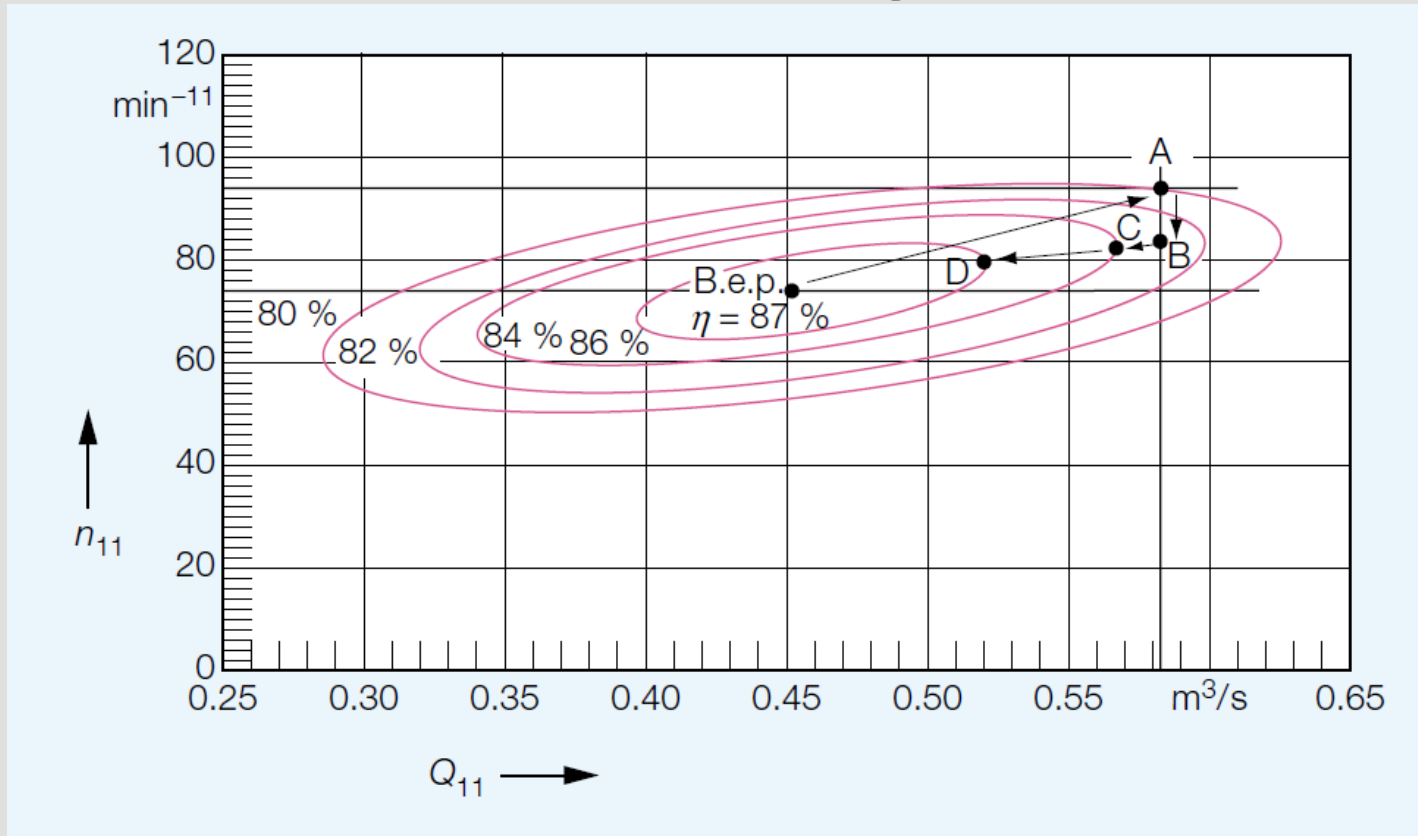


The aim of my PhD-work

- Analyse losses in converter-fed hydrogenerators
 - Iron
 - Copper
 - Mechanical

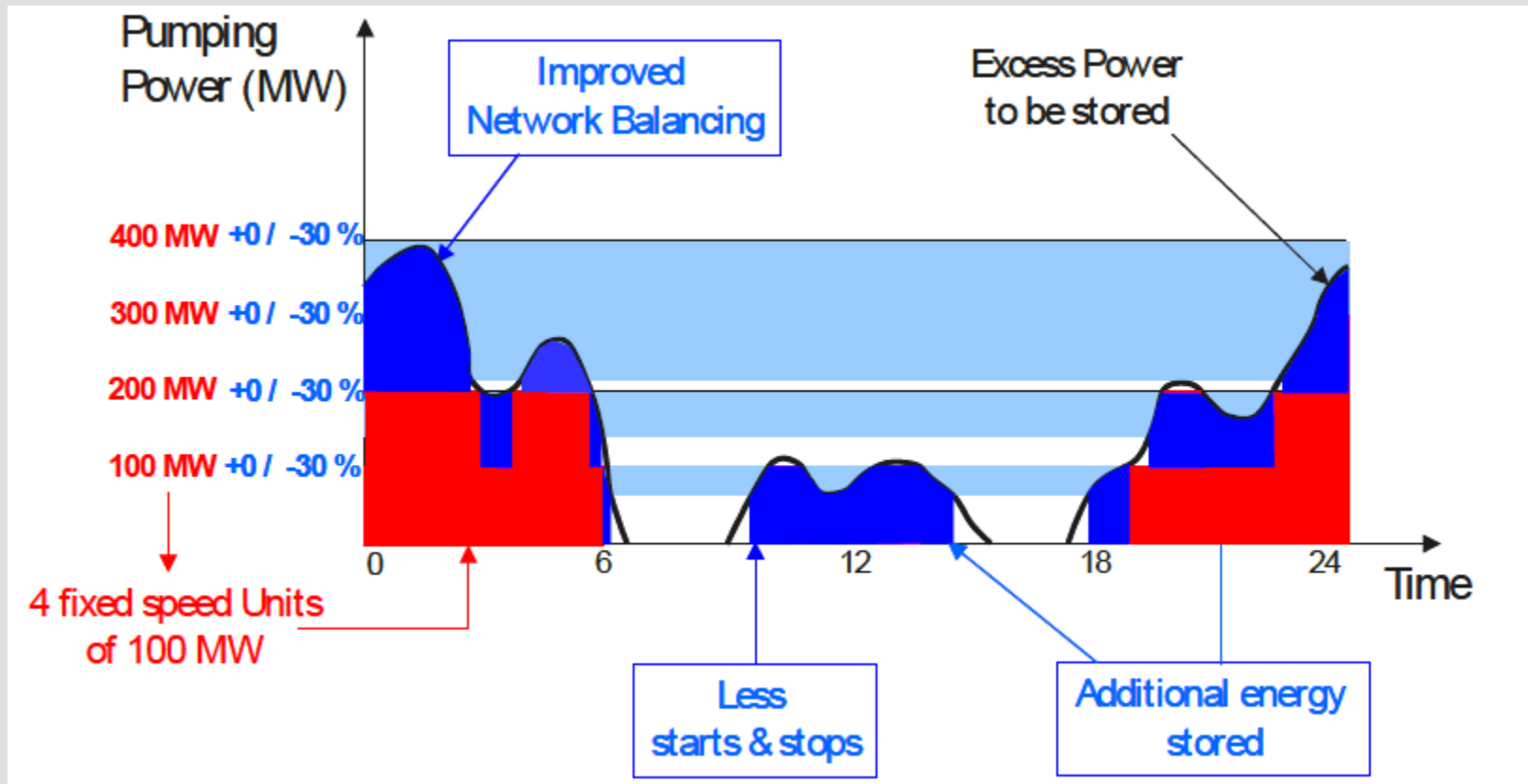


Variation in discharge or head



J. Merino, A. Lopez, «ABB Varspeed generator boosts efficiency and operating flexibility of hydropower plant», ABB Review 3, 1996

Pumped storage plants



G.D. Ciocan et al. «Variable speed pump-turbines technology», 2012

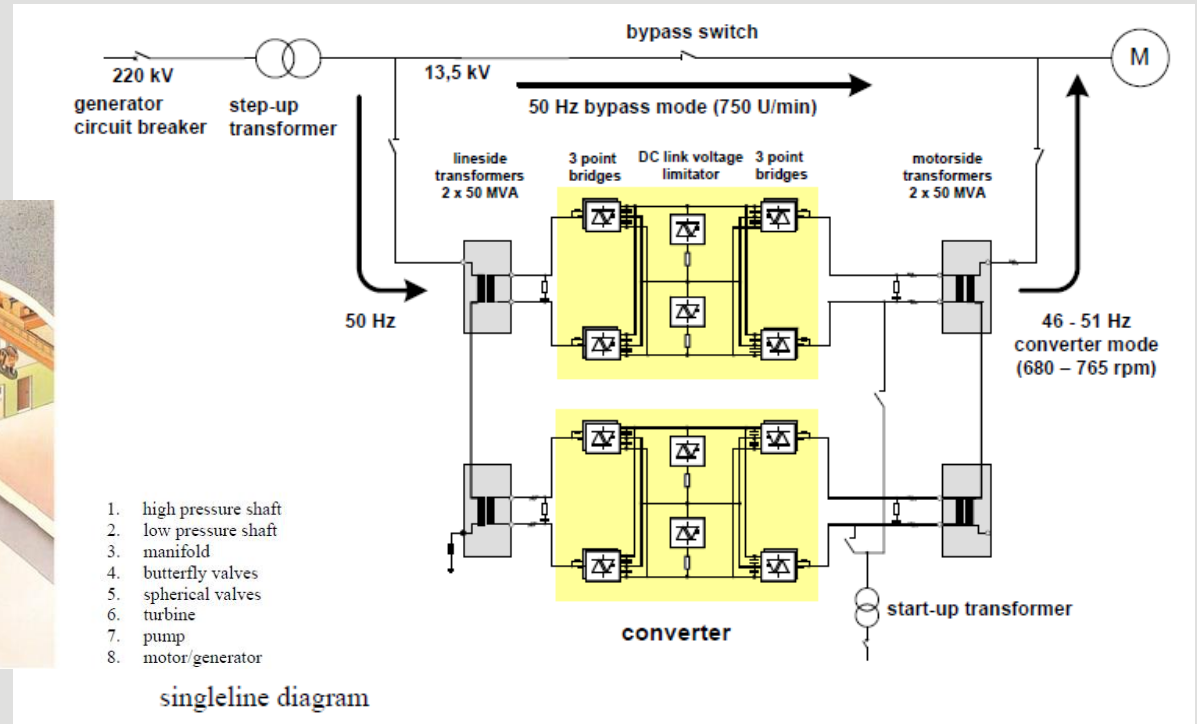
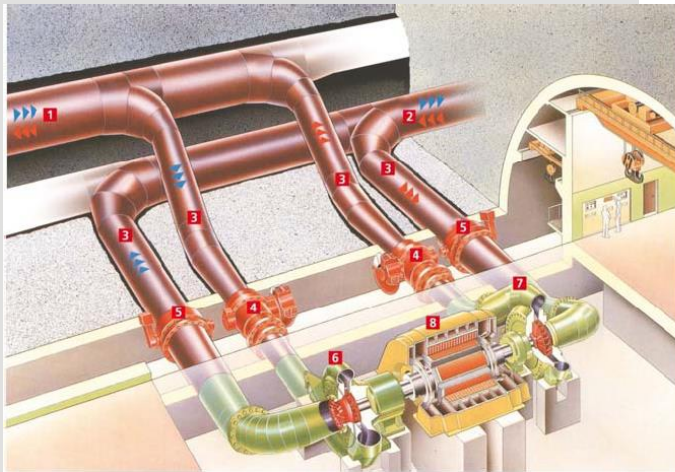
Is it innovative? In hydro, yes.

- Not traditionally used in large hydropower
 - Can choose speed optimal to turbine
 - Can choose frequency optimal to generator
 - Can vary speed for varying load/head
- Previously used for
 - ship propulsion
 - smaller scale applications like wind power
 - motor drives

Will it be used?

- 100 MVA converter-fed machine already installed for pumping in Switzerland
- If pumped storage is going to be used on a larger scale, some form of variable speed operation must be used to ensure adequate operating efficiencies

Grimsel 2 Switzerland – 100 MVA



H. Schlunegger & A. Thöni, «100 MW full-size converter in the Grimsel 2 pumped-storage plant» Hydro 2013 conference

Questions?

