

Modern Power Transmission Systems



1

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Modern Power Transmission Systems

Key Words

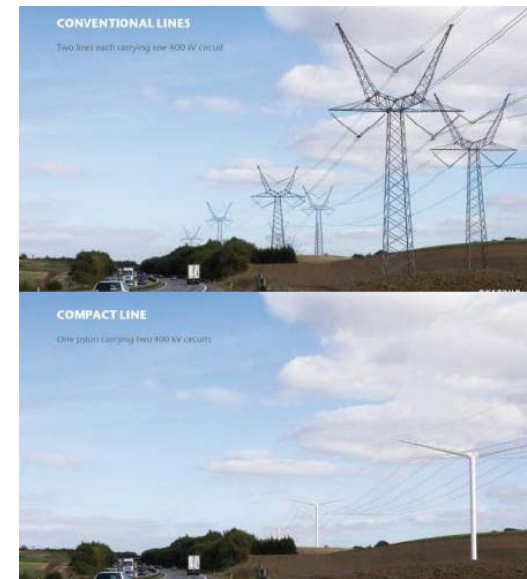
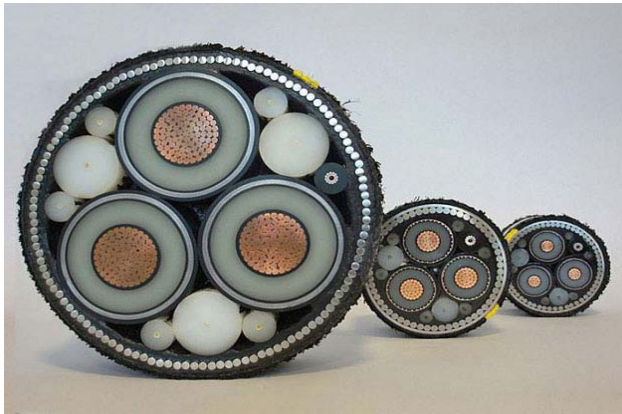
- Transmission power systems
- HVAC transmission cable technology
- Future Grid Structures
- VSC-HVDC transmission, future perspectives
- Offshore networks
- Bulk wind power integration
- Modern power system protection schemes
- Transient simulations – PSCAD/EMTDC
- Insulation coordination
- Harmonics in transmission power systems
- Transmission network components
- High Voltage and material technology
- Condition and lifetime assessment
- Overhead line corona audible noise



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Research Projects

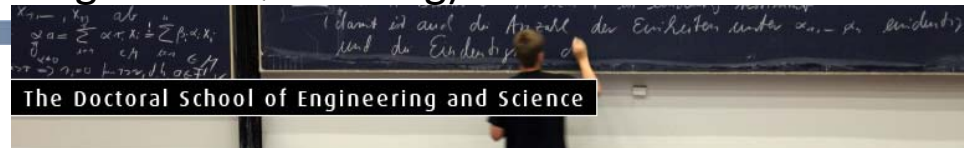
- HARMONY - Harmonic identification, mitigation and control in power electronics based power systems (2013-2018)
- Active filter functionalities for power converters in wind power plants
- DANPAC - HVAC transmission cable networks (2010-2015)
- Development of a Secure, Economic and Environmentally-friendly Modern Power System (2012-2015)
- Power Pylons of the Future (PoPyFu) (2014-2017)
- SALS Smart Adaptive Load Shedding



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Ongoing PhD Projects

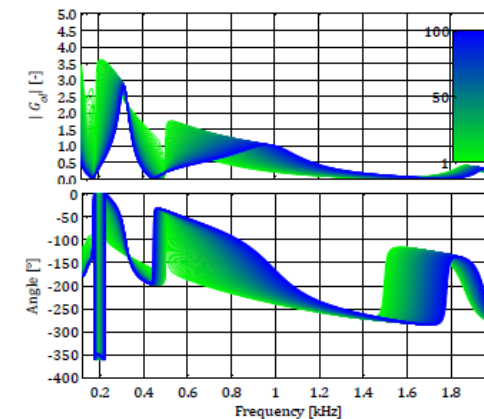
- High Power Medium Voltage DC/DC Converter (Catalin Dincan)
- Harmonic Stability in Power Electronics Based Power Systems (Esmail E)
- Planning and Control of Offshore VSC-HVDC Multiterminal Transmission Grids (Roni Irnawan)
- Protection of Multi-Terminal VSC-HVDC Transmission Lines (Mani Ashouri)
- Harmonic Modelling, Propagation and Mitigation for Large Wind Power Plants Connected via Extra Long HVAC Cables (Mohammad Kazem Dowlatabadi)
- Control Tuning of Phase Measurement Units - based Protection Systems with VSC-HVDC controls to Mitigate Instability of System (Hesam Khazraj)
- Modelling of Long Submarine Transmission Power Cables (-)
- Voltage Control in the Future Power Transmission Systems (Nan Qin)
- Small Scale Harmonic Power System Stability (Changwoo Yoon)
- Technologies for the Power Supply of Electric Railways in Denmark (Athanasios Stamatopoulos)
- Adaptive Protection for Medium Voltage Marine Applications (Catalin Ciontea)
- Electrical Design of a New, Innovative OHL Transmission Tower made in Composite Materials (Tohid Jahangiri and Qian Wang)



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Current research topics

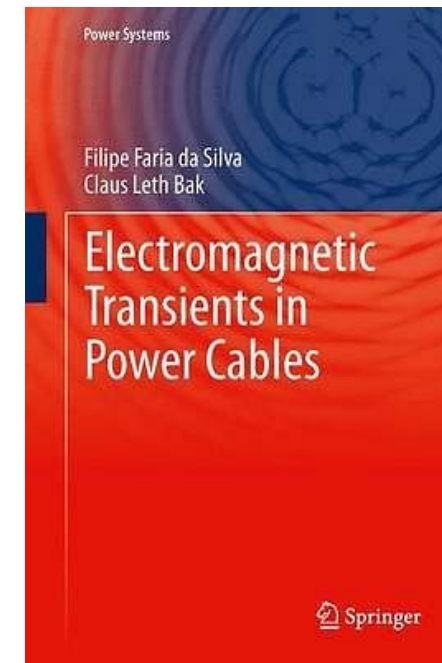
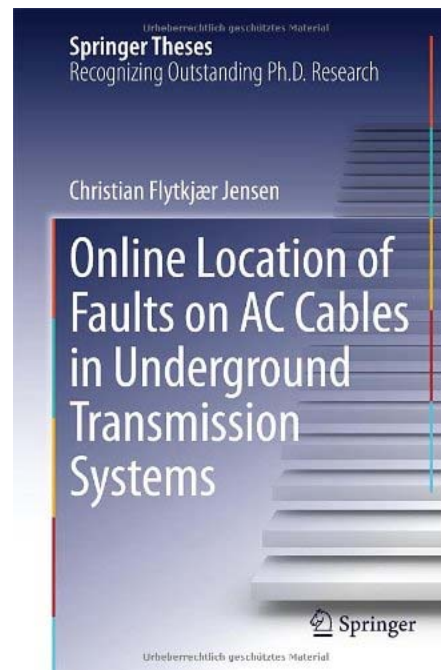
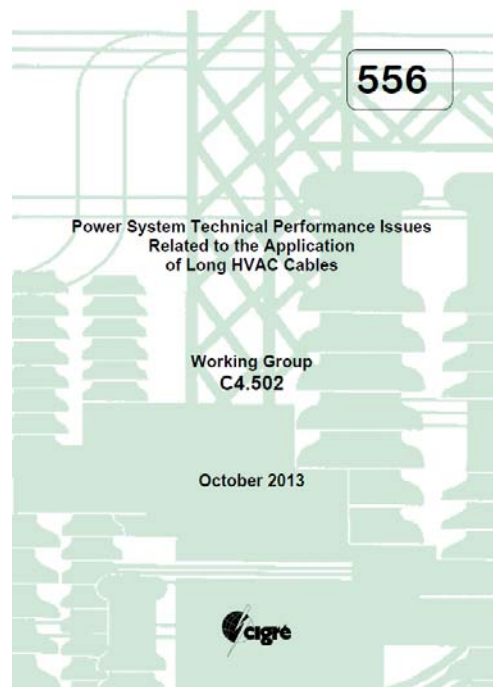
- Underground cables in the transmission system
- High voltage OHL in composite material
- Railway electrification – voltage quality and unbalance
- Harmonic interaction in multi-inverter networks (PV and WP, also offshore WPP)
- Network stability including HVDC
- Protection of grids
- HVDC/MVDC technologies for the future offshore grid



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Example of Research topics: Underground transmission cables

Five industrial PhD students (together with Energinet.dk) + several MSc's have been working with various issues of undergrounding the transmission system for 10 years.



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Example of Research topics: High Voltage

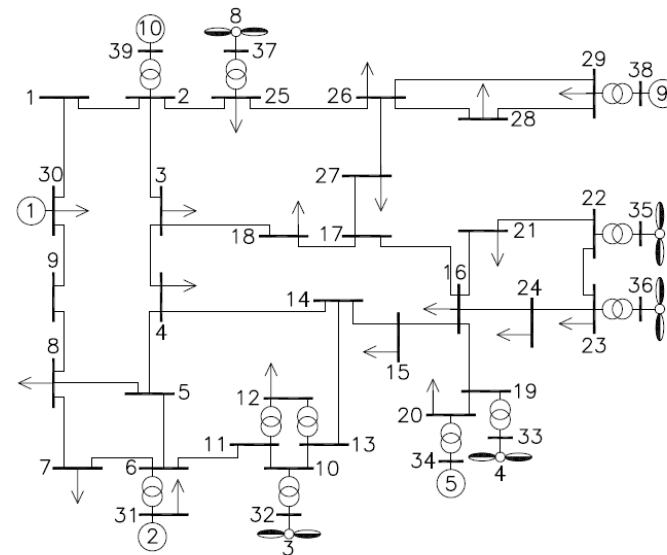
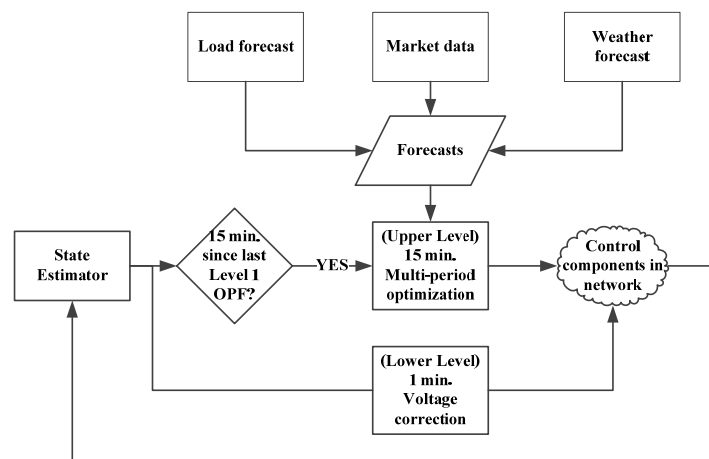
PoPyFu (Power Pylons of the Future) employs two PhDs working with design and testing of a brand new all-composite 400 kV tower (no standards available for the respective designing)



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Example of Research topics: Network Stability

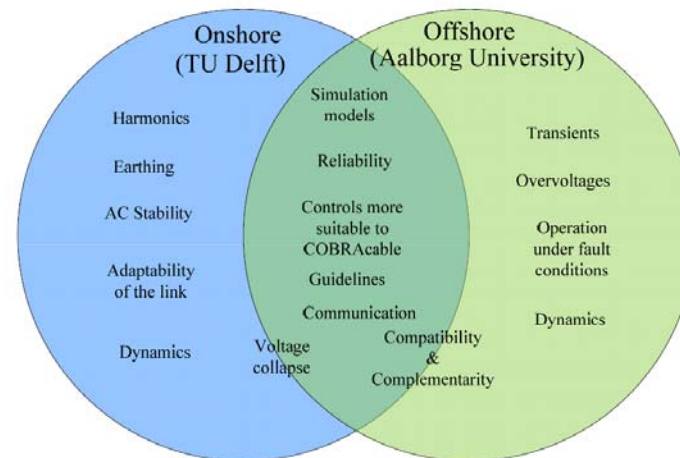
- Industrial PhD from Energinet (Nan Qin) to finish in 2016. Nan works with loss-saving automatic voltage control employing a multi-period optimized use of switchable components like shunt reactors and tap changers. Completed with acceptance of thesis in SPRINGER Outstanding theses series.
- Foreign PhD paid by the Iranian government (Bakhtyar Hoseinzadeh) to finish in 2015. Bakhtyar works with adaptive methods for load shedding in a transmission network dominated by renewables. Developed into SALS project funded by Danish ForskEl.



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Example of Research topics: HVDC

- Definition of Connection Requirements for Operation of the COBRACable as an adaptable Multiterminal HVDC-VSC link is a new project with TUDelft, Energinet.dk and TenneT. It intends to propose a generic set of specifications for a multiterminal access for OWPP to the COBRA Link. Two cooperating PhD's.

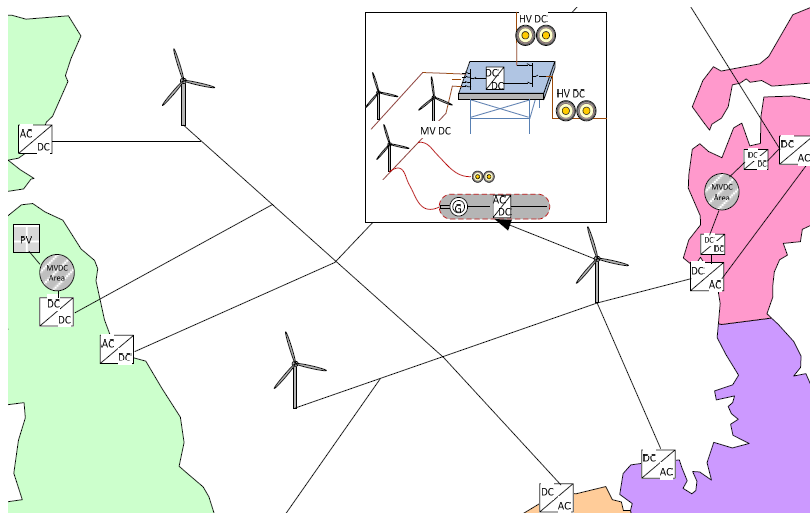


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Example of Research topics: MVDC

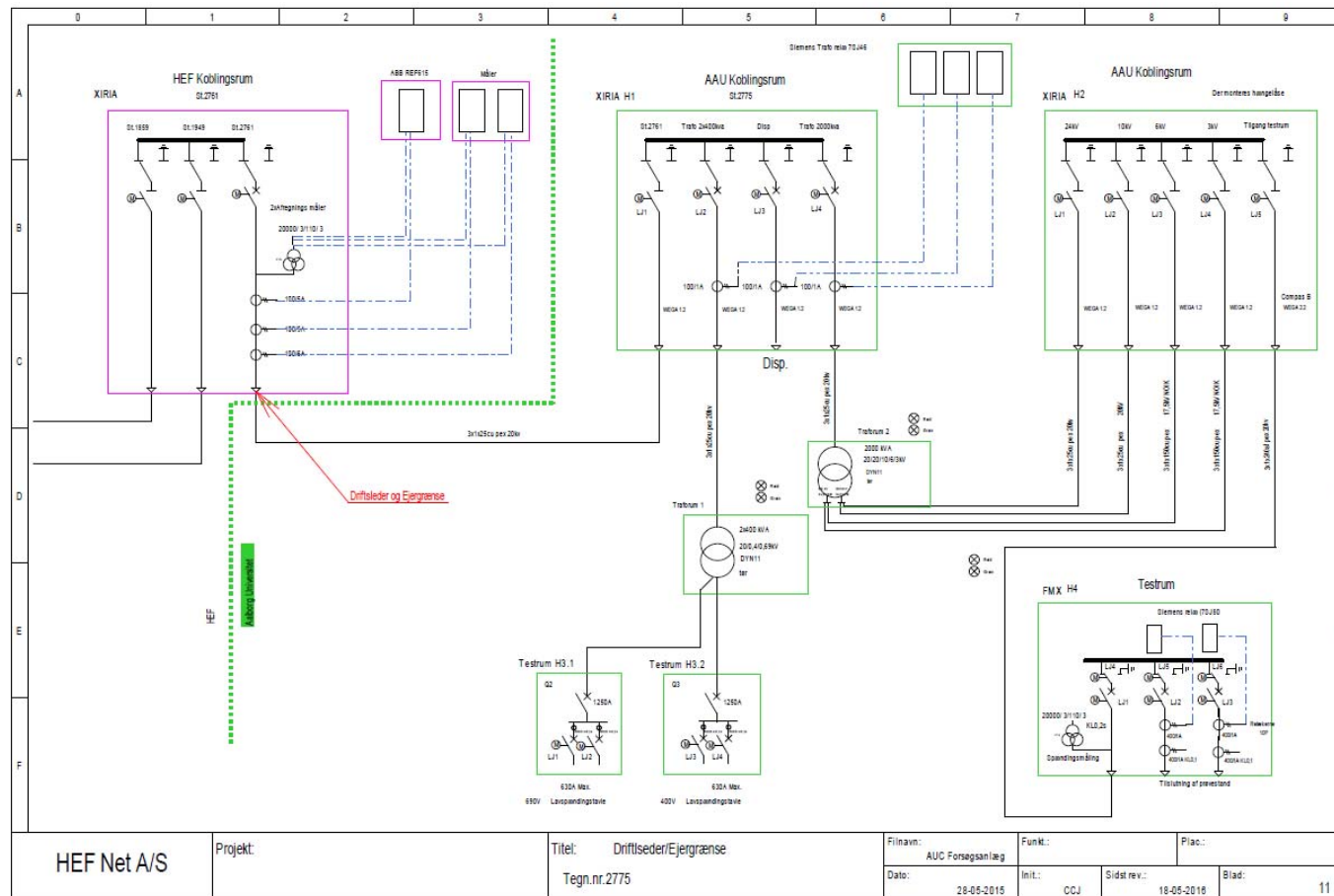
Our strategy is to create a competence centre in MVDC technology to be used in WPP's of the future, employing not LV, but MV in the range of few kV's and up to maybe 36 kV.

A PhD and a Postdoc have been employed to start the process and other projects are already in line



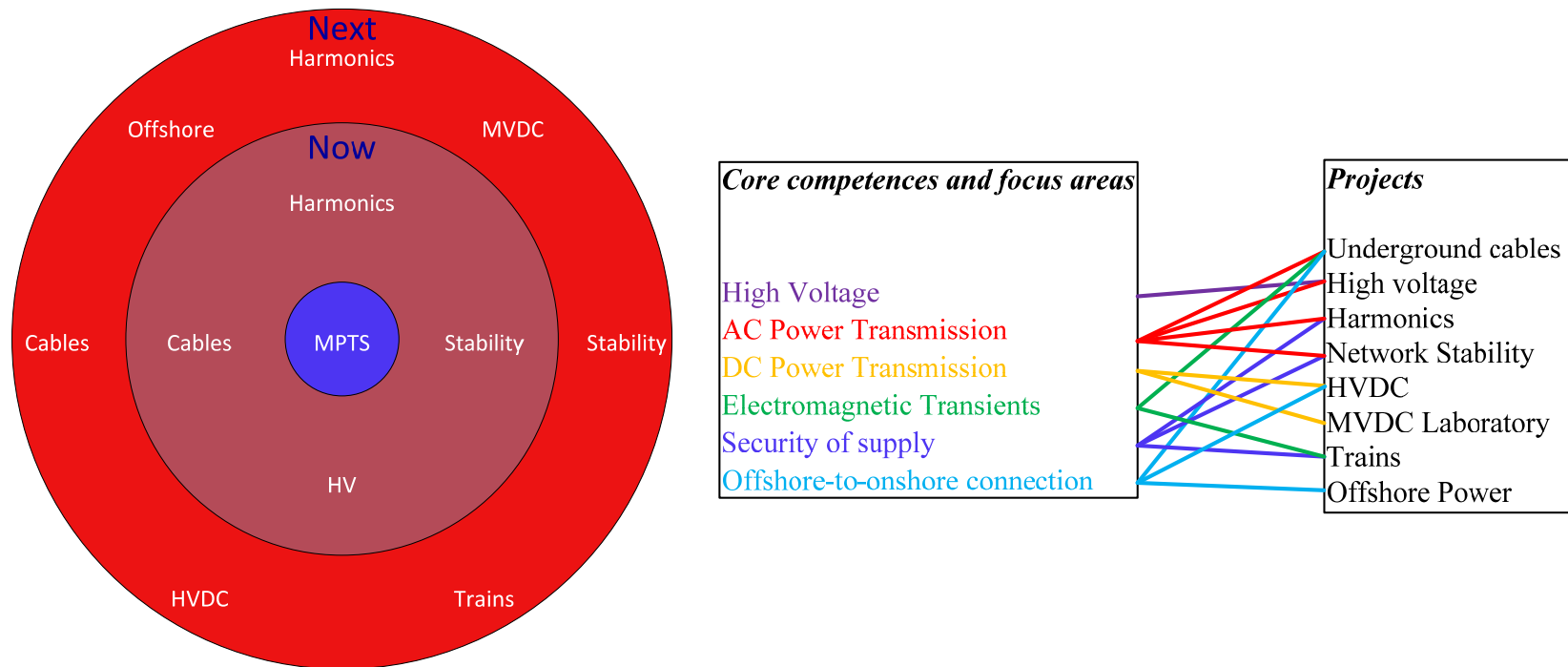
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Single line diagram for 20/20-10-6-3 kV 2 MVA MV laboratory



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Core competences and focus areas



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- State-of-the-art laboratory facilities in both HV and MV (up to 20kV and 2MVA)
- Measuring and test equipment for field testing



Partners: Energinet.dk, DONG Energy, Siemens, ABB, Vattenfall, DEIF, Tennet, TU Delft....