

Modern Power Transmission Systems



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Modern Power Transmission Systems

Key Words

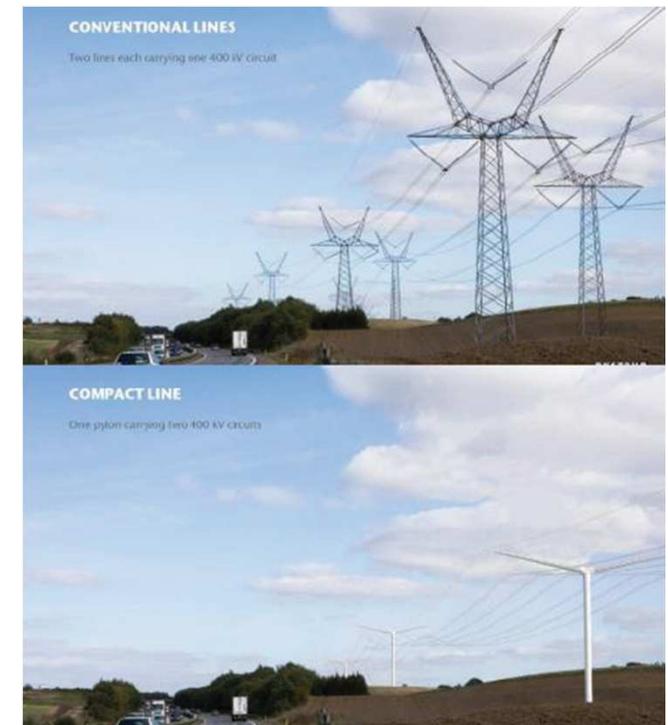
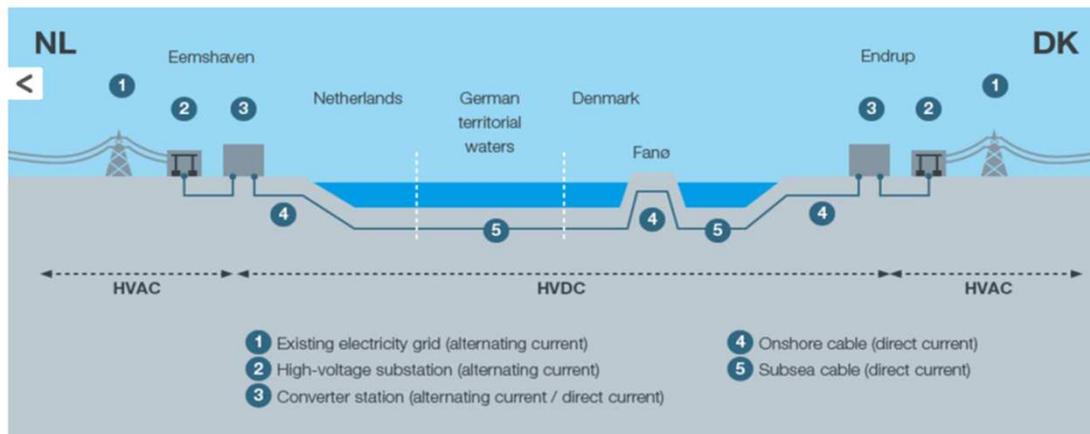
- **Transmission power systems**
- **HVAC transmission cable technology**
- **Future Grid Structures**
- **VSC-HVDC transmission, future perspectives**
- **Offshore networks**
- **Bulk wind power integration**
- **Modern power system protection schemes**
- **Transient simulations – PSCAD/EMTDC**
- **Insulation 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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Ongoing Research Projects

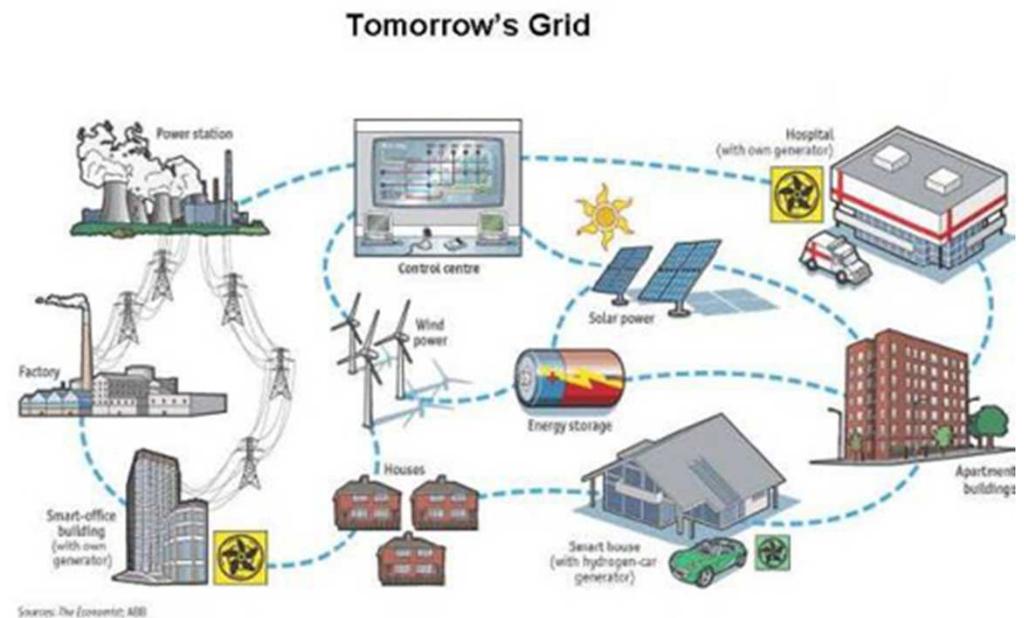
- HARMONY - Harmonic identification, mitigation and control in power electronics based power systems (2013-2018)
- Power Pylons of the Future (PoPyFu) (2014-2018)
- SALS – Smart Adaptive Load Shedding (2016-2018): *Dynamic, decentralised and optimised load shedding*
- COBRACable – Multi terminal HVDC-VSC link (2015-2019)
- Multiple individual PhD projects: *12 at the present*



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Previous Research Projects

- 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)
- Overhead line audible noise
- Multiple individual PhD projects



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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)
- Advanced Protection Technologies of a Cable Dominated Network with large Scale Power Electronics (Kaiqi Ma)
- Scada-Based Reliability & Protection for Active Distribution Network (Abdul Wachid Syamroni)
- 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)
- 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)

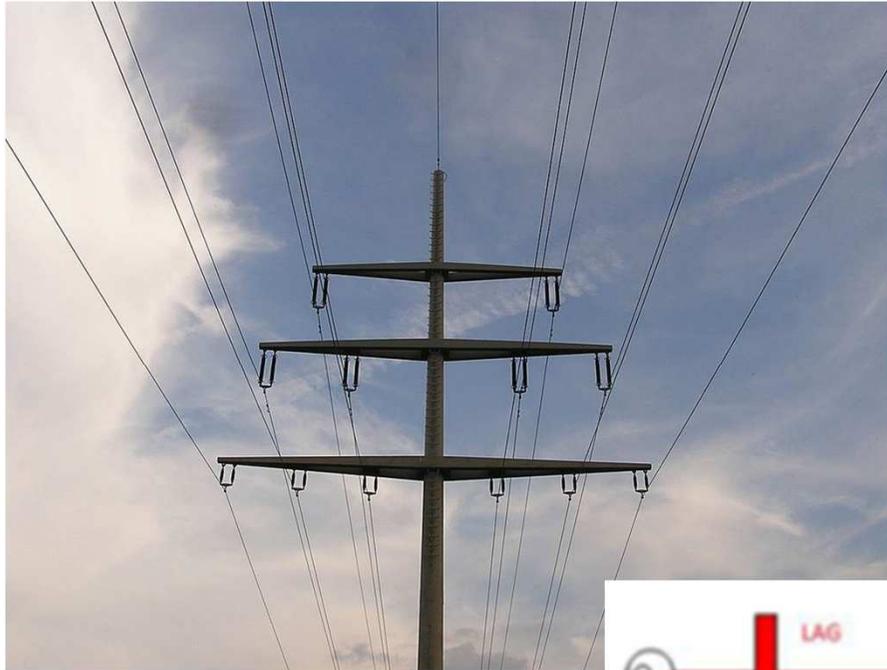
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Current research topics

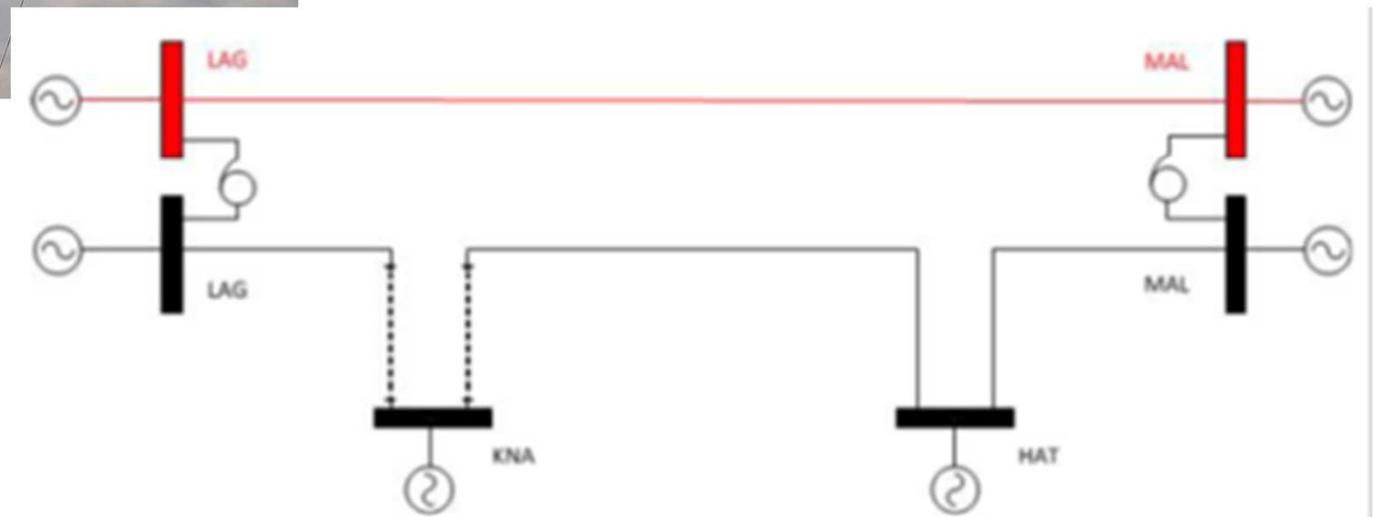
- Underground cables in the transmission system
- High voltage OHL in composite material
- Railway electrification – voltage quality and unbalance
- Harmonic interaction in multi-inverter networks (PV and WP, also offshore WPP)
- Network stability including HVDC and wide-area monitoring
- Protection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



Funny protection schemes ☺



ENERGINET



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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 standard, guidelines or experience exist for the respective designing)

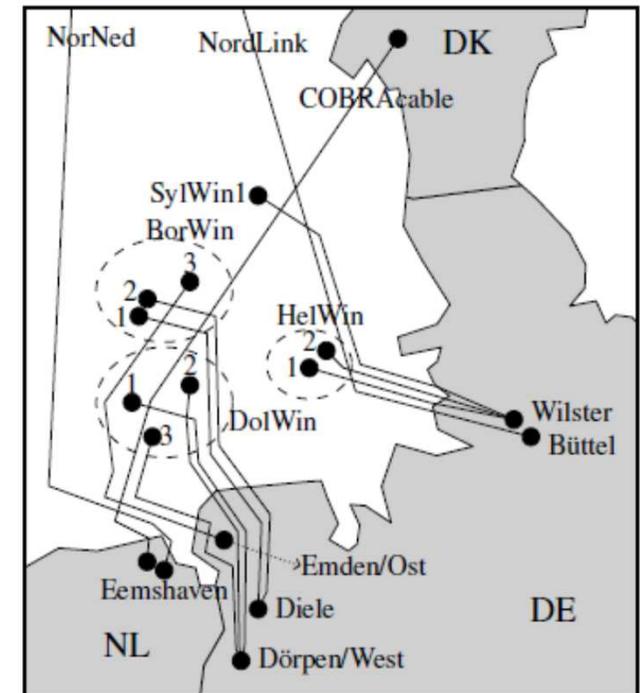


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Example of Research topics: HVDC grids

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 will propose a generic set of specifications for a multiterminal access for OWPP to the COBRA Link.

A new control interface has been designed allowing the usage of multivendor converters in multi-terminal HVDC, while maintaining the IPR confidential. It operates as plug-and-play and can be used for grids use configuration changes

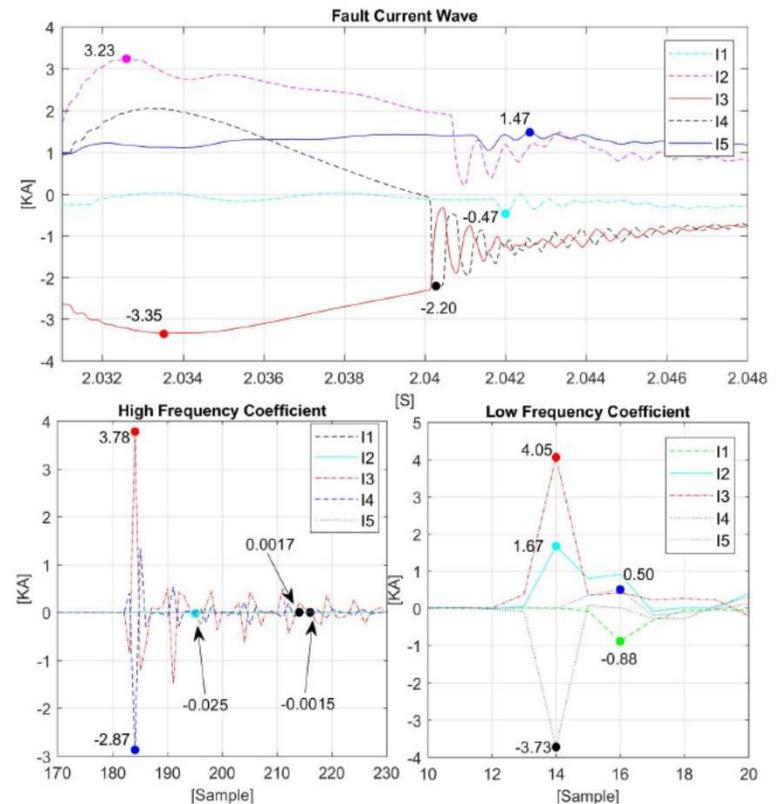
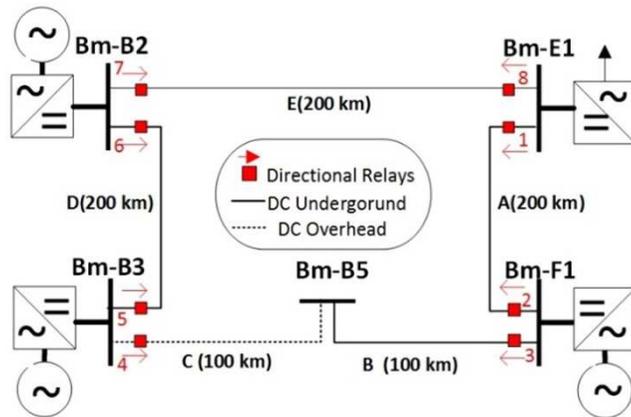


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Example of Research topics: Power System Protection for modern grids

New multiterminal HVDC grids new relays able to operate selectivity and to pinpoint the fault. Simultaneously, large power-electronic generation in a cable-based grid impacts the short-circuit power and the efficiency of traditional protection philosophies

Three projects are running in these topics

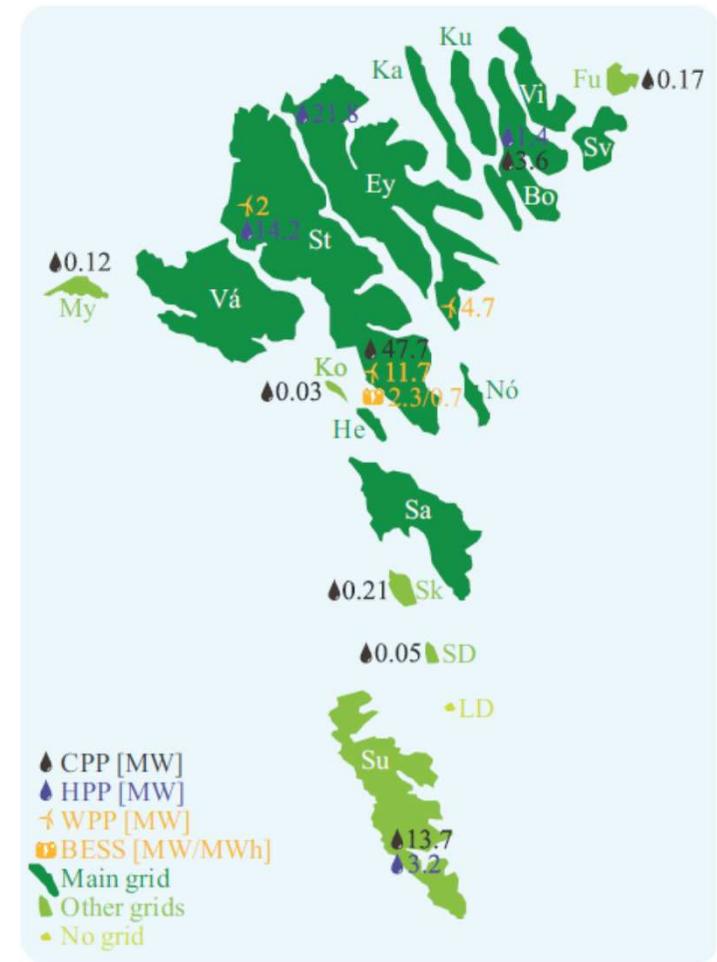
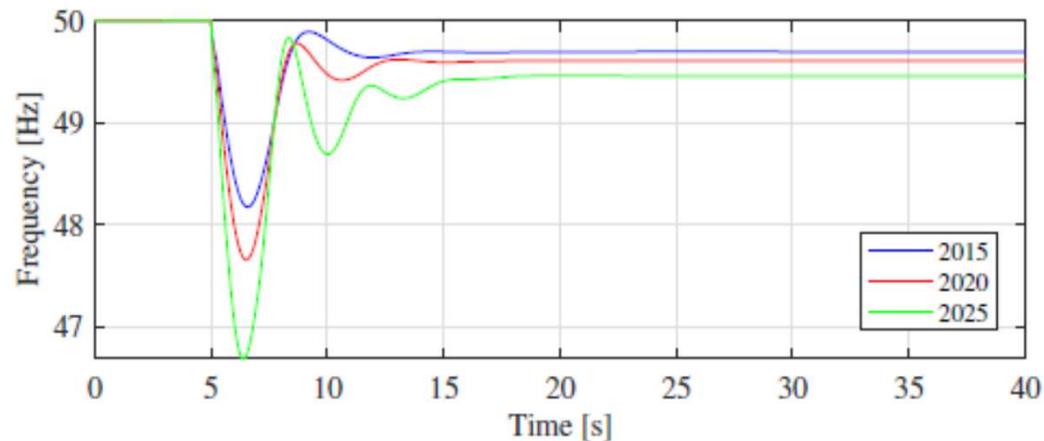


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Example of Research topics: Operation of 100% renewable energy in islanded grids

A new project will start in the fall together with the Faroese system operator: SEV

The project will study the technical feasibility of having 100% renewable energy in Faroe Islands by 2030: Primary and secondary controls



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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
- RTDS and OMICRON



Close relation with industry:
Energinet, Ørsted, Siemens,
ABB, Vattenfall, DEIF, Tennet,
TU Delft, SEV, Bandedanmark