Nordic workshop in power system protection and control

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Activities on Protection at Chalmers

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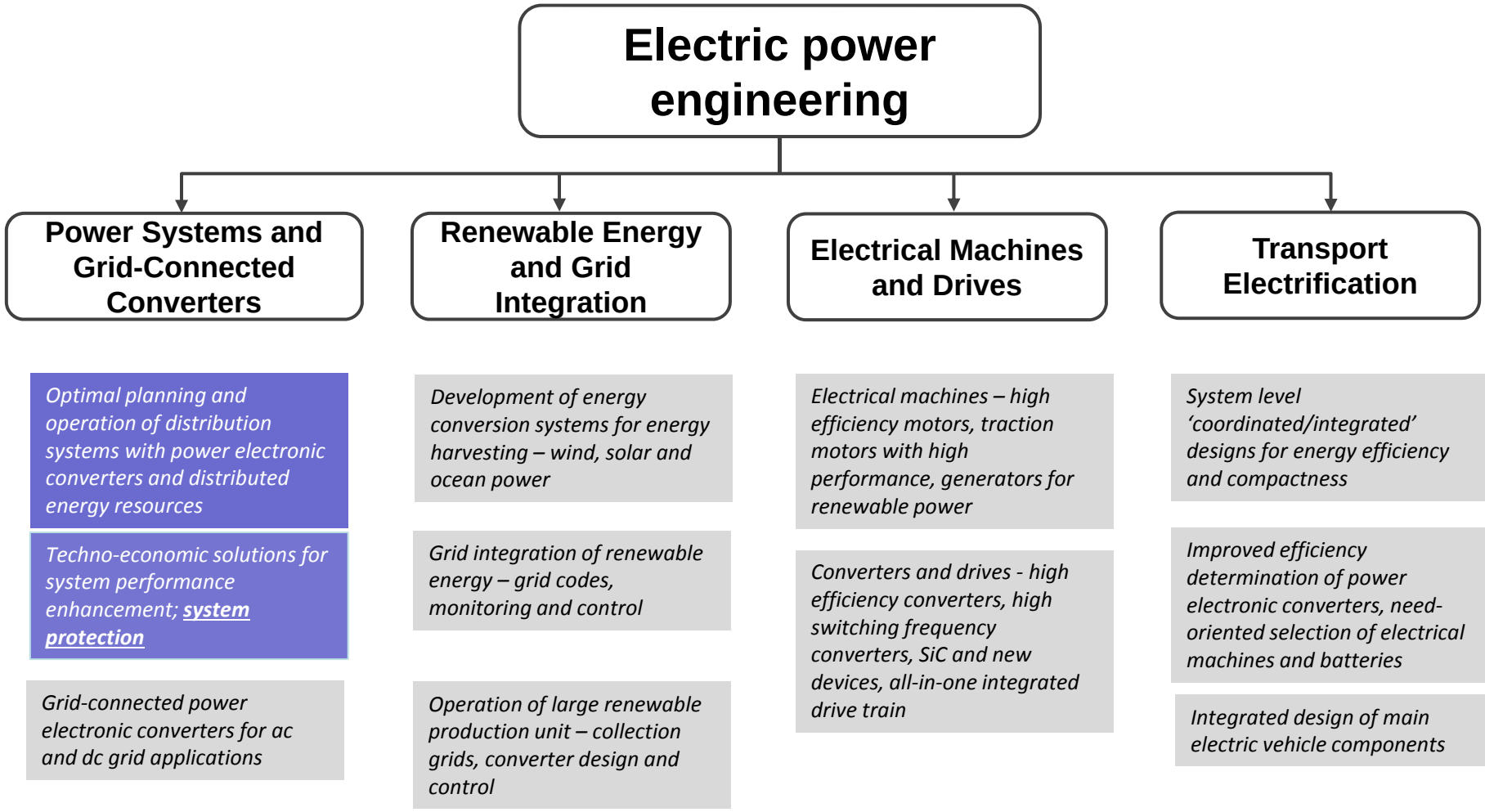
Outline

- Electric Power Enginering at Chalmers
- Master theses on protection
- New PhD project on system protection against voltage collapse

Research Strategies



Research on intelligent distribution systems

Driving Force:

Increasing distributed energy resources and electric transportation in distribution system with advanced control, protection and optimization enabled by ICT

Fossil Free Energy District (FED)	m2M GRID	Smart energy buildings (HSB LL)	UNITED-GRID
Urban Innovative Action Aims to demonstrate a smart energy district that enables high share of renewable energy. Will be used as a test plattform for comming projects.	ERANet Smartgrid Plus Aims to develop solutions for coordination of multiple micro-grids	Chalmers–GE cooperation Aims to develop intelligent control system for buildings with local generation and energy storage and to assess the influence on the distribution system	Horizon 2020 LCE01 Develops advanced cyber-physical solutions for intelligent distribution system Self-healing and ”setting-less” protection based on measurements

Master thesis:

Impacts of Solar Photovoltaic on the Protection System of Distribution Networks

A Case of the CIGRE Low Voltage and a typical Medium Voltage distribution networks in Sweden

Liwanga Namangolwa, Elizabeth Begumisa
Chalmers, 2016

Available at:
http://publications.lib.chalmers.se/records/fulltext/240754/240754.pdf

Aims of the thesis

The thesis attempts to answer following questions :

- How is the overcurrent protection coordination affected when solar PV is included?
- How do fault current levels change when solar PV is integrated in the distribution network?
- What is the hosting capacity in terms of protection?
- What are the mitigation solutions to address these impacts?

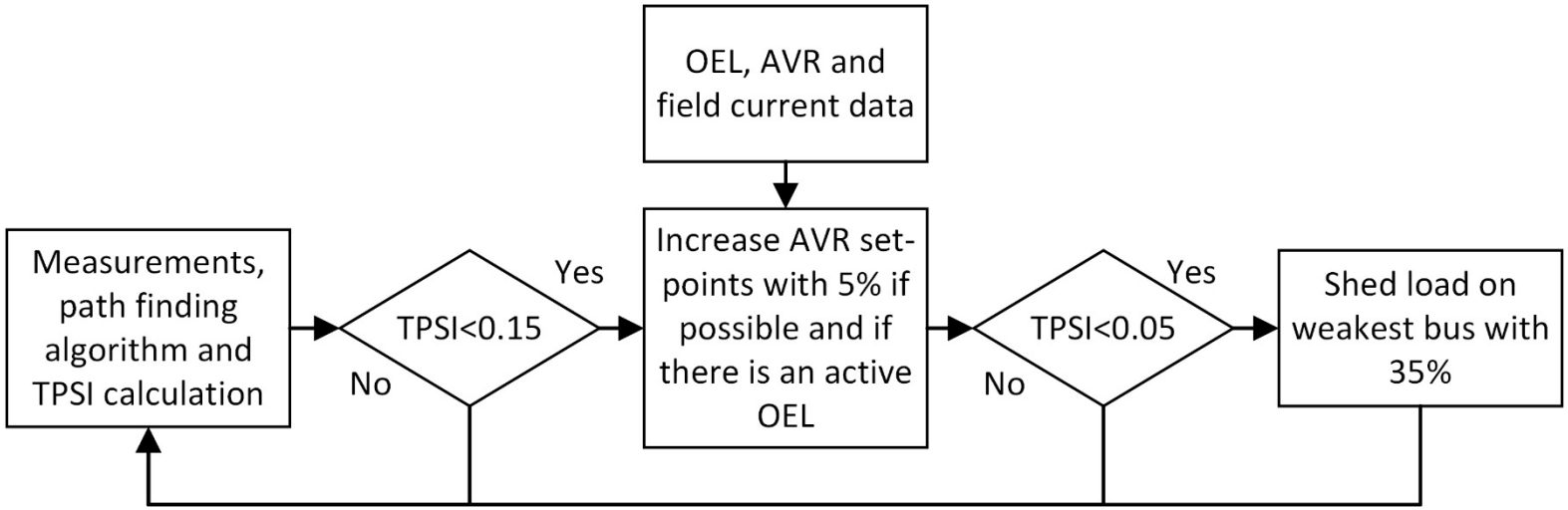
Master thesis:
Development of a system protection model against voltage collapse in PSS/E

David Stenberg & Joakim Åkesson
Chalmers, 2016

Available at:
http://publications.lib.chalmers.se/records/fulltext/243594/243594.pdf

Aims of the thesis

- To develop and implement a system protection model to prevent voltage collapse for the Nordic 32-bus test system in PSS/E.
  - Used to predict and prevent voltage collapse.
  - The input signals: voltage stability indicators (TPSI) and signals from over excitation limiters (OELs).
  - Corrective actions: Control of synch. gen. AVR set-points and/or load shedding.



Master thesis:
Coordinated Control Method For Prevention of Voltage Collapse

Ahmed Sultan Esreb
Chalmers, 2017

Available soon!

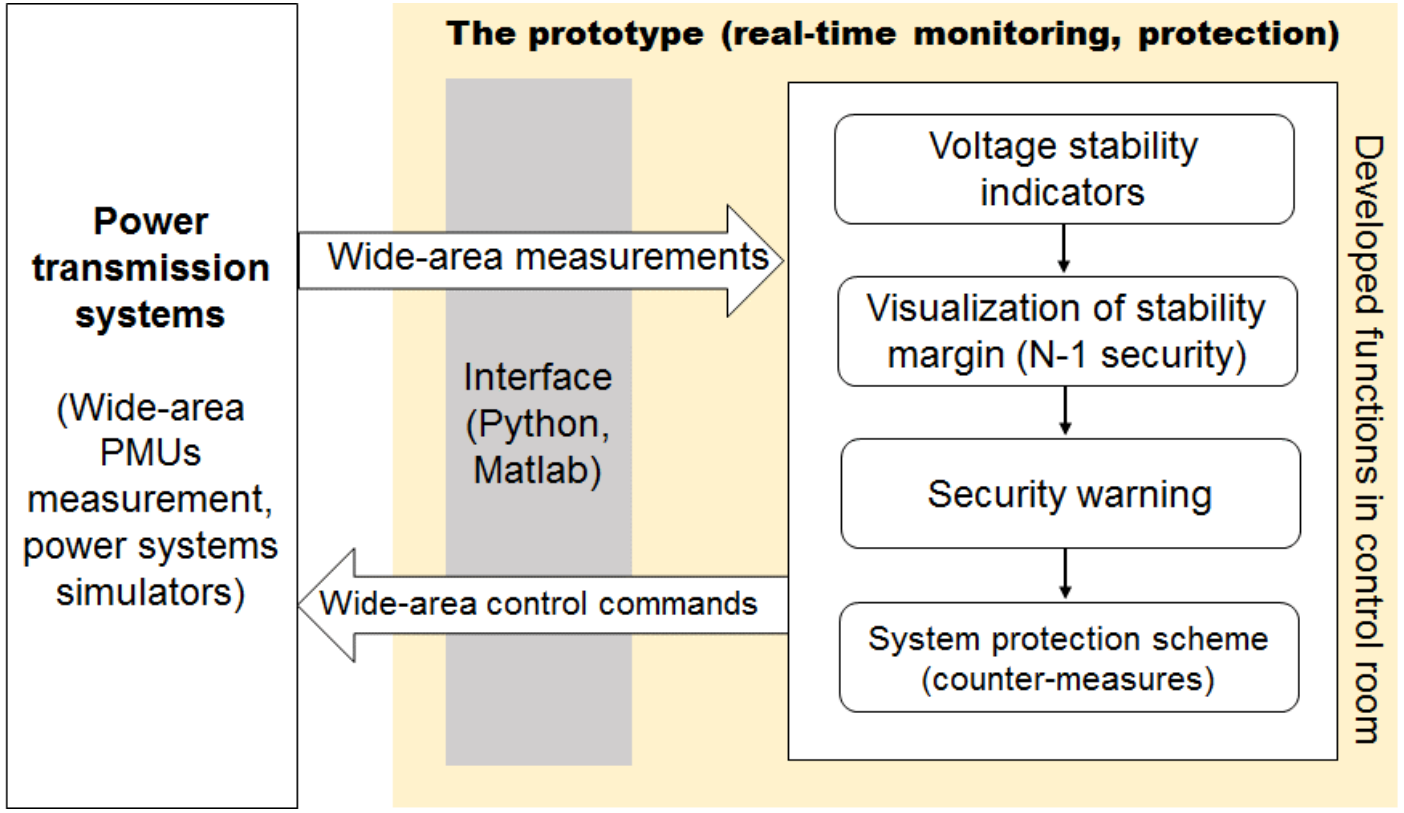
Aims of the thesis

- To develop and implement a system protection model to prevent voltage collapse for the Nordic 32-bus test system in PSS/E.
  - Used to predict and prevent voltage collapse.
  - The input signals: voltage stability indicators (ISI, VCPI) and signals from over excitation limiters (OELs).
  - Corrective actions:
    - ✓ Coordinated control actions of AVR set-points, OLTCs, FACTS devices, load shedding.
    - ✓ Can load shedding be avoided/minimized?

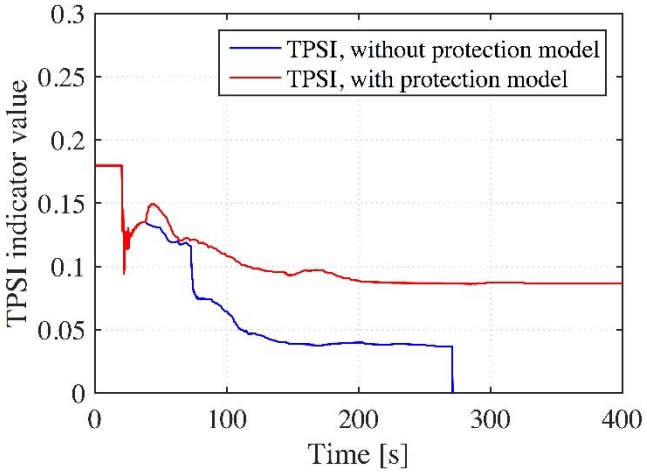
New PhD project:
Advanced visualization of voltage stability limit and system protection based on real-time measurement

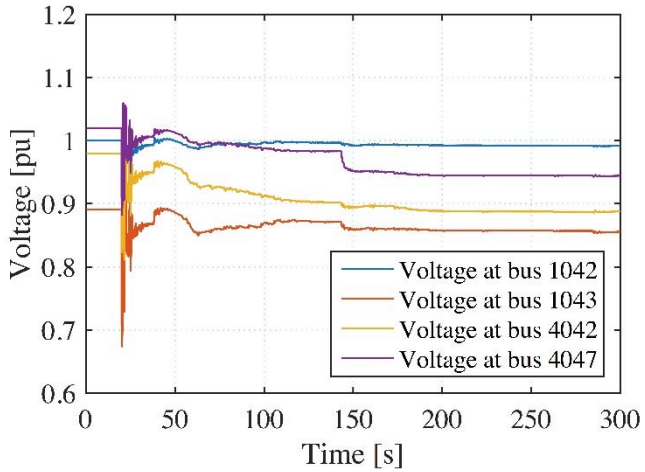
Partners:
Chalmers,
RISE/SP, SvK

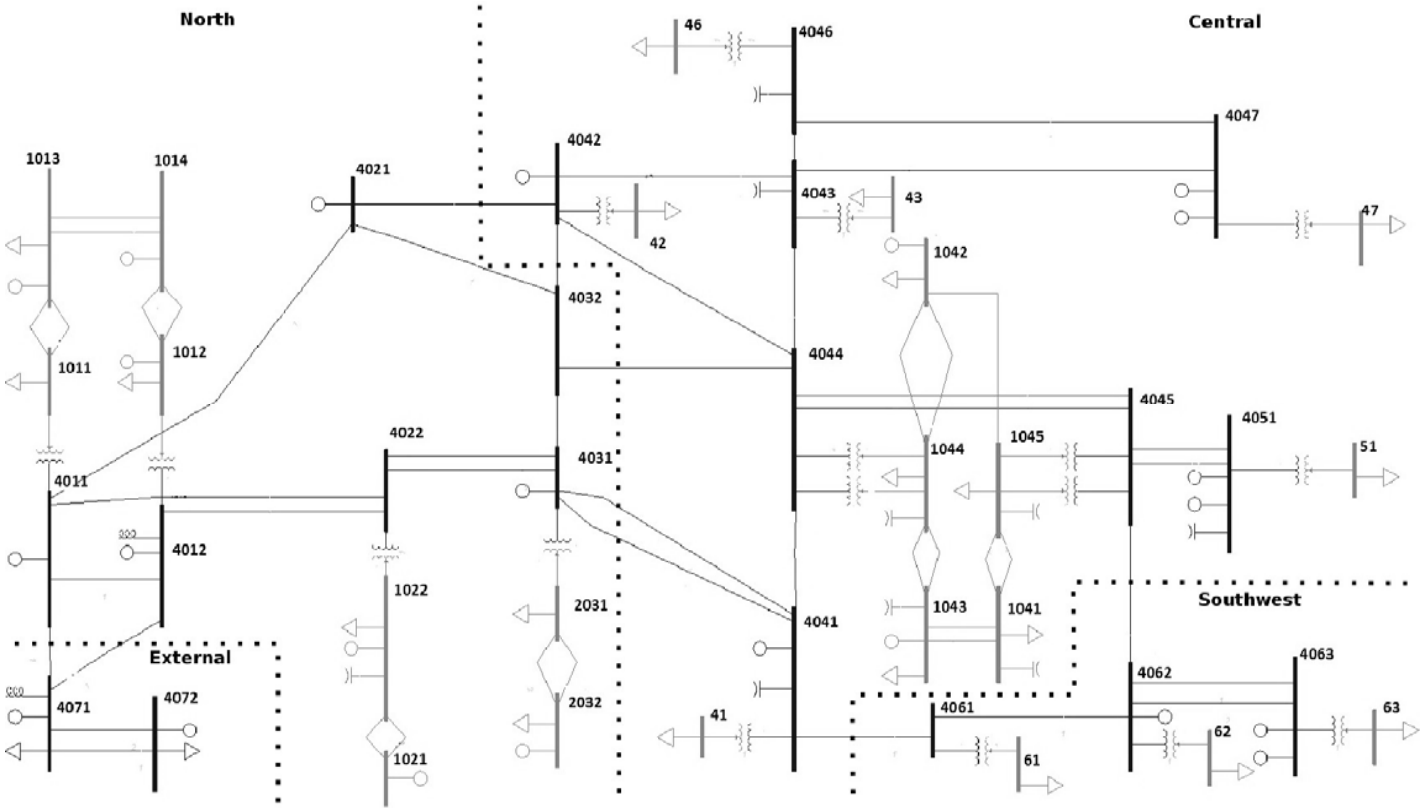
Funded by
Swedish Energy
Agency & SvK



The prototype will be validated in lab environment and by real measurements.


TPSI, without protection model
TPSI, with protection model
TPSI indicator value
Time [s]
0
0.05
0.1
0.15
0.2
0.25
0.3
0
100
200
300
400


Voltage at bus 1042
Voltage at bus 1043
Voltage at bus 4042
Voltage at bus 4047
Voltage [pu]
Time [s]
0.6
0.7
0.8
0.9
1
1.1
1.2
0
50
100
150
200
250
300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