Secure Operation of Sustainable Power Systems – SOSPO
Project Fact Sheet

Center for Electric Power and Energy (CEE)

Project objective

The objective is to develop new solutions that can ensure stable and secure operation of the future power system where a large share of the power production is based on fluctuating renewable energy sources. This includes R&D of methods for real-time assessment of system stability and security, in operator interfaces and decision support, and in methods for intelligent wide-area prosumption control. CEE is leading the project and is responsible for 6 out of 8 work packages in the project.

Project benefits

The project will have strong societal and private sector impact:

- The project works towards a solution to one of the major challenges associated with the realization of future visions for power systems with a very high proportion of CO2-free power production, namely ensuring stable and secure system operation of such systems. Without a solution to this problem, these visions cannot be realized.
- The development of tools and operational solutions that enable secure and stable supply of power in a transmission system where the majority of power production is based on wind energy is a major benefit of this project. The technical solutions are of interest for system operators and manufactures of operational tools, while the deduced benefits (ensuring stable and secure operation of future system) are of great importance for society.

What does the project deliver?

As for the project's major development activities, the goal is to develop and implement 3 methods for stability assessment, a method for security assessment, and two methods for wide-area control (countermeasures). Furthermore, a SW-platform will be developed that enables a real-time demonstration of the developed methods.
The major scientific milestones and targets defined for the project involve 14 journal papers, 10 conference papers, 14 workshops/seminars, 9 tool/methodology demonstration events, and 3 review meetings with an international advisory board.

Dissemination

Overview of the dissemination activities is provided at: http://www.sospo.droppages.com/Deliverables

Schedule

January 1st, 2012 to December 31st, 2015.

Partners

CEE, DTU (project leader);
Lund Univ., Sweden;
Siemens AG, Germany;
AUT, DTU;
Chalmers Univ., Sweden;
KenM Consulting, USA.
ETH Zurich, Switzerland;
Energinet.dk, Denmark;

Budget

32.2M DKK

More information

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See also www.sospo.dk and www.cee.elektro.dtu.dk.

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Project Dissemination

Publications

Journal Publications	**Status**
[1] H. Jóhannsson et al., "Wide-area assessment of aperiodic small signal rotor angle stability in real-time," IEEE Transactions on Power Systems, vol. 28, no. 4, 2013.	Published 2013
[2] T. Knüppel, M. Blanke, and J. Østergaard, "Fault diagnosis for electrical distribution systems using structural analysis", Int. J. Robust. Nonlinear Control, 2013.	Published 2013
[11] E. Dmitrova, M. Wittrock, H. Jóhannsson, and A. Nielsen, "Early prevention method for power system instability," IEEE Transactions on Power Systems, 2013.	Under review
[12] S. Sommer and H. Jóhannsson, "Reduce-factor-solve: Computing Thevenin impedances and reduced networks for real-time stability assessment," IEEE Transactions on Power Systems, 2013.	Under review

Conference Publications	**Status**
[3] S. Sommer and H. Jóhannsson, "Real-time thevenin impedance computations," in 2013 IEEE ISGT conference, Washington D.C., USA, February 2013.	Published 2013
[4] H. Morais, X. Zang, and M. Lind, "Supervision functions - secure operation of sustainable power systems," in 12th IFAC/IFIP/IEA Symposium, Las Vegas, USA, August 2013.	Published 2013
[5] J. Weckesser et al., "Impact of model detail of synchronous machines on real-time transient stability assessment," in 2013 IREP Symposium, Aug. 2013.	Published 2013
[6] M. Wittrock et al. "An implementation and test platform for wide area stability assessment methods," in 2013 IEEE PES ISGT Europe, Copenhagen, Denmark, October 2013.	Published 2013
[7] A. Perez et al. "Suitability of voltage stability study methods for real-time assessment," in 2013 IEEE PES ISGT Europe, Copenhagen, Denmark, October 2013.	Published 2013
[8] L. Zeni et al., "Influence of current limitation on voltage stability with voltage sourced converter HVDC," in 2013 IEEE PES ISGT Europe, Copenhagen, Denmark, October 2013.	Published 2013
[9] H. Jóhannsson et al, "System security assessment in real-time using synchrophasor measurements," in 2013 IEEE PES ISGT Europe, Copenhagen, Denmark, October 2013.	Published 2013
[10] J. Mathieu et al., "Uncertainty in the flexibility of aggregations of demand response resources," in The Annual Conference of the IEEE Industrial Electronics Society (IECON), Vienna, Austria, November 2013.	
[13] J. Mathieu et al. "Technical resource potential of non-disruptive residential demand response in Denmark," Submitted to 2014 IEEE PES General Meeting, Washington, DC, July 2014.	Under review
[14] J. Weckesser, et al., "Early prediction of transient voltage sags caused by rotor swings," Submitted to 2014 IEEE PES General Meeting, Washington, DC, July 2014.	Under review
[15] A. Andreas et al., "Stabilizer fault emergency control using reconfiguration to preserve power system stability," IFAC 2014 Conference, Cape Town, S. Africa, Aug. 2014	Submitted
[16] S. Tabatabaeipour and M. Blanke, "Calculation of critical fault recovery time for nonlinear systems based on region of attraction analysis," IFAC 2014 Conference, Cape Town, S. Africa, Aug. 2014	Submitted
[17] J. Weckesser et al., "Sensitivity based assessment of transient voltage sags caused by rotor swings," PSCC14 Conference, Wroclaw, Poland, August 2014	Submitted

Internal project reports	**Status**
[R1] G.-Y. Yang and O. J. Olesen, "WP1: Future scenario description, system in context and specifications," tech. rep., CEE, DTU, 2013	Published 2013

Contribution to research based education

Student projects

1. Modelling and Simulations of Power System Stability Problems, MSc. Project, Pauli Petersen.
2. Methods for Static Security Assessment in Electric Power Systems, MSc. Proj., Jakob G. Møller
3. Energy Demand Characteristics and Seasonal Variations of Controllable Loads in Power, BSc. Project, Mads Sørensen and Theis Bo Rasmussen.
4. Modelling the Swedish System and a Simulation of the 2003 Blackout, MSc. Proj., J. Liu.
5. Voltage stability analysis of a system with VSC-HVDC converters, PhD course, Lorenzo Zeni.

Courses with SOSPO related learning activities

31380 – Intelligent Systems (student assignments/projects)
31372 - Hierarchical and distributed automation (student assignments/projects)