



European Research Infrastructure supporting Smart Grid Systems Technology Development, Validation and Roll Out

TRANSNATIONAL ACCESS PROVISION

RESEARCH INFRASTRUCTURE DESCRIPTION AND
TRANSNATIONAL ACCESS CONDITIONS

SINTEF Energy Research



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1 Research Infrastructure

Name of Infrastructure/Installation	National Smart Grid Laboratory (NSGL)
Location	SINTEF Energy Research - Trondheim, Norway
Web Site	https://www.sintef.no/en/sintef-energy/

2 Description of the Research Infrastructure

The **National Smart Grid Laboratory (NSGL)** is located in Trondheim at the campus of the Norwegian University of Science and Technology (NTNU) and jointly operated by SINTEF and NTNU. The laboratory has been recently refurbished and is under upgrade with state of the art solutions/technologies. The laboratory mainly consists of three platforms: the smart network testing facility, the smart house demonstration and the distributed energy storage infrastructure.

Smart network testing facility: The core of the National Smart Grid Laboratory is the smart network testing facility. The facility can provide a flexible and reconfigurable electrical layout for conducting experiments at low voltage levels (e.g. 400 V AC or 800 V DC). The electrical system can be configured to represent a distribution or transmission grid with high penetration of renewable units including storage units and power electronics converters.

The laboratory is equipped to perform real time simulations of electrical systems and their controls. Three OPAL-RT units are available for parallel simulation. This enable the possibility of testing control algorithms or schemes with rapid prototyping techniques. More advanced features are the Hardware in the loop (HIL) and the Power Hardware in the loop (P-HIL) based on the OPAL-RT platform and a high bandwidth, six-leg configurable power converter (200 kW) acting as a power interface.

The following components are available in the laboratory:

- Over 250 m² of laboratory space and possibility of running multiple experiments in parallel
- OPAL-RT units with cumulatively 10 cores activated
- 200 kW high-bandwidth power converter operating as a grid emulator (5 kHz large signal bandwidth and 20 kHz small signal bandwidth)
- Several 20 kW and 60 kW two level converter units
- 50 kW generator-motor based on induction machine
- 20 kW synchronous generator with a synchronization panel as in small hydro plants
- A network equivalent for distribution grids with configurable line impedance and resistance

The network facility is suitable for a range of purposes like:

- Testing advanced Smart Grid technology for short-term management and islanded (microgrid) operation in future smart distributions systems.
- Testing equipment and concepts for continuous stand-alone operation as a microgrid in remote/isolated areas (i.e. new grids to be started in developing countries, islands, remote settlements etc.).
- Testing connection of independent (household) microgrids as a bottom-up approach for establishing a local, expandable power system for developing regions without an existing transmission network.



Smart house demonstration: The smart house replicates a domestic environment with real appliances but under controlled conditions. The Smart House laboratory can be used to demonstrate and visualise new concepts for active load control, to test and supervise human behaviour and to test new technological solutions. They will be highly relevant for smart grids (e.g. smart meters, sensors, communication systems, interfaces and protocols, display systems, control systems, smart appliances, small scale DG, small-scale distributed energy storage, charging of electric vehicles, decision support systems).

EV charging and distributed energy storage infrastructure: The main elements of the lab are:

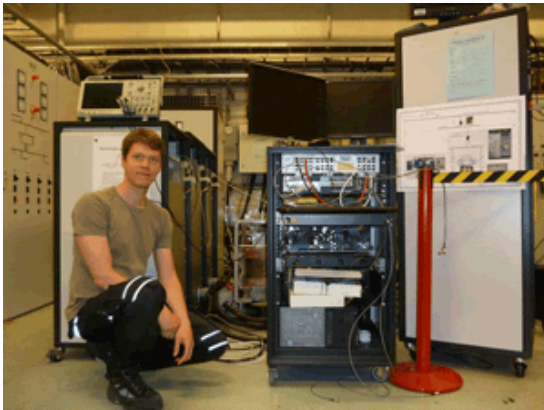
- A test system for energy storage systems (“battery tester”)
- Energy storage batteries and supercapacitors
- Distributed electricity production with PV
- Emulated systems
- A physical façade integrated system
- A novel, complete system for smart energy storage developed by a commercial actor
- A climate chamber



Laboratory concept

Real time simulated power systems and controls (RTSPC)	200 kVA power supply interface Integrating RTSPC and PPSC	Physical power systems and controls (PPSC)	Smart home / smart Building	Control centre (s)
			Energy storage PV, EV	
Measurements infrastructure				
Communication infrastructure				
Data access (remote real time access, database access)				

3 Services offered by the Research Infrastructure



The National Smart Grid laboratory supports:

- Smart transmission grids
- HVDC grids
- Smart active distribution grids
- Micro grids
- Integration of Smart grids, smart houses and smart industries
- Integration of renewables (large scale, DG)
- Smart Grid and home automation
- Smart electricity use
- Electrification of transport
- Energy storage in Smart Grids
- Energy conversion in Smart Grids
- Power system stability in Smart Grids
- Monitoring, control and automation in Smart Grids
- Communication technologies for Smart grids
- Information security and privacy in Smart grids
- Reliability challenges in Smart Grids - dependencies of Power Grid and ICT
- Smart grid software
- Big data management and analytics in Smart grids



4 Brief description of the organization managing the Research Infrastructure

SINTEF Energy Research has completed and participated in many national and transnational projects dealing with research related to energy systems. This involves e.g. market studies, energy system modelling and simulation as well as the small and large-scale integration of renewable energy systems into the grid. The department is also responsible for research and development of several market simulation and hydrothermal scheduling models that are used by almost all of the Scandinavian market players, TSOs and the Norwegian regulator. A special part of this is the work with smart grids, channelled in the group of Active Grids. The group has a long experience with power quality and reliability measurement and management, end-user characterisation, and active use of new communication technology and innovative market solutions.

SINTEF Energy Research is developing solutions and systems in the fields of power production, conversion, transmission and distribution, and the efficient end use of energy. A substantial part of the institutes R&D and demo activities are within the electrical power engineering domain. By January 2014, SINTEF Energy Research had a staff of approx. 240 persons. In cooperation with Norwegian University of Science and Technology (NTNU), we have 7000 m² of modern laboratories available for research, development and education. In 2012, the Company participated in 25 EU projects and coordinated three of them. In addition, we actively participate in a number of the EU's technology platforms, which design the strategies related to our various disciplinary areas.

The main tasks of SINTEF Energy Research within ERIGrid includes holistic system integration, implementation and demonstration of use cases/scenarios. Also, provisioning of the National Smart Grid Laboratory for Trans-national Access (TA).

5 Transnational Access conditions offered by SINTEF

The National Smart Grid Laboratory is located at Sem Sælands vei 11, Trondheim, Norway.

For safety reasons, for critical applications, the users are not expected to operate the systems by themselves; even when safety instructions will be provided, tests will be carried out by staff of SINTEF. For the rest of applications and after ad-hoc training, the user group will have full access to the related facilities for the duration of the stay (with the support of SINTEF's researchers and laboratory technicians when necessary). The scheduling of the experiments will be agreed and booked prior to the stay according to the availability of the involved staff and equipment. Administrative documentation for the access (contract, non-disclosure agreement, etc.) will comply with ERIGrid common indications.

In addition to the general corporate services (internet connection, canteen, etc.) and the support and advice on accommodation and transportation to SINTEF's infrastructure, the access being offered includes supervision and help of SINTEF's staff:

- As a complement to the pre-access contacts between the user group and SINTEF, the stay will start with an introductory meeting with a senior researcher for confirming the stay conditions (confidentiality, safety indications), scheduling the activities, explaining the on-site procedures, clarifying the logistics and technical details.
- Preparatory work: a laboratory technician will assist the users for the installation of the devices, electrical connections, use of the specific instrumentation, preparation of a test procedure (if necessary) based on the users requests, and programming of the experimental conditions.
- The guest researcher will be placed within the building of SINTEF Energy Research and gets access to the lab facilities.
- SINTEF's researchers will support the realisation and follow-up of the experiments.
- SINTEF's researchers will support the results interpretation, data processing and analysis, and test report preparation

In principle, a typical stay of 1 month is foreseen for a single user group but this period could be extended depending on the concrete user project. The user group (usually 2 persons) can use the infrastructure for the defined time.

Reimbursement of expenses:

User expenses for the Transnational Access are paid by ERIGrid (EU H2020 Programme). This includes travels to NSGL (SINTEF Energy Research) by plane, accommodation, daily subsistence, and daily transportation during the stay.

For the user projects taking place in NSGL, SINTEF will refund the stay expenses when the stay is finished: the user must declare the incurred expenses and present the invoices/receipts to SINTEF in order to get the refund.

Logical expenses must be made by the user: travels will be made in economy class and conventional hotels (not luxury) or equivalent accommodation will be used. As an indication (it is not a daily allowance), a maximum subsistence fee of 160 €/person must be considered per day.

6 Contact details for Research Infrastructure

National Smart Grid Laboratory (NSGL) – SINTEF Energy Research Address: SINTEF - Sem Sælands vei 11, 7034, Trondheim, Norway Website: https://www.sintef.no/en/sintef-energy/	
<i>For Management/Organization Issues:</i>	
Boye A. Høverstad Tel.: +4795154202 E-mail: boye.a.hoverstad@sintef.no o	
<i>For Technical issues:</i>	
Kjell Ljøkelsøy Tel.: +4790194173 E-mail: Kjell.Ljokelsoy@sintef.no	