



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

TRANSNATIONAL ACCESS PROVISION

RESEARCH INFRASTRUCTURE DESCRIPTION AND TRANSNATIONAL ACCESS CONDITIONS

Fraunhofer IWES Kassel



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1 Research Infrastructure

Name of Infrastructure/Installation	Test Center for Smart Grids and Electromobility (IWES-SysTec)
Location	Fraunhofer IWES, Kassel, Germany
Web Site	www.energiesystemtechnik.iwes.fraunhofer.de

2 Description of the Research Infrastructure

In the IWES-SysTec test center for smart grids and electromobility, Fraunhofer IWES is developing and testing new equipment and operation strategies for smart low and medium voltage grids. In addition, investigations regarding grid integration and grid connection of electric vehicles and their power generated from renewable energy sources as well as photovoltaic systems, wind energy plants, storage and hybrid systems are carried out under realistic conditions here. A large open-air ground of approx. 80,000 m² offers sufficient space and very good conditions for solar and wind energy. Furthermore, the open-air ground provides configurable distribution grid sectors (low and medium voltage).



Figure 1: The main building of IWES-SysTec with the labs SysTec PNI and SysTec TPE

In the eastern area of the premises there is a hall presently with two laboratory divisions: one of the labs, which is entitled “**SysTec PNI**” includes a testing area for low and medium voltage converters or distribution grid equipment. There it is possible to develop and test the electrical properties and in particular the ancillary services of distributed generators in the power range up to 6 MVA. A mobile test container able to be used to measure the fault-ride-through of generation plants has been integrated into the laboratory. The second lab “**SysTec TPE**” is equipped with facilities to test grid integration of electric vehicles and power storage, such as hardware simulators for batteries, bidirectional charging controllers, charging columns and a three-phase grid simulator with 270 kVA rated capacity.

SysTec PNI: Lab for Network Integration

The PNI is part of the Fraunhofer IWES SysTec test center for smart grids and electro-mobility.

Currently devices connected to the low voltage grid with rated power up to 1.25 MVA and those with connection to medium voltage networks up to 6 MVA may be tested. For the testing of the static and dynamic response of generators and network assets different test setups are available.

- **Control room**

The test sequence as well as the control of the test facility is controlled from a central control room. As part of the control the relevant electrical data, in particular power quality data, can be acquired, recorded and analyzed centrally. Matlab® / Simulink® applications may be integrated into the control.



Figure 2: View into the control room of the Lab SysTec PNI

- **Low voltage test bay**

For investigations of devices connected to low voltage networks a tap transformer (1.25 MVA) with a wide, finely adjustable voltage range from 254 VAC to 690 VAC as well as an electronic AC grid simulator (100 – 900 VAC, 45 – 65 Hz, max. 1 MVA) is available. For investigations of generators with inverters, e.g. photovoltaic inverters, fast controllable DC sources (14 units, with max. 3000 ADC @ 1000 VDC) can be utilized. Programmable loads with 3 x 200 kW resistive load, 3 x 200 kvar inductive load and 3 x 200 kvar capacitive load, which may be adjusted in 1 kW and 1 kvar steps respectively, are available as well. The low voltage test bus bar is divided into 2 bus bar sections to allow an easy investigation of line regulators, e.g. voltage stabilizers. To research interactions between different components operating on the same grid part configurable low voltage networks can be connected to the test bus bar.



Figure 3: Inside view into the Lab "SysTec PNI"

- **Medium voltage test bay**

By utilizing digital test signal generators the secondary control technique (protection relays and controls) of generating units and network assets can be tested. For testing the transient behavior a mobile test container (LVRT test facility) is available, which is integrated into the central lab control as well. Since the test setup is inside a container even on-site measurements and tests of complete power plants are possible. In this case the test facility is connected to the medium voltage network between the equipment under test and the network connection point of the grid operator. It produces voltage dips on the medium voltage side of the equipment under test without disturbing the public power grid. With the LVRT test facility 3-phase as well as 2-phase faults can be generated.

3 Services offered by the Research Infrastructure

Within IWES-SysTec Fraunhofer IWES offers the following services to research and industrial partners:

- Examination of distributed generators (PV inverter, CHP units, diesel gen-sets etc.) in accordance with different grid connection guidelines (low voltage, medium voltage)
- Field and laboratory tests of hybrid systems, small wind power plants and individual smart grid components as well as tests with hardware emulations under defined operating profiles
- Real time distribution grid simulations to test control centres and the grid integration of distributed generators, electric vehicles and power storage (hardware-in-the-loop)
- Investigation of operating performance strategies for individual plants and hybrid systems (e.g. photovoltaic, storage facilities, heat pumps, combined heat and power)
- Metrological examination of performance (tripping characteristic) of protection devices
- Measurements of power quality and analyses of performance



Figure 4: MV Equipment under test:
Power transformer with OLTC

4 Brief description of the organization managing the Research Infrastructure

The Fraunhofer-Gesellschaft undertakes applied research of direct utility to private and public enterprise and of wide benefit to society. With a workforce of over 24,000, the Fraunhofer-Gesellschaft is Europe's biggest organization for applied research, and currently operates a total of 67 institutes and research units. The research activities of the Fraunhofer Institute for Wind Energy

and Energy System Technology IWES cover wind energy and the integration of renewable energies into energy supply structures. Fraunhofer IWES was established in 2009 as a merger of the former Fraunhofer Center for Wind Energy and Maritime Engineering CWMT in Bremerhaven and the Institute for Solar Energy Technology ISET in Kassel.

The Transnational Access will be conducted at Fraunhofer IWES Kassel within the R&D Division Systems Engineering and Distribution Grids, which has a long term experience in the systems technology for the utilization of renewable energies such as solar energy and wind energy as well as for other electricity generators, storage systems, and electrical vehicles. Converters and other equipment are being developed which support the new requirements of smart grids. The laboratory equipment of the Division Systems Engineering and Distribution Grids allows carrying out tests not only of smart grid equipment but also of complete sections of smart LV/MV-distribution networks using new ICT technologies.

5 Transnational Access conditions offered by Fraunhofer IWES

All the offered experimental systems included in IWES-SysTec are in the same location in Rothwesten, near to Kassel, Germany.

For **safety reasons** the users are not expected to operate the lab infrastructures by themselves; even when safety instructions will be provided, experiments and tests will be carried out together with the staff of Fraunhofer IWES. 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, etc.) and the help and advice on accommodation and transportation to Fraunhofer IWES's infrastructures, the access being offered includes supervision and support of Fraunhofer IWES's staff:

- As a complement to the pre-access contacts between the user group and Fraunhofer IWES, 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) on the basis of the users requests, and programming of the experimental conditions.
- Fraunhofer IWES's researchers will support the realisation and follow-up of the experiments.
- Fraunhofer IWES's researchers will support the results interpretation, data processing and analysis.

In principle, a typical stay of 2 work weeks 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 IWES-SysTec (Fraunhofer IWES) by plane, accommodation, daily subsistence, and daily transportation during the stay. Fraunhofer IWES will reimburse each User with a daily grant following the "Bundesreisekostengesetz" as a lump sum covering all expenses for subsistence during the stay at the Facility.

For the user projects taking place in IWES-SysTec, Fraunhofer IWES will refund the stay expenses when the stay is finished: the user must declare the incurred expenses and present the invoices/receipts to Fraunhofer IWES 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 94 €/ person must be considered per day. Lunch will be provided by Fraunhofer IWES free to the user.

6 Contact details for Research Infrastructure

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