



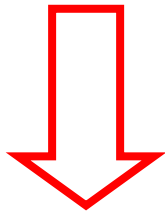
European Network of Excellence of DER Laboratories and Pre-standardisation

Dipl. Ing. Roland Bründlinger
arsenal research, Erneuerbare Energietechnologien

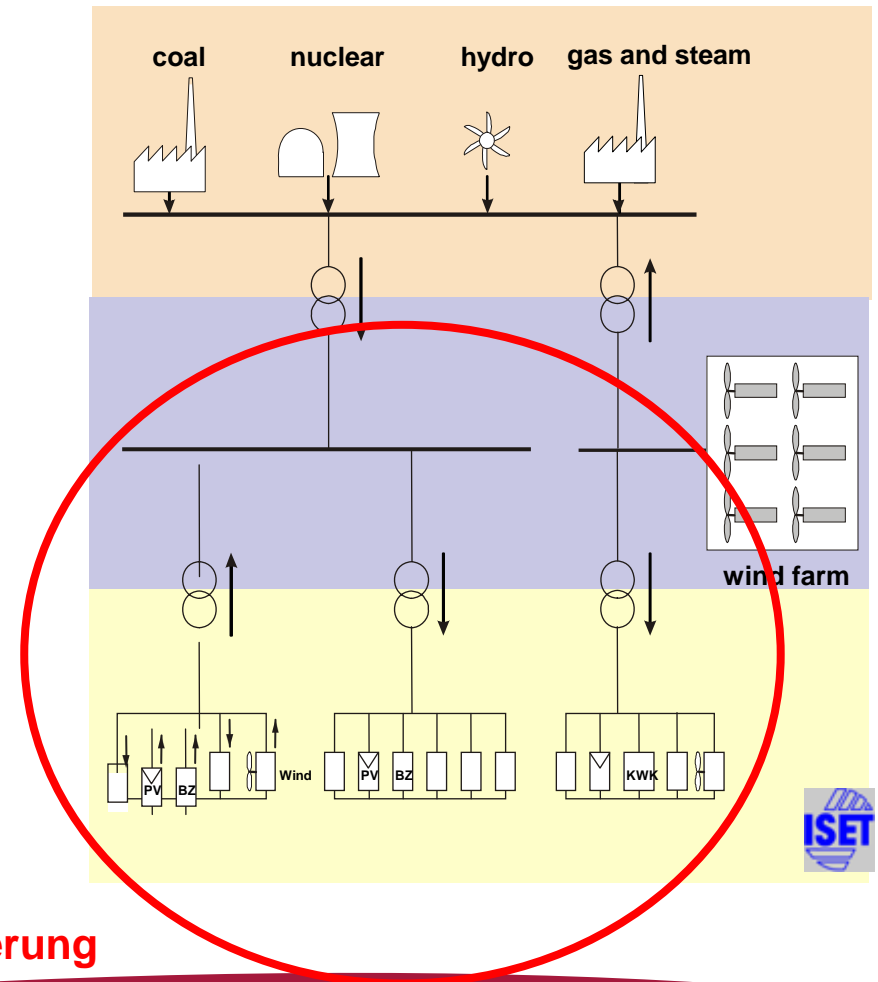
- Hintergrund – Warum DERlab?
- Was ist das Europäische Netzwerk DERlab?
 - Zielsetzungen
 - Partner im Netzwerk
 - Dienstleistungen
- DERlab Vision & Mission

Wandel der Stromversorgungsstrukturen

- Dezentrale Ressourcen & Erneuerbare Energieträger
- Bidirektionaler Leistungsfluss in den Verteilnetzen
- Aktives Lastmanagement
- Kommunikationstechnologien



Neue Anforderungen an die Standardisierung



- **Steigender Anteil von Erneuerbaren, dargebotsabhängigen Energien und Verteilter Erzeugung.**

- **Enorme Investitionen in den kommenden Jahren:**
 - **Ersatz von alternden Kraftwerken**
 - **Erneuerung und Ausbau der Netze**

- **Großer Bedarf an Know-how um die Effizienz der zukünftigen Investitionen sicherzustellen.**

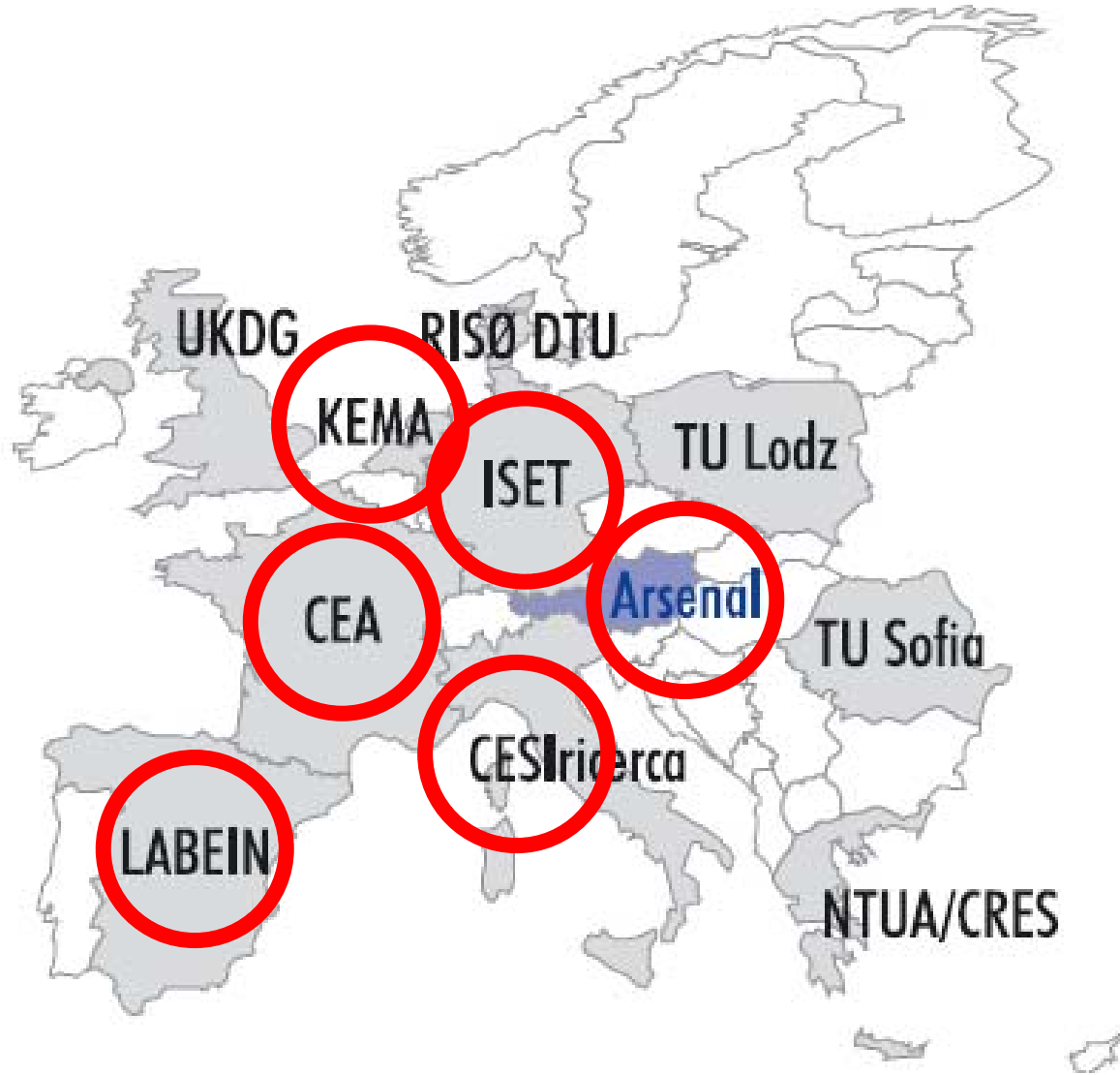
- **Dringender Bedarf an angewandter Forschung und geeigneten Forschungsinfrastrukturen, um neue Lösungen und Komponenten unter realitätsnahen Bedingungen prüfen zu können – Simulation alleine ist nicht ausreichend**

- **Nur unabhängige Labors bieten**
 - **Das Know-how sowie die Forschungs- und Prüfinfrastruktur zur Entwicklung von Prüf- und Zertifizierungsrichtlinien für DER**
 - **Unabhängigkeit – d.h. nicht gebunden an Versorgungsunternehmen, Hersteller oder Infrastrukturbetreiber – gewährleistet Objektivität**
- **Vernetzung auf Europäischer Ebene ist zentral für die Schaffung eines Europäischen Markts für DER**
- **Entscheidung der Europäischen Kommission zum Aufbau eines umfassenden Exzellenznetzwerks**

- Entwicklung eines integrierten Europäischen Labors für Forschung und Entwicklung im Bereich DER
- Unterstützung der Entwicklung Europäischer Standards
- Integration der wichtigsten Europäischen Labors und Schaffung einer weltweit führenden Gruppe zur Entwicklung einheitlicher
 - Anforderungen,
 - Qualitätskriterien,
 - Prüf- und Zertifizierungsrichtlinienfür Systeme und Komponenten für die Integration von DER und EE

Wer ist DERlab?

Forschungs- und
Prüfinsstitute





DeMoTec - Design Centre for Modular Supply Technology



100 kVA photovoltaic inverter under test



Hydrogen powered microturbine in a test rig

Outline

The ISET Test and Certification Centre for Distributed Energy Resources comprises the Design Centre for Modular Supply Systems (DeMoTec), EMC laboratories, outdoor facilities for PV modules and systems, battery test facilities,

power electronics labs and laboratories for bio mass powered generators. The DeMoTec hosts a laboratory LV and MV grid with distributed generation units.

This laboratory environment enables tests concerning DER grid integration focussing on

grid control, local generator control, power and communication interfaces. A primary role of the hardware environment is to assure the performance and safety of DER equipment and later on help to develop standards. Further the laboratory serves as demonstration and training facility.

ISET addresses application-oriented research in the field of electrical engineering and systems technology for the use of renewable energies. The spectrum covers ranges from theoretical investigations over experimental studies and field tests through to the development of devices and systems. Above all, the institute concentrates on the fields wind energy, photovoltaics, bio energy, hydro power and marine energies, energy conversion and storage, static converters, hybrid systems, and energy economy. Specialised professional competences include especially power electronics, control engineering, process engineering and information systems.

At the two locations of the institute in Kassel and Hanau some 125 people are engaged, denoting a capacity in human resources of about 95 full-time employees, some 75 are regularly employed staff. The annual budget of 6 million Euros (plus some 3 million Euros of running R&D sub-contracts for the numerous project partners) is funded externally to about 80%, parallel to the basic funds provided by the Ministry for Science and Art of the state of Hesse.

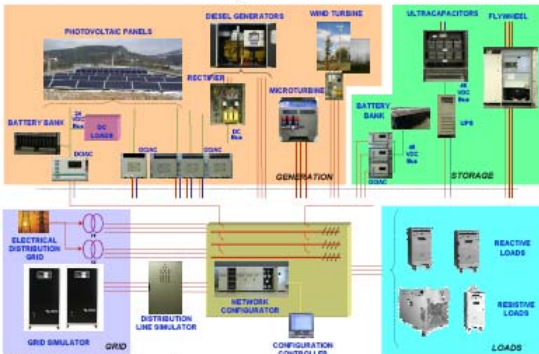


Company Profile

Founded in 1927, KEMA is a commercial enterprise, specializing in high-grade technical consultancy, inspection, testing and certification. Much of the company's work centers round innovative technology. As an independent organization, KEMA supports clients concerned with the supply and use of electrical power and other forms of energy.



LABEIN's DER demonstration facility



Microgrid system schematics



PV panels at LABEIN's roof



Wind turbine

outline

In the last years, LABEIN-Tecnalia's Energy Unit has been involved in several R&D projects related to Distributed Energy Resources (DER) and Microgrids. A facility for the development and demonstration of DER technologies has been set up.

Projects: LABEIN-Tecnalia's microgrid will be integrated with other similar systems into the Medium Voltage (MV) distribution grid.

Objective: Study microgrid interaction with the MV grid in order to foster the development of new products for the electrical grid of the future.

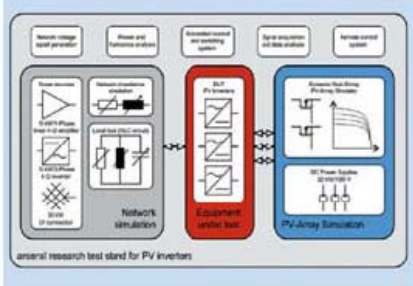
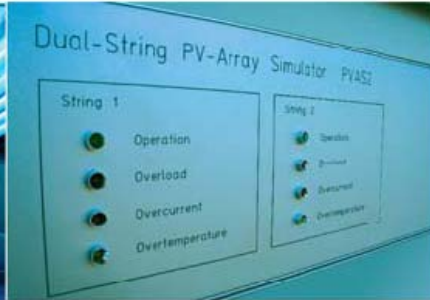
LABEIN is an organization with more than fifty years experience in Research and Development, with the mission of providing support for company innovating capabilities using technology as a competitive tool.

At LABEIN, we study and assimilate the business strategies of our clients so that, with our collaboration, they result in technological innovation strategies.

LABEIN is part of the Tecnalia Corporation, which is the fifth Private Research Organization in Europe .

The Energy Unit of Tecnalia has the following main activities:

- Operation and management of networks and equipment. Demand Side Management. Microgrids.
- Electronic metering, protection, control and quality of supply.
- Connectivity, communication systems and protocols.
- Interconnection of DER and Renewables.
- Emerging generation technologies: wave energy, biomass, Fuel Cells.
- Hydrogen production and storage.
- Energy regulation and socio-economics.



The arsenal research PV and DR components laboratory comprises a comprehensive set of facilities for PV Modules and DR Inverters, enabling a broad and comprehensive range of tests on equipment.

The laboratory environment includes among others a flexible test stand for grid-connected inverters for PV and other DR applications

and facilities for environmental simulation (Solar radiation, Temperature, Humidity, Pressure, Vibration...). In addition, arsenal research's Power Service Center provides extensive facilities for tests of electrical equipment for LV and MV applications up to the MVA range.

From its position as a recognized

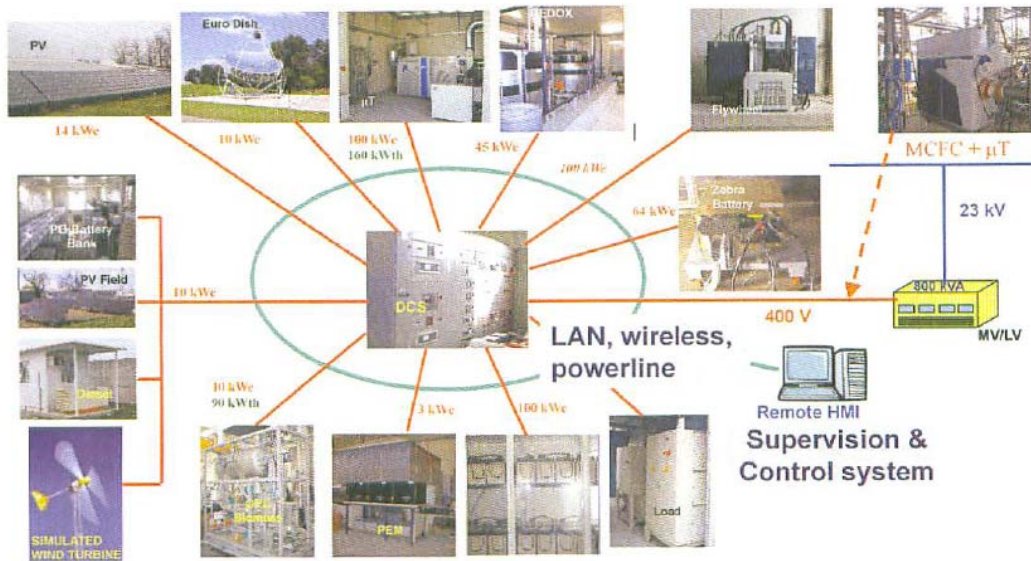
test lab, accredited to ISO 17025 and certified to ISO 9001, arsenal research supports its clients during assessment and improvement of quality, safety and performance of their equipment.

Besides laboratory R&D testing and certification, pre-standardization and training are further key activities to achieve this objective.

Founded in 1950 as a national centre for research and testing in the field of electrical, mechanical and geotechnical engineering, arsenal research is today a 100% subsidiary of the Austrian Research Centers (ARC).

Within the ARC – Austria's main holding for applied research with more than 1000 employees – arsenal research focuses on mobility and electrical energy issues. With more than 50 years of experience and 175 people involved in laboratory, research, development and accredited testing and certification, international research activities are now the basis for an extensive collaboration with industry.

In the field of Distributed Energy Resources arsenal research focuses on Photovoltaic Systems and Components as well as inverter-based generation and the interfaces to the network. The services extend from applied R&D, testing and measurement to market-oriented activities including compliance testing of new products.



Outline:

CESI RICERCA, supported by National Research and EU Dispower project, implemented a low voltage Distributed Generation Test Facility, that consists of a PV based hybrid system, a solar thermal dish Stirling, an ORC CHP plant fuelled by biomass, a CCHP system with a gas microturbine, various innovative storage systems, a flywheel and

remotely controllable loads. Test facility network is highly configurable in order to reproduce grid disturbances and testing islanding operation. The management system treats generators as distributed resources, supplying services to the grid. Individual generators give response to fast transient dynamics, while

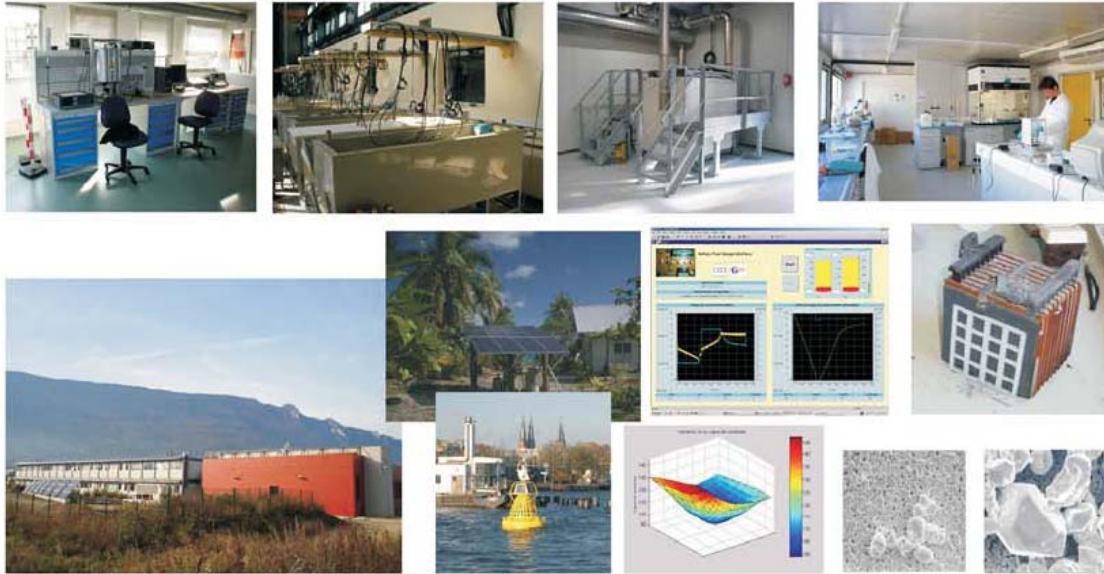
central dispatcher coordinates generators according to Power Quality requirements, in order to balance power flow and improve economics (short term forecasting tools are integrated). The communication system uses different devices and methods: PLC, wireless equipment, wired Ethernet, 61850 protocols etc.

CESI RICERCA SpA has been established at the end of 2005 as a separate company owned entirely by CESI "Centro Elettrotecnico Sperimentale Italiano Giacinto Motta" SpA, with the mission to take over funded research activities of national and international interest and it started operating on January 1st 2006.

CESI RICERCA S.p.A. is currently owned by ENEA "Italian National Agency for New Technologies, Energy and the Environment" (51%) and CESI S.p.A. (49%).

Four hundred researchers and technicians - and their main laboratory facilities - were moved from CESI to CESI RICERCA SpA. The new company will carry out research in the electricity and energy sector, with strong emphasis on experimental applications, thus ensuring the consistent continuation of all current research activities and the development of new strategic projects in the future. Focus of the mission is to ensure the technology transfer in order to improve the operation of the Italian electrical system from the environmental, safety, security and economic point of view.

The company will also ensure the proper diffusion of scientific results to provide a good indication of the potential of emerging technologies in the electrical energy field.



Outline

Involved in photovoltaic energy for over 20 years, the former GENEC group (now as L2S at INES) is in charge of R&D on renewable energies, with the main objective of reducing the lifetime costs of PV systems. The activities on batteries began in 1990. L2S now involves 25 researchers among which 16 permanent staff.

The general mission of INES/L2S is to perform R&D in the field of photovoltaic components and systems. It is organized in two groups: "PV systems" and "storage systems".

The "storage systems" group tests and validates storage technologies, especially the electrochemical technologies.

Particular emphasis is given to the development of innovative management strategies and of prediction tools for determining the costs and values of storage systems.

In the DER-Lab network, INES/L2S is coordinating activities on the storage function within other distributed energy resources.

Institute Profile

The newly created INES is the French national research institute for solar energy. It results from the gathering of most of the French research actors in the field of solar energy. More than 100 researchers from CEA, CNRS and Savoie University are already working at INES.

INES is organized in 3 facilities:

RDI (Research, Development, Innovation): PV and solar thermal, including storage, from the materials to components and systems up to energy-efficient buildings,

Demonstration: performance assessment of components, systems, models, including those developed by INES RDI,

Training & Information: training for main stakeholders and decision-makers (building professionals, architects, consultants), communication to improve the public awareness of solar energy.

The INES RDI facility is organized in 3 laboratories:

LCS (Laboratory for Solar Components)

- Silicon production
- PV cells (silicon, organic)

L2S (Laboratory for Solar Systems)

- Photovoltaic systems
- Electrical storage systems

LIS (Laboratory for Solar Integration)

- Solar thermal systems
- Building integration of solar energy

Wer ist DERlab?

Universitäten





outline

SYSLAB is the test facility for distributed power systems technology at Risø National Laboratory. It includes facilities for testing components, component-system interaction and complete systems.

The facility can handle components up to 50kW and has space and equipment for testing physically large units such as flow batteries and hydrogen production, consumption and storage equipment.

SYSLAB is a real distributed system with three 2-bus bar systems placed 300m and 700m apart. There is the added possibility to configure the network in several ways. The system includes wind turbines, diesel genset, solar generators, office loads as well as several types of controllable loads.

SYSLAB has very flexible control possibilities since all units in the system are equipped with a dedicated control computer - a so-called node computer. All the node computers are connected via

network. The node computers have input/output cards installed for measurement at the terminals of the associated unit.

Complex test sequences can be specified and programmed using the distributed control system.

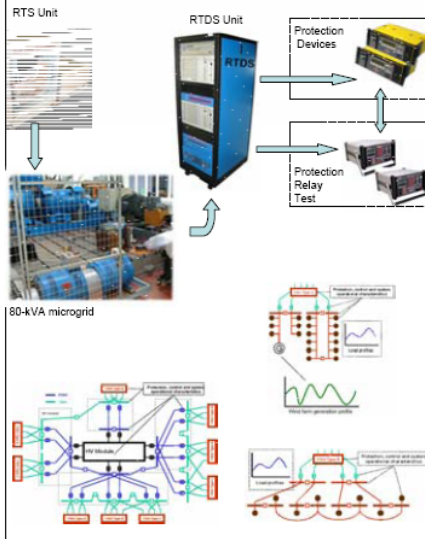
The facility can be used in the research on communication requirements and standards for distributed power systems.

SYSLAB is also being used extensively for education and training.

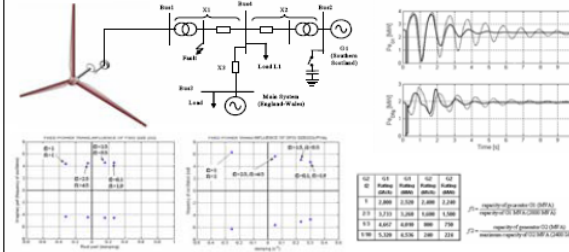
Risø is a national laboratory with research activities in the field of sustainable energy systems. Risø has one of the leading research groups on wind energy covering most topics ranging from wind resources and turbulence over aeroelastics and control to wind power integration and control of power systems with a high fraction of wind power. Major activities include development of computer based tools for analysis and development of wind turbines and wind power in power systems. Risø also has a long experience in running large experimental facilities and carrying out field measurements. Risø has been very active in the standardisation work for wind turbines and has been a major contributor to the wind turbine standards framework. Risø has a similarly been very active in the development of testing methods for wind turbines.

Risø is situated at Roskilde 40km from Copenhagen. There are 700 employees and about 110 people in the Wind Energy Department.

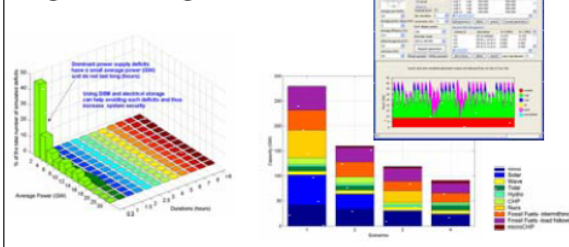
DER Protection and System Design



Wind Generation Stability and Control



Large-scale Integration of DERs



Network and Generator Protection, Control and Communication Components

- Development of novel techniques and algorithms for DER integration.
- Design and testing of prototype protection devices.
- Solutions to the integration and control of large number of dynamic generation units on potentially unstable networks.
- Appropriate communication techniques (from real time control to hourly or daily operations).

Modelling, Simulation and Management of Networks with DERs

- Development and validation of models of new forms of generation (e.g. DFIG wind turbines and fuel cells).
- Modelling tool of LV unbalanced distribution networks with microgeneration.
- Development, modelling and installation of pilot active distribution network management schemes

DER Integration and Infrastructure Options

- Scheduling of conventional generating plant with increased amounts of intermittent resources.
- Analysis of energy storage technologies.
- New tools to analyse the value of demand-side management in systems with high levels of intermittent renewables.
- Displacement of conventional generating plants by new and renewable DERs.

The Centre for Sustainable Electricity and Distributed Generation, a collaborative venture building on extensive on-going research at The University of Strathclyde, Imperial College London and The University of Manchester, was established in order to bridge the gap between academic research and the needs of industry to meet the 2010 targets on renewable energy for the UK. Its focus is on providing fundamental research aimed at achieving cost effective integration of Distributed Generation (DG) into operation and development of the UK electricity systems. The Centre investigates the technical and economic performance of transmission and active distribution networks and as well as the devices and systems that are connected to them with a view to develop and evaluate new concepts and solutions using software simulation or hardware testing as appropriate. The activities of the Centre also contribute to the realisation of the DTI/OFGEM Electricity Networks Strategy Group objectives through co-ordination with its Distribution Working Group and Transmission Working Group, and the DTI Electricity System Technical Issues Steering Group.



outline

The **Electric Energy Systems Laboratory (EESL)** of the National Technical University of Athens covers the educational and research activities in the area of electric energy systems and offers various degrees of experimental training for students, as part of the relevant courses of Power System Analysis, Power Generation, Power System Control and Stability, Transmission and Distribution Networks, Power System Protection,

Renewable Energy Sources, SCADA and Digital Techniques in Power Systems. Each year the EES Laboratory offers 14 undergraduate courses in the area of electric power systems, 5 courses at postgraduate (PhD) level and numerous professional training and seminar programs. The Laboratory is active in research for more than 20 years now, closely affiliated to the **Institute of Communication and Computer Systems (ICCS)**.

It has participated in more than 40 research projects, most of which are collaborative EU funded projects.

The Department of PV systems and DG of **CRES** participates in European research projects and collaborates with local and European industry. The department activities are mainly focused on the areas of PV and hybrid systems, battery storage and Distributed Generation.

The **Institute of Communication and Computer Systems (ICCS)** is a private law body associated with the School of Electrical and Computer Engineering of the National Technical University of Athens (NTUA). ICCS was established in 1989 by the Greek Ministry of Education in order to carry out research and development activities in the fields of telecommunication systems and computer systems and their applications in a variety of sectors, such as electric power systems, software and hardware engineering, control systems and biomedical engineering. The personnel of ICCS comprises faculty members of the School of Electrical and Computer Engineering of NTUA, senior researchers of the Institute, external researchers and postgraduate students of NTUA. Currently, the active research personnel of ICCS consists of 90 members of the faculty, 30 senior researchers and 200 external researchers and PhD students.

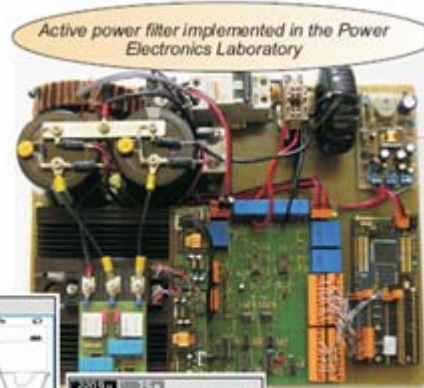


Wind Generator

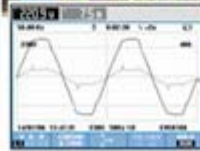
Hybrid System Control-RES Laboratory



Thermo Collector and Photovoltaic-RES Laboratory



Active power filter implemented in the Power Electronics Laboratory



Transient diagrams of the load current and the source voltage of the single-phase bridge uncontrolled rectifier operating with the active power filter

Outline

The work on the project Network of DER Laboratories and Pre-Standardization is being carried out in the LABORATORY OF POWER ELECTRONICS, in the LABORATORY ON RENEWABLE ENERGY SOURCES, in the ADVANCED CONTROL SYSTEMS LABORATORY, in the HIGH VOLTAGE LABORATORY and in the THERMAL POWER ENGINEERING LABORATORY.

The work on the project will be supported by the participants from Ministry of Economy and Energy, Bulgarian Institute for standardisation and Bulgarian Institute for metrology. The University is actively involved in the work of various technical committees of the Bulgarian Institute for Standardisation (BDS) and particularly participates in the work of BDS' Technical Committee 79 "Electrical Energy".

Area of Scientific expertise: DER and hybrid RES linked with the related areas: power electronics-design and simulation of AC/DC, DC/AC and AC/AC converters, simulation of wind and water generators, testing of real objects of RES, process control software and architecture on industrial computers, HV testing, determination of thermal efficiency. **Training and education capabilities** of all laboratories.

The TECHNICAL UNIVERSITY is a higher-education institution providing MS and PhD degrees in a large number of subjects in the fields of machine building and metal working, electronics, computer science and technologies, automation, transportation, management. The University comprises 10 main faculties and also divisions for foreign education programmes. For the time being there are more than 9500 full-time, about 2000 part-time students and about 480 PhD students at TUS. The teaching staff of TU is more than 1000 people, of which 51 professors, 393 associate professors. Besides, the staff of R&DS consists of more than 130 employees, of which 40 are researchers. The basic fund of TUS is about 30 million Leva. TUS is a large educational and research complex with on a number of educational, research and applied facilities, using many unique equipment.

TUS also realizes a significant amount of international research activities, primarily under the auspices of the EU Programs: Socrates Erasmus, Leonardo, Fifth and Sixth Framework Programs and the bilateral projects with EU countries.

THE RESEARCH AND DEVELOPMENT SECTOR (R&DS) is a unit of TUS whose tasks are connected with the organization and administration of the contracted research activities. These functions are mainly performed by using the teaching staff and infrastructure of TUS. In 2005, through the intermediation of R&DS more than 500 contracts were in action. The realized total amount is over 3 millions Leva. Besides the R&DS staff, more than 500 members of the teaching staff have taken part in contract implementations as principal executives or leaders.



150 kV rectifier



MV/LV distribution network model



2.4 kW Fuel Cells system



12 kW Battery storage with Sunny Islands inverters



Protection relays test lab



6.5 kWp PV panels on Institute of Electrical Power Engineering elevation

Outline

The Electrical Power Engineering Research and Test Laboratory comprises a number of test facilities that enable both theoretical and experimental studies related to various DER aspects.

They include electromagnetic compatibility in the range of power quality phenomena, modern network control systems (incl. microgrids) supporting deployment of DER in distribution grid, verification of DER interconnection schemes, etc.

Area of research studies and tests covers also testing of HV and LV equipment, digital protection relays, EMC of electrical devices, etc.

Measurement equipment is employed in research, expertise and testing services for utilities, power stations and various industrial plants.

The University makes the most of tradition and takes advantage of the newest accomplishments of civilisation to participate in development of science, culture and economy and in solving important scientific, technical and social problems. The main objectives of the University functioning are the following:

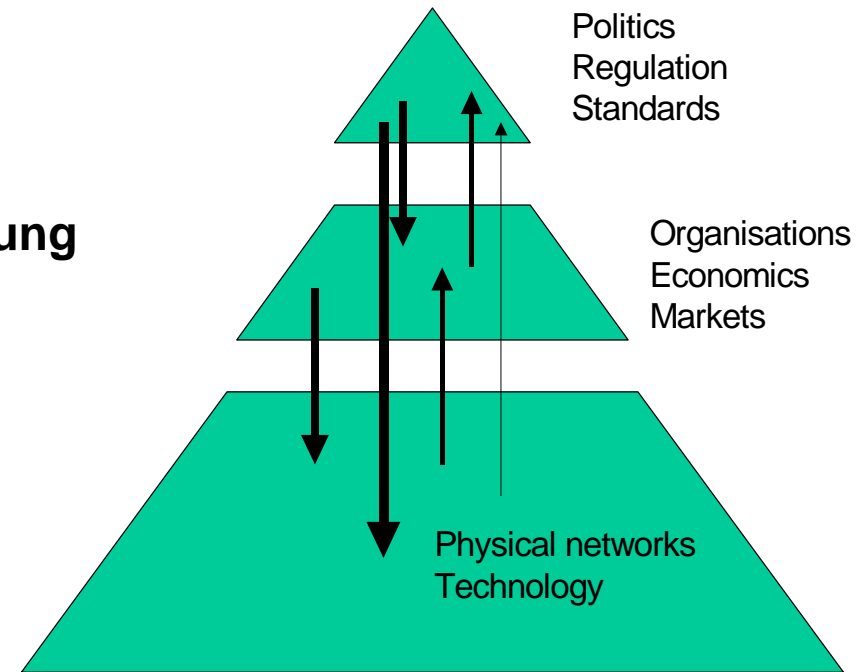
- educating professional engineers who can demonstrate their knowledge in science, engineering, technology,
- conducting research on the highest international level,
- educating researchers for the University and other academic and economic centres,
- participating in civilisation transformation and enriching national culture, in particular science and technology.

The main research activity of the Institute of Electrical Engineering encompasses:

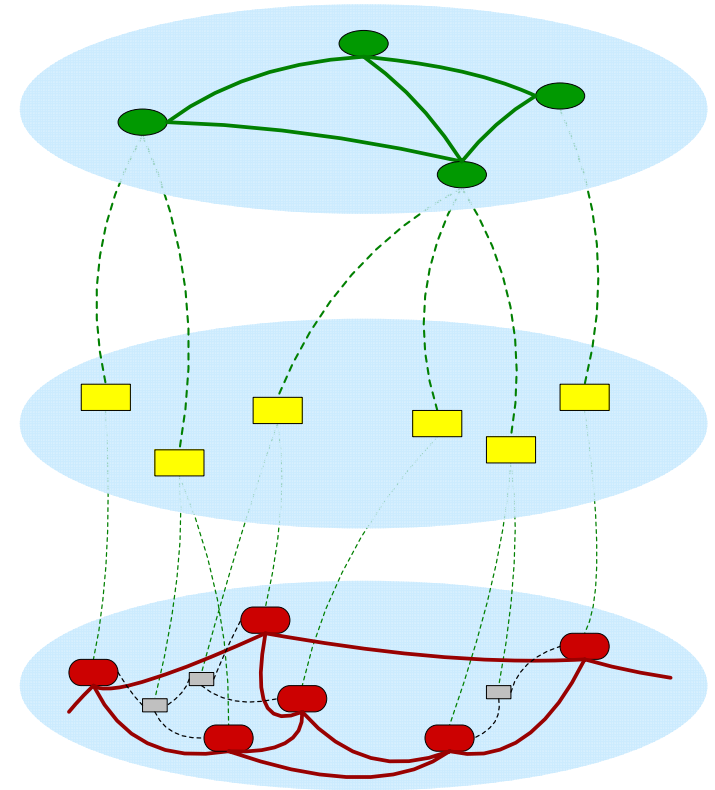
- Power system modelling and simulation
- Power quality
- Integration of DERs into the power network
- Energy markets
- Optimisation of power plant operation
- Optimisation of lighting networks and devices
- High voltages
- Electric Traction

The Institute is co-organiser of the International Conferences on Electrical Power Quality and Utilisation and European Electricity Market.

- **Umfassendster Pool von DG Laborinfrastruktur in Europa**
- **Langjährige Erfahrung mit DG Technologien.**
- **Starker Background im Bereich Prüfung & Zertifizierung.**
- **Aktive Teilnahme an nationalen, europäischen und internationalen Standardisierungskomitees.**
- **Partner aus dem akademischen und kommerziellen Bereich.**
- **DERlab deckt alle 3 Ebenen ab.**



- **Forschung: Konzeptprüfungen, Prototypenentwicklung und -prüfung,...**
- **Entwicklung und Validierung von Anforderungen für den Anschluss, Sicherheit, Qualität, Betrieb und die Kommunikation von DER**
- **Entwicklung von neuen Prüfrichtlinien**
- **Ausbildungs- und Trainingsdienstleistungen im Bereich DER**
- **Aktive Unterstützung bei der Entwicklung neuer Standards.**



➤ **DERlab Vision:**

- **To be the #1 reference lab for DER integration into power systems**

➤ **DERlab Mission:**

- **Unterstützung aller Stakeholder durch**
 - **research and development and**
 - **pre-normative research and standardisation**
- **Mit dem Ziel der optimalen Integration von DER und EE in das Energieversorgungssystem**



Kontakt


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