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

TRANSNATIONAL ACCESS PROVISION

RESEARCH INFRASTRUCTURE DESCRIPTION AND
TRANSNATIONAL ACCESS CONDITIONS

RSE DER-TF
Distributed Energy Resources Test Facility

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Project Duration:	**54 month**

Project co-funded by the European Commission within the H2020 Programme (2014-2020)

1 Research Infrastructure

Name of Infrastructure/Installation	**Distributed Energy Resources Test Facility (RSEDER-TF)**
Location	Ricerca sul Sistema Energetico – RSE S.p.A.
Web Site	www.rse-web.it

2 Description of the Research Infrastructure

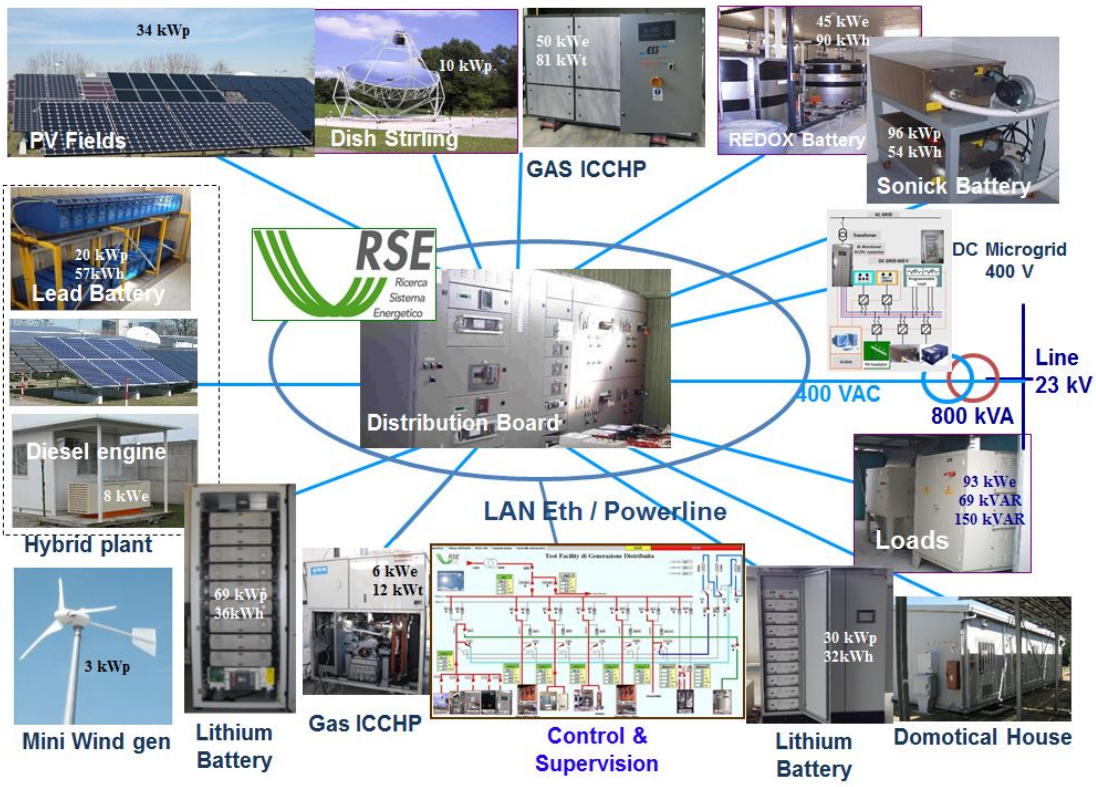
RSE DER-TF (Distributed Energy Resources Test Facility) is a real low voltage microgrid that interconnects different generators, storage systems and loads to develop studies and experimentations on DERs and Smart Grid solutions.

The Facility extends over an area of about 20000 m^2, is interconnected to the MV Grid by means of a 800 kVA dedicated transformer (23 kV/400 V) and has an overall capacity of 350 kW (active power) and 300 kVAr (reactive power).

Different types of DER generators are connected as PV Fields, Wind Generator, Diesel Generator and natural gas CHPs (Internal Combustion Engines). The facility has an overall storage capability of about 230 kWh based on different storage technologies as Lithium, Flow (Redox), High temperature Nickel-Sodium and Lead (VLRA) batteries interconnected to the grid with dedicated converters. Resistive, Inductive and Capacitive Loads (overall capability of about 90 kW, 70 kWAr inductive and 150 kWAr capacitive are connected to the grid in order to simulate different typologies of actual users loads).

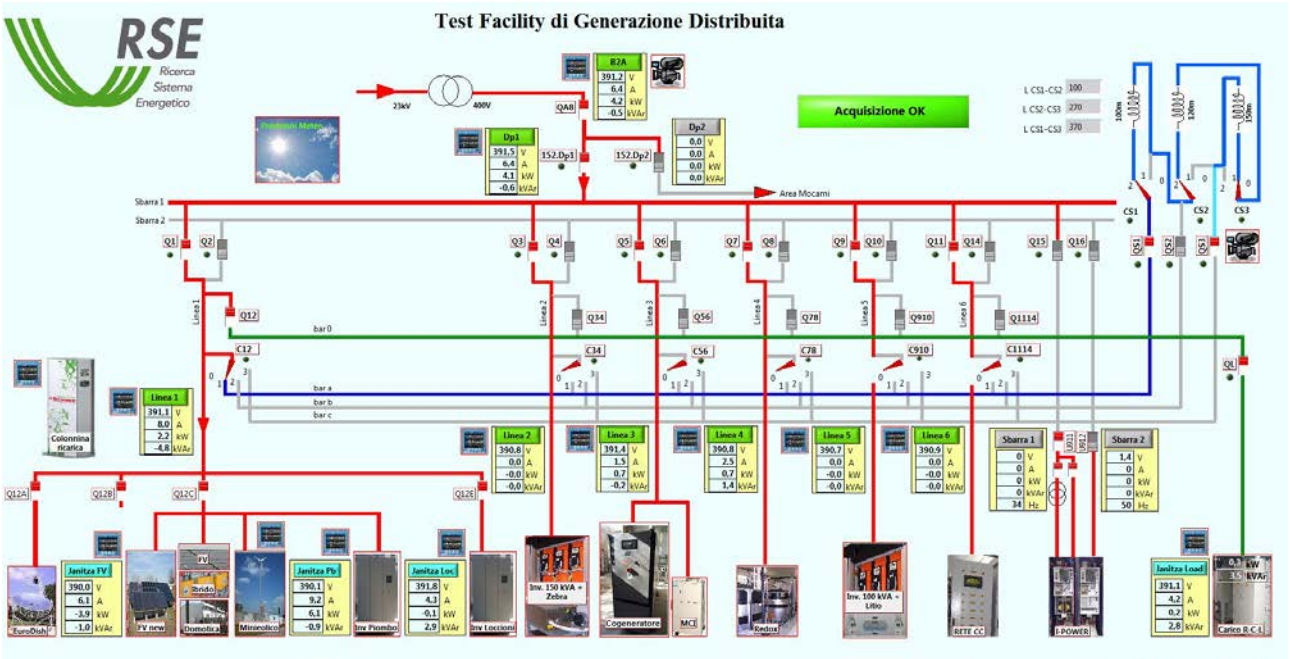
The microgrid is configurable (locally or remotely) at the interconnection board in order to obtain different grid topologies: radial grids and also meshed configurations. There's also the opportunity to extend feeders till one kilometre. The microgrid is able to operate grid connected or in islanded mode thanks to specific droop control algorithms implemented in some converters.

The interconnection board (main bars and all feeders) and all the DERs are provided with electrical measure equipment, set up to collect and analyse the experimental data derived from the field test.



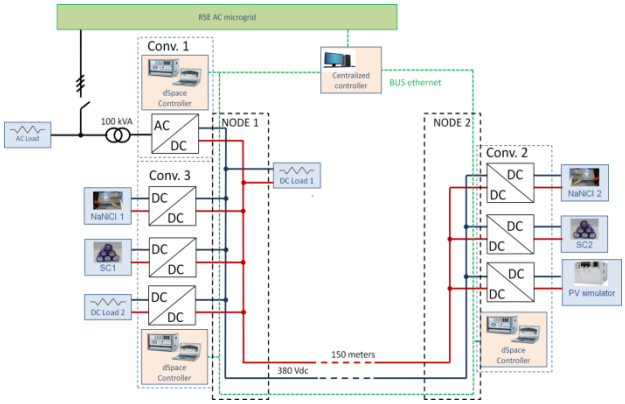
A Supervision and Control system has been developed in order to monitor and control all installed resources.

Different Energy Management and control functions have been implemented and can be used in order to fulfil with the requested objective (economic optimisation, renewable resources balancing, self-consumption, voltage control, state estimator). Resources control can be performed manually or in a full automated mode according to the different Microgrid control functions. New Management and control functions (also from third parties) can be easily integrated to DER Test Facility Control System. Communication has been developed mainly based on LAN Ethernet. Archive functions as data storage and retrieval are integrated in SCADA.



In addition, integrated to the AC microgrid, there are components and facilities that can extend the infrastructure testing capabilities as:

- **Low Voltage DC Microgrid** (380 V, 100 kWe) capable to operate in islanding mode ore interconnected to the AC grid. The DC microgrid operates at nominal voltage of 380VDC with bi-directional interface inverter (100 kW_E), two Zebra batteries (each 30kWp, 16kWh), two super-capacitors banks (each 30 kWp, 8 seconds), a PV emulator (30kW_E), a DC fully controllable resistive load (30kW) connected to DC BUS by DC/DC converters and a DC programmable load (30kW) directly connected to DC grid. The grid can operate in islanded mode or connected to the main AC grid (DER Test Facility).



- **Face to face converter:** a bi-directional converter (200kWE) able to generate a second independent net at variable voltage and frequency to test components behaviour at different grid conditions. The supplied system consists of two back to back inverters. One inverter is connected to the grid and supplies power to a DC bus. The other inverter converts the DC bus power to a three phase variable frequency, variable voltage output. The power supplied by the voltage source is up to 200kW at a power factor of >0.8. The face to face converter can be used as a **Grid Simulator** in order to test components and grid sections at different voltage and frequency.

- **“Domotic house”**: this test facility is a 60 m2 building representing a common residential flat with living room, kitchen, bedroom, and bathroom. This facility makes possible to carry out several tests on different energy management strategies but also simulates the user presence thanks to an appropriate subsystem which operates each single domestic appliance as it may do a real family living in a house. The independent data acquisition & monitoring system allows to evaluate the actual results of the different energy strategies.

- **EV Charging station**: A multistandard fast charging station compatible with all CHAdeMO, CCS and Type 2 AC vehicles currently on the road is connected to the Smart Grid. This charger is the ideal choice to serve all these electric vehicles. Typical charging times range between 15 and 30 minutes.

- **SW Interface**: the DER-TF SCADA is written in LabVIEW and can be interfaced with other any software for both measurements acquisition and device control. The available protocols for data access are the following:
    - NI LabVIEW DataSocket protocol
    - OPC DA protocol
    - MODBUS TCP protocol

3 Services offered by the Research Infrastructure

In the Distributed Energy Resources Test Facility of RSE, the architecture and management system of the microgrid and the specific features of the described infrastructure provide the following services (but not limited to):

- Development, optimization and testing of **smart grid operation and control algorithms**.
- **On grid and off grid** (islanded) AC microgrid testing
- **DC microgrid** testing (including management and control algorithms)
- Characterisation and testing of **Generators and Storage** systems
- Innovative **instrumentation and component** testing
- **AC/DC converters** testing grid connected and in **islanding** operation
- **Management of EV charging station:** testing of charging control and management algorithms
- **Domotical House management:** testing of management and control strategies

4 Brief description of the organization managing the Research Infrastructure

RSE (Ricerca sul Sistema Energetico) SpA (*www.rse-web.it*) is a Non-profit Research Organization established to take over funded research activities of national and international. About 350 technicians and researchers – and their main laboratories – carry out strategic research in the electricity and energy sector, with strong emphasis on experimental applications. The mission is to perform public interest R&D programs to address the national energy, environmental and economic goals, with an open view to the EU research initiatives. RSE SpA is currently 100% owned by GSE, “Gestore Servizi Energetici” SpA, a public company entirely owned by the Italian Government.

Competencies: On the basis of three-year Implementing Agreements for the research activities on the electric system with the Ministry of the Economic Development (MiSE), RSE SpA is mainly financed through a public fund related to the national electric system. RSE is currently cooperating in more than 60 international research projects and coordinates as leading partner more than 150 main research centres and companies in the energy field in Europe. RSE is moreover actively involved in supporting the Ministry of Economic Development with the aim of implementing the EU SET-Plan.

RSE is active in several international network and technology platforms as the European Industrial Initiatives on Electricity Grids (EEGI, GRID+ coordinator) and Wind Energy (EEWI), the Joint Programme of the European Energy Research Alliance (EERA) on Smart Grids (as JP Coordinator) and Storage, and Implementing Agreements of the International Energy Agency (ISGAN Chairman and ISGAN/SIRFN member). It is also active in the CEN-CENELEC-ETSI Smart Grid Coordination Group and in several IEC and CIGRE’ working groups. RSE has a noticeable experience in research and experiments on Smart Grids, DER characterization and integration in distribution networks. Among the others, RSE has coordinated the I3 project DERri, under the EC Research Infrastructures programme.

The RSE DER-TF (managed and operated by the Power Generation Technologies and Materials Department) is an infrastructure available for all RSE researchers in order to develop and test Smart Grid and Microgrid concepts including management and control optimization, advanced power system architectures, DER and storages integration, electric mobility. In addition RSE DER-TF is used by several industries (in the aim of cooperation agreements) in order to develop and test with RSE new components and smart grid management and control functions.

5 Transnational Access conditions offered by RSE

All the offered experimental systems included in the RSE DER_TF are located in the RSE premises in Milan, Italy – Via Rubattino, 54.

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 operatively carried out by the staff of RSE closely supporting the external team of users. For **the rest of applications,** and previous ad-hoc training, the user group will have full access to the related facilities for the duration of the stay (with the support of RSE's researchers and laboratory technicians when necessary). RSE may decide, for organizational or safety reasons, to limit the access in particular circumstances.

The stay of the users will be regulated by a specific User Team Contract, signed in advance by the Team reference person, that will contain in detail of the access conditions agreed for the specific project. A template of the contract model will be provided by RSE to the Team of Users long before the stay at the infrastructure.

The **scheduling of the experiments** will be agreed and scheduled prior to the stay according to the organization planning of RSE and the availability of the involved staff and equipment.
Administrative documentation for the access (contract, non-disclosure agreement, etc.) and related procedures 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 RSE's infrastructure, the access being offered includes supervision and help of RSE's staff:

- Introductory actions. An RSE Senior Engineer will be dedicated to the Team of Users, being the reference for all aspects related to their stay in RSE. As a complement to the pre-access contacts between the user group and RSE, the stay will start with an introductory meeting with the dedicated 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 compatibly with the organization and requirements of the testing infrastructure, and programming of the experimental conditions.
- Testing implementation. RSE's researchers will support the realisation and follow-up of the experiments and supervise the execution of the tests.
- Post-testing support. RSE's researchers will support the results interpretation, data processing and analysis, and test report preparation.

In principle, a typical stay of 2 weeks is foreseen for a single users group. However, depending on the specific project and on its implementation, an extension of the stay period, or a break of the stay in following phases, whenever convenient, may be agreed before or during the execution of the project.

The user group (usually 2 persons) can use the infrastructure limitedly to the agreed time. The users will be requested to declare their use of the infrastructure by signing in an RSE form at the end of their stay basing on the final balance.

Reimbursement of expenses:

User's live expenses for the Transnational Access are paid by ERIGrid (EU H2020 Programme).

RSE will:

a) Provide for the lunches of the User, during the working days in RSE's canteen

b) Reimburse travel expenditures of each User (one only return ticket per User, unless differently agreed for the specific project). RSE requests the User to provide preventive indication of the travel expenses to be incurred and to condition the reimbursement to its preventive approval; travels will be made in economy class.

c) Reimburse each User with a daily grant of 150 Euros/day as a lump sum covering all expenses for lodging and subsistence during the whole period of stay at the Facility (including working days and holidays).

RSE will basically reimburse the users expenses (as indicated in the previous points b) and c) at the end of the stay basing on the final balance: The user must declare the incurred expenses by signing RSE forms and submit invoices/receipts to RSE in order to get the reimbursement.

6 Contact details for Research Infrastructure

<table>
<tr><td colspan="4">Distributed Energy Resources Test Facility (DER-TF) - RSE
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