CYPrus grid optimal integration and control of RES ParkS

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ERIGRID Connecting European Smart Grid Infrastructures

AIT AUSTRIAN INSTITUTE OF TECHNOLOGY TOMORROW TODAY

ERIGRID-Final event-1st April 2020

CYPRESS project general facts

HOST: Smart Electricity Systems and Technologies Laboratory (SmartEST), AIT – Vienna

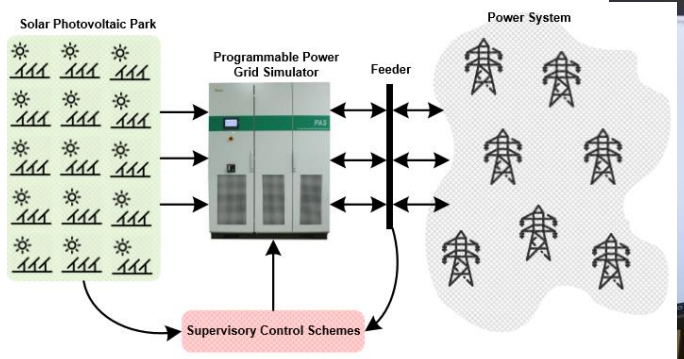
Task Force: EAC &FOSS team

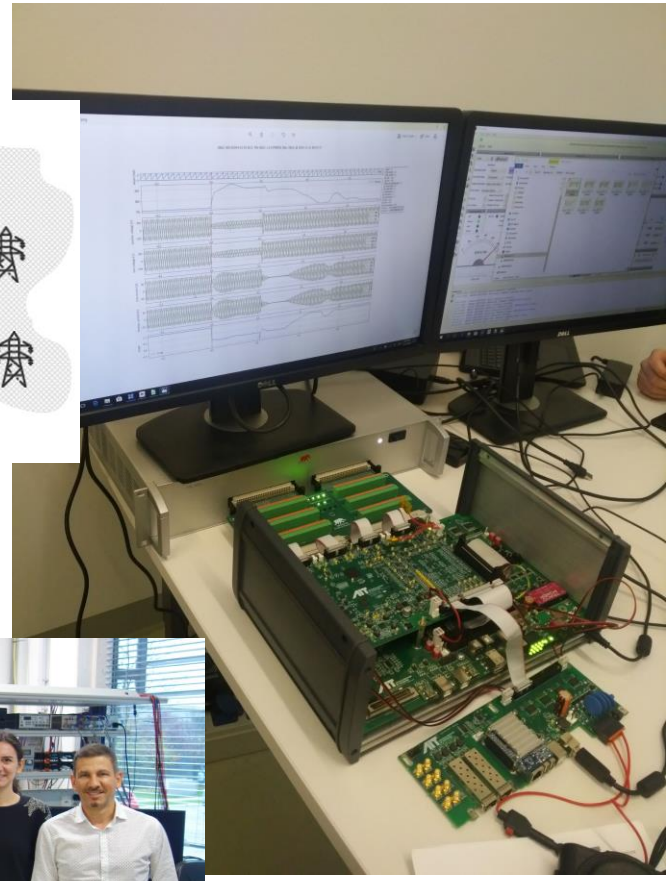
Timeframe: 2-09-19 to 20-09-19

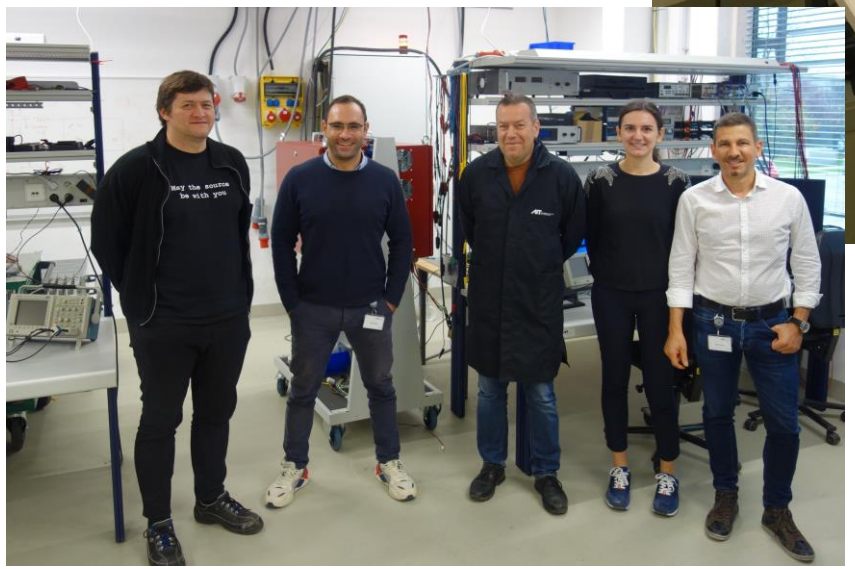
Framework: ERIGRID

Main Infrastructure used: Typhoon HIL 602+
AIT SGC Controller card B model
AIT HIL Controller

Main objective: Perform grid integration studies of selected Photovoltaic parks integrated on the island power system of Cyprus.







Some facts regarding the PV integration in Cyprus grid

- Cyprus's potential for solar power is one of the highest in the European Union, but it currently imports most of its energy sources.

- Only around **10%** of the renewable energy share has been achieved so far, which keeps Cyprus on track to reach the EU climate and energy targets for 2020.

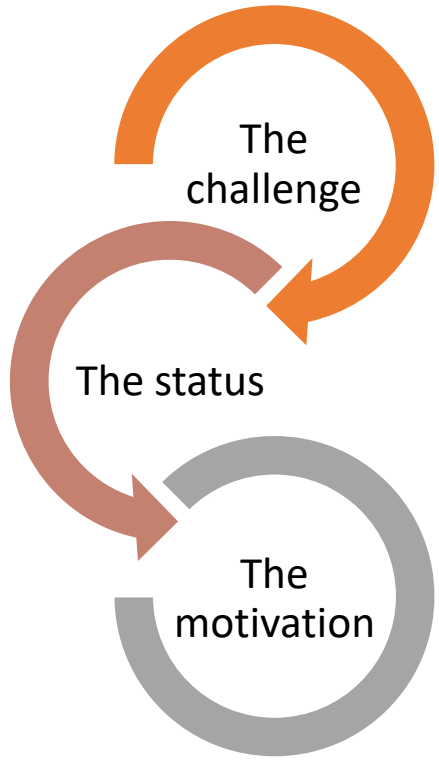
- According to the Cyprus Renewable Energy Roadmap, renewable energy could provide **25% to 40%** of the total electricity supply in 2030.

Challenge and motivation

The main **challenge** for EAC-DSO is to minimize the cost of operation/losses and reduce the interruptions

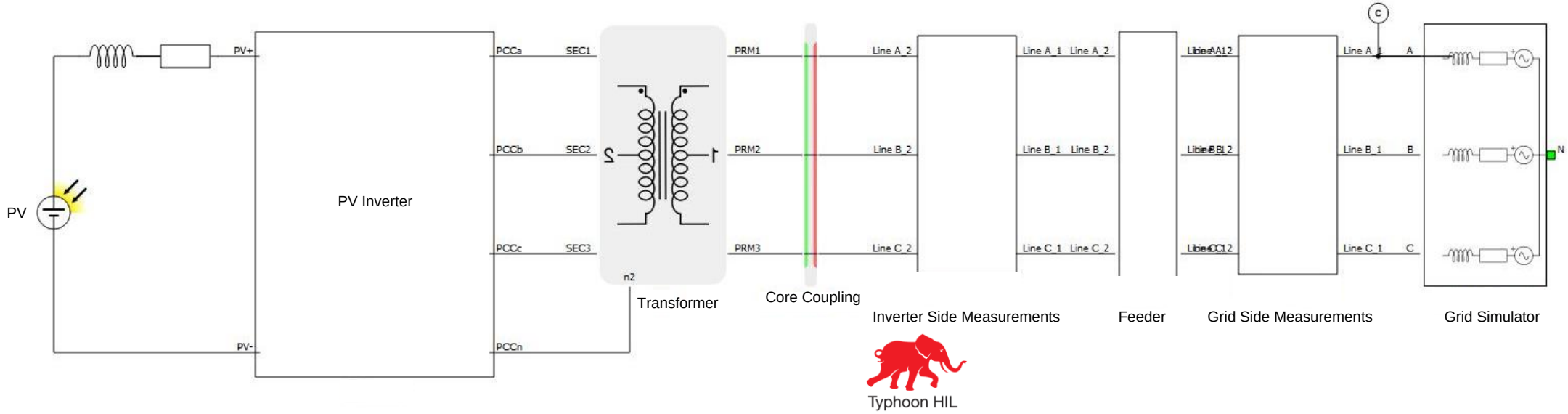
For their studies, offline modeling and simulation tools were widely introduced to study power system and its operational challenges.

Study and analyze the grid of Cyprus, capturing the real time behavior of its active assets i.e. PVs
-under certain events
-under different control logics



Brief overview of the goals/objectives

- **High fidelity modeling** of the Photovoltaic parks and power system feeders
- **Comprehensive study** and analysis of the integration and interaction of the studied Photovoltaic parks and power system feeders using real time Hardware in the Loop (HiL) environment and **realizing different scenarios and case studies**
- **Development of control algorithms**



Test case1: Islanding functionality

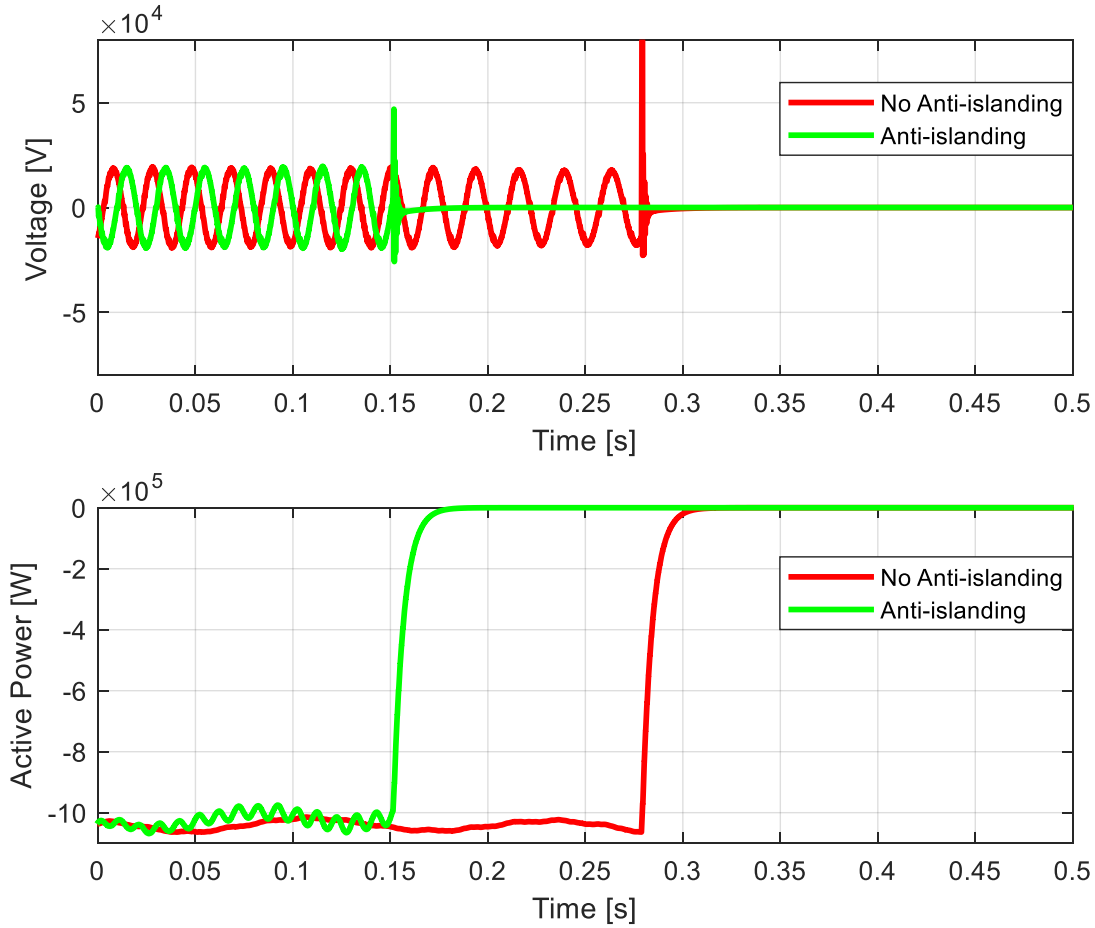
The main challenges of studying islanding for an operator in real conditions

- A long-standing requirement (UL1741 / IEEE 1547) for PV systems→ So, security issues arise when in real conditions.
- Unintentional island detection helps prevent potential hazardous conditions → risk in equipment
- PV highly dependent on irradiance and temperature→repeatability of the tests
- High costs associated with field tests in PV

Test Case1: Anti-islanding functionality

- The anti-islanding functionality was tested(sudden disconnection of the feeder from the main grid)

- All tests according to IEEE1547 were performed to prove that the inverter disconnected **<2 s** after



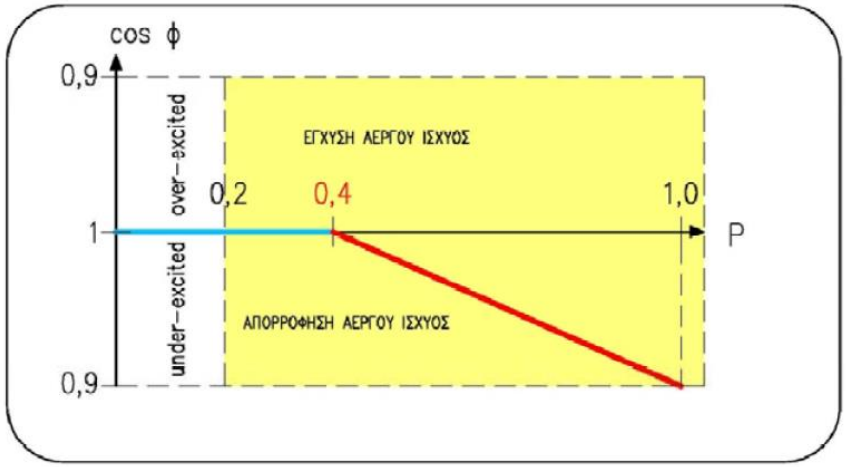
Test case2: Grid support functions enabled/Testing Low Voltage Ride Through

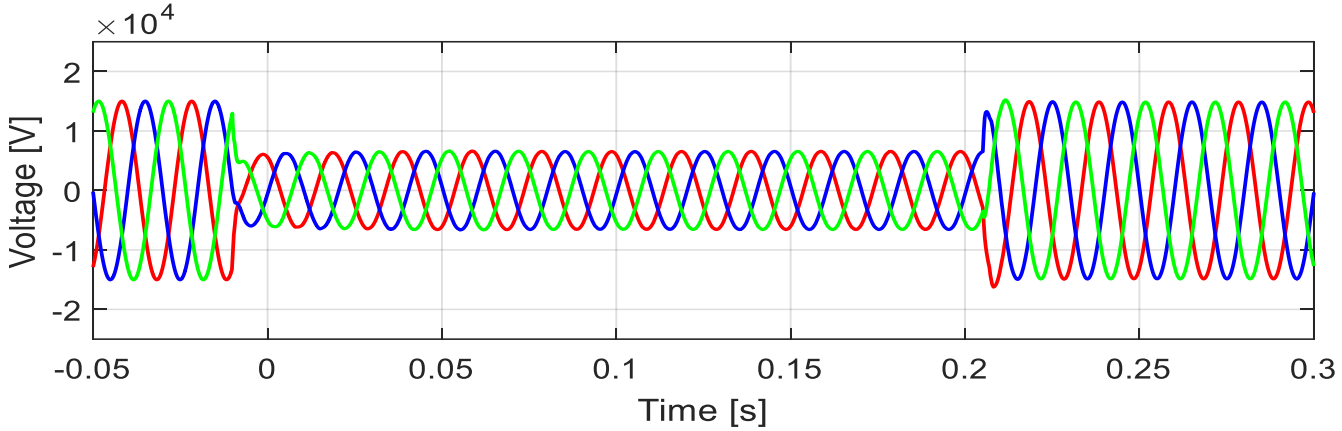
The main challenges of studying LVRT for an operator in real conditions

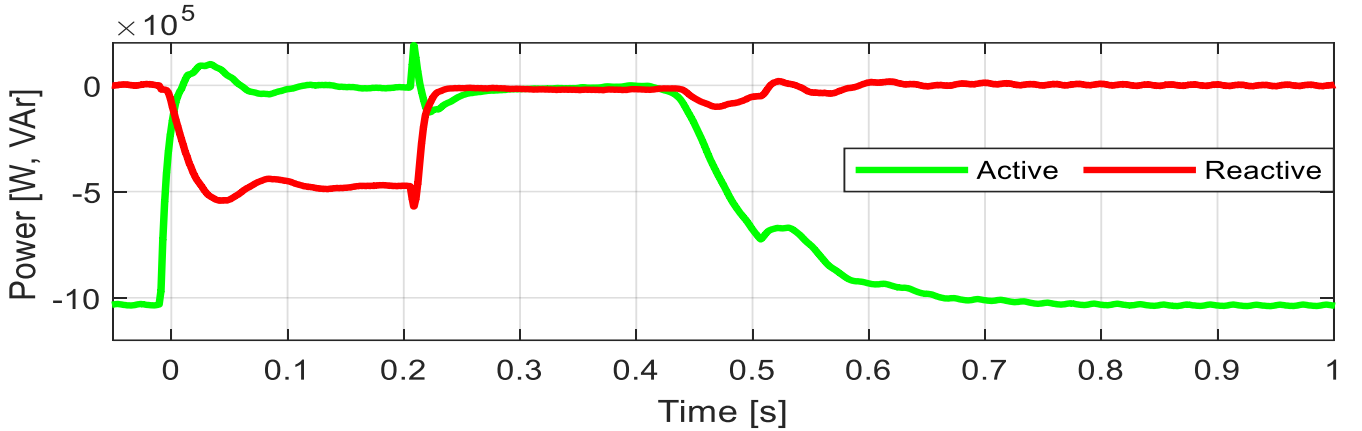
- PV highly dependent on irradiance and temperature
- Full-load tests are required by grid codes.
- High current is drawn from the grid.
- High costs associated with field tests in PV.
- Lack of flexibility
- Power losses and security issues

Test case2: Testing Low Voltage Fault Ride Through capabilities of solar inverter-CHIL

- Tests were carried out at certain power levels, typically low-, medium- and full-load tests(0%,10%,40%,70%,90%)
- Voltage sags taken from EAC grid

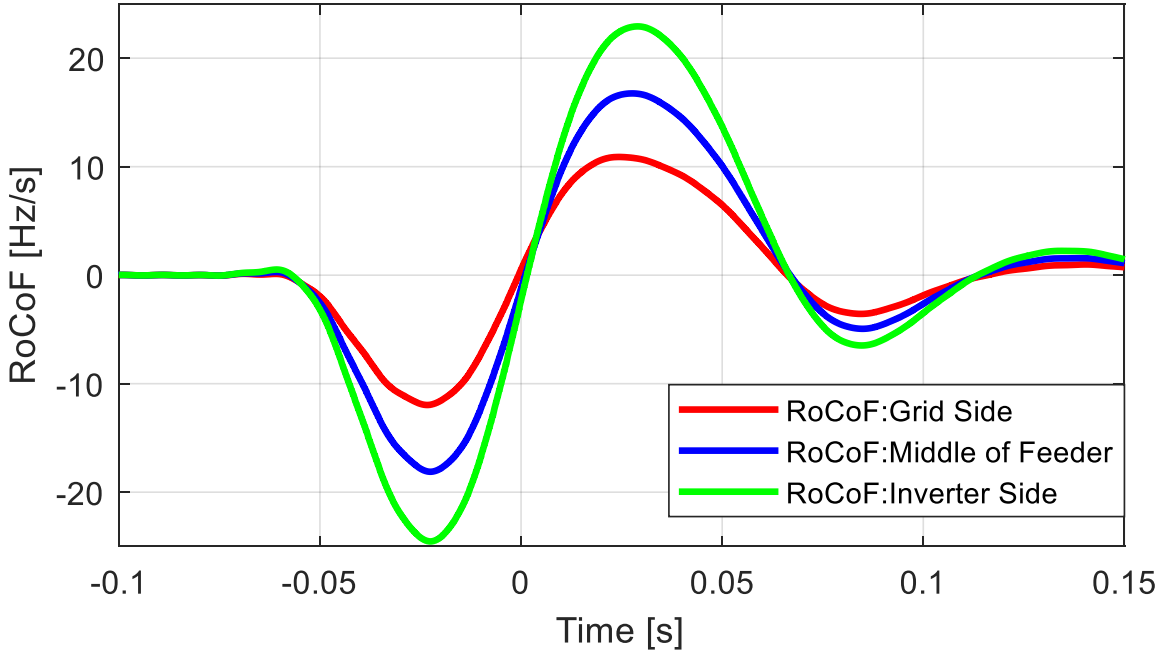






Test case3: RoCof studies when Grid support functions enabled

- RoCoF characteristic responses of the composed system following a disturbance event.
- RoCoF relays are mandatory to be set to 1.7 Hz/sec as the threshold setting to be sustained for 600 msec.
- RoCoF responses are thoroughly analysed.



Benefits from the exchange/lessons learned

→A contribution in the analysis of the RoCoF behaviour across a distribution feeder of the EAC grid and what a potential high rate integration would imply for the system.

→A testing of the anti-islanding control capabilities of certain PV inverters during unintentional system islanding conditions within the real Cyprus grid.

→An analytical approach for examining and validating grid support functionalities by the PV inverter

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