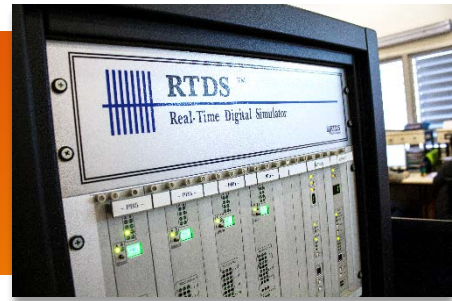


## TESTS with RTDS

### Real Time Digital Simulator

### Hardware in the loop (HIL) laboratory

### tests in Real-Time



CIRCE has the capacity to perform real time laboratory tests to study the interaction between Intelligent Electronic Devices (IED) and Power Systems. These tests allow to obtain information about the performance of an IED and its interaction with the grid. This information helps to the development, debugging and pre-commercialization validation of the device.

The penetration of new smart control and protection equipment into the power systems, as well as power electronic devices, makes crucial to analyze the interaction of these new equipment with the network. RTDS allows, previously to commissioning stage, to perform tests to check the behavior of intelligent electronic devices (IEDs) applying real transient phenomena that occurs in power systems. In addition, from the point of view of the grid, benefits and potential risks of the installation of these new devices can be analyzed in detail. The performance of these devices under common network conditions such as the presence of harmonics, voltage and frequency transients, faults in the grid or energization, among other effects, are very useful for the study of the behavior of different control and protection devices.

The study of the interaction between the devices and the grid modeled in RTDS provides relevant information to the developer about its behavior, helping to anticipate potential problems previously to its commercialization and commissioning. It also allows grid operators to verify the effect and impact on their networks.

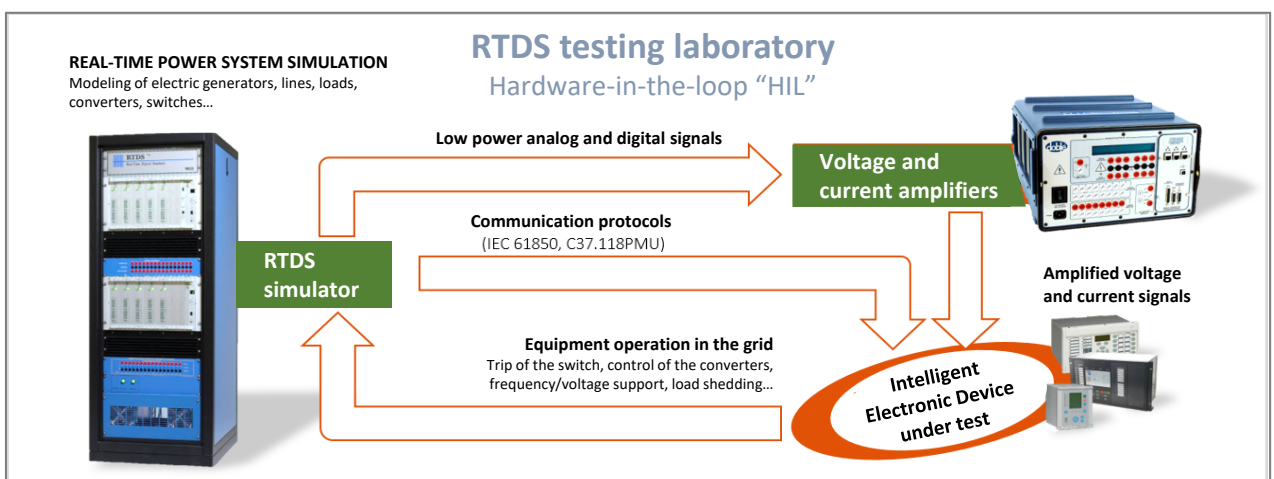
## Solutions with RTDS

### Focused on:

Protection and control relay manufacturers, DSOs / TSOs, manufacturers of control systems for power electronic converters, manufacturers of IEDs that interact with the grid, technology centers.

### What do RTDS tests provide?

- ✓ Testing control and protection relays in a safe laboratory environment.
- ✓ Checking and debugging behavior of the algorithms implemented in IEDs.
- ✓ Ability to anticipate phenomena that may appear on the grid due to the connection of the equipment under test (FACTS, wind and solar generators...)
- ✓ Study on how grid conditions affect to the IEDs (harmonics, faults, connection and disconnection of loads and generators, lines and transformers energizing...).
- ✓ Validation of the control equipment or protection before connecting the power part to the mains.
- ✓ Achieving a required TRL 6 within a research project.



## SERVICE OFFERING

### What we offer?

- ✓ Protection relay operation test applying short-circuit tests in the network modelled in RTDS.
- ✓ Study of current transformers saturation effects on the operation of real protection relays.
- ✓ Grid modeling to study the behavior of equipment under transient phenomena.
- ✓ Test of wide area protection systems.
- ✓ Tests of protection and control systems using communication protocols: IEC 61850, C37.118.
- ✓ Study of potential risks for the power system before and due to the connection of a new equipment.
- ✓ Reproduction of previous real events and research of IED failures.
- ✓ Transient phenomena that occurs during the connection and disconnection of converters, line energization, generators connection...
- ✓ Other transient phenomena to be defined with the client.

### Tools

- ✓ Hardware RTDS with 2 racks, 10 PB5 processor cards and multiple digital and analog inputs and outputs.
- ✓ Communication cards working with IEC 61850 (Sampled Values and GOOSE) and C37.118-PMU protocols .
- ✓ DOBLE ENGINEERING voltage and current amplifiers.

## WORK REFERENCES

CIRCE accumulates a wide experience in the execution of these type of tests, including previous collaborations with companies such as Endesa and REE.



In addition, CIRCE has carried out numerous research projects in this field:

- **Petersen coil** – Endesa Distribución research project for the installation of a control and protection system for resonant grounding systems; ([www.cired.net/publications/workshop2014/papers/CIR\\_ED2014WS\\_0299\\_final.pdf](http://www.cired.net/publications/workshop2014/papers/CIR_ED2014WS_0299_final.pdf))
- **MIGRATE** – Massive Integration of Power Electronic Devices) European Comission project -H2020 program, aims to study the behavior of present protection systems in grid transmission with high penetration of renewable energies and power electronics.

## BENEFITS

### General benefits:

- ① Analysis of the performance of IEDs under test previously to their commissioning.
- ② Tests can be applied directly to the protection/control comercial hardware device or to its prototype.
- ③ Allows to perform laboratory tests fixing grid conditions that in field would be potentially destructive.
- ④ The utilities demand the homologation and validation of the protection relays that plan to install in their network. Therefore, RTDS tests can be a demanded and highly valuable requirement for the commissioning of new equipment by the owner of the grid.
- ⑤ Tool with high demand in the industry: protection manufacturers, TSOs/DSOs, etc.

### Economical benefits:

- ⑥ Anticipates the detection of problems to a laboratory test stage, which allows a quick resolution of them, avoiding possible future damage to the equipment.
- ⑦ Provides useful information thanks to anticipation and detection of potential problems that may arise during its in-field operation.
- ⑧ Important potential for fixing failures and algorithm debugging previous to commissioning, saving costs to:
  - Devices developers and manufacturers (control systems of power electronic converters, protections manufacturers).
  - DSO/TSO: Avoid posible undesired protection relay trips, negative interactions between IEDs and the grid, installation of new protection and control systems.



## CONTACT

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