OPAL-RT TECHNOLOGIES

Success Story

Two OPAL-RT HYPERSIM Real-Time Simulators Installed in RTE's HIL Test Facility for the INELFE Project

The High Voltage DC (HVDC) link between France and Spain, INELFE (France-Spain Electrical Interconnection), was commissioned in 2015. Composed of two parallel Voltage-Sourced Converter (VSC) links, it is the most powerful VSC link in the world.

The interconnection consists of four AC lines, with a total commercial exchange capacity of 1,400 MW, making up only 3% of current maximum demand in the peninsula. The new HVDC doubles the current connection capacity, which will result in increased security of supply, and, above all, greater grid stability by increasing its connection with the European system.

This new interconnection is the first VSC installation operated and maintained by the French (RTE) and Spanish (REE) Transmission System Operators. Converter stations in the interconnection were designed and built by SIEMENS, while Prysmian cables & Systems was awarded the contract for the installation of cables.

1. Challenge

After the commissioning of HVDC and FACTS devices, manufacturers usually provide customers with a black box model of their control systems. These models, which are suitable for Electromagnetic Transient (EMT) real-time simulation, are difficult to maintain during the lifespan of the equipment. One solution is to use manufacturer-supplied physical replicas of control systems.

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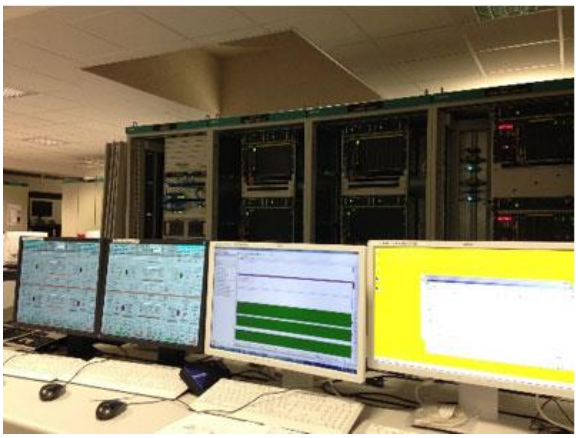
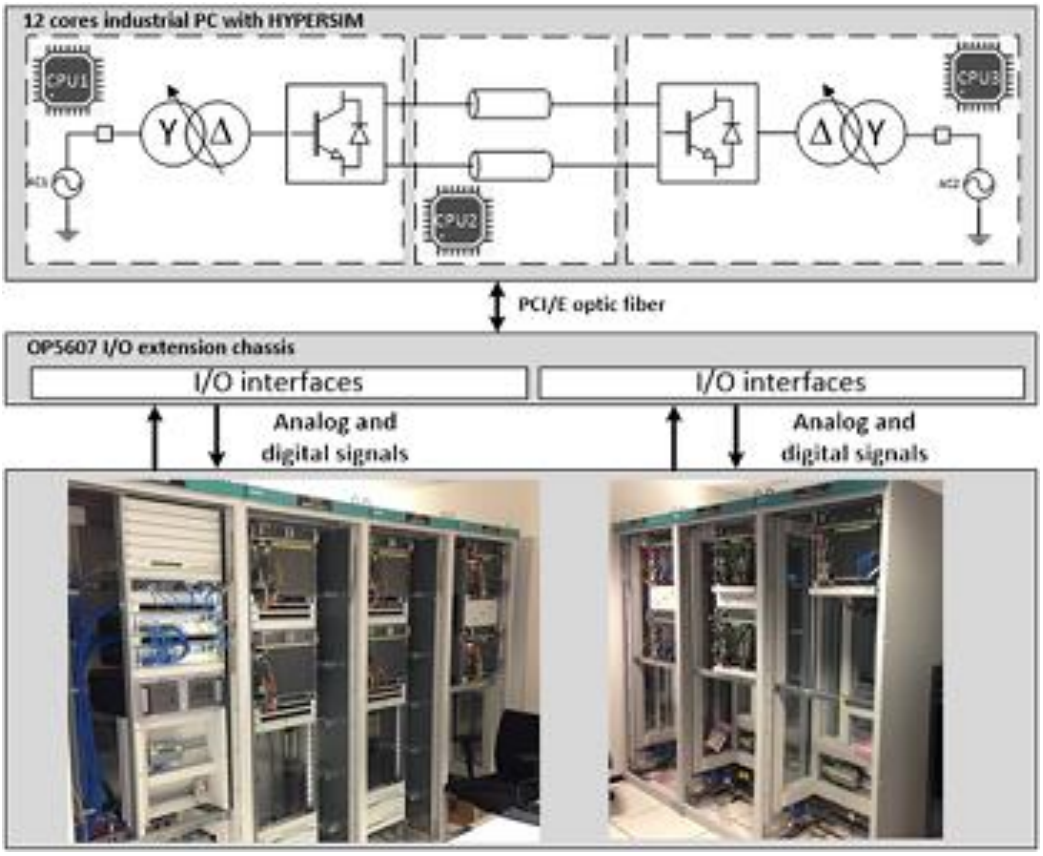
2. Solution

As a result, to validate the various modeling approaches for the different types of phenomena and to demonstrate interoperability and the absence of detrimental interactions, RTE opted for hardware-in-the-loop architectures, with replicas of the physical control systems. In this area, as part of its ongoing HVDC projects, RTE assembled a hardware-in-the-loop test facility in collaboration with Hydro-Québec and OPAL-RT. This facility, called SMARte, uses HYPERSIM simulators and employs OPAL-RT's solutions for the modeling and simulation of VSC-based equipment to perform testing of INELFE controls.



The objectives of this testing facility are mainly to study adverse control interactions and test multi-vendor and multi-infeed schemes. It is also used to validate the various modeling approaches for a large range of different phenomena, and to support maintenance activities.

The two HYPERSIM real-time simulators installed in the facility and dedicated to the INELFE project were connected to two control system replicas. The HYPERSIM platform, which relies on an open architecture, high-speed parallel processing and modular scalability, was used to develop and simulate the VSC converters and the AC grids as shown in the image below.



Additional OPAL-RT equipment used in the facility were:

- The OP5600, a modular and flexible design fully customized to meet specific I/O requirements
- An OP5607 I/O expansion unit
- An OP5030, which was used for process control, data acquisition and/or running real-time simulation.

3. Results

Using OPAL-RT's real-time simulation technology, RTE was able to test control system functions in the France-Spain Interconnection and ensure its proper operation. The HVDC line began operating in the 3rd quarter of 2015, doubling the power exchange capacity between France and Spain and improving the quality of the supply in Europe.*

4. Testimonial

``The commissioning of INELFE replicas in RTE laboratory was a clear success. Thanks to the test bench developed in collaboration with OPAL-RT**, the technical challenges were analysed prior to commissioning. The HYPERSIM platform provided a flexible and a high-performance solution to test MMC controls. It is the only platform that offers an iterative solver and meets the real-time constraints within a 25µs time step. ``

- Sébastien Dennetière, RTE

Ref: source: http://www.inelfe.eu/?What-is-Inelfe&lang=en)

**Ref : S. Dennetière, H. Saad, B. Clerc, E. Ghahremani, W. Li, J. Bélanger, “Validation of a MMC Model in a Real-Time Simulation Platform for Industrial HIL Tests”, IEEE General Meeting, Denver, July 2015.