OPAL-RT TECHNOLOGIES

Success Story

SuperGrid Institute inaugurates a platform for the study of HVDC power networks in collaboration with OPAL-RT

1. Challenge

SuperGrid Institute was created in France in 2014 to research the electrical grid of the future. This year, in collaboration with OPAL-RT, they inaugurated a platform to model and simulate HVDC power networks in real-time. This platform will help increase the technological readiness of the control and protection strategies developed by the institute.

Control and Protection of HVDC Installations

HVDC installations contain costly equipment essential to the proper functioning of the electric grid. It is therefore crucial to **protect them against faults that may appear on the network,** such as short circuits, lightning, etc. For that reason, SuperGrid Institute installed a platform designed to test and validate **new protection and control algorithms**. The architectures recommended by the research teams will be modeled and tested in real time thanks to OPAL-RT's HYPERSIM simulation system.

2. Solution

Mixed CPU / FPGA Architecture for Greater Accuracy

SuperGrid has chosen to equip itself with OPAL-RT simulators, which have the unique feature of providing a mixed CPU/ FPGA architecture. The parallel computation on CPU is particularly suitable for the **simulation of the electromagnetic transient phenomena (EMT)**, while FPGA technology can simulate applications based on **high-frequency power electronics**. The combination of both offers more precise simulation capabilities while respecting the real-time constraints. As with all OPAL-RT platforms, SuperGrid researchers will be able to perform both Hardware-in-the-Loop (HIL) tests and Rapid Control Prototyping (RCP).

Modular Multilevel Converter (MMC) Testing

Modular multilevel technology is standard for HVDC. However, controlling the modular multilevel converters is much more complex since it requires balancing the voltage between each capacitor. This operation is difficult and requires a high computing power, as well as very fast communication between the central control and the submodules. SuperGrid Institute's requirements were therefore clear: the tests must take into account the disturbances and uncertainties induced by the use of power electronics and real input/output communications. The installation was supplemented by power amplifiers to be able to perform **tests using actual electric current flows**. This technique, provided by OPAL-RT and its partners, is called Power-Hardware-in-the-Loop (PHIL) simulation and is used by SuperGrid Institute to test MMC converters. The reduced-scale converters are thus connected to the OPAL-RT real-time simulators via the power amplifiers.

Communicating with Standardized Protocols

It was important for SuperGrid to be able to communicate with actual devices used in electrical substations and test them with the HIL method. Accordingly, OPAL-RT real-time platforms must support the standardized communication protocols, including the **international IEC 61850 standard** for the automation of substations.

About OPAL-RT TECHNOLOGIES

OPAL-RT is the world leader in the development of PC/FPGA Based Real-Time Digital Simulator, Hardware-In-the-Loop (HIL) testing equipment and Rapid Control Prototyping (RCP) systems to design, test and optimize control and protection systems used in power grids, power electronics, motor drives, automotive industry, trains, aircrafts and various industries, as well as R&D centers and universities

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