APPLICATIONS

HVDC AND FACTS

HVDC and FACTS devices are among many critical technologies for ensuring and enhancing the controllability, reliability, and safety of modern power networks. The RTDS Simulator has revolutionized the testing process for HVDC and FACTS scheme controls.

All of the major control system manufacturers use the RTDS Simulator to test their HVDC and FACTS controls during Factory Systems Testing. Systems successfully tested include LCC- and VSC-based HVDC, modular multi-level converters, network and industrial SVCs, STATCOM, TCSC, DVR, UPFC, and more.

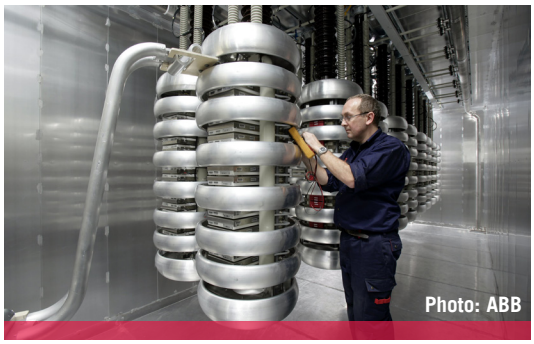


Photo: ABB

THE RTDS SIMULATOR IS USED BY UTILITIES WORLDWIDE FOR HVDC AND FACTS PROJECTS

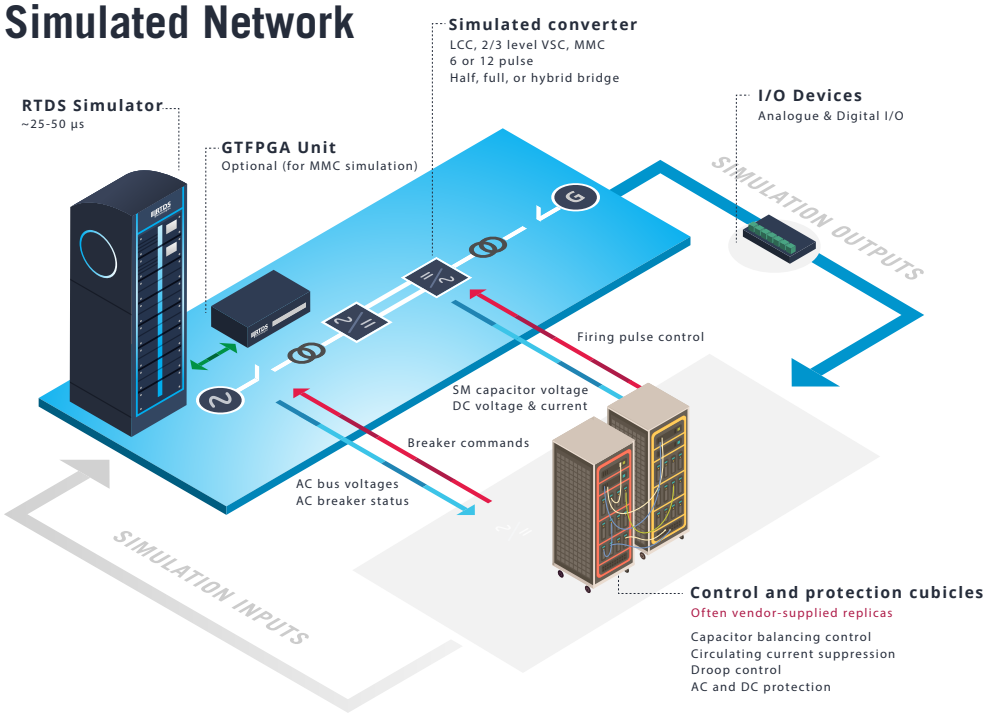
Many electrical utilities around the world have purchased an RTDS Simulator to connect to replica controls for HVDC and FACTS projects. A slightly simplified copy of the controls are delivered to site along with an RTDS Simulator to represent the power system. These "replica Simulators" are then interfaced with the controls and are used to investigate proposed network changes and control modifications, to test scheme upgrades and refurbishment, and to train utility personnel.

Rio Madeira HVDC Project: Brazil's Operador Nacional do Sistema Elétrico is responsible for the coordination and control of the 2,375 km long Rio Madeira HVDC link. The controls for this project were tested exclusively on the RTDS Simulator.

Trans Bay Cable: This 85 km submarine HVDC cable transfers energy from the City of Pittsburg to the City of San Francisco. This was the world's first ever HVDC project to use an MMC system, and was tested using the RTDS Simulator.

North-East Agra UHVDC Project: Power Grid Corporation of India is responsible for the world's first ever multi-terminal UHVDC transmission link. The link includes four terminals in three converter stations with a total converter capacity of over 8,000 MW—the largest HVDC transmission system ever built. This project was tested using the RTDS Simulator.

Simulated Network



LEARN MORE ABOUT THIS APPLICATION AT RTDS.COM/APPLICATIONS/HVDC-FACTS

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A WIDE VARIETY OF HVDC AND FACTS MODELS ARE AVAILABLE IN THE RSCAD MODEL LIBRARY

The RTDS Simulator's Substep environment allows for the simulation of power electronics-based schemes, maintaining a small timestep to accurately represent high-frequency switching and circuit dynamics. These power electronic subnetworks can be interfaced to large scale grid simulations to study the interactions between power electronics and the AC network.

The circuit and valve topology is user configurable, with both fixed topology converters and individual switching components available.

- **VSC Models:** Two- and three-level resistively switched converter models including T-type, NPC, buck and boost; point-to-point and back-to-back schemes
- **MMC Models:** Up to 1024 submodules per valve with half, full, and/or hybrid configurations; customized topologies, internal valve to ground faults, and damping submodules available
- **LCC Models:** Six- and twelve-pulse LCC valve groups supporting a broad range of valve faults both internal and external to the converter
- **Firing Pulse and Ramp Generators:** High resolution firing pulse words can be produced in the Substep environment or brought into the simulation directly with digital inputs
- **Frequency-Dependent T-Line:** 8– or 12-conductor frequency dependent phase domain travelling wave transmission line models in the Substep environment

THE CONTROLS FOR THE RIO MADEIRA HVDC SYSTEM—THE LONGEST TRANSMISSION LINK IN THE WORLD—WERE TESTED ON THE RTDS SIMULATOR


Photo: ABB

CASE STUDY: DE-RISKING HVDC WITH GREAT BRITAIN'S NATIONAL HVDC CENTRE

The Caithness-Moray (CM) HVDC project, led by the National HVDC Centre, was completed and energized in January 2019, on time and within the approved budget allowance. The project will transmit up to 1200 MW of power through a 113 km subsea cable between the Caithness and Moray regions in the north of Scotland. The CM project, the most significant investment in northern Scotland's transmission system since the 1950s, will transmit renewable power (including both off-and on-shore wind) to load centres.

The first phase of the CM project is a point-to-point link, but the project is designed to be expanded to three, four, or five terminals to accommodate the connection of additional renewable power in the Shetland isles and other locations. The RTDS Simulator allows the National HVDC Centre to simulate the converter stations, DC link, and AC network of interest and use the safe, flexible digital simulation environment to test the link's operation and control.

Real-time simulation technology and expertise allowed Great Britain's National HVDC Centre to provide a variety of services and support for the Caithness-Moray HVDC project:

- Grid integration risk analysis and mitigation studies
- Grid code compliance demonstration
- AC system interaction studies
- Pre-commissioning testing
- Commissioning event diagnostics
- Control operator training