RTDS® News

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Technologies

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Multi-Module Converters - MMC Model

RTDS Technologies has made some exciting new developments in the area of modeling MMC-based converters for HVDC and FACTS. In addition to the current CHAINV3 and MMC4 processor based components a new model has been created to run on an FPGA. The new component is fully integrated into the small timestep sub-network providing valuable modeling flexibility with detailed modeling of up to 512 submodules per valve - more than 3000 submodules per HVDC station! The new model will be used for development purposes and detailed factory acceptance testing. A firing pulse control has also been developed to demonstrate the full capabilities of the new model.

MAJOR EXPANSION AT SOUTHERN CALIFORNIA EDISON

Southern California Edison (SCE), one of the largest electric utilities in California, has recently expanded their RTDS real-time power system simulator to 20 racks using the latest generation of processor cards. The expanded RTDS is housed in SCE's new

RTDS Lab ~ Southern California Edison

Smart Grid and Renewables R&D Lab located in Westminster California. SCE is heavily involved in power systems research which aims to improve system reliability, security and efficiency. SCE's research areas which benefit from access to real−time simulation equipment include the study of wide area control and protection, smart grid technologies and the integration of renewables. With the latest expansion of the RTDS Simulator, SCE is now able to model a significant portion of their major transmission network, as well as, portions of neighboring networks to which SCE is interconnected.

RTDS equipment at SCE includes significant I/O capability so that external control and protection equipment may be interfaced to the simulator for closed loop testing. In addition to traditional analog and digital interface signals, the RTDS also includes LAN based communication protocols for interconnection with IEC capable protective relays, as well as, data concentrators used to receive Phase Measurement Unit data.

In response to the significant outage in the Western U.S. power grid in 1996, SCE began a program of installing Phase Measurement Units (PMU) at select 500kV and 230kV stations. Control and protection equipment is being considered which uses information from those PMUs to dynamically assess system stability and take corrective measures in order to maintain stability. Such wide area control and protection is a significant deviation from traditional methods whereby a protection device is responsible for monitoring and protecting a very limited portion of the power

GTNET PMU

Testing of Phasor Measurement Units (PMU devices) is necessary for any PMU application, be it a simple visualization and archiving system or a more complex set of real-time system operations tools. PMUs are available from virtually every manufacturer of protection and monitoring equipment. PMUs can be an embedded function within relays or disturbance recorders or alternatively they can be standalone products. RTDS simulations can now include PMUs allowing the PMU data to be used for but not limited to monitoring of oscillations, angle difference, system frequency and voltage stability. Other ideas for PMU data include situational awareness, alarm and operational limit settings, state estimation and congestion management to name a few.

system − often a single component such as a transmission line. In the case of wide area control and protection, information from a variety of locations is used to determine whether the system is in a state susceptible to a major outage and if so what corrective action may be taken to restore safety margin.

The complex algorithms running on a centralized controller that receives and analyzes data from a wide area of the network and which can take control action at many places in the network must be extensively tested prior to the installation of that controller into the system. Incorrect control action at a time when the system is approaching the stability limit could exacerbate the problem. Given the controller's ability to have such a major impact on system operation, extensive testing envisioning a wide array of contingencies is required. Before installation in the field the wide area control and protection equipment being considered by SCE will be interfaced to a model of the power system running in real−time on the RTDS. The ability to run the system model continuously in real−time permits fully closed loop testing where evolving events can be modeled with the controller's actions affecting the simulation. Access to instantaneous phase information from the real system may be used to validate simulation cases and to confirm load flow conditions prior to the simulated disturbance.

If the wide area control and protection schemes can be shown to be effective, it will permit increased transmission capacity over existing rights of way, while still maintaining system stability and security.

Detailed models of PMUs are available on the RTDS. Their computed phase information is sent from the simulator to the interfaced controller using the C37.118 communication protocol such that the controller responds as it would when connected to the actual power system.

Advancements in Simulation Technology

- ◆ RSCAD Version 3.000 has been released and is available for download from our website to all customers currently enrolled in the Software Maintenance and Simulation Support Program. This new release contains many new features and enhancements including:

  - Upgrade to Java 7 giving an improvement in handling and the overall speed of RSCAD.
  - Cable Version 2.0. This new program boasts a revamped GUI with innovative features:
    - ◊ Pipe type cables
    - ◊ XLPE type cables (ability to enter the thickness of the semi-conducting layers)
    - ◊ Automatically create a Draft file with a cable component and corresponding data entered
  - CBuilder has been upgraded from a custom in-house compiler to a cross-platform version of GCC. This exciting new upgrade provides many advantages:
    - ◊ Increased support for standard 'C' language features
    - ◊ Significant improvement to the efficiency of the generated code
    - ◊ A facility has been created to capture the actual execution time of components in RunTime
  - Our component library has been updated to include:
    - ◊ Li-ion battery model and sample case have been added
    - ◊ Updated generator control models

- ◆ Phasor Measurement Unit (PMU) models including P Class, M Class and 16 point DFT with PLL tracking.

- ◆ GTNET-PMU allows modeled PMU output to be sent to external PDC using C37.118 communication protocol. Up to eight PMU models can be accommodated through one GTNET card.

- ◆ GTSYNC card and library component for synchronization of the RTDS simulation via GPS reference signals with external devices. The reference signals can be 1PPS, IEEE 1588 or IRIG-B.

- ◆ GTNET-SV component that will support two published data sets according to IEC61850-9-2LE when operating at 80 samples per second or one data stream with operating at 256 samples per second.

Part of the power system model development for the wide area protection studies will be done by Professors Chakrabortty and Bhattacharya at the North Carolina State University. SCE has awarded a grant to NCSU to develop an experimental framework for testing transient stability, frequency response and oscillation damping of the US Western Interconnection using the RTDS.

One of the specific control schemes that is being considered by SCE is a Centralized Remedial Action Scheme (C−RAS). Traditional Remedial Action Schemes (RAS) operate on a local area using only information from the immediate area where they operate. With the C−RAS the RAS schemes will be operated from a central location taking into account information from a large area of the power system. It is expected that the C−RAS will permit optimization of the load shedding and generator tripping that is required to maintain system stability in case of major system disturbances. Testing the C−RAS will be a major undertaking and will require representation of a large portion of the power system. The RTDS will be used to model the power system network and interconnect to the C−RAS hardware.

Back row l-r: Chris Clarke, Joshua Park, Allison Auld, Nagy Abed; Front row l-r: Hector Camacho, Aleida Gonzalez, Michael Gonzales, Juan Castaneda

SCE is also considering use of their RTDS to study the impact of integrating some 4,500 MW of wind power from the Tehachapi Wind Resource Area into the grid. The use of large scale Lithium−ion battery storage and inverter technologies are being contemplated for use in improving grid performance. The wind turbines, Lithium-ion batteries and power electronic components may be modeled on the RTDS with the controllers for the power electronic based converters interfaced to the simulator to evaluate their performance.

SCE engineers are in the process of gathering component information that is required to assemble the large scale power system model that will be simulated using the RTDS. Parameter data and controls settings for major components such as thyristor protected series capacitors, generator controls, HVDC systems and Static Var systems is required for the RTDS models. All control systems cannot be expected to be available for interfacing to the RTDS. Those controllers that are not available are modeled on the RTDS using components from the Controls Library or alternatively using the RTDS built in C−Builder capability. With C−Builder the user is able to develop the control algorithm using C language. Engineers involved with the assembly, validation and interconnection of the large scale system model to the external controls are expected to gain a detailed understanding of the interaction between the existing system and the new controllers.

SCE is testing smart grid technologies in a portion of their network in the City of Irvine. As part of the project the interoperability and interaction between various components comprising the smart grid will be evaluated. RTDS simulation equipment will be used to test advanced distribution system automation concepts including automatic reconfiguration of the distribution circuit topology in the event of a disturbance. The distribution system and communication links are modeled on the RTDS. Scripts are then used to initiate a wide variety of fault scenarios to determine whether the logic for the universal remote circuit interrupters (URCI) operate correctly to reconfigure the network to isolate the fault.

RTDS Technologies and SCE members continue to work together to ensure that the RTDS simulator is able to meet the requirements for the simulation studies being undertaken at SCE.

RTDS Training Courses

We are currently accepting registrations for the following course:

ADVANCED RTDS SIMULATOR TRAINING - GTNET, PMU, IEC 61850 AND PMU APPLICATIONS

September 17 - 21, 2012 in Winnipeg, CANADA

Email christine@rtds.com for more details.

Upcoming Events

PAC World 2012

Budapest, HUNGRY

June 25 - 28, 2012

Booth 17

IEEE PES General Meeting

San Diego, USA

July 22 - 26, 2012

Visit our Hospitality Suite in the Cunningham room!
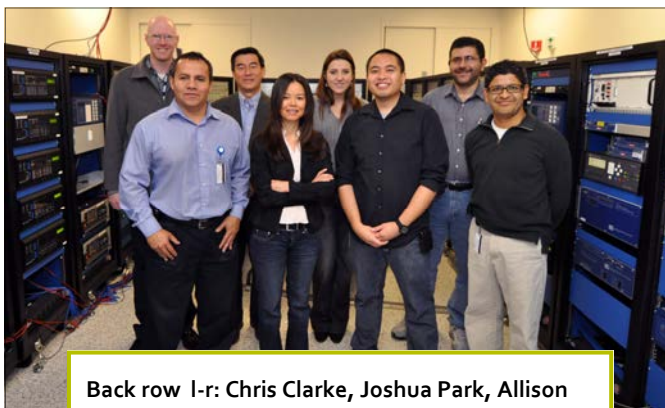
CIGRÉ Paris

Paris, FRANCE

August 27 - 31, 2012

Booth 17