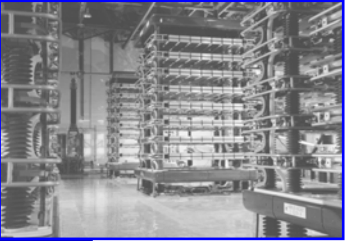


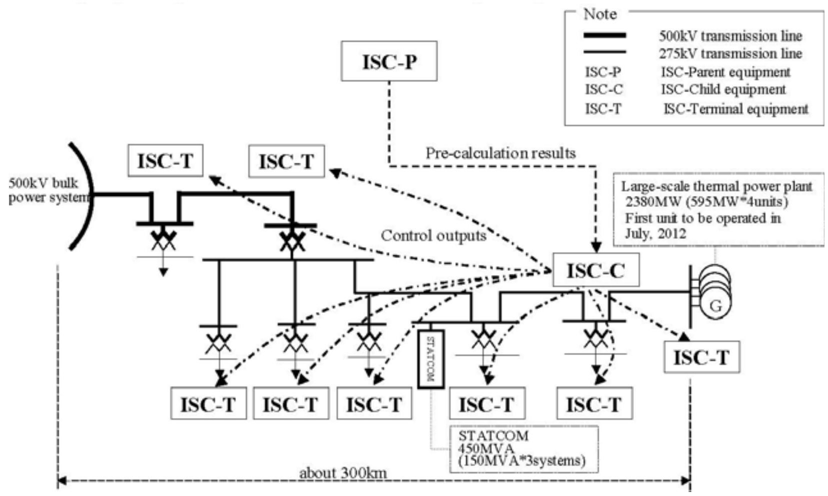
RTDS NEWS

Fall 2010

Real time digital simulation for the power industry

Team members responsible for the testing:

Takashi Kinoshita & Kuniaki Anzai (Chubu EPCO)
Takashi Yamamoto (Chuden CTI)
Shinji Kuramoto (Toshiba)



Chubu Electric Power Corporation – Testing Real Time Dynamic Security Assessment and Control

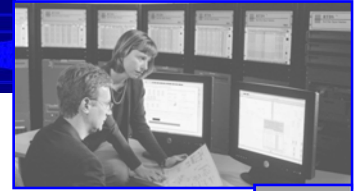
Chubu Electric Power Corporation – Chubu EPCO, is the third largest utility in Japan serving customers in central region of Japan. Chubu's R&D Center, located in Nagoya, recently used their RTDS® power system simulator to test an Integrated Stability Control System (ISC). The controller is to be commissioned in conjunction with the installation of a new 2380 MW thermal power plant planned for 2012.

The new thermal power plant is to be located approximately 300 km from the main connection into Chubu's 500 kV bulk power transmission grid. In an effort to maximize the total transfer capability (TTC) without construction of additional transmission lines and yet maintain adequate security, a special control system has been specified. The control system is designed to cope with complex problems including transient and voltage stability issues and in general enhance the TTC of the twin circuit 275kV lines used to transfer the power from the new generation to the grid. The illustration at the top of the page shows the major power system components as well as controller components comprising the overall system. The ISC is able to control the settings and operation of components such as transformer taps, generator real and reactive power and terminal voltage as well as switched capacitors and inductors. On−line transient stability assessment of the system is performed by the ISC every 30 seconds. The on−line transient stability algorithm attempts to anticipate various fault conditions and, if needed, adjust power system component settings to ensure that the system remains stable in case of the anticipated fault. If an actual fault condition is detected the controller switches to a real−time analysis mode in order to compute the necessary stabilizing control in approximately 200 ms.

In order to test the controller, a detailed model of the power system was built using Chubu EPCO's RTDS Simulator. The power system model included the new generators and their controls (AVR, Governor/Turbine, Stabilizers), as well as, power system components such as the STATCOM units, two and three winding transformers with tap changers, switched capacitor and inductor banks and representation of the transmission lines and a portion of the system into which the new generation is connected. Due to the number of elements that can be controlled, a large number of signals were required to be exchanged between the RTDS Simulator and the external controller under test. A GTNET card running the DNP3 protocol was used as the mechanism for signal exchange. Over 650 binary signals and 135 analog signals are exchanged between the RTDS Simulator and the external controller.

Once the system model and the interface to the external controller were verified, script files were prepared to alter system conditions on the modeled power system. Control action taken by the ISC could then be monitored and recorded to confirm proper operation. Due to the large number of monitoring and control points audio and visual cues were added to the RSCAD/RunTime screen to indicate when particular events were initiated by the

RTDS Technologies



controller. Simulation cases were run for over an hour to verify the controller's performance over a wide variety of conditions.

In addition to testing the non-emergency response of the controller to such things as changes in load and configuration, the controller was also tested to determine its performance under faulted conditions. Severe faults were applied to confirm that the controller's actions would maintain stability of the new generators and that the voltage oscillations were maintained within safe regions.

Reference: K.Suzuki, N.Saito, H,Nishiiri, T.Kawahara, T.Maeda, Real time dynamic security assessment and control by combining FACTS and SPS, paper C2 – 109 CIGRÉ 2010.

IRC Switch

Large scale real time power system simulations are becoming more and more common. Utilities, manufacturers and research groups are looking to large scale simulators to develop, investigate and demonstrate new technologies as well as network behaviour. Wide area protection and control, integration of renewables, Smart Grid initiatives and many other factors are pushing the use of large scale real time simulation.

RTDS Technologies is committed to providing the best possible technology for real time power system simulation and has invested significant effort directed towards large scale simulators. Part of that effort included the development of the IRC Switch which provides direct Inter-Rack Communication (IRC) between as many as 60 racks.

For simulators with more than seven racks the IRC Switch is advantageous. In fact the larger the simulator the more benefit the IRC Switch will bring.

The IRC Switch is for use with GTWIF based simulators which are otherwise limited to six IRC connections per rack. If the IRC Switch is not used for a simulator with more than seven racks, not all racks will have direct communication with one another. Very large scale networks have been successfully built and operated on simulators with more than twenty racks, but the restriction on the IRC connections had to be taken into consideration when building the simulation models. With simplified connections and full communication between all racks, the IRC Switch allows the implementation of large scale simulations without restrictions.

Faulted Generator Model

Through collaboration and sponsorship of a Ph.D. project at the University of Manitoba, as well as, with subsequent in-house work, RTDS Technologies has developed a phase-domain synchronous machine model capable of modeling internal stator faults.

The main motivation for developing the model is to test protection systems for synchronous generators. The initial release of the model, which is currently available in the latest version of RSCAD, uses a slightly simplified implementation, but allows readily available and familiar DQ machine data to be used.

The full implementation of the new machine model is described in the *IEEE Transaction on Energy Conversion, Vol. 25, No. 1, March 2010, pgs 34-48*. The full implementation is capable of representing winding- and permeance-related time harmonics, but requires very detailed information about the physical geometry of the machine. Since the physical geometry is very seldom, if ever, available to those creating the circuit models, the simplified version with the DQ data entry was implemented.

Using the new model with the DQ data entry, various elements of a physical generator protection relay were tested. These included stator-ground protection elements such as phase differential (87G), neutral differential (87N) and neutral overvoltage. Since the model with the DQ data entry cannot represent space harmonics, it cannot be used for testing protection elements based on the existence of third harmonic on the neutral and terminal. Other protection elements tested were phase overcurrent (50/51P), neutral overcurrent (50/51N), negative sequence (46), loss of field excitation (40), overexcitation (24), reverse power (32), out-of-step (78), overvoltage (59), and undervoltage (27).

UPCOMING EVENTS

WETEX
Exhibition Mar 8-10, 2011 in Dubai, UAE

PSCE
Exhibition Mar 20-23, 2011 in Phoenix, USA

Wind Power
Exhibition May 22-25, 2011 in Anaheim, USA

IPST
Exhibition Jun 14-17, 2011 in Delft, Netherlands

RTDS Technologies
RTDS Technologies Inc. 100-150 Innovation Drive, Winnipeg, Manitoba, Canada R3T 2E1
Telephone: 204 989 9700 Fax: 204 452 4303 Email: rtds@rtds.com Website: www.rtds.com