RTDS Technologies

RTDS NEWS

The RTDS Technologies team

WHAT'S NEW: SEPTEMBER 2015

Testing a nuclear fusion reactor controller at the National Fusion Research Institute in Korea

Did you know that RTDS Technologies is actively involved with many industry R&D groups?

Upcoming Training Courses

We are currently accepting registrations for the following courses. Please contact **christine@rtds.com** for more details.

INTRODUCTORY RTDS® SIMULATOR TRAINING

October 19 - 23, 2015
Winnipeg, Canada

IEC 61850 APPLICATIONS TRAINING

October 26 - 30, 2015
Winnipeg, Canada

Upcoming Events

APAP 2015

September 20-23, 2015
Nanjing, China

International HVDC Conference

October 18-22, 2015
Seoul, Korea

RUGRIDS-ELECTRO Conference

October 20-23, 2015
Moscow, Russia

RTDS Technologies China User's Group Meeting

November 9-11, 2015
Beijing, China

GUEST ARTICLE

HIL Testing for the International Thermonuclear Experimental Reactor's Coil Power Supply Plant using the RTDS Simulator

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In Kwon Park — RTDS Technologies

Generating electricity from a nuclear fusion (as opposed to fission) reaction is still largely regarded as a concept reserved for science fiction. In actuality, however, it is much closer to reality than we may think. The International Thermonuclear Experimental Reactor (ITER) is a large scale international research project. The purpose of the project is to prove that fusion technology can meet the ever-growing demand for energy without a negative impact on the environment. The ITER is currently being built in Cadarache, France. The goal of the project is to achieve a Q factor of 10, which means generating 500 MW of fusion power from a 50 MW input.

The core of the technology is a reactor in which nuclear fusion is initiated and maintained continuously. The reaction occurs at a very high temperature — ~100M degrees Kelvin. All physical substances involved exist in plasma form at that temperature, including any type of metal or ceramic. This plasma must be isolated and controlled. One way of maintaining isolation is by utilizing a very strong magnetic field. This method can be achieved using a device called a Tokamak — a hollow metal vacuum vessel in the shape of a torus, in which the plasma can freely flow. However, the flow must be carefully controlled in order to achieve the necessary heating and continuous fusion reaction. This control is achieved using differently directed magnetic fields. Therefore, the vessel that contains and controls the plasma is essentially a very large magnet, where the necessary magnetic field can be generated and regulated. The strong magnetic field is generated by a coil with a considerable amount of current flowing through it — in the range of 68 kA. The only feasible way to maintain such flow of current in the coils is by utilizing superconductivity. Thus, the reactor is a fascinating combination of superheated plasma (>100M K) and a super-low temperature magnet (<5 K).

The Toroidal Field (TF) coil power supply system is responsible for maintaining and controlling this large amount of current. The total capacity of the entire power supply system is around 2.3 GVA, with an accompanying reactive power compensation system (SVC) which can regulate reactive power up to 750 MVar. In the event of control failure, the impact would be disastrous — the immense power contained in the vessel might be released in an uncontrolled manner. Therefore, the controller of the power supply system must be tested and verified for every possible circumstance imaginable before it is fully operational.

In order to carry and control this large amount of current, the power supply system is composed of thyristor valves, which usually require a substantial amount of reactive power. In a typical thyristor valve based HVDC system, about 60% of its real power output becomes the necessary reactive power compensation amount. This explains the necessity for a 750 MVar sized SVC system.

Continued on next page

RTDS Technologies

Visit us online!

Don't miss our 2015 China User's Group Meeting!

November 9-11, 2015
Beijing, China

After the phenomenal success of our North American User's Group Meeting this spring, we are thrilled to announce our 2015 China User's Group Meeting!

This event will be an incredible opportunity to connect with other users of the RTDS Simulator, to explore new applications of the Simulator, and to stay informed on new developments. The event is open to all users, regardless of location, and to all power industry colleagues who are interested in real time digital power system simulation.

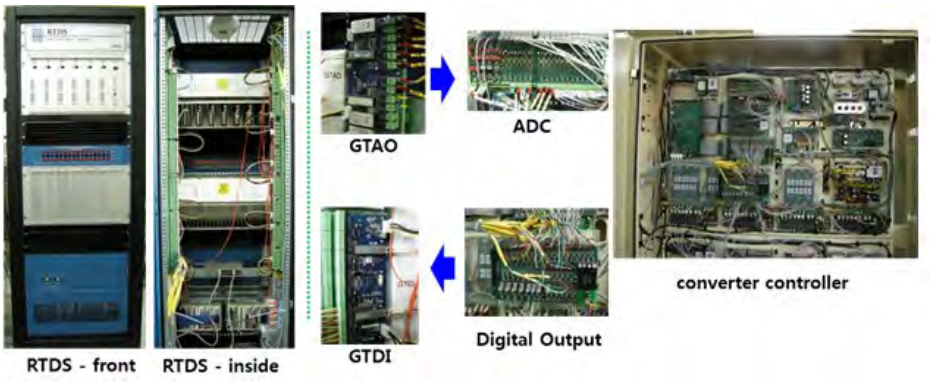
We are inviting RTDS Simulator users to submit abstracts for presentation at this event. Presentations can discuss any aspect of the user's real time power system simulation work. If you plan to submit an abstract, please email **christine@rtds.com** with notice of your intention. Abstract deadline is September 15, 2015.

Registration is now open—be sure to register early as there will be a limited number of seats available. Registration deadline is October 1, 2015.

Click here to learn more and to register

The basic building block of the coil power supply system is similar to a conventional HVDC system: a 6 pulse thyristor valve bridge. By combining a number of these basic building blocks, a coil power supply system can be constructed.

Because of cost, complexity, and safety concerns, it is impossible to test a coil power supply control system with a real ITER fusion reactor. Additionally, the fusion reactor design requirement only allows for a very small number of emergency stops during the reactor's life cycle. Therefore, it is imperative to utilize a hard real time electrical power simulator for testing. The necessary controller for the power supply system was developed by the National Fusion Research Institute in Korea. The coil current controller is implemented on the recent Zynq FPGA from Xilinx and has been tested in a hardware-in-the-loop (HIL) simulation environment using the RTDS Simulator. Throughout the various tests, the RTDS Simulator has been able to successfully fulfill this role in the development process. In the HIL environment, the RTDS Simulator represents the numerous thyristor bridges and the couplings of many different coils in the reactor in real time. The measured signals, such as voltage and current, can be passed on to the controller in the exact same way that they would be in the final real-world application. Then the controller command, a major portion of which is the firing command for the thyristors in the numerous converters, can be brought back into the simulated environment. The testing environment can therefore represent the dynamic closed loop characteristics of the system. The figure below shows the closed loop testing of the coil power supply controller using the RTDS Simulator.



Innovation 101: How we stay on the cutting edge

RTDS Technologies is actively involved in a multitude of industry R&D initiatives

The power industry is one of rapid innovation and change. Because the RTDS Simulator is used worldwide by the power industry's innovators, RTDS Technologies recognizes the importance of being actively involved in industry research and development initiatives. RTDS Technologies is an actively contributing member of a wide variety of industry working groups, task forces, and committees, including IEEE working groups, the UCA International Users Group, NASPI, IEC working groups, and CIGRE working groups. Get the full list at **www.rtds.com/industry-involvement**.

a glimpse of our

New Features

- The sub-step three-level VSC, which runs at a sub-timestep as small as 1/3 of the small timestep in order to reduce switching losses by about 50%, can now receive input from the GTDI card at each sub-step.
- The number of passed G values in a subsystem has been increased from 100 to 230.
- When implementing two network solutions in a single rack, the maximum number of single-phase switches has been increased from 100 to 200.

Click here to log in to the RTDS client area, where you can access the full RSCAD release notes.

If you have an idea for a new feature, please send it to **feedback@rtds.com**. We want to hear from you!