

Challenge

GE Power Systems, one of the world's leading suppliers of power generation technology, energy services and management systems is a division of General Electric. In its Schenectady Generator Testing Lab, GE performs assembled generator tests on prototype generators or on generators where customers specifically request tests. For the most part, when GE Power sells and builds a generator, customers accept previous test data from a prototype as verification of performance. However, some customers demand, and pay for, a generator to be tested.

Doug Ives, Instrumentation and Control Systems Engineer for GE Power Systems, oversees the test processes and the data acquisition processes used when testing generators. He reports that GE performs about three assembled generator tests per year. "It may only take up to 3 days to test each generator," says Ives, a 26-year veteran with GE, "but each will often require 3 weeks to setup." "We're interested in verifying the efficiency of the generator, the performance of the generator, as well as a variety of electrical constants," says Ives. "For example, we want to know how the generator will perform if struck by lightning. There are number of constants having to do with transient and sub-transient performance, particularly on new prototypes. It's a very interesting test where we take the output of the generators from open circuit to short circuit very suddenly and very precisely, so it creates a huge amount of current for a very short duration."

This application note will review the type of tests GE Power performs on generators, why GE Power chose to upgrade their Generator Testing Lab system in 2000 and 2001 with KineticSystems' VXI hardware and software and how their VXI system performs.

Solution

At GE's Generator Testing Lab, KineticSystems' VXI hardware provides GE Power's primary data acquisition for steady-state data (data that isn't transient in any way or doesn't change rapidly).

"The VXI system," says Ives, "is designed to acquire real time information and either display it to the operator or record it under certain conditions, depending on what we're doing. The KineticSystems solution is extremely fast compared to what we used to have."

As one of the world's leading suppliers of power generation technology, GE Power Systems often has to perform testing on the generators they sell or build for their customers. Some of the key electrical test objectives include excitation requirements, short circuit ratios and temperatures.

The KineticSystems' VXI hardware is used to provide GE Power's primary data acquisition needs. GE's test engineers deemed KineticSystems' VXI solution the best test system for their needs due to its extremely high speed, user-friendly software, reliability, versatility, and great after-sale support.



The previous system used by GE Power Systems was installed in 1985. According to Ives, the primary reasons that system was replaced were: lack of speed, lack of state-of-the-art technology and lack of replacement parts. Ives was convinced a VXI system could deliver the speed necessary to achieve a one second refresh rate on test signals, along with providing durability and the temperature tolerance the test equipment would need.

Ives brought in several hardware and software vendors and was introduced to KineticSystems. He recalls, “Originally, a rep chose a software vendor working with a LabVIEW application and was going to integrate a custom solution for me within the LabVIEW environment. However, as things evolved, and I began getting a clearer view of where I wanted to go software-wise, I began looking for alternative vendors and selected GE Fanuc as the primary software vendor. That was a nicer fit for my application. My final solution was KineticSystems hardware and Fanuc’s CIMPPLICITY® software that was modified to work with KineticSystems’ DAQ Director software.

“I kept hearing there were a lot of VXI vendors, but I never really ran into many of them. So we talked seriously to only two VXI vendors, KineticSystems and another one. Besides the fact that the KineticSystems rep was the only rep that really worked with me, the physical design of the KineticSystems modules and their remote terminal ports were also a big plus, even though other suppliers have similar connections. The biggest plus was being able to work with a rep who was able to help me develop a software concept and a hardware concept without having anything written down. Eventually, I took everything in my head and put it on paper, but the rep took lots of notes and we really collaborated on the system.

“I did come out with an RFQ with specifications of what I wanted. In most cases, KineticSystems met the spec.”

VXI Hardware Configuration

“There are a wide variety of types of sensors used in generator testing. All the output of the sensors goes into the KineticSystems’ VXI equipment where all the information is gathered and displayed for the operator or printed out as a result of running the test.

“We have four input nodes and each node has a rack and a large number of termination panels that run up to the cards inside the rack. Two of those nodes are dedicated to taking thermocouple information. The third node is for AC voltages. The fourth node is for DC voltages and for measuring resistance with temperature detectors.

GE Power installed the VXI test system in 2000 with a pre-planned upgrade made in 2001. According to Ives, the KineticSystems VXI line provides a very large channel density per card, per node. That is important because each test often requires 1,000 channels or more. “Since I’m running a semi-static system, my speeds are relatively slow compared to the number of channels.”

The first node in GE Power’s configuration consists of a KineticSystems’ V208 Analog-to-Digital converter (ADC) card which has a number of multiplexers (each with 96 channel) attached to it. For thermocouple inputs, KineticSystems’ V208s are used with up to seven multiplexer cards with a frame rate fast enough to provide data updates about once per second for all the channels on the cards.

Two nodes handle all the thermocouples. A third node acquires all DC signals and all resistance temperature detector signals. Each card in that node has 64 channels with its own ADC and scanner all built into one unit. In fact, every 32 channels has its own ADC.

“I have another node,” says Ives, “that takes a bunch of other inputs, accelerometer inputs and that kind of thing, where I’m running at lower channel counts to get a higher frequency rate. All my AC signal inputs I’m running through an RMS converter made by KineticSystems. It’s an SC30 card. Basically it’s a variable gain and RMS converter and we’ve added front-end filtering to that, so that I can notch filter at 50 or 60 Hz. It takes the AC signal and performs a true RMS conversion on it, to give it a DC signal to the cards that are setup.

There is a lot of versatility built into the system and it can be reconfigured fairly rapidly.

The GE’s VXI system consists of 2,400 channels and includes a wide-range of VXI products from KineticSystems including ADCs, multiplexers, signal conditioning, Slot-0 controllers, a fiber-optic interface, and several other supporting hardware modules and software.

Software Solution

GE’s VXI equipment interfaces with a Dell 750 MHz server that contains the software drivers for the front-end boards. GE uses KineticSystems’ DAQ Director™ software to enter the data. Says Ives, “The software is putting all the data, as fast as it comes in, into Name Share Memory. I have another program that’s pulling the data out of Name Share Memory, performing the engineering conversions and displaying data to the operator. The latter program is GE Fanuc software called CIMPLICITY.

Says Ives, “DAQ Director basically takes and runs the front-end cards and provides an Access database which tells DAQ Director, Fanuc or any other external software you wanted to use, how to convert the data coming in from raw counts, into engineering units. So DAQ Director goes out and brings in the data via a fiber optic FOXI interface card. The drivers from DAQ Director take and put the data into memory. They refer to it as Name Share Memory, but it’s basically specific memory allocations that it then provides reference for the Fanuc software to go in and take the data back out of memory.

“The DAQ Director software runs at a rate in real time determined by whatever type of card it’s talking to. So the data is refreshed at a rate dependent on the number of channels and card you’re talking too. Let’s say that rate exceeds once per second. The CIMPLICITY software is designed to run at a once per second rate. In other words, every point is updated once per second. To some extent, it really doesn’t matter how many points you throw at it, it still runs at that same scan rate.

The software updates itself once per second no matter how often the Name Shared Memory is updated. So, basically, the system data is updated once per second.

Results

“Speed has been a huge benefit of the new system,” reports Ives. “That went far beyond my expectations. I could never describe to my management what to expect. They understood it would be faster and better, but what I couldn’t describe to them, and I tried to, were the improvements and enhancements in cycle times, as a result of having faster information available. We would also be able to store the information on disk, with the idea that we could go paperless if we wanted too, but at this point we’re printing the test results on paper, as well as storing them on computer.

Recommended Products

- **V208:** 16-bit, 100,000 Sample/sec ADC Subsystem
- **V195:** 13-Slot C-Size Mainframes with 1 KW Power Supply
- **V213:** 32/64-channel, 16-bit ADC with DAC & TTL Options
- **V241:** 24 to 96-channel, High-level Multiplexer
- **V243:** 96-channel, Low-level Signal Conditioner
- **V710:** 16-slot Signal Conditioning Termination Panel
- **V765:** 32-channel Termination Panel
- **V792:** Rack-mount, Isothermal Termination Panel
- **V120:** FOXI™ VXI Slot-0 Controller
- **V122:** FOXI™ PCI Host Adapter
- **AC10:** DAQ Director™ Software for Windows NT

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“Other advantages have been the ease of using the software and I’ve had really fantastic customer service from KineticSystems. They developed the SC30 card based on my needs and they modified it based on my needs and requirements. I found a problem with the system and they were very responsive in trying to find the problem and they solved it. They’ve been incredibly supportive.

“I’ve had almost no trouble with the cards,” says Ives. “I’ve had one card failure since I’ve owned the system two years now and they fixed it promptly and sent it back to me.

“KineticSystems has been great.”

Web sites of companies mentioned in article:

General Electric: www.ge.com

KineticSystems: www.kscorp.com

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