

Industry: Design Validation  
 Products Used: LabVIEW™ 6i • PCI • SCXI™

# Automating Downhole Instrument Testing Using LabVIEW and PCI

by Stephen Corkran, Senior Systems Integrator/Project Manager, Quantum Controls, Inc., USA

**The Challenge:** Replacing a manual testing system used for validating instruments designed for oil wells with an automated testing system that networks seven pressure testing chambers, monitors chamber data, reports alarm conditions, and executes preprogrammed commands with an easy-to-use control system.

**The Solution:** Using National Instruments LabVIEW 6i, we networked seven pressure chambers and routed the chamber process variables into a National Instruments SCXI signal conditioning system, allowing the operator to monitor the information in the control room.

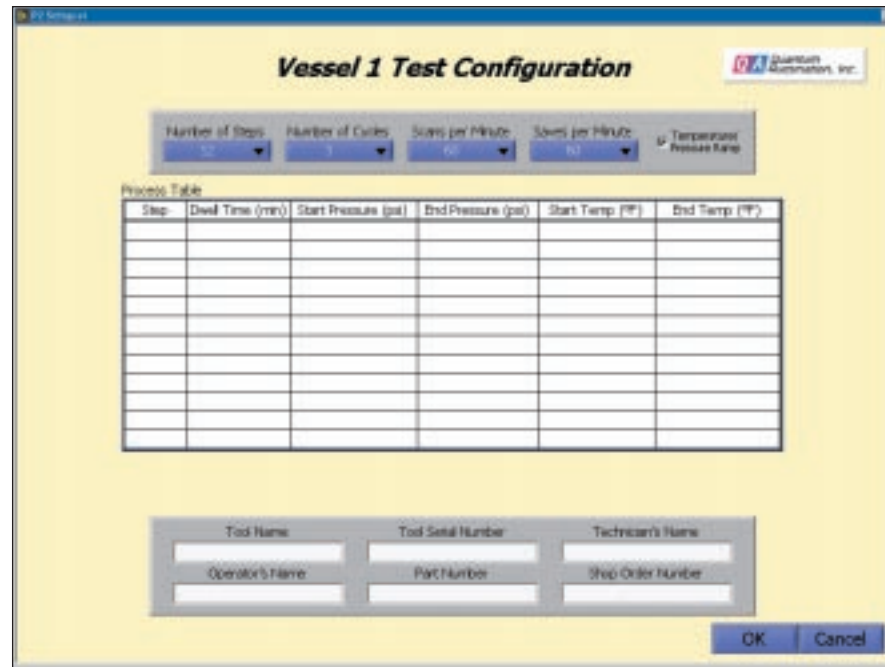
## PC Clarifies Operator Control

Manually controlling and monitoring seven pressure chambers simultaneously can be an overwhelming task for several operators. Now, one operator can monitor and control the measurement and automation system for seven pressure chambers.

**The new system can generate reports off of any completed test, even while other tests are running. This provides us the ability to customize as many reports desired.**

Quantum Controls, Inc., used National Instruments LabVIEW to monitor and control seven pressure vessels from one PC. An operator can view detailed sensor data from each chamber using the tab control in the main test operations user interface. Using a modal subsection of the screen, the system displays alarm conditions for any of the chambers under test. Regardless of which chamber detail is visible, we can immediately identify the tolerance conditions with this modal display.

We connected the individual sensor signals and control points to the PC through



Main Test Operations User Interface

a single National Instruments SCXI chassis. The SCXI multiplexes, isolates, and filters the data before sending it to the National Instruments PCI-6035 data acquisition board. Control signals are sent via relay outputs.

Signals include pressure, temperature, pump control, and valve control.

## Recipes Speed Product Testing

With the previous system, operators manually

entered setpoints and monitored the system continuously. Using the recipe configuration integrated into the new test system, operators now can fully specify a test scenario. The recipe configuration allows for scenario repetition, allowing a single scenario to run repeatedly without operator intervention.

Once the system configures a recipe, the PC will load, run, and monitor the test. The system can configure additional recipes while tests run in other chambers. The PC-based LabVIEW user interface allows intuitive navigation between different chamber tab control pages. This navigation

allows the operator to multitask, and enables more scenarios to run each hour. A tab control page displays numerical status data for all seven chambers simultaneously.

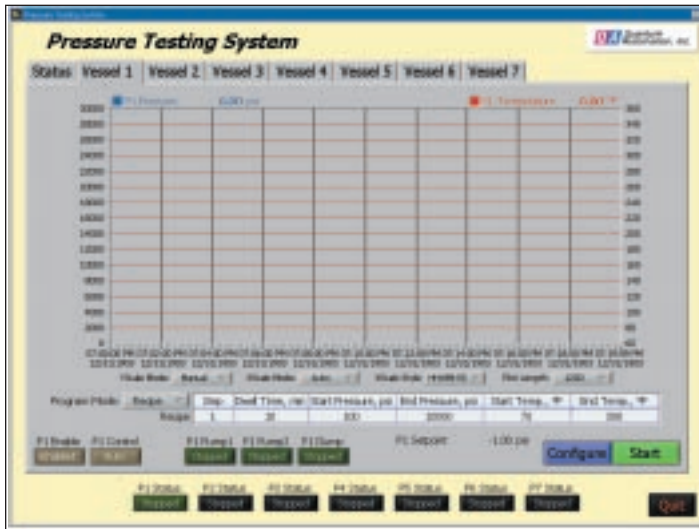
The new automated control allows operators to configure recipes to run during off hours and weekends. We plan to add additional capability, allowing for remote monitoring of tests via the Internet. We estimate an increase of more than 300 percent in testing capability, significantly reducing cost of personnel.

Though the previous system could generate multiple reports at a time, we had to rerun the test in its entirety if the report was unacceptable or required an alteration. The new test system stores data electronically, and can generate reports off of any completed test, even while other tests run. This provides us the ability to customize as many reports as necessary.

## Modular Code Speeds Development

Because the system monitors and controls seven chambers that are very similar, we needed a test architecture that allows modular

## Customer Solutions



Recipe Configuration User Interface

code reuse. We utilized two primary architectural decisions to enable the scalability from one to seven chambers with the ability to add more in the future.

The first architectural decision involves separation of the user interface from the remainder of the code. This independence allows additional chambers to quickly integrate into the system. We utilized a

### **With the new PC based LabVIEW system, one operator can run seven tests simultaneously.**

tab control to regulate the user interface. Hence, we added new chamber interfaces by creating a tab for the new chamber and adding a corresponding case in the user interface case structure. Each user interface tab initializes and maintains a circular buffer in memory, which opulates a front panel graph. The circular buffer is a fixed size,

which is usually measured in seconds of data. For example, a buffer size of 36,000 handles ten hours of data at a one second scan rate before overwriting begins. The plot length on the graph is an integer divisor of the circular buffer size. Dividing the circular buffer size by the plot length provides the number of pages in the buffer. The default plot shows two pages of data.

Once the data fills the first two pages, the plot shifts by one page. Hence, one half of the plot updates new data while the other half displays data. Since plot length is selectable, the number of pages viewed at one time can change without affecting the buffer. Other viewing options include auto range, which shows the current data and manual range, which scans through historical data.

The second architectural decision employs data acquisition (DAQ) server technology. The DAQ server handles all of the monitoring and control. The system calls

it by reference, enabling expansion of the data acquisition and control portion of the application without amending the main virtual instrument (VI) diagram. We can add additional chamber inputs and outputs (I/O) simply by expanding the DAQ server. In addition, we can run the data acquisition server in a standalone state. This allows for

simple calibration, engineering units scaling, signal testing, and verification.

Once we completed the architecture, we developed and tested the first chamber's code. With the first chamber operation verified, we could rapidly implement the other chambers by expanding the DAQ server and creating additional user interface tabs.

### **Conclusion**

On the old test system, we could not perform unsupervised tests, and could only generate a report in a predetermined form. In addition, we could only manually control one system at a time.

With the new PC-based LabVIEW system, one operator can run seven tests simultaneously. We can now generate custom reports while tests run. Late night and weekend tests no longer require an operator to be present to supervise the system. ■

*For more information, contact  
Stephen Corkran, Systems Integrator,  
Quantum Controls, Inc.,  
2500 Wilcrest, Suite 630,  
Houston, TX 77042  
Tel: 713-355-3900  
Fax: 713-339-1199  
E-Mail: corkran@QAutomation.com*



[ni.com/success](http://ni.com/success)

(512) 683-0100 • Fax (512) 683-9300 • [info@ni.com](mailto:info@ni.com)

For worldwide contact information, please visit [ni.com/niglobal](http://ni.com/niglobal)