

Lawrence Youngblood, Vice President of Corporate Development

Replacing Obsolete Turbomachinery Control Black Boxes

“Black boxes,” when talking about industrial compressors, refer to compressor controls that are mounted in separate panels (often containing customized instrumentation) inside a plant’s control center. Historically, they were considered to be the best available technology for maintaining consistent turbomachinery control. Figure 1 illustrates how many black boxes are installed in plants, while Figure 2 illustrates a basic system architecture.

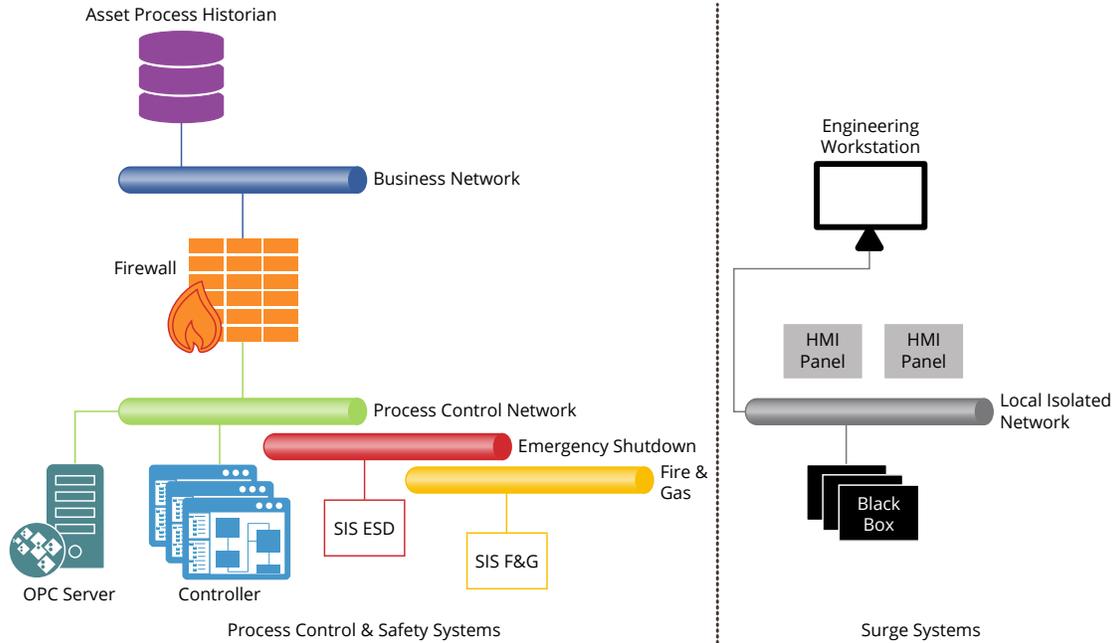


Figure 1. Typical black box installation

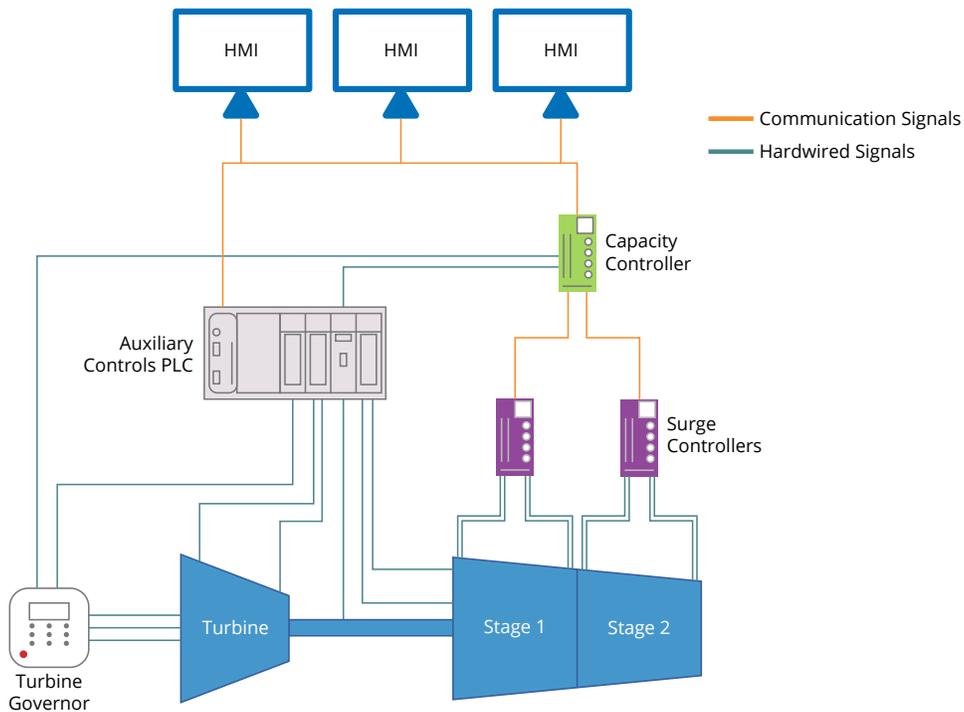


Figure 2. Typical turbine and compressor system architecture and connections

Based on Figures 1 and Figure 2, it is clear to see that the surge system with the black box is siloed, meaning that it does not communicate with the rest of the systems and data are not easily accessible.

Challenges of Siloed Black Boxes

Companies with siloed applications have several overall challenges:

1. Wasted employee productivity
2. Integration complexity and cost
3. Lack of real-time visibility

Wasted Employee Productivity

Black boxes are developed on the OEM proprietary platform and are also highly specialized/customized, meaning that (a) black boxes are incompatible with each other and with the process control and safety systems and (b) employees require special training to maintain the system. Another source of wasted productivity is the limited operator interface, which makes it more difficult for maintenance technicians to determine the cause of a fault. Limited information from error codes means it takes longer for employees to troubleshoot problems, wasting time and productivity.

Information Technology (IT) also experiences wasted productivity due to the time required to integrate and maintain a black box as well as acquiring new versions of the software and integrating and maintaining those new versions. At the same time, IT is responsible for maintaining and updating the process control and safety systems, which are on a different platform.

Integration Complexity and Cost

As mentioned as part of the wasted employee productivity challenge, black boxes are difficult to integrate and maintain. They are also more expensive to maintain because they are built on the OEM's proprietary platform, which means that expensive spare parts are required as well as the extra training costs for employees. Customers may also need to renew expensive annual licenses and service contracts with the OEM to provide support for this one system.

Lack of Real-Time Visibility

As illustrated in Figure 1, black box data are not available at the business network level, preventing operations from seeing the entire operation and being able to easily analyze key data. Siloed data from the black boxes may be viewed at the local engineering workstation; however, this information only provides a fragmented view of the compressor surge system and does not address how the entire system is functioning together.

Solving Your Challenges

An integrated platform is the solution to black box challenges. Figure 3 shows one architectural approach for integrated control.

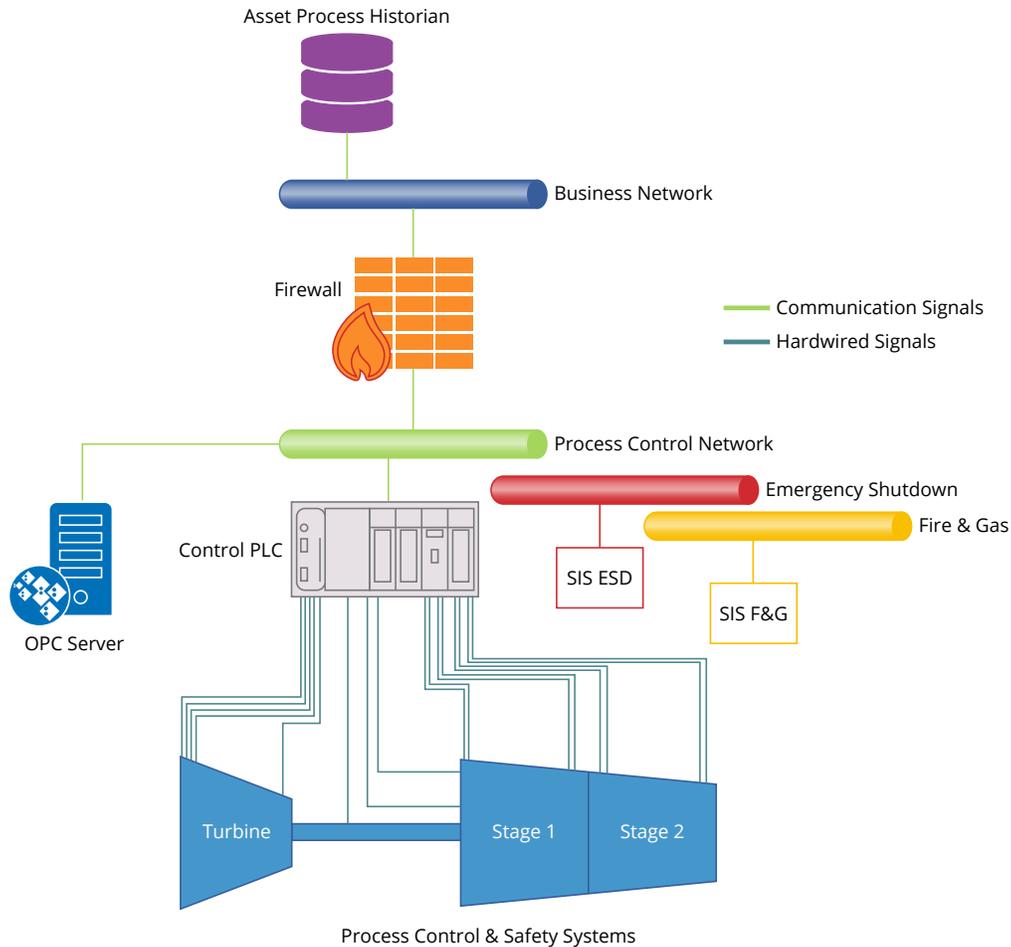


Figure 3. Integrated control

S&C provides *OptiRamp* and conventional turbomachinery control integrated solutions on a single hardware and software platform. One such example is the Honeywell Experion® PKS platform with C300 controllers.

Figure 4 illustrates the advantages of using a unified control platform for all systems versus a siloed black box.

- Integrate with the process control system (PCS), which is monitored 24/7 by board operators
 - Make key data points available for analysis and not locked away in the black box in the OEM data model
 - Have technical staff available to support, troubleshoot, and optimize various control strategies, depending upon operational conditions
 - No extra spare parts are required because they are included with the existing C300 spare part supply
 - No special licenses are required
- Closed system
 - Not supported
 - Responsible for large rotating equipment and plant production
 - Not visible to the operator—it is a black box, but it is an important black box
 - No visible optimization or “knowledge” of how the system is functioning without expert advice from the OEM

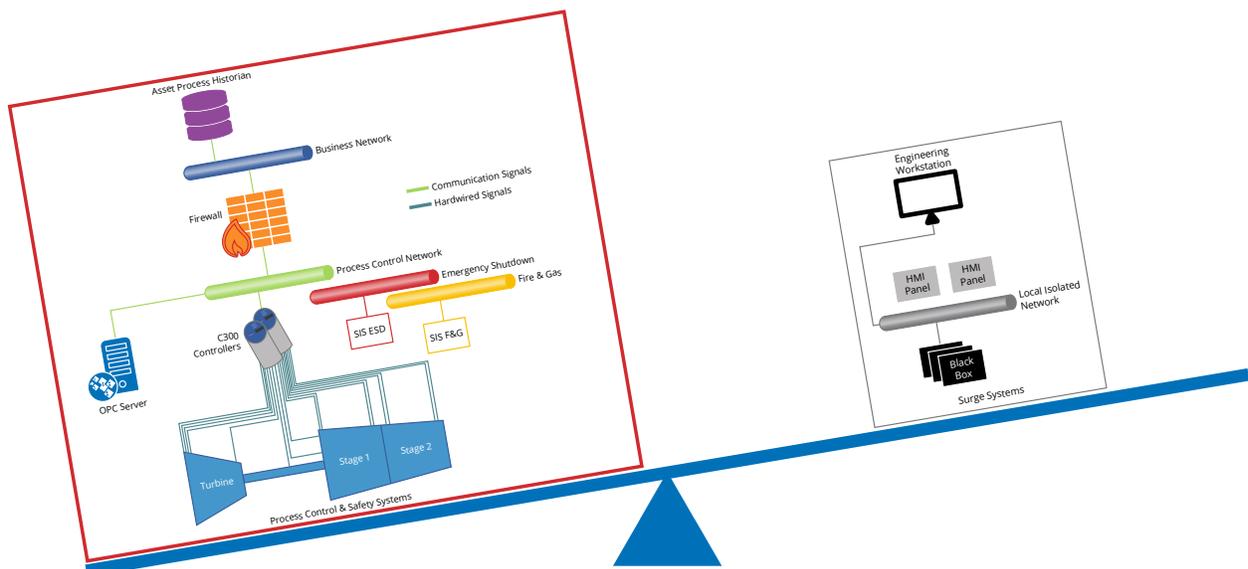


Figure 4. Advantages of a unified control platform

An integrated, unified control platform helps solve the challenges presented by a siloed black box; specifically:

- Increase process efficiency across your organization
- Provide significant cost savings
- Dramatically improve visibility
- Provide scalability
- Allow for user-driven innovation

Organizational Process Efficiency

S&C's turbomachinery solutions are configured using the same set of tools as the existing process control system (PCS), meaning that system engineering is simplified and integration/installation is consistent with other systems. Additionally, the Honeywell platform integrates multiple tasks within the single platform, which simplifies hardware connections and communication. With IT no longer needing to procure, install, and maintain multiple platforms as well as the various integrations between them, IT is able to spend more time improving the business operations.

Another source of improved organizational process efficiency is that employees only require training for a single platform that is used for all process control and safety systems. Knowledge becomes more universal, and tribal knowledge about and special training for a separate system is no longer needed.

Maintenance technicians are also able to access more data about issues, reducing troubleshooting time. S&C provides another tool to help analyze and troubleshoot critical event: the *OptiRamp* Critical Archive (ORCA). ORCA is a critical archive that enhances the Honeywell DCS and enables fast archiving for a key data before and after a control event (a critical event). We provide a resolution in milliseconds versus the 1-second archiving engine of Honeywell itself. ORCA's storage and parsing capacity allows this dynamic feature to store greater quantities of critical event data and to analyze what specific parameter caused the shutdown as well as how other parameters reacted to the change. Figure 5 illustrates ORCA's architecture.

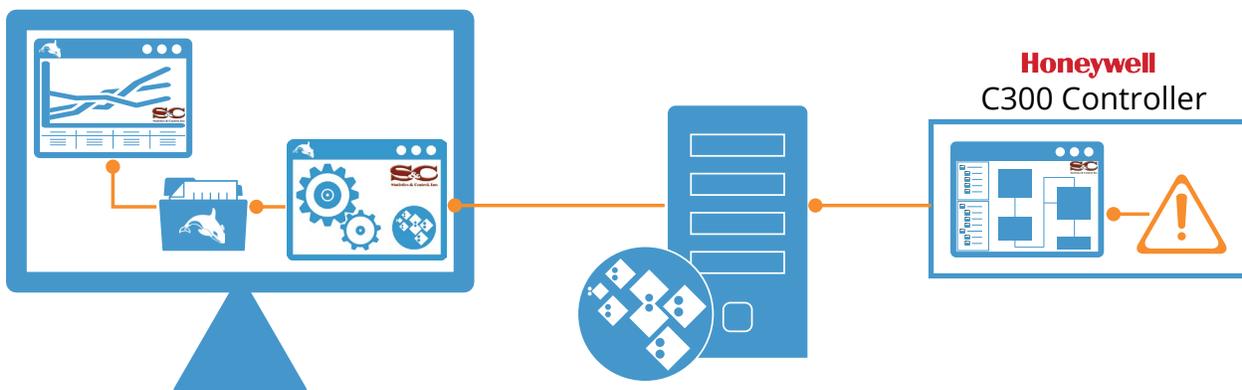
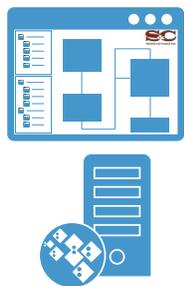


Figure 5. ORCA architecture

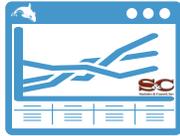


Critical Archive Control Module: Resides on Honeywell's C300 controller; continuously collects analog data using a Critical Archive Custom Algorithm Block (CAB) with predefined frequency. A Redundancy Algorithm CAB is also available for redundant ORCA configuration.

Build-In OPC Client: Used for communication between the Critical Archive Control Module and ORCA Runtime



ORCA Runtime: Monitors built-in OPC client and creates CSV files in a designated folder to store critical archive data



ORCA Viewer: Decrypts and presents CSV file data in a usable form (trends and data tables)

Benefits of ORCA include the following:

- Embedded application (Critical Archive Control Module) residing on Honeywell's C300 controller
- Continuously collect analog data using a Critical Archive Custom Algorithm Block (CAB) with a predefined frequency
- Easy to configure
- No operating system, patches, etc.
- Designed to provide valuable insight into high-speed process conditions and events

Figures 6 through 8 show examples of analyzing ORCA critical event data in the ORCA Viewer, which decrypts the critical archive data and presents it in usable forms (data tables and trends).

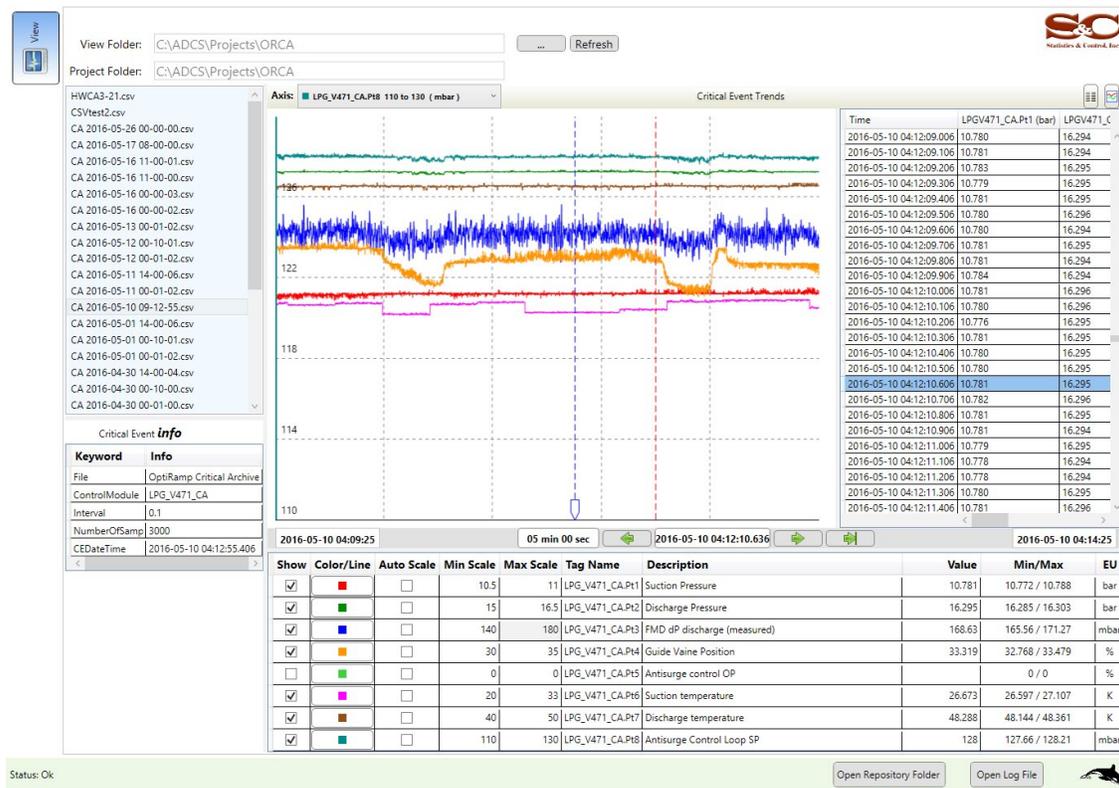


Figure 6. ORCA trend and data table

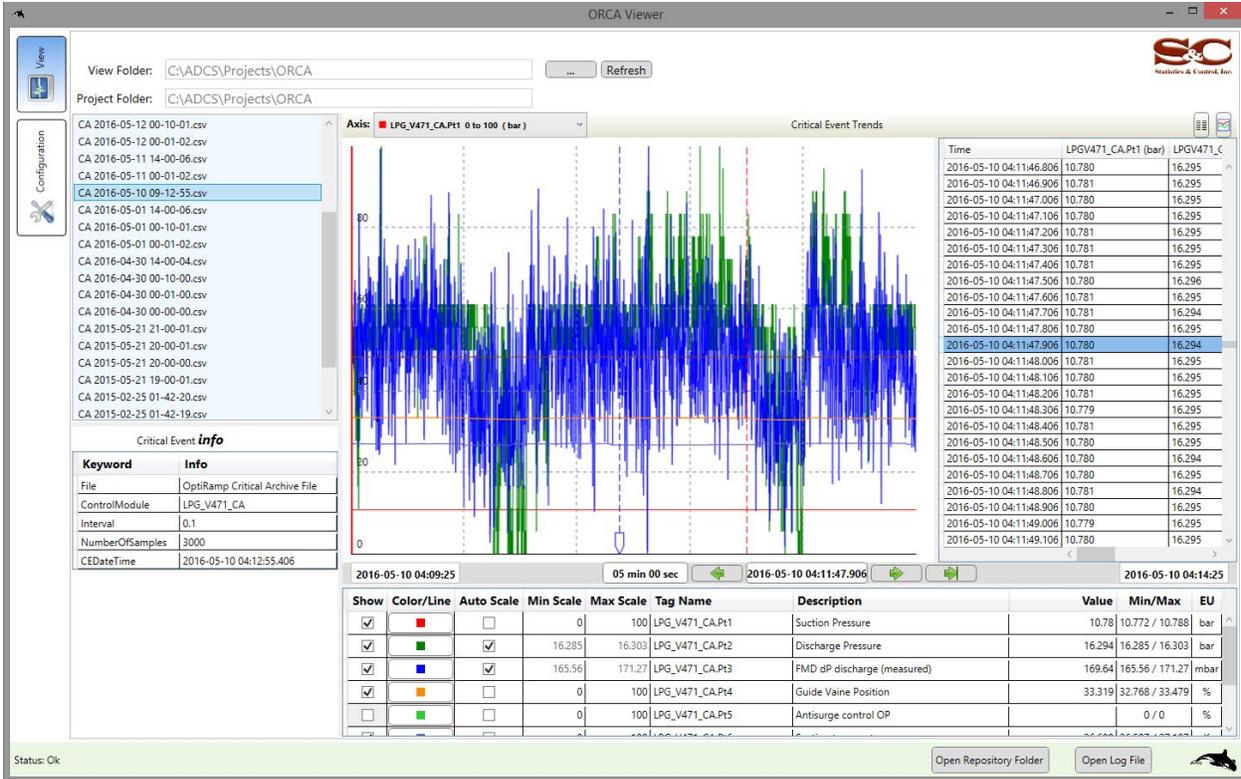


Figure 7. Zoomed in view of data set

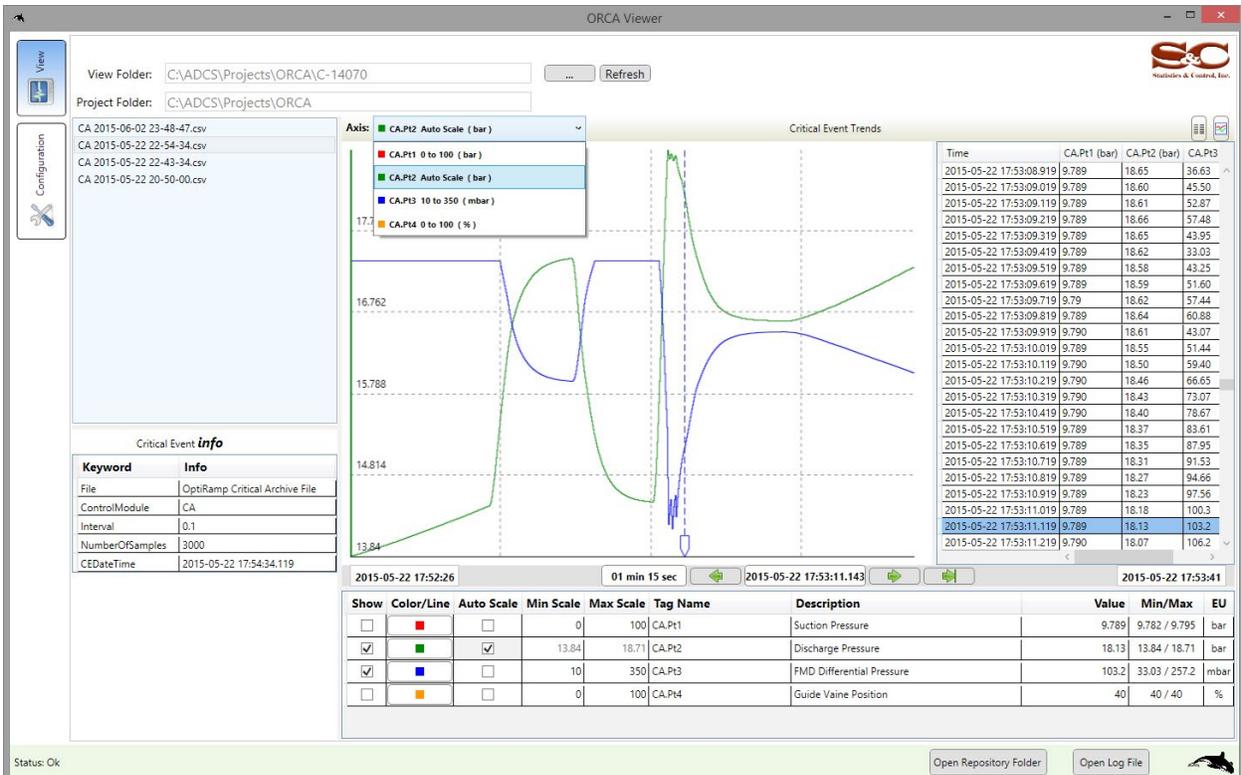


Figure 8. Analyzing a critical event

Significant Cost Savings

Using a unified control platform provides cost savings in a number of areas, including

- Increased employee productivity
- Less employee training required to maintain the system
- Reduced installation costs
- OEM special license and separate annual service contract no longer needed
- Reduced maintenance costs due to (a) using a single platform and (b) being able to troubleshoot and address problems quicker
- Reduced costs in terms of spare parts because they are included in the existing C300 spares

Dramatically Improve Visibility

As illustrated in Figure 3, a unified control platform integrates the turbomachinery control into the process control network, which makes the data easily accessible at all levels and in real time. These data may be easily analyzed, and operations can see how the entire operation is functioning instead of seeing a fragmented view. When all real-time information is easily accessible, resources are not wasted in extracting data and trying to piece it together into a cohesive view. Additionally, employees are better informed and are able to make better and faster decisions.

Provide Scalability

Black boxes are limited in their functions and in the number of I/Os they can handle. If process changes occur requiring additional functionality, additional black boxes would need to be added. The control platform can be appropriately sized for specific applications, allowing process changes to be scaled appropriately. This scalability also allows for user-driven innovation

User-Driven Innovation

Because S&C's turbomachinery control solutions are consistent with the PCS, users can quickly implement process changes. The S&C tools are also easy to use and allow customers to make process changes themselves without needing S&C to be retained on an expensive contract. Training time for these changes is also reduced.

Conclusion

S&C provides a complete package for conventional turbomachinery control solutions and OptiRamp solutions, including ORCA, that is integrated into a unified control platform. With the functionality capabilities of the control platform, black boxes are quickly becoming a thing of the past. Advantages of using our solution include increasing organizational process efficiency, significant cost savings, dramatically improving visibility throughout the organization, providing scalability, and allows for user-driven innovation.



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4401 Westown Parkway, Suite 124 | West Des Moines, IA 50266 USA | 1.515.267.8700 | www.stctrl.com