DCS Conversions to Wonderware FactorySuite®

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ARCHITECTURE AND BENEFITS OF A CONVERSION

Introduction

This paper describes the benefits of off-the-shelf HMI software for DCS console replacement. Typically, DCS systems older than five years can greatly benefit from such an upgrade by significant savings in:

- Total cost
- System integration
- Point checkout

Once installed, the resulting system will be familiar to the operator, thereby reducing the risk associated with a completely new operator console. In the latter half of the paper, we will be specifically focusing on the use of conversion utilities to convert Bailey® DCS consoles to InTouch, but similar gains can be achieved with other DCS systems.

By converting to an HMI system, users will:

- Minimize plant downtime throughout the conversion process
- Preserve their existing investment in control equipment and wiring
- Benefit from the application of newer technology

By converting the operator console stations to InTouch, the user preserves the operations knowledge already developed, thereby reducing the risk of loss of plant operations during the conversion process. Once the conversion is complete, the control system can benefit from new functionality and expand to integrate with other plant systems such as asset management and historians. It will now be able to provide information from the sensor to the boardroom. The user will now have easy access to information which can be of benefit to the entire operation—information that had previously been trapped at the control level.

Since many of the DCS I/O servers have been available since the mid-nineties, several DCS systems have incorporated HMI software as a core component. Various DCS I/O servers, such as Honeywell, Foxboro, Moore, Provox, and Yokogawa, have been available for some time; in the case of Bailey, more than 100 systems have converted to InTouch with the Bailey DCS.

DCS Systems Composed Primarily of Proprietary Components

DCS systems have been composed of proprietary components and delivered as proprietary systems, with support and components only available from a single manufacturer. While purporting to provide lowered risk and a single point of responsibility, this approach locked the user into a single vendor.

Other systems, such as control systems from PLC vendors, power system suppliers, or drive systems, are difficult to integrate or the cost to develop proprietary interfaces can be exorbitant. A single vendor has substantial difficulty just trying to stay current with the huge number of independent control vendors who introduce new products spurred on by the improvements within the computer field.

Interfaces to information systems, such as historians and management information reporting systems, have been constrained by the changes in technology, standards, and the differing requirements that information and reporting systems dictate compared to control system information output. Older DCS technology met none of the newer information technology standards, limiting the openness and connectivity to other data users within the plant.

Enhancing ROI of an Older DCS System

Expanding its connectivity and integration with the rest of an operation can extend the ROI of an older DCS system. By its nature, a DCS is good at regulatory control and while there can always be improvements, the DCS, upon installation, was a major improvement over traditional control systems prior to the DCS. It probably still provides good regulatory control, given the huge costs of changing a complete DCS system out, and the probable benefits from improvements within the DCS manufacturers' control system domain. When converted, there are several areas where major new improvements will be available:

a. Information

Management needs good information about its operations to enact the changes that can help an operation achieve the improvements that assist the plant in:

- Reducing operating costs
- Operating more effectively
- Improving throughput
- Eliminating the need for significant capital expenditures to meet temporary or increased customers needs.

Historians permit relational queries of time-series data.

Expert systems might assist operations in understanding the effect of changes or upsets, discovering and suggesting the key setpoint changes for maximum throughput and minimal impact on the entire plant. Operations might work better with maintenance if operations could get involved with the maintenance system in a total productive maintenance philosophy. Maintenance and asset management systems might benefit from real-time information about plant operations, delaying unnecessary maintenance or triggering maintenance prior to potential failures. Or simply, management might have more insight into the costs, constraints and ramifications of the operations of several production lines.

ROI on information is difficult to calculate since it is the application of the information that contains the ROI. But just think what an operations team, maintenance team, operations manager or plant manager could do if they could query data from several systems.

b. Replacing obsolete systems

In some cases, obsolete equipment, such as older operator consoles, are completely out of date and often parts are no longer available. Moving to newer PC technology with appropriate redundancy strategies brings the replacement costs down by a factor of 10 for new components available on the market. In some cases, obsolete monitors costing $5000 can be had for under $800, while complete consoles costing $30,000 can be under $5000 for PC-based technology. Interfaces to third party PLC vendors or drives might be under $1000 versus $5000 or as much as $40,000 for an interface to a DCS to a PLC.

Commercial technology provides technology upgrades paths that are quite reasonably priced, with many sources, reducing the total cost of ownership.

c. Gateway restrictions to data in third party equipment

Money, of course, doesn't tell the whole story. Effectiveness plays a much larger part. In fact, the DCS may only need to exchange a handful of status points with the PLC or drive system but needs back a wealth of diagnostic information for the operator. Since the DCS is the gateway for the operator DCS console, the PLC gateway or interface may be a large bottleneck for extracting this diagnostic information and may prove such a burden that the diagnostic information is simply not made available to operations or maintenance, limiting a company's ability to take advantage of the equipment it has.

In many cases, the HMI is capable of pulling hundreds and thousands of status points easily from many different control systems at the same time, eliminating the need to bring these third party status points through the DCS. Operations and maintenance now have access to information that was previously expensive or inaccessible.

In most cases, the DCS vendor may not actually have the interface available or may not be able to keep up with the versions and variety of third-party interfaces that a user desperately needs. An HMI software company that regularly supports 50 vendors provides toolkits to independent third parties, building and maintaining third party hardware and software protocol support for hundreds of vendors.

d. Open systems and best of breed

The competitive marketplace develops systems that previously didn't exist and it combines new technologies in ways that were unheard of just a few years ago. Best of breed supports the concept that no one vendor can be all things to all users. The best of the best improves overall performance and users are receiving OEM solutions or integrating disparate systems within a plant. Information from control systems, asset management, quality and lab systems, historians, and tracking systems, all could be organized to measure performance, compare operating characteristics over time, or restructure operations. Only open systems can deliver information from different sources without compromising the underlying selections.

e. A Distributed Open Systems Architecture:

Using the architecture first developed by Kevin Totherow of InSource (refer to his paper "Viagra for the DCS" at www.insourcess.com), the DCS installation can be significantly improved by using a distributed open systems architecture that assists in meeting the different needs of the control system, operations and the plant management information system.

Each layer of the plant has its own requirements. Rogue users, computers or information systems that don't understand the impact of their actions cannot disturb the control system. Control systems are transferring very small amounts of data very fast; turning on a large 1000 HP drive, for instance, is a single bit of information but delaying that information while sending an email to 200 users with many large attachments could halt the production line or seriously compromise quality and/or production. Operations wants access to information from many different systems without necessarily passing the data thru the DCS gateway. Management may want to bring data from:

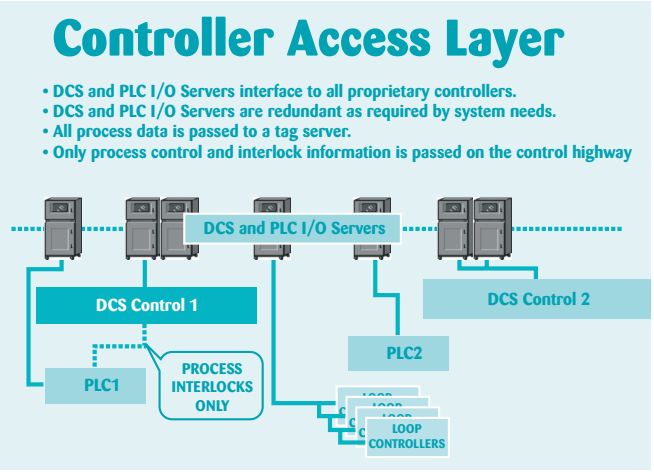
- The control system
- Drives control system
- PLC systems
- Quality and lab system
- Tracking systems
- Historians
- Other plant systems

Each of the following layers addresses the needs of these different users within a plant and exposes the data in a secure manner.

f. Controller Access Layer – a firewall for the control system[1]

The control system needs to respond to the data requirement needs of the supervising systems in a timely fashion. Operational staff need to understand what is occurring in production, require that alarms provide timely notification to be able to take actions, and many points need to be tracked to be able to understand and review plant operations.

At this level, the Controller Access Layer or I/O server layer, the interface to the control system (in this case, a Bailey® I/O Server), writes commands and polls the controller for data changes. An I/O server is a specific software interface that handles all communication to the control system and serves data to its clients, such as an HMI or historian. At no time is this data exposed to any other data, such as email, since the control data needs to be acquired as quickly as possible and serviced over a 19.2Kb link via a Bailey® CIU. It should be noted that the SemAPI high-speed interface is also supported by the Bailey® I/O server; however, most existing facilities will employ the original interfaces unless performance dictates changes. No performance limitations or degradations have been experienced using the Bailey® I/O Server on a PC versus a standard console/CIU installation.



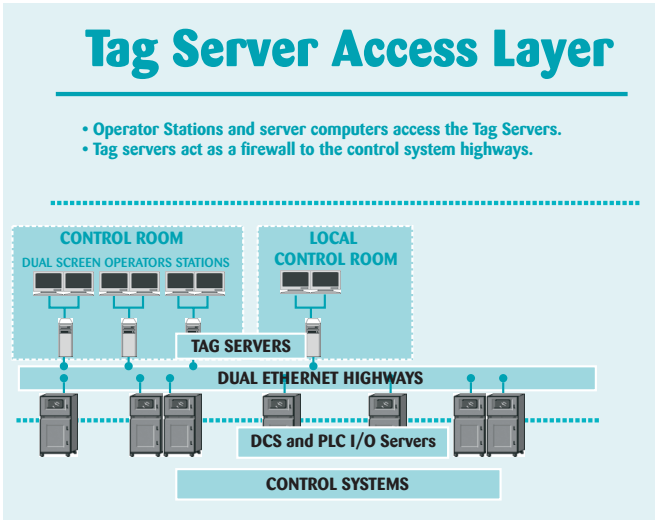
Best practices would suggest a dedicated, redundant pair of Bailey I/O servers to act as the firewall to the next levels and permit on-line upgrades or repairs. Even triple redundancy is possible, although overkill. The system is not limited to a single pair of communication servers and it can support multiple pairs linked to logical areas of the plant, supporting stand-alone areas such as power generation or separate production lines.

The Controller Access I/O layer may also include I/O servers for other control equipment, supporting Ethernet, RS232, wireless or proprietary interfaces and networks. The low cost of additional I/O server computers may help to segregate other equipment or functional plant areas.

g. Tag Server Access Layer

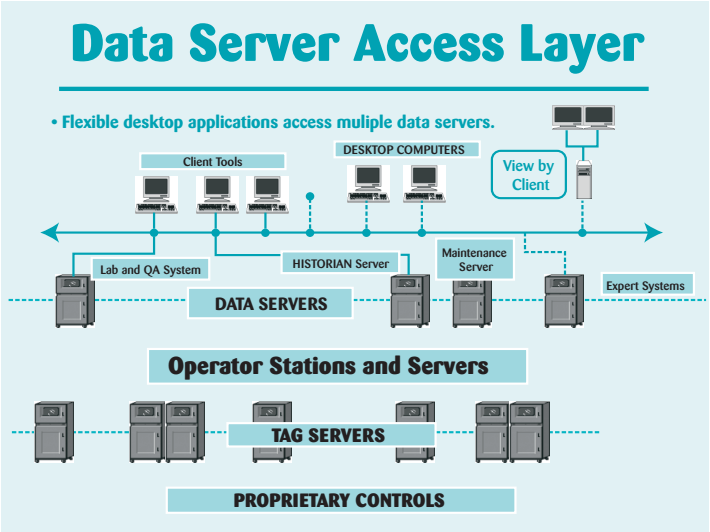
The Tag Access Layer and server (or redundant tag access server) communicates to the I/O servers and gathers all the tag data. It also provides the front-end processing for graphics that display information to other operator consoles. Other operator consoles remotely reference these Tag Access Servers in a client/server arrangement; they will not access the Bailey I/O servers directly, thereby reducing the load. Communication is via high-speed Ethernet using standard, commercially available hardware and NT networking, network management and security tools.

It is at this level that the Total Cost of Ownership turns the corner. Commonly used hardware is now employed as operator consoles and access to control system data is via standard commercial database and networking mechanisms.



(1) For more information, please refer to the following paper: Kevin Totherow, "Viagra for the DCS", InSourcre Software Solutions. www.insources.com

h. Data Server Access Layer



Other systems, such as historians, expert systems, asset management, and management systems can now have easy, painless, low cost, secure data access without duplicating data retrieval from the control system.

Information from the control system can be shared with the other stakeholders within the plant. Frequently, operators have great access to valuable information that is not pertinent to their performance.

Asset management systems could benefit from historical operational hours of equipment to perform lean just-in-time maintenance and to plan preventative maintenance prior to failure. Condition-based asset monitoring has a special meaning when the control system and asset management can exchange information easily.

Historians can benefit an operation by having identical data in front of the operator and in a historical format for long-term analysis. Historians are preferable over simple trending engines since historian databases permit relationship analysis of the underlying control data to discover unacknowledged facts about plant operations.

Expert systems allow on-line improvements in control system actions and advanced alarm notification, monitored by operations personnel.

Quality and lab systems can get real-time data so that corrective actions can be taken before the end of a production run or analysis can be correlated to historical data.

Total Cost of Ownership of a distributed open systems architecture begins to take a completely different meaning.

Immediate Advantages:

The conversion has several advantages:

- Lower cost of console replacement compared to a DCS system.
- Conversion provides lower risk since the utilities convert the existing application, leaving the same application that the operation staff already knows. Further, systems can be applied in parallel with existing consoles, building operational confidence and permitting training.
- Engineering, and system checkout significantly reduced.
- Use of fragile, deterministic DCS networks minimized.
- Minimum retraining for operations staff.
- Predictable system for operations staff to continue meeting production goals with little conventional swing-over or risk.

Strategic Advantages:

The long-term strategic advantages include:

- Process data becomes available to the entire organization.
- DCS points from non-PLC control data can be recovered.
- Extends the life of the control system.
- Incremental projects can be phased in.

What are Other Users and Industries Doing?

Other DCS users of HMI consoles include water & wastewater treatment plants, power plants, gas plants, pulp & paper plants and large mining operations.

Now that we have laid the foundation for the architecture and benefits of a conversion, let's see it in action. The following mining application delivers the details of an actual conversion of 30 nodes of a large Bailey® control system.

Case Study

Authored by Ready Engineering Corporation
www.readyengineering.com

Mining Application Replaces 30 DCS Consoles

A large InTouch application replacing 30 DCS consoles was implemented at Hudson Bay Mining and Smelting Company (HBM&S) located in Flin Flon, Manitoba, Canada. The application is not intended to win merit on outstanding process graphics, as they are designed to reflect the old Bailey® PCV (Process Control View) graphics, which are quite simple. The design and implementation of the system integration, connectivity, and overall solution, however, is quite unique. DCS users are generally skeptical about using third-party operator interface products on their control system and Bailey® users are certainly no exception. This paper shows what is required to gain the confidence of this discerning group of users.

Wonderware InTouch is now the ideal solution for graphical interfaces on Bailey® distributed control systems. In a combined effort, HBM&S and Ready Engineering Corporation located in Spruce Grove, Alberta, Canada deployed the latest version of InTouch (7.1) with the Standard Automation and Control Bailey® DCS I/O Server to give Bailey® DCS user HBM&S leading-edge HMI technology that runs on industry standard computers, operating systems, and networks.

1. Serious Maintainability Problems

HBM&S solved serious maintainability problems through the DCS console replacement project. The Bailey® operator consoles and the version of the QNX operating system required by PCV (Process Control View) were obsolete. As a result of this operating system constraint, supported hardware was limited to obsolete components that were unobtainable. In particular, the motherboards and processors, and video and network cards required for the system were simply no longer available. Further, choices for data storage and archiving were limited to IDE drives and the sharing of process and business information could be accomplished only through Bailey® classConnect/DDE.

2. Upgrade to Wonderware InTouch

Upgrading to Wonderware InTouch allowed HBM&S their choice of state of the art, off-the-shelf computers and peripherals that run on the industry standard Windows NT or Windows 2000 operating system. This improved the response or speed of the running applications and was commented on from all plant personnel. Wonderware's scripting abilities give them power and flexibility in their operator consoles that were previously unfathomable. The InTouch application has the added benefit of interfacing easily with all plant control systems and management software. For example, the Mill application not only provides plant data from the Bailey® DCS but eliminates the Bailey® Harmony driver, which was used to communicate with the GE PLCs on site. The application will also benefit from ActiveX trend components of InSQL and ActiveFactory for enhanced trending capabilities. This will provide all levels of operations, maintenance, and management with pertinent, timely process and business data.

3. Graphic and Database Conversion Utilities

The application design and replacement of the Bailey® DCS operator consoles at HBM&S was done using sophisticated graphic and database conversion utilities, which significantly reduced the cost and timeline of a console upgrade program. A graphic converter, a database converter, and an alarmspecsync converter were used as follows:

a. The graphic converter translates tags, animation links, static data, popups, symbols, alarm groups and keystrokes.

b. The database converter translates the Bailey® tag database into InTouch or InSQL useable format

c. The alarmspecsync converter generates the scripting to continuously update the application with the configurable alarm specifications in the Bailey® control blocks.

4. Reduction of 80% of Engineering Cost and Time

The client was comfortable in saying that they felt the utilities provided a reduction of engineering cost and time of at least 80%.

5. Customized Conversion Utilities and Templates.

These conversion utilities were customized for HBM&S to meet their specific needs. In this case, the conversion utilities and InTouch scripting were customized to allow their mixed facility of Bailey® PCV 4.3 and PCV 5.2 operator consoles to be standardized to better-than-PCV 5.2 functionality. This resulted in features such as key-stroke support, mouse functionality, pinable popups, graphic scanning, alarm inhibits, block details and tuning, system and module status, and enhanced navigation and security on all the new InTouch nodes, regardless of whether they were previously PCV 4.3 or PCV 5.2.

6. Conversion from Bailey® Wintools to InTouch.

Figure 1 is a typical Bailey® graphic as shown in the Bailey® WinTools graphical editor. The conversion to InTouch produces a graphic that appears identical to the original, as shown in Figure 2 on the following page. This allowed the upgraded operator consoles to be introduced into the plant with little or no impact on the operating personnel. Shortly after the InTouch application was installed in the Mill, the operator was asked to start up a section of the Mill and he did so with no prior training on the new system. When replacing a console, the comment often heard from plant personnel who used PCV 5.2 was, "it looks just like the old Bailey® system."

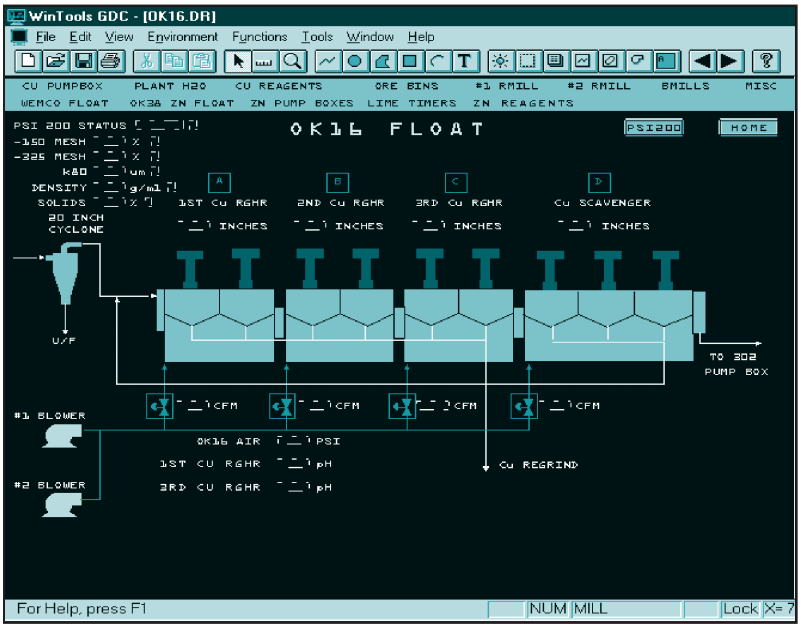


Figure 1: Bailey® Graphic from Mill Application in Bailey® WinTools Graphical Editor.

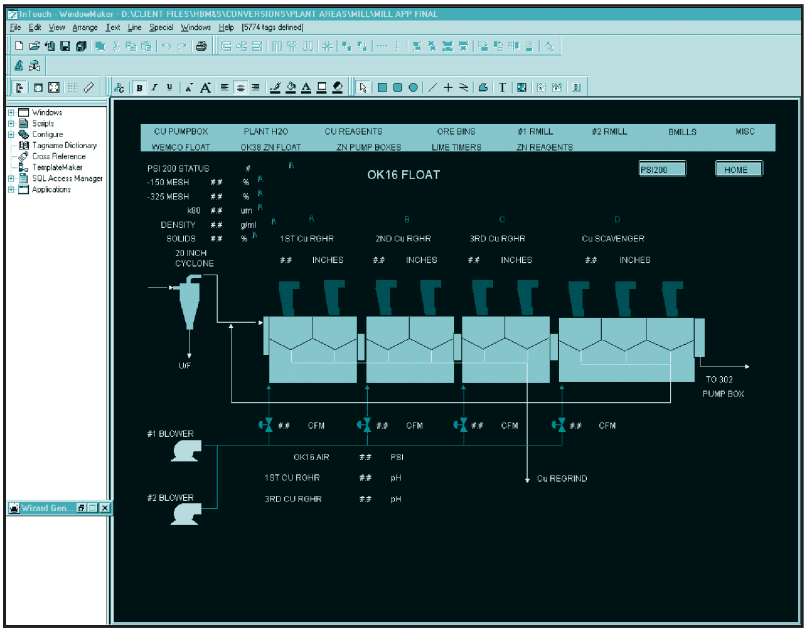


Figure 2: Bailey® Graphic Converted to Wonderware InTouch.

7. Six Individual Applications from an Application Template

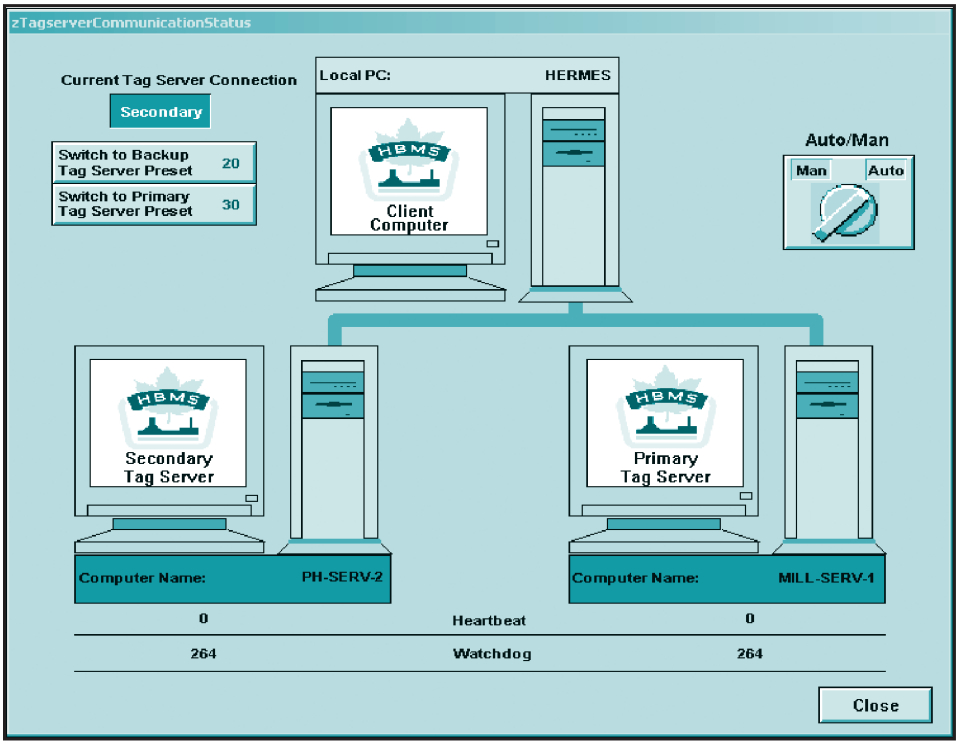
The application developed for HBM&S consists of 6 individual applications for the various process areas on site that combine to produce copper and zinc, as well as small quantities of precious metals. The individual applications were developed from an "application template" that was designed to incorporate all requested functionality for all areas and support the application deployment method. This provided standardization throughout the plant site. The design of the application template enabled maintainability and greatly reduced the time and, ultimately, the cost to develop the 6 individual applications. To create an application for a new area all that had to be done was import the converted graphics and database through the import utilities provided within InTouch. All other aspects of the application such as the menu bar graphic, control popup graphics, scripting, alarm groups, access names, pre-mapped function keys, security, and WindowMaker/Viewer properties were designed in the template to be used with any application.

8. Network Application Development

The applications were deployed using Network Application Development (NAD). This method reduces the time and cost involved in making changes to an application compared to their old system. Through one development node, modifications can be made to any application and automatically distribute the updated applications to the appropriate nodes on the network.

9. Redundancy

With any control system, redundancy is extremely important and this application was no exception. Each area of the plant that had the appropriate Bailey® hardware for redundancy was configured to simulate the Bailey® Primary/Redundant server architecture, once again maintaining familiarity for the user. For areas that did not have the appropriate hardware for a Primary/Redundant setup, the network infrastructure allowed this server architecture to be implemented by referencing another node on the network (in a different area) to be the redundant server. To aid in the visualization of the application redundancy, there was a graphic designed to portray the status of the system at any given time (Figure 3). The graphic allowed the user to set the primary and redundant nodes as well as the duration of time allowed prior to switching the to redundant node.



Redundancy Configuration/Status Graphic.

10. Distributed Alarms and Alarm Inhibit

The applications also use distributed alarming, which along with the network infrastructure allow any alarms on site to be viewed, silenced, and acknowledged from any node on the network with the proper security levels. The alarm summary also gives the user the ability to inhibit and un-inhibit alarms and maintains a list of current tags that are inhibited. Other features of the alarm page include the options to select historical or summary alarms, select a range of priorities to be shown, retrieve current updating values for selected tags, and go to the selected tag's primary display. Alarm system connectivity and flexibility was the result of these scripted options.

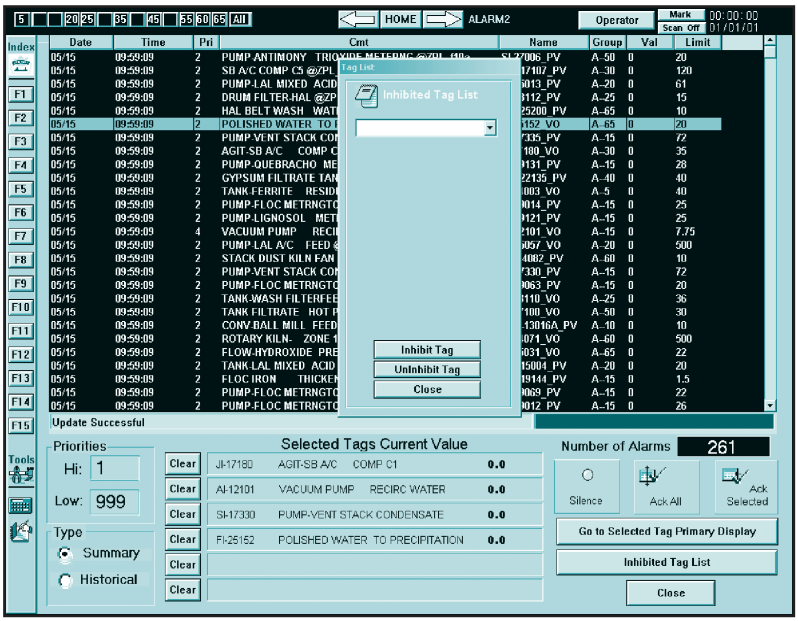


Figure 4: Alarm Summary Page.

11. Control Popups available across many Screens

One of the key operating characteristics is to be able to access a control faceplate found in one section of the mill while monitoring the results in a very different part of the mill. This requires that control popups be configured to be available across several or all screens.

Figure 5 illustrates the "Pinable Control Popup" and the optional control popup accessed by the added "right click" functionality scripted within the application. These increase the process control operator's efficiency as the control popups can be accessed in numerous ways (key strokes, left and right mouse click, and pinable control popups) and carried "on top" from graphic to graphic when starting process equipment.

12. Security

Figure 6 shows the "Operator Log-On" popup box that is used to identify the particular plant personnel operating and to distribute security levels based on the login name.

13. Graphic Scanning

Graphic scanning is an option scripted within the applications. The operator has the ability to configure the application to automatically scroll or "scan" through up to 12 process graphics at a configurable rate. The buttons with the distinct yellow arrows perform the advanced navigation function. These buttons allow the operator to manually scroll through the last 10 graphics that were called. For system performance there is only ever one graphic open at any time, therefore scripting was implemented to buffer the last 10 accessed graphics and re-call them in the operator's desired order, previous or next.

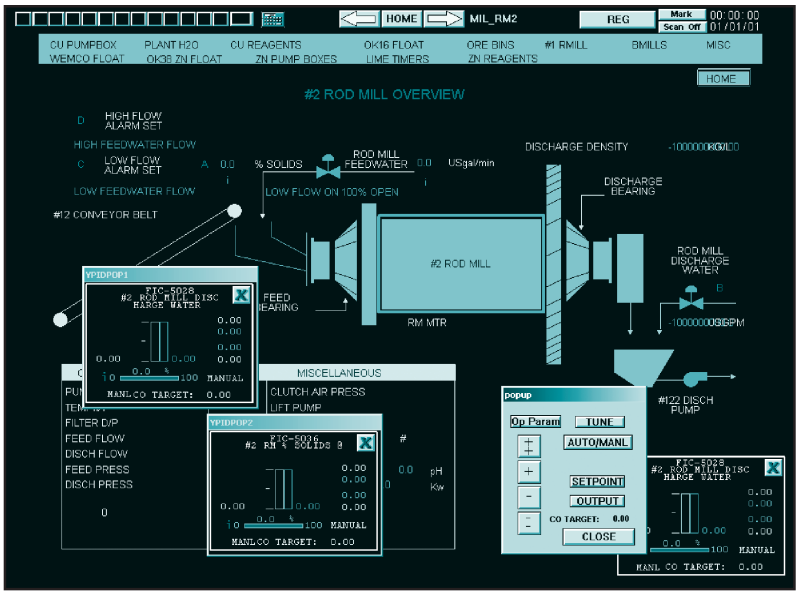


Figure 5: Pinable Control Popups and added "right click" popup functionality.

14. Bailey® DCS Block details and Loop Tuning

The application was designed not only to enhance operator efficiency but also to permit easier plant maintenance access to Bailey® tag information. One example of this is illustrated in Figure 7, which shows a popup window identifying the important attributes of a selected tag in the Bailey® DCS configuration. This window also gives the maintenance personnel the option of accessing a "Block Details" graphic, which allows them to actually modify the tunable specifications of the selected tag within the Bailey® configuration. Also accessible is a "Tune" graphic that allows tuning of control loops within the Bailey® configuration.

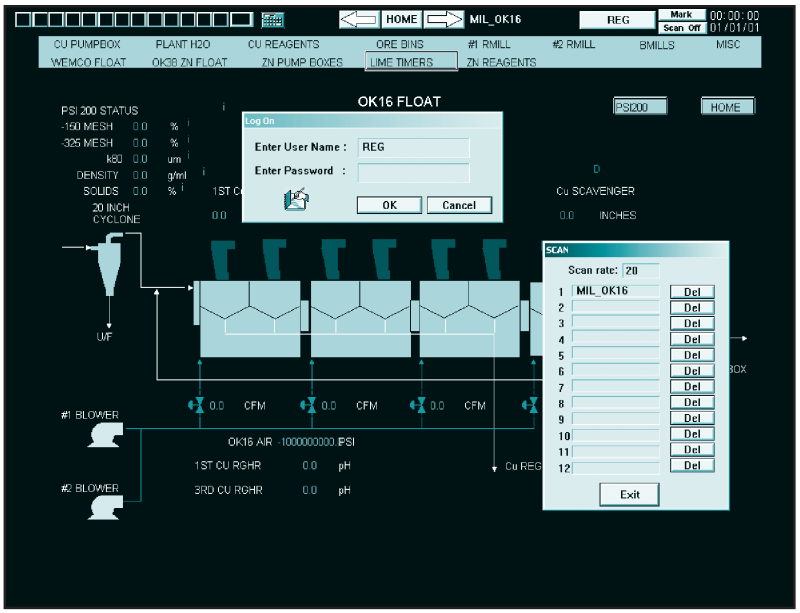


Figure 6: System Log-On for application security, advanced navigational tools and Graphic Scanning.

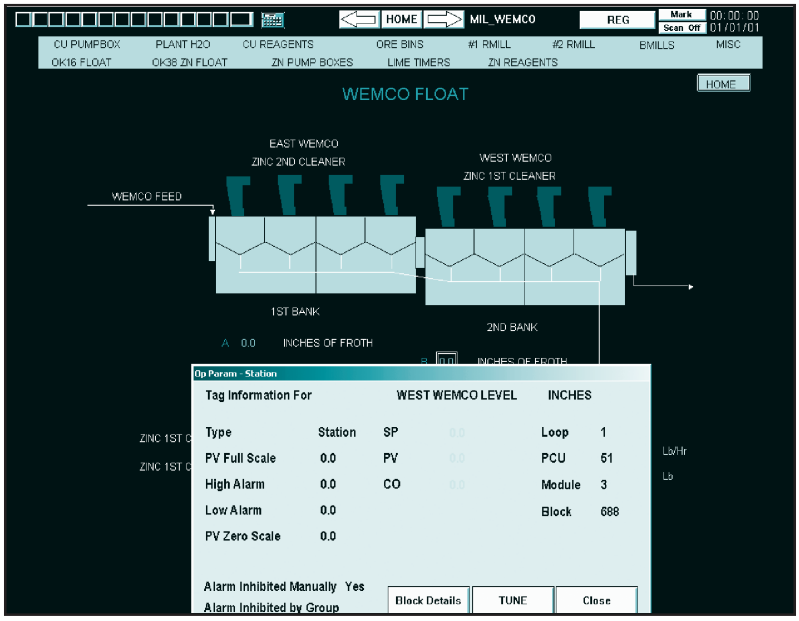


Figure 7: Various Application Maintenance Options.

Summary

The replacement of the Bailey® DCS consoles featuring these advanced graphical and database conversion utilities will result in lower capital costs, lower long-term maintenance costs and increased flexibility to make changes from one central location while permitting the consoles to be converted in a relatively smooth process rather than recreating the entire application. The conversion left the new system with virtually identical operating characteristics, significantly reducing the re-training of operations staff, which is a major area of concern when operating staff already completely understand the existing controls and are responsible for any production loss.

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