

Arnott's Biscuits

Online batching system streamlines process operations at Australia's largest biscuit manufacturer



Arnott's Biscuits Huntingwood production facility near Sydney is the largest biscuit manufacturing facility in Australia, producing over 31,000 biscuit products per year.

Using only 5 oven lines, the facility produces the same amount of output as it did at its former residence, where it ran 11 lines and had two-thirds more personnel operating the plant.

Arnott's engineering manager, Mike Dwyer, proudly describes it as "the most sophisticated biscuit making factory in the world today."

The Huntingwood factory occupies 44,000 square meters, and its 5 manufacturing lines operate 24 hours a day. Each line consists of a mixer, a forming line, ovens, secondary processing and packaging.

There are also numerous associated processes: yeast, ferment, vol and invert manufacture, Vitaweat cookers, creaming machines, ingredient preparation and storage, truck receivals, packaging facilities, and an automated warehouse.

THE CHALLENGE

Arnott's Biscuits required a single integrated control system that would link its Manufacturing Resource Planning software BPCS with the plant floor controllers.

The goal was to remove the paper trail traditionally found in the manufacturing process and streamline process operations. Arnott's Biscuits wanted a means by which they could design mixing procedures using methods that did not require programming skills - effectively an online batching system. However, they were wary of the usual limitations of such a system. They did not want to rely on PCs for process control and needed much greater capacity than typical batching systems to allow an unlimited number of recipes.

As well as receiving shop orders from the BPCS, Arnott's wanted to report back batch statistics from the plant floor to the BPCS and to integrate inventory control, accounting and quality control information.

THE SOLUTION

Arnott's and Citect entered into a partnership agreement whereby Citect Professional Services worked alongside Arnott's Engineering Group to design, install and commission the entire control system from the sequence control and recipe handling to the ERP system interface. Citect also worked closely with Civil and Civic, Reimelt, Sasib Bakery and other factory designers.

Citect designed system that integrated the customers' BPCS, SQL Server database,

THE CHALLENGE

To provide Arnott's Biscuits with an online batching system that would :

- ❑ Interface the Manufacturing Resource Planning (MRP) software with plant floor systems
- ❑ Streamline process operations
- ❑ Provide greater capacity than a typical batching system
- ❑ Remove paper trail and data-entry error
- ❑ Provide for an unlimited number of recipes

THE SOLUTION

Citect Professional Services partnered with Arnott's Engineering group to design, install and commission the entire control system from the sequence control and recipe handling to the ERP interface. Citect designed a system that integrates the customer BPCS, SQL Server, CitectSCADA, CitectSCADA Reports and Allen Bradley PLCs.

THE BENEFITS

The system is easy, reliable, and improves production processes by removing paper trail and manual data entry error. The system also provides the capacity required to run an unlimited number of recipes.

CaseStudy

Citect
Real-time Intelligence

Over the course of 18 months, 8 full time Professional Services engineers delivered:

- Project management
- Technical management
- High level design
- Ethernet network design
- Functional specification
- CitectSCADA and PLC programming
- SQL Server programming
- Hardware supply
- CitectSCADA and CitectSCADA Reports workstations
- CitectSCADA Reports configuration
- Installation

CitectSCADA, CitectSCADA Reports and Allen-Bradley PLC-5s to provide a solution for Arnott's control system requirements. The system facilitated the flow of information from the BPCS to the factory floor and back, without the need to re-enter data at any point. It provided for the fast and accurate flow of production planning information, the execution of production activities and the recording of materials used during manufacture.

This system, designed by Citect, does not require high levels of user intervention and manual data entry, thereby streamlining processes and minimizing data entry error.

The factory's Ethernet and AB Data Highway plus (DH+) networks seamlessly link its CitectSCADA stations with almost 100 individual Allen-Bradley PLC-5 and SLC-500s, along with Arnott's AS400-based administration and warehousing computer system (BPCS).

BPCS

The BPCS system contains shop order requests, inventory control and accounting details. Shop order requests are transferred to the Recipe Database for production, while batch statistics are transferred from the Recipe Database to the BPCS for inventory control and accounting purposes.

Recipe Database

An SQL Server is used to store the recipes. Recipes include not only the batch parameters, but also the sequential control for the PLC program. The entire recipe is stored in tables that once downloaded to the PLC interface with the sequence engine to provide full sequential control of the process.

Recipes may be created online via the "Mixing Procedure Design Utility" that allows non-technical personnel to design and error check mixing recipes.

This provides flexibility and advanced error checking prior to download. New recipes can be created or existing recipes altered without

affecting production, and any existing process or ingredient can be incorporated into the new or altered recipe.

Existing recipes can easily be modified to account for fluctuations in environment or ingredients or to test new products. As the recipes are created in the database and downloaded as required to the PLC, a potentially limitless number of recipes can exist for any mixer.

When shop order requests are received from the BPCS, the recipe database attaches the appropriate recipe with the shop order, and sends the request and recipe to the CitectSCADA operator interface using Citect Plant2Business.

Batch statistics are then uploaded from CitectSCADA, again using CitectSCADA Reports, and the recipe database associates them with the appropriate shop order request and passes them back to the BPCS.

CitectSCADA Operator Interface

The CitectSCADA operator interface presents the shop order requests to the operators, and allows them to select the most appropriate order for production. CitectSCADA then downloads the attached recipe to the PLC for production.

CitectSCADA also provides the plant floor operator interface for normal HMI purposes. During production, the operators are prompted for and required to confirm manual operations at the CitectSCADA terminal. At the completion of a given batch, the batch statistics are passed back to the recipe database for reporting to the BPCS.

BENEFITS

All plant floor control is performed by the PLCs. The recipe information downloaded to the PLCs include the Phase (S88 terminology), sequence that is stored in tables in the PLC as well as the Phase parameters.

A table driven sequence engine was developed in the PLC ladder logic. Only the values in the tables that drive the PLC logic need to be changed to implement the different mixing procedures for each product. Since the recipes themselves are stored in a SQL Server database, the number of recipes available is unlimited.

Multiple batches are possible in the sequence engine, permitting multiple runs of the same recipe sequence until the shop order is complete. This requires the number of batches for a given recipe to be calculated in the Recipe Database from the shop order request and downloaded with the recipe.

Batch statistics, including detailed and accurate data such as temperature fluctuations, are totaled through the sequence and reported to CitectSCADA at the completion of a given batch for reporting to the BPCS. These statistics are compared to test results and product quality in order to improve product consistency and increase output.

Robustness

Many batching systems rely on a PC-based controller that must be running to progress steps and control the sequence. No redundancy or computer failure is accounted for in these systems.

Should a system fail, such as the Recipe Database or the BPCS, the other systems can continue operating until a change of recipes is required because all sequence control is in the PLC.

The redundancy of the CitectSCADA system allows operator intervention at any station, thus removing dependence on a single PC for system integrity

Communication Network

Reliable transfer of information to and from the various devices throughout the plant is a vital part of the system. As such, application server redundancy and industry standard networking technologies were implemented.

The three application servers running CitectSCADA are fully redundant (six computers) and connected via the LAN.

Switched Ethernet operating at 100 mpbs at the switch connects all servers, hubs and routers in a physical star configuration.

Hubs located in various areas throughout the plant are connected to the switch by fiber optic cable. Industry standard protocols TCP/IP and IPX/SPX were used for the corporate system, recipe database, CitectSCADA operator interface and PLC communications.

The commissioned system consists of 25 CitectSCADA operator interfaces, 6 fully redundant CitectSCADA servers, 2 redundant Novell file servers and 17 PLCs and 88 SLCs.

“The result of the partnership is a user-friendly system of operator graphics which interfaces to each process of the factory.”

- Mike Dwyer,
Engineering Manager,
Arnott's, Huntingwood



CONCLUSION

Citect provided Arnott's Biscuits with a single integrated batching system, which interfaces seamlessly with its BPCS system as well as plant floor controllers. The user-friendly, reliable system improves production processes by removing errors that results from manual data entry. Furthermore, the system provides the capacity required to run an unlimited number of recipes.

As a result of the project's success, Arnott's have subsequently employed Citect to provide an identical control system at its Victorian plant in Burwood.

"The result of the partnership is a user-friendly system of operator graphics that interfaces to

each process of the factory. It also incorporates a fully functional interface to the MRP system used by the Arnott's group. Data for the production run is downloaded into the Citect system as the production proceeds during the day; all ingredient usages are transmitted to the MRP system. All data is up to date within half an hour of the actual production".

"The cooperation of the team for the development of systems meeting Arnott's Biscuits' requirements was marvellous and a credit to the individuals involved. I can recommend the partnership style of the design team to any future prospect as it worked to such advantage for Arnott's," concludes Mike Dwyer, Engineering Manager, Arnott's, Huntingwood.

ITEM	
Contract Sum	AUD \$1.5 Million
Number of CitectSCADA Tags	46,218
Number of Digital Alarms	4,600
Number of Trend Tags	432
Number of I/O Devices	17 x AB PLC-5/80
	88 x AB SLC
	5 x AB PLC-5/30
	4 x Memory
	8 x Disk
Average Response Time	0.8 Seconds
Observed Response Time	Sub 1 Second
Observed Time to call up a Graphics Page (with all display data)	1 Second

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