CENTUM VP Batch

Industry: Specialty Chemical, Pharmaceutical
Product: VigilantPlant Solutions

CENTUM Batch Automation

The CENTUM VP Distributed Control System (DCS) provides scalable and powerful solutions for continuous, batch, and hybrid applications. CENTUM VP Batch is the ISA-88 (IEC-61512) batch control package, which provides recipe management and process management functions interfaced to the CENTUM VP DCS. CENTUM VP is unique in performing unit supervision functions in completely redundant real-time controllers offering an availability of 99.99999 percent, or “seven-9s”. CENTUM Batch VP recipe management, scheduling and production information management functions can also be easily integrated into Manufacturing Operations Management (MOM/MES), supply chain and enterprise management systems to meet the increasing demands for leaner and more agile manufacturing operations.

CENTUM VP Batch offers flexible and scalable batch management software for centralized recipe and process management combined with distributed unit supervision. CENTUM VP Batch is field proven, having been used to automate a wide range of batch processes from simple, single product/single unit processes to flexible and complex multi-product/multi-path processes, with ease of use, outstanding reliability, and sophisticated functionality.

Using CENTUM VP Batch users benefit from:
- Reduced lifecycle engineering costs
- Shortened time to market
- Improved plant performance
- Reduction in unexpected control failures

Features of the CENTUM VP Batch System include:

Scalable and Reliable System Architecture
- Scalable Solution from Unit Control to Site

Automation
- Highly Reliable Controllers
- Effortless Integration with Other Systems

Modular Engineering
- Hierarchical and Modular Configuration
- Object Oriented Phase Logic Structure
- Easy Testing Environment

Powerful and Advanced Unit Supervision
- User Configurable Unit State Matrices
- Plug-in Exception Handling and Monitoring Routines
- Support for Audit Trails, Electronic Records and Signatures

Easy Operation
- Intuitive View of Batch and Equipment Control
- Integration of Automated Control and Manual Operations
- FDA’s 21 CFR Part 11 Support

Electronic Batch Records
- Flexible Batch Reporting
- Complete Batch Production Information Management System

Intelligent Solution Suite
- Recipe Management
- Production Planning and Scheduling
- Batch Production Information Management

Scalable and Reliable System Architecture

Batch processes often require complex, modular and advanced resource management regardless of the scale. This is, especially true when multiple products require flexible combinations of equipment modules, units, lines and trains. CENTUM VP provides solutions for batch control irrespective of process scale.
CENTUM VP Batch controls plants of any scale with a single architecture.
The smallest CENTUM VP Batch system consists of a single PC, with operation, monitoring and engineering functions, integrated with a compact field control station. The system can be expanded online as your plant grows.

Unit procedures are executed in highly reliable controllers.
In CENTUM VP Batch, the unit supervision function, which is the ISA-88 activity requiring the highest reliability, runs on ultra-reliable controllers. This means all unit procedures, operations, and phases are loaded and executed in controllers which can be fully redundant. It was the first system to completely execute unit recipes, including unit procedures and unit formula, in the controllers, thus, leading to increased system reliability. This allows a control recipe to be able to run to completion without regard to the state of other PCs, servers or any other hardware. Furthermore, a completely integrated database is provided to simplify system configuration with automatic backup of configuration data a standard feature.

Simple Interfacing
CENTUM VP is able to communicate with any OPC enabled control or information system using OPC interfaces that are integral components of the system. Connection with PLCs, skid based controls, laboratory information systems, electrical facilities, machining equipment, automated vehicle systems, and warehouse control systems have been field-proven in many projects. CENTUM VP’s integral OPC interfaces enable effortless connectivity to hundreds of different systems via OPC. The integrated functions permit data from OPC enabled systems to be displayed and used in CENTUM VP the same as field I/O signals.

Modular Engineering
Yokogawa’s wealth of batch control experience is evident in the CENTUM VP Batch package, which is based on the ISA-88 batch control standard.

This modular, hierarchical package supports reusable components and libraries for easy engineering. Configurations can also be tested by simulating field control stations in a PC.

Hierarchically structured logic allows intuitive engineering.
Hierarchically structured unit instruments and modular Sequential Function Charts (SFC) offer concise and intuitive engineering making control strategies easy to modify and less costly to maintain. The single integrated engineering tool and database further reduces engineering costs by making the initial development and maintenance of control strategies less costly.

Only one set of phase logic and graphics needs to be configured for similar equipment. In CENTUM VP Batch, a unit instrument is assigned to each batch unit (e.g. reactor, centrifuge, filter dryer etc). A unit instrument comprises hierarchically structured modules using Sequential Function Charts (SFCs). Operations, phases, and graphics can be written using generic names (aliases), thus making the logic independent of equipment. For example, a generic name such as “Valve” can be used to express a tag in logic instead of the actual tag name. For many batch units, only one set of operations and graphics need to be developed. Multiple reactors can run concurrently without needing equipment specific operations.

Easy Testing and Simulation Environment
Applications can be tested using Yokogawa’s unique Virtual Test Function add-in without the actual controller or I/O. For all types of processes, development and testing of control applications can be done without dedicated hardware. With just a PC, system engineering, testing, and verification can be performed anywhere. The Virtual Test Function simulates the complete controller function, including the downloaded unit supervision functions, as well as providing a simple loop back simulation for all I/O, without requiring any engineering. Virtual Test Function is started simply from a pull-down menu and you can run batches, debug phase logic, verify unit coordination and test exception handling as if the process controller was connected to the process. This enables accelerated project schedules, reduces development and testing bottlenecks on projects and contributes to the lower TCO (Total Cost of Ownership) that is experienced with CENTUM VP controlling your batch processes.

Powerful and Advanced Unit Supervision
Traditionally, operation and monitoring have been performed individually for each piece of equipment, but centralized supervision of unit instruments can greatly simplify plant operations.

A state transition matrix is built into unit instruments enabling each unit to have a unique set of states, commands and state transitions. CENTUM VP provides a fully integrated operation and monitoring environment that allows operation and monitoring to be tailored to equipment configurations.

A batch process typically consists of multiple pieces of equipment (e.g., reactor, mixing tank, or spray dryer). Each unit has multiple equipment and control modules such as temperature sensors, pumps, and valves, which must be centrally controlled by unit supervision. In CENTUM VP, unit instruments are used to centrally control the various, independent, equipment and control modules that make up a unit.

**State Transitions**

Custom state transition matrices containing process and industry specific state and command names and transition logic can be created. The state transition matrix built into every CENTUM VP unit instrument provides a standard set of command, states and transition logic to speed engineering. The default commands/states include start/restart/running, pause/paused, and suspend/suspended. Built-in state transition logic is easily configured to allow restarting unit procedures after exceptions have been handled; options include restarting from where the exception occurred, from the start of the previous phase or operation or from the start of the next phase or operation.

When the standard does not fit your needs you may simply build your own state transition matrix giving units unique state and command names and transition logic. For example in regulated industries the system can be easily configured so some units have state names such as “Clean”, “Dirty” and “Expired” with custom transition logic. When this is done, the system’s standard event log will record unit state transitions using your terminology, not a generic standard term.

**Modular Exception Handling**

Exception handling, including detection of failures, interrupt processing, and continuous monitoring routines can be simply plugged into your control strategies. It usually takes many engineering man-hours to develop sequence control for exception handling and interrupt processing for batch control. The unit supervision function in CENTUM VP allows these routines to be easily plugged-in as required by the process.

**Easy Operation**

The control of batch processes often involves many manual operations such as manual additions, starting/stopping equipment, and activities operators must perform on the production floor. Often it is difficult to coordinate automatic control system activities and manual operator activities. CENTUM VP offers a simple, clear operating and monitoring scheme with hierarchical display windows, interactive guidance for on-site operations, and many other features to make life easier for operators.

**Intuitive view of the statuses of running processes:**

Sequential Function Charts (SFC) visually represents the statuses of individual unit procedures, operations and phases. Operators can follow the progress of unit procedures, operations and phases in real-time, automatically configured displays. The display windows are hierarchically organized with a navigator window allowing easy access to the desired window.

**System coordination of manual operations and automatic sequences:**

Mobile terminals such as tablets can be used as production floor terminals to perform the same operations as if in the central control room. In addition, using interactive messages (appearing as dialog boxes), work instructions can be sent to operators no matter their location. These dialog boxes are able to provide acknowledgement of received messages as well as provide data entry. This functionality lets manual operations be easily coordinated and integrated with automatic sequences.

**Audit Trails and Access Control for Regulatory Compliance**

To comply with regulations, such as the FDA’s 21 CFR Part 11 applicable to the pharmaceutical industry and good engineering and software practices, CENTUM VP records and retains audit trails for engineering
configuration and recipe data. When required electronic signatures may be used as evidence of who made the change.

Depending on the operator’s level of security clearance, security restrictions can be set in detail for monitoring, using display windows, display terminals, process equipment, and the like, as well as for actions on each equipment and control module. The user name and password must be entered for authentication by electronic signature when logging on to the system or performing an action on equipment. Double authentication supporting done-by/checked-by requirements can be set for critical operations. User actions are automatically time-stamped, recorded, and retained as operational audit trails. Yokogawa is committed to provide customers in regulated industries with products and services to help them comply with the FDA’s 21 CFR Part 11 regulation for pharmaceutical manufacturing.

Electronic Batch Records

Control systems produce large amounts of operational results that are vital for making business decisions concerning productivity, quality, and safety improvements. Exaquantum/Batch, a Batch Plant Information Management system (Batch PIMS), automatically saves all CENTUM VP Batch batch history information to an open, ISA-88 based, relational database. It features functions to automatically log the manufacturing results of process management and unit supervision, consumption of raw materials, alarms occurring in manufacturing, and many more, all of which can easily be displayed.

Flexible Batch Reporting

Batch reports can be easily generated using Microsoft Excel. Using the CENTUM VP Report Package (a plug-in for Microsoft Excel), batch reports can be easily generated that include formula target values, actual values, batch trends, alarm and event logs, including records of operator actions, associated with a batch and much more. Standard report templates are provided to facilitate easily building your batch reports.

Complete Batch Production Information Management System

Exaquantum/Batch not only automatically collects and stores operational batch data it also preserves master and control recipes and changes to the plant equipment hierarchy using the complete data set for automatic analysis of your plant's productivity and efficiency.

As systems become more automated, operational efficiency and quality are expected to improve, but it is crucial that managers use this data effectively. Exaquantum/Batch provides a standard set of analysis tools that automatically provides metrics that can be used to measure operational excellence for batch operations, equipment utilization and product development. These critical measurements enable quick identification of areas for improvement. With Exaquantum/Batch, the necessary data to be acquired does not need to be defined; instead, batch history data is acquired, analyzed and displayed automatically. Exaquantum/Batch is ready to go immediately after installation.

Examples of reporting and analytical capabilities include:

- Integrated batch reports that can be customized for each master recipe, or recipe family
- Unit utilization automatically calculated
- Events and alarms compared on a batch relative basis
- Gantt charts displaying batch execution in real-time and in batch relative time
- Batch Production performance ratings automatically calculated for each batch and rolled up on a master recipe basis
- Cycle times with mean and standard deviation automatically calculated and displayed for each batch and unit recipe

CENTUM VP Batch and Exaquantum/Batch provide the basis for a plant and enterprise-wide integrated information system configured to meet the specific requirements of the batch processing industries. Based upon the ISA-95 Enterprise-Control System Integration standard Yokogawa can provide integrated Manufacturing Operations Management (MOM/MES) that involve simple integration of Yokogawa or other manufacturers’ products, up to fully integrated solutions consisting of intelligent field instruments, automated batch control integrating manual operations, recipe management, production planning and scheduling and batch production information management.
Intelligent Batch Solution Suite

Recipe Management
CENTUM VP Batch provides recipe management functions for creating and managing master recipes. The master recipes have the advantage of being unit-independent. With CENTUM VP Batch, process engineers can develop master recipes independently of unit configurations and without the aid of a system engineer. Simply by using a PC, master recipes can be tested and verified with Yokogawa’s unique virtual test function, thus reducing time to market. CENTUM VP Batch master recipes can be integrated with peer batch control systems, MOM/MES systems and enterprise systems.

Scheduling
Batch systems must now be able to manufacture different products in varying volumes, with frequent interruptions of orders or changes of product being manufactured. The systems must, therefore, accurately comprehend production plans and the current state of progress, and react quickly to changes. The CENTUM VP Batch schedule interface enables your preferred scheduling package to be integrated with your batch control system.

Batch Production Information Management – Exaquantum/Batch
Exaquantum/Batch is an intelligent ISA-88 based Batch Information System. It provides analysis and reporting facilities that collect, store and display current and historical data from batch production, equipment and recipe viewpoints. This enables easy user access to batch information for decision support, production planning, production scheduling, analysis, process improvement, quality and legislative compliance purposes including using ISA-95 to exchange data with business systems.

Complimentary Software Solutions

Asset Management - Plant Resource Manager (PRM)
PRM (Plant Resource Manager) collects diagnostic information from field devices through various fieldbus networks, such as Foundation Fieldbus and HART, and manages the information in unified databases. With these databases, maintenance schedules can be planned allowing work procedures and spare parts to be managed efficiently. Field devices can be centrally managed thanks to systematic predictive maintenance, reducing TCO and maximizing process up time.

Event Analysis Package - Exaplog
Exaplog graphically analyzes historical messages in the production control system that contain all the plant operations, in order to locate nuisance alarms and inefficient operation sequences, and thus improve production processes.

Operation Efficiency Improvement Package - Exapilot
Exapilot improves the operation efficiency by standardizing and automating the operation procedures based on the expertise of experienced operators. Automating the execution infrequent modular procedural operation provides a structured and reliable method of implementing SOPs according to ISA-106 standards.

Alarm Management - AAASuite
AAASuite is an advanced alarm administrator designed to address issues with alarm settings of control modules. Specifically with batch process, alarm settings need to be dynamically set according to the status of the batch. AAASuite provides enabling and disabling of alarms according to operation and phase in order to reduce known nuisance alarming that would be caused by normal operation.

Summary
Yokogawa’s batch solutions are field-proven worldwide in a wide range of batch processes and industries including fine chemicals, pharmaceuticals, food & beverage, and pulp & paper, to name just a few.

Yokogawa works in partnership with users to boost productivity and profitability, increase reliability and quality, reduce time-to-market, and increase efficiency. Our experienced staff offers skilled, comprehensive support encompassing improvements of single units, updates to existing plants, and design for and operation of new plants. We are not just another supplier, but your most trusted automation partner and provider of solutions.