General Specifications

Models VP6H6660, VP6E5165, VP6E5166
VP Batch
(Batch Management Packages)

GS 33J05L15-01EN

CENTUM VP

[Release 6]

■ GENERAL

This document describes the specifications of VP Batch, the Batch Management Packages.

A batch process is the multi-product variable production method where the recipe and/or production volume of a product is changed for each operation. It contains numerous variables such as recipes, operation or production methods. Furthermore, it requires a wide range of functions which are to be executed via communications with a supervisory computer such as scheduling function for production efficiency, result data acquisition and analysis for information management.

The VP Batch packages are created based on the batch operation know-how accumulated through Yokogawa's rich experiences over the years and are compliant with ANSI/ISA-88.01 (referred to as ISA-88.01), the standard on batch control. The VP Batch consists of the following packages.

- *VP6H6660 Process Management Package*
- *VP6E5165 Batch Builder*
- *VP6E5166 Recipe Management Package*

By using VP6E5170 Access Administrator Package (FDA: 21 CFR Part 11 compliant) together with the above packages enables CENTUM VP to comply with the requirement of FDA: 21 CFR Part 11 for pharmaceutical industry.

■ FUNCTION SPECIFICATIONS

● Structure

The packages consist of the three functions.

Recipe management

Creates master recipes on a computer or Engineering Station (ENG) of CENTUM VP configured on Ethernet.
This function is included in the "VP6E5166 Recipe Management Package" which is independent from the Standard Engineering Function. This VP6E5166 package can also be used on a Human Interface Station (HIS).

Process management

Creates control recipes as well as manages operations. The function consists of a batch builder and a process management. VP6E5165 Batch Builder is used on an ENG and VP6H6660 Process Management Package is used on an HIS. The Process Management Package is divided into three types by the number of simultaneously-operated recipes (called ACTIVE recipes).
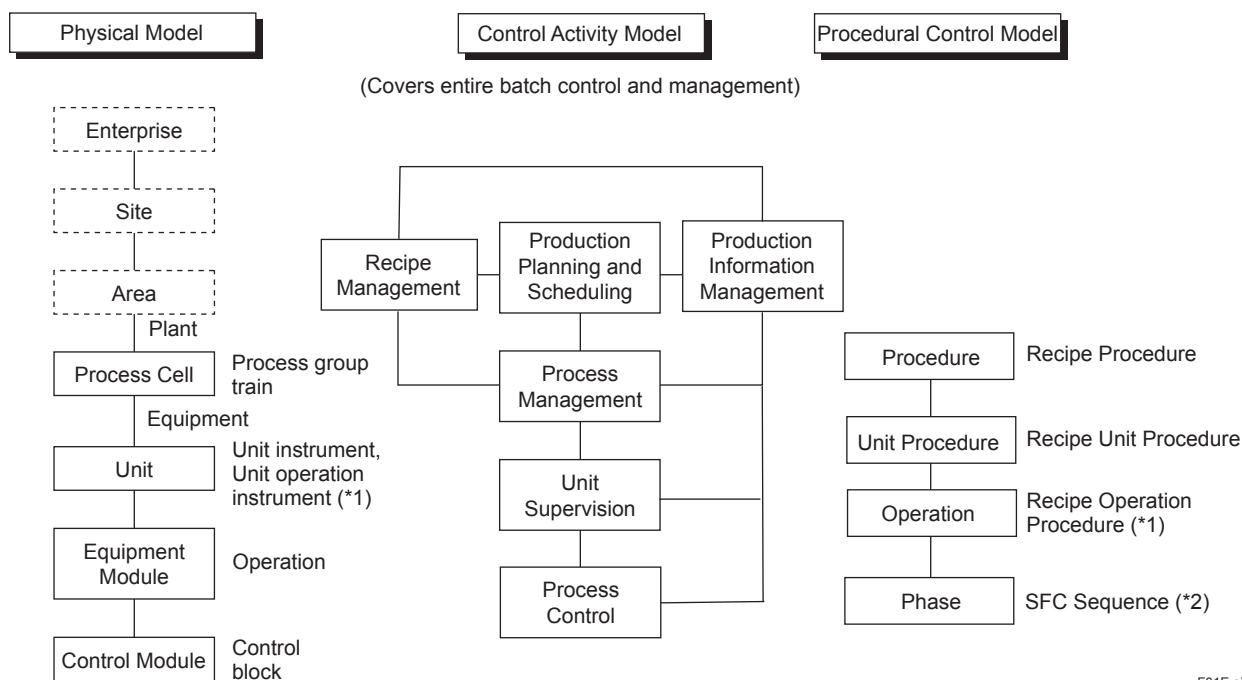
Unit supervision

Operates and manages unit instruments on a Field Control Station (FCS). The function consists of a builder and an FCS execution, which is included in the Standard Engineering Function and the FCS Control Function.

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● **Features**

Compliant to the typical model of ISA-88.01
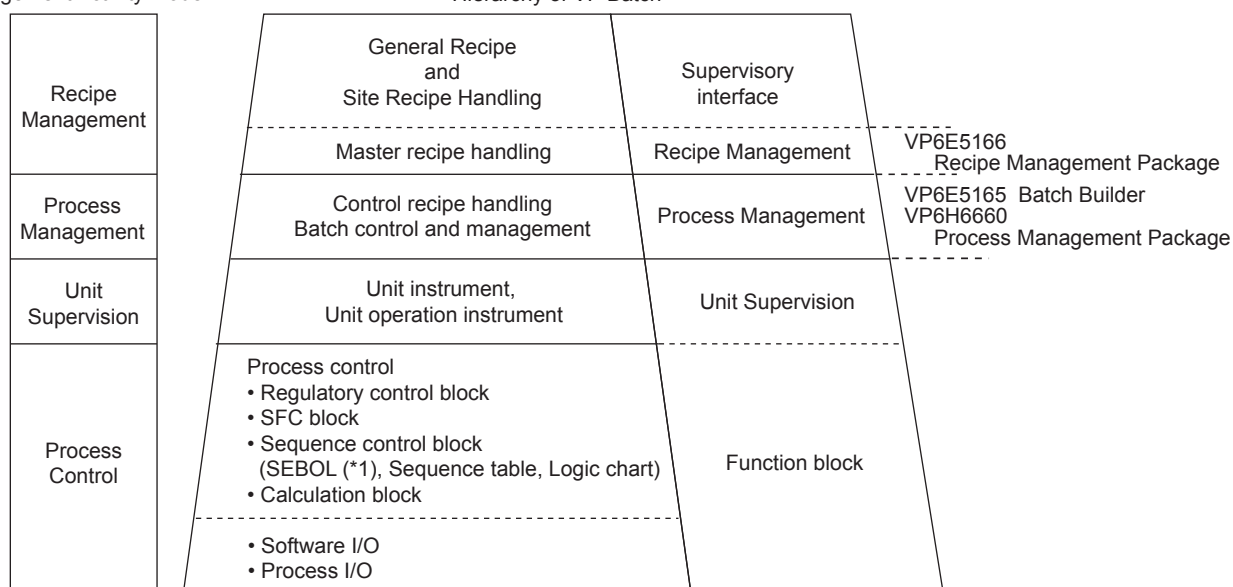The VP Batch packages conform to the ISA-88.01 batch control standardization guidelines.

Physical Model	Control Activity Model	Procedural Control Model

(Covers entire batch control and management)

*1: AFV30☐/AFV40☐/A2FV50☐/A2FV70☐ Field Control Unit is required.
    For more details, refer to "■ OPERATING ENVIRONMENTS".
*2: SFC stands for Sequential Function Chart.

Figure ISA-88.01 Batch Control Functions Model and VP Batch

Note: The VP Batch supports Master Recipe and Control Recipe among all the recipe models described in the ISA-88.01
      (i.e. General Recipe, Site Recipe, Master Recipe, and Control Recipe).
*1:   SEBOL stands for SEquence Batch Oriented Language.

Figure ISA-88.01 Management Activity Model and VP Batch

Open packages
The VP Batch packages interact with the following interfaces:

• Schedule Management Interface (included in the Process Management Package)
• Information Management Interface (implemented by Exaopc OPC Interface Package)

Efficient engineering
The VP Batch packages are equipped with various utilities, online maintenance function, as well as tools to standardize programing that offers engineers comfortable environment for programing.

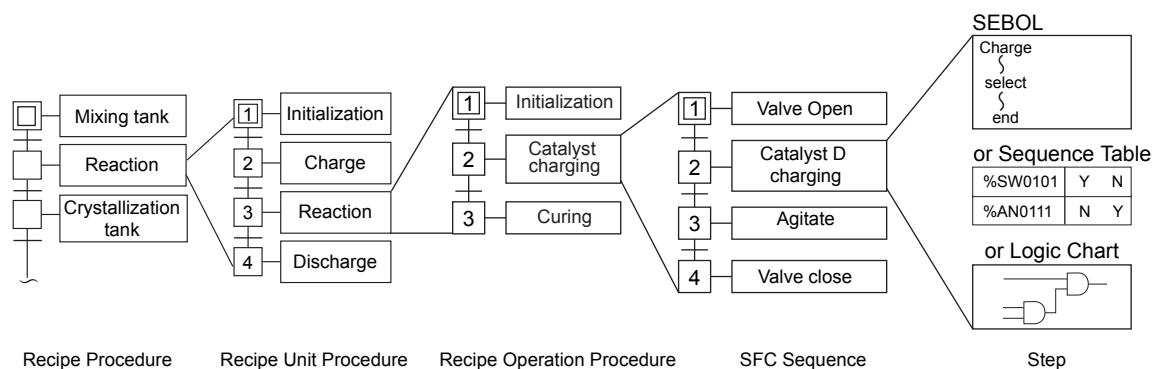**Supporting wide range of applications**
In a batch process, there may be multiple production lines, many levels of units, and combinations of both have complicated configurations. Or, a unit may be used to produce multiple recipes using different data and procedures. The VP Batch yields to satisfy a wide range of users' requirements.

Standardized operation and monitoring windows
Various operation windows are available such as Product Overview to select a production recipe, Batch Setup dialog, and operation windows. The Product Control View for recipe operation and the Graphic View are also available.

Hierarchy of production procedures using SFC
Production procedures are described in three levels of Sequential Function Charts (SFC). SFC Sequence steps are described by Sequence Batch Oriented Language (SEBOL), Sequence Tables, and Logic Charts. SFC sequences can also be launched directly from a Recipe Unit Procedure when the production procedure is less complicated. In such case the production procedure can be described in two levels of SFC without using the Recipe Operation Procedure.

Figure Hierarchy of Sequence Configuration

Independent Use of Unit Supervision
In a production process where recipe changes are not necessary, the process operation can be performed using the unit supervision alone. In a continuous process, the unit supervision function can be used without recipes.
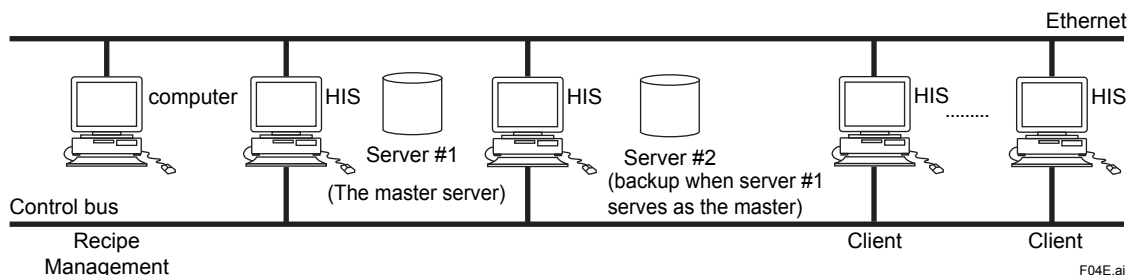
Client/Server Structure
A client/server configuration can be established among HISs equipped with Process Management Package.
Up to two servers can be defined per Recipe group; one is used as a master server and the other is a backup server. The sever station processes requests from client stations. The sever stations and the client stations monitor and operate recipes by referring to the data in the server station.
No. of server stations: Up to two stations per recipe group
No. of client stations: Up to 14 stations per recipe group

Figure Client/Server Structure

Recipe Management Backup Function
Recipe Management is a Windows Explorer-like viewer for recipes for preventing losses of master recipe data in the incidents like a hard disk drive crash.

■ PACKAGE FUNCTIONS
● Diagram of Function Overview

*1: Except for using Recipe operation procedure
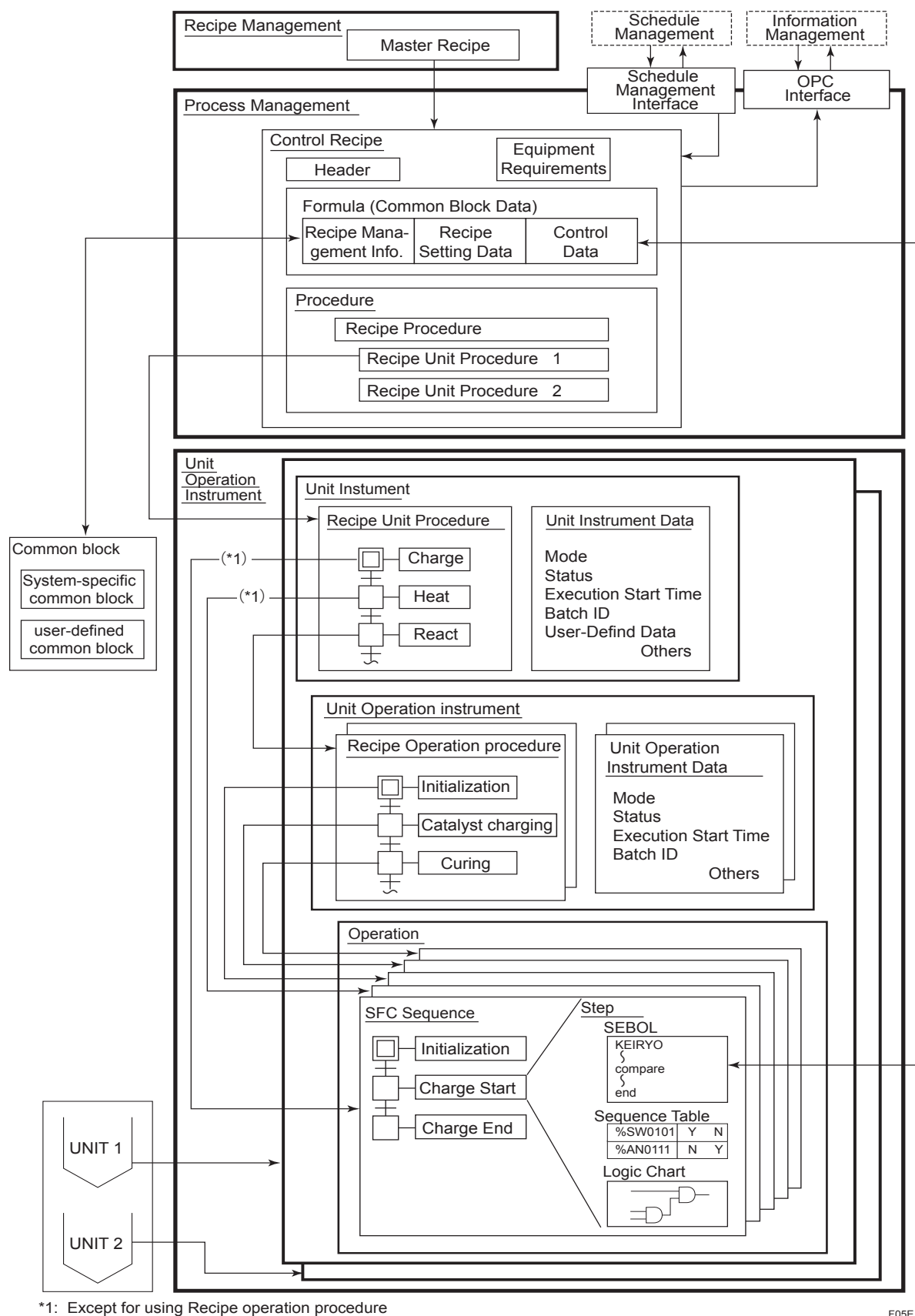
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Figure VP Batch Function Overview

● Recipe Management

A recipe is a set of information necessary for making a product. Specifically it defines what equipment, procedures, methods, and parameters are to be used in producing the product.

There are two types of recipes; one is a master recipe and the other is a control recipe. The Recipe Management function creates, edits and manages master recipes.

The Recipe Management function is independent from the Standard Engineering Function, which can be used on a computer without operation and monitoring and builder functions. However, the computer that runs recipe management needs to be connected to server stations via Ethernet.

Recipes managed by the recipe management functions are configured of the following items:

Header
Information such as recipe name, version, creator, etc. for management of recipes.

Procedure
Description of procedure to make a product
e.g.:   Description of an order of use of equipment/units such as a reactor and a crystallization tank.
          Description of an order of SFC sequences such as charging, heating, reacting, and cooling.

Formula
Parameters for making a product.
Import/export from/to in a CSV format file is available.

Equipment Requirements
Conditions of the equipment /units needed for making a product

● **Process Management**

The Process Management, consisting of the following functions, manages batch operation:

Creation of Control Recipes

A control recipe, used in an actual batch operation, is created from a master recipe by adding a batch ID and assigning unit instruments. The master recipe is created using the Recipe Management package.

Reuse of control recipes

A user can duplicate a control recipe with a good production result and re-use. Either Duplicating Control Recipe command or Control Recipe Exporting Formula command to export the control recipe to a CSV format file can be applied.

Except for the batch ID and the recipe reservation time, the Duplicating Control Recipe command duplicates all the formula data values from the selected control recipe. Original recipe batch ID in the duplicated control recipe replaces the batch ID in the original control recipe.
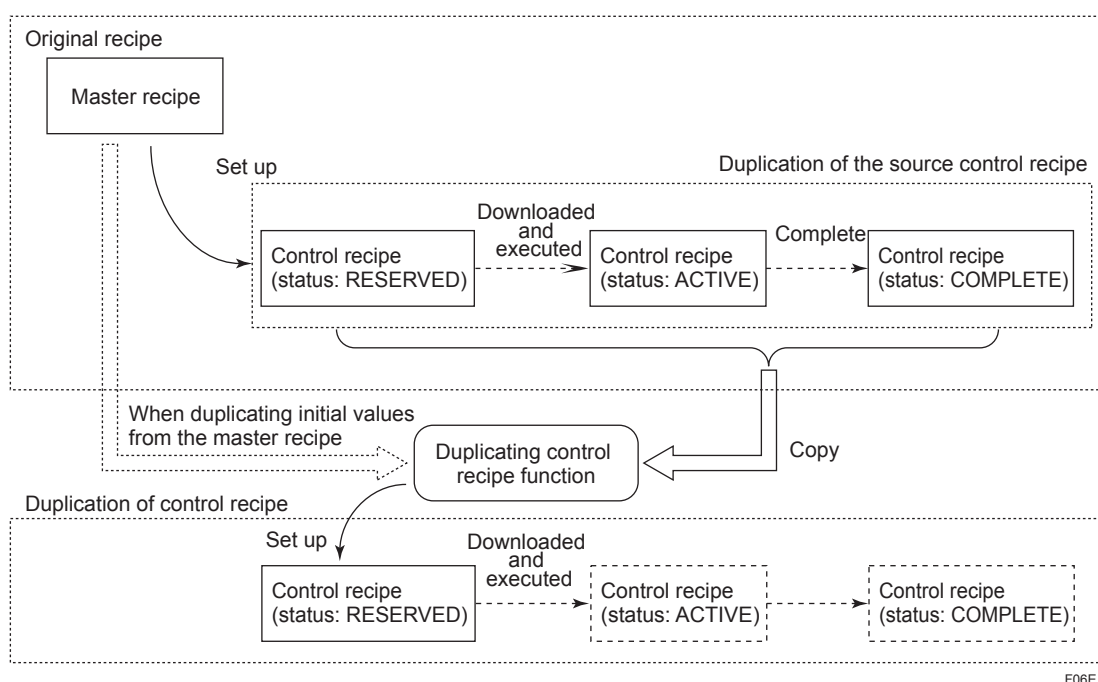

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Figure Flow of Control Recipe Copying Function

The Control Recipe Exporting Formula commands exporting the selected control recipe in a CSV format file (auto/ manual export is selectable). An operator can import this CSV format file to a master recipe to reflect the data of the control recipe to the duplicated one.

Upon completion of the batch process, two types of file formats can be selected by the Builder function:

 • General-purpose export file:
    Contains all the data used by a control recipe for the purpose of analyzing the control recipe. Automatic export setting upon completion of each batch is available.
 • Export file for recipe procedure builder:
    Contains all the data needed for defining a master recipe in the Recipe Procedure Builder to help creating a new master recipe by importing the data.

Batch Execution Management
Performs operations such as downloading and starting of control recipes.

Batch Operation and Monitoring
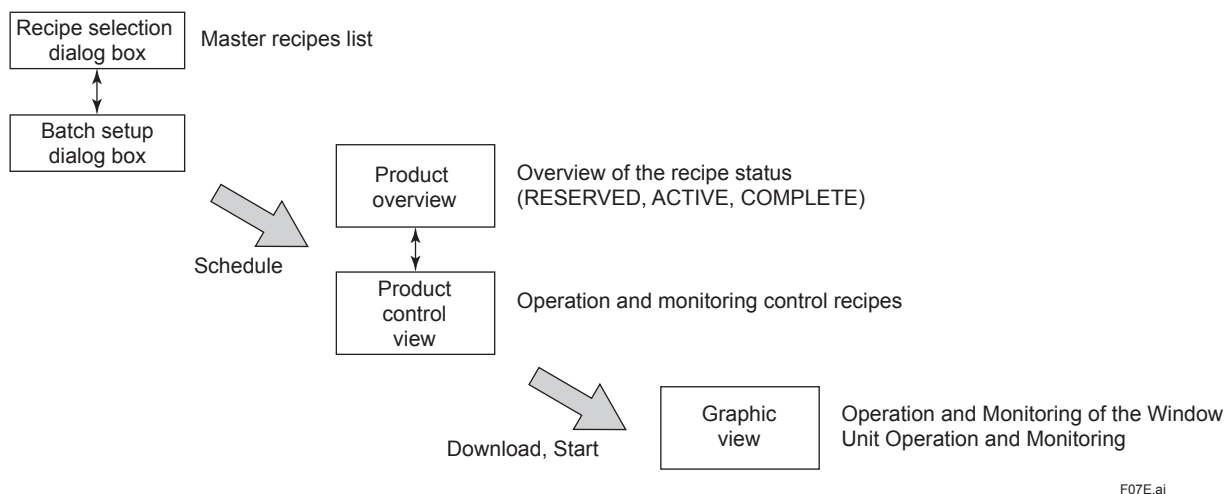Operation and monitoring of batch operation via standard or user-defined windows.

Figure Example of a batch operation

Common block
Common block stores recipe parameters defined by a recipe formula and batch result data. Data areas in Common blocks can be shared among the unit recipes within the same recipe. There are two types of common blocks: one is a user-defined common block and the other is a system-fixed common block.

Batch Result Acquisition/Batch Report
While a batch process in progress, its relevant data is kept in an FCS. Batch Result Acquisition is a function to acquire these data into an HIS as a result data.

The various acquired data can be retrieved searching by the batch ID for printing or to use in application programs. The following data are saved during the batch execution:

• Historical messages
• Common block data
• Historical trend data

These data can be printed as a batch report in an arbitrary format at the end or other timing during the batch operation together with "VP6H6530 Report Package" which contains the conventional batch journal function.

The Report Package acquires a tag's current value, tag attributes and closing data in addition to the above data so that a user can generate detailed batch reports. Since the Report Package accumulates batch data via OPC communication, "VP6H2411 Exaopc OPC Interface Package" is required to be installed on an HIS.

Batch Related Trend Data Filing

This function extracts the data synchronized with the Batch ID and the start/end time from the binary trend data (*1) acquired by Trend Data Acquisition of HIS Standard Operation and Monitoring Function. It then saves the data in a CSV format file.

Two types of batch-related trend data files can be generated upon completion of each batch. The data file type is selectable, as well as whether to create batch-related trend data files or not from the appropriate Builder:

• CSV format file: For use in various systems.
• Binary format file: For visualizing batch-related trend data in the trend view at the end of the batch operation.

　　Note: For trend data acquisition, VP6H1100 Standard Operation and Monitoring Function is required.

　　*1: Complies with continuous type, batch type, and other station trend types, but not with reference pattern trend and long-term archive trend.

Trend Data Filing is a function of VP Batch. This function can not be used in case CENTUM CS is used for the recipe server of VP6H4450 Multi-Project Connection Package.
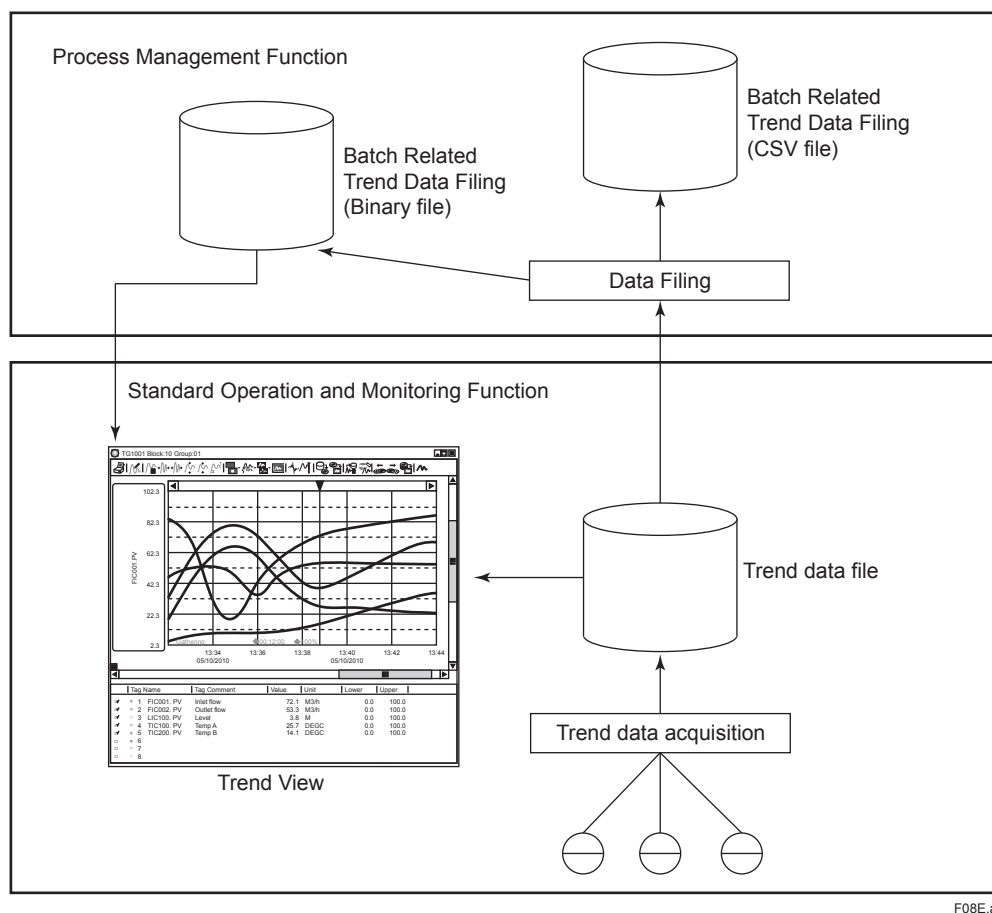

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Figure　Batch Related Trend data Filing

● Unit Supervision

Plant control instruments and devices can be handled as a single unit being grouped by the Unit Supervision function. For example, an entire reactor process in a batch process can be regarded as a unit. The number of instruments and devices are given a faceplate as a unit, and by sending a command to the unit activates the entire equipment in the group. Operators do not have to operate devices by the tag numbers. It helps simplify the operation significantly.

A unit instrument consists of control algorithms and data for controlling the unit. Control algorithms are divided into the following three categories:

• Status Transition Matrix: Manages sequence operation by the relationships among modes, commands, and statuses.
• Recipe unit procedure and recipe operation procedure: Regulates the execution order of SFC sequences by SFC.
• SFC sequence and step: Regulates SFC sequence and step of equipment and devices in each process such as charging, heating and reacting.

Those data are called as unit instrument data. Recipe batch ID downloaded to a unit instrument as well as semi-fixed data that are not required to be modified by the batch specific to a device are saved as tuning parameters.

The VP Batch packages (VP6H6660, VP6E5165, and VP6E5166) are required for the use of non-resident type unit instruments. In other words, resident type unit instruments that implement fixed procedures can be used without the VP Batch packages. Unit operation instruments cannot be used independently and they always must be used under non-resident type unit instruments.

Status transition matrix
A Status Transition Matrix describes, in a matrix form, how a unit instrument's mode and status are changed and how unit instrument, unit operation instrument and Operation react when a change mode or status command is received. The matrix is user-definable.

Recipe unit procedure
A recipe unit procedure determines the manufacturing procedures and control methods corresponding to a unit.

When a part of the manufacturing methods vary by processes, a recipe unit procedure may be applied. Thus this part of manufacturing methods may be defined as a recipe unit procedure and downloaded to an FCS. Then this procedure can be executed by a unit instrument.

Recipe operation procedure
A recipe operation procedure determines manufacturing procedures and control methods by the unit in more detail.

A part of manufacturing methods may also be defined as a recipe operation procedure and downloaded to an FCS. Then this procedure can be executed by a unit operation instrument.

SFC sequence
An SFC sequence is launched from the recipe unit procedure or the recipe operation procedure. An Operation contains control algorithms and data for controlling devices, and the SFC sequence describes control algorithms. The mode, status, alarm, number of steps in execution, and step names are some of the data items in the Operation fixed for the system.

Step
An SFC sequence step is described by SEBOL, sequence table or logic chart.
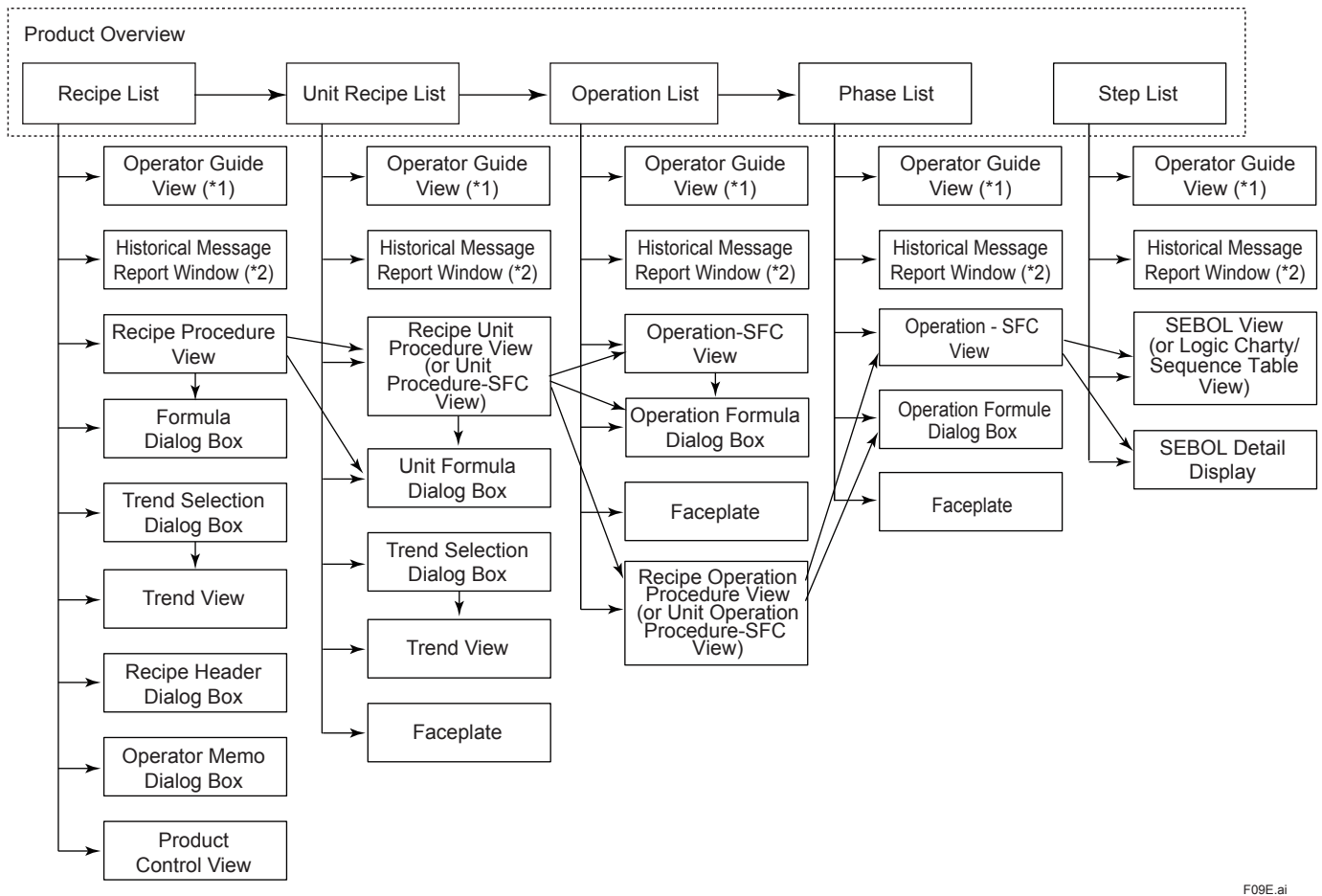
Unit instrument data
Unit instrument data is a library of data which shows the status of devices supervised by a unit instrument. Two types of data exist; one is a unit specific data and the other is a user-definable data. The fixed data items include mode, unit status, alarms, date and time of execution start and stop, batch ID, user codes 1 to 4, and recipe group numbers. The maximum 256 user-defined unit instrument data is available. Formulas are not downloaded to the unit instrument data, and those are saved in the common block data area.
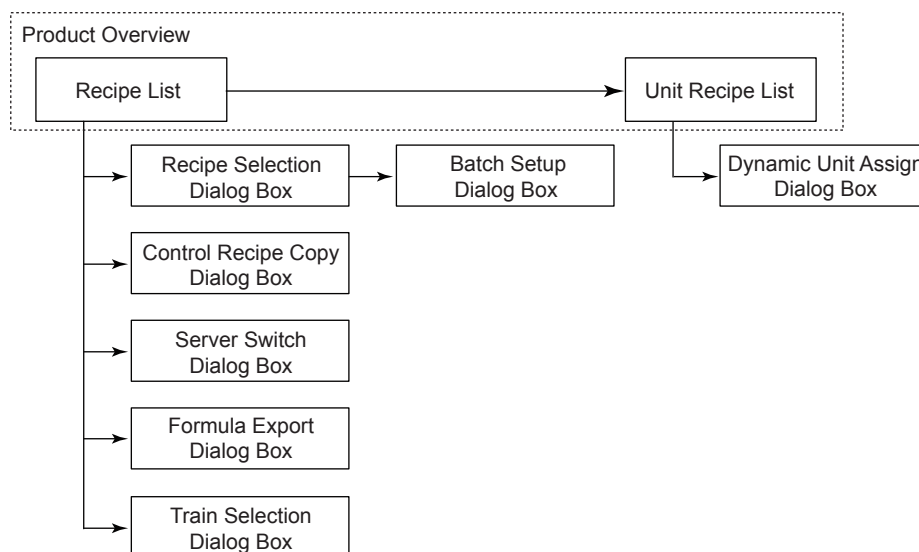
● **Operation and Monitoring Functions**

The operation and monitoring windows are provided as human-machine interfaces. They are grouped as Product Overview and Product Control Views.

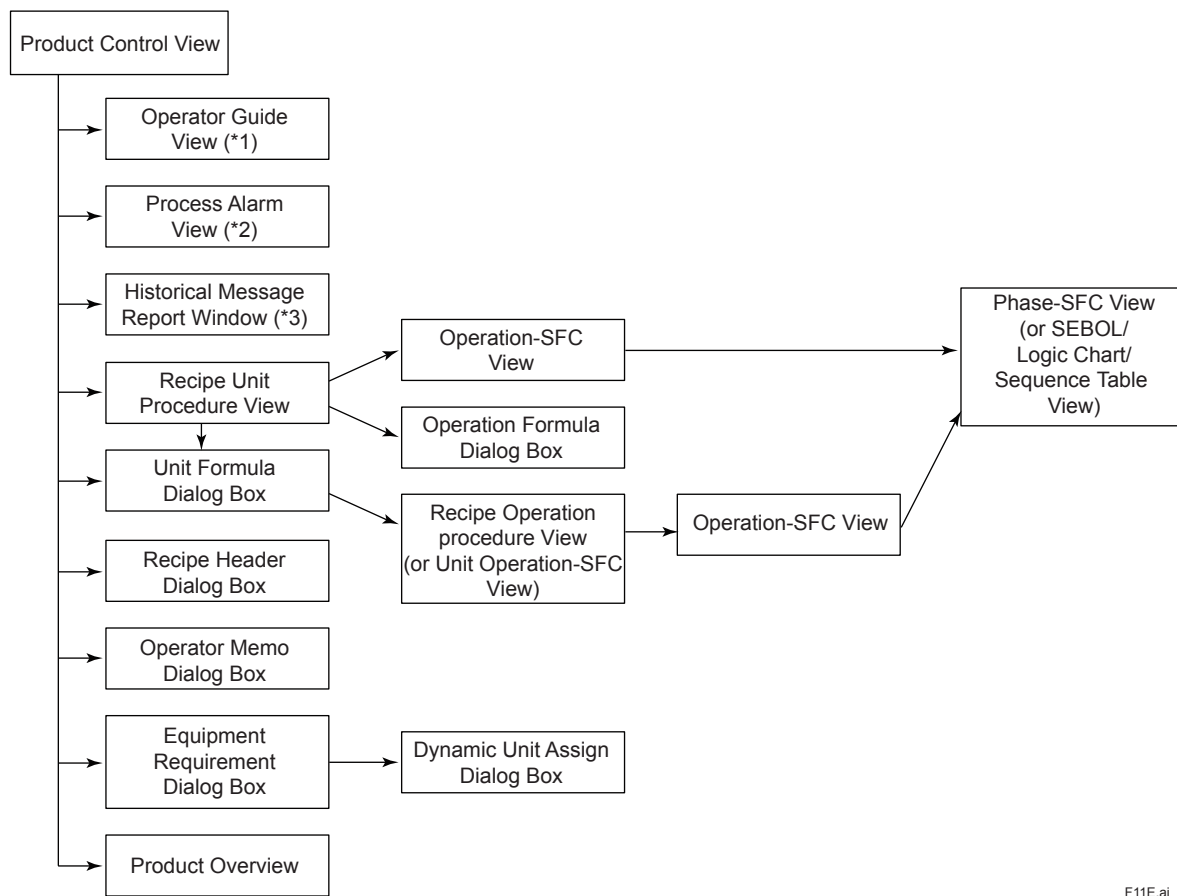Windows that can be opened from the Product Overview are as shown below.

Figure Product Overview Windows (for Information Display)

Figure Product Overview Windows (for Operations)

Windows that can be opened from the Product Control View are shown below.

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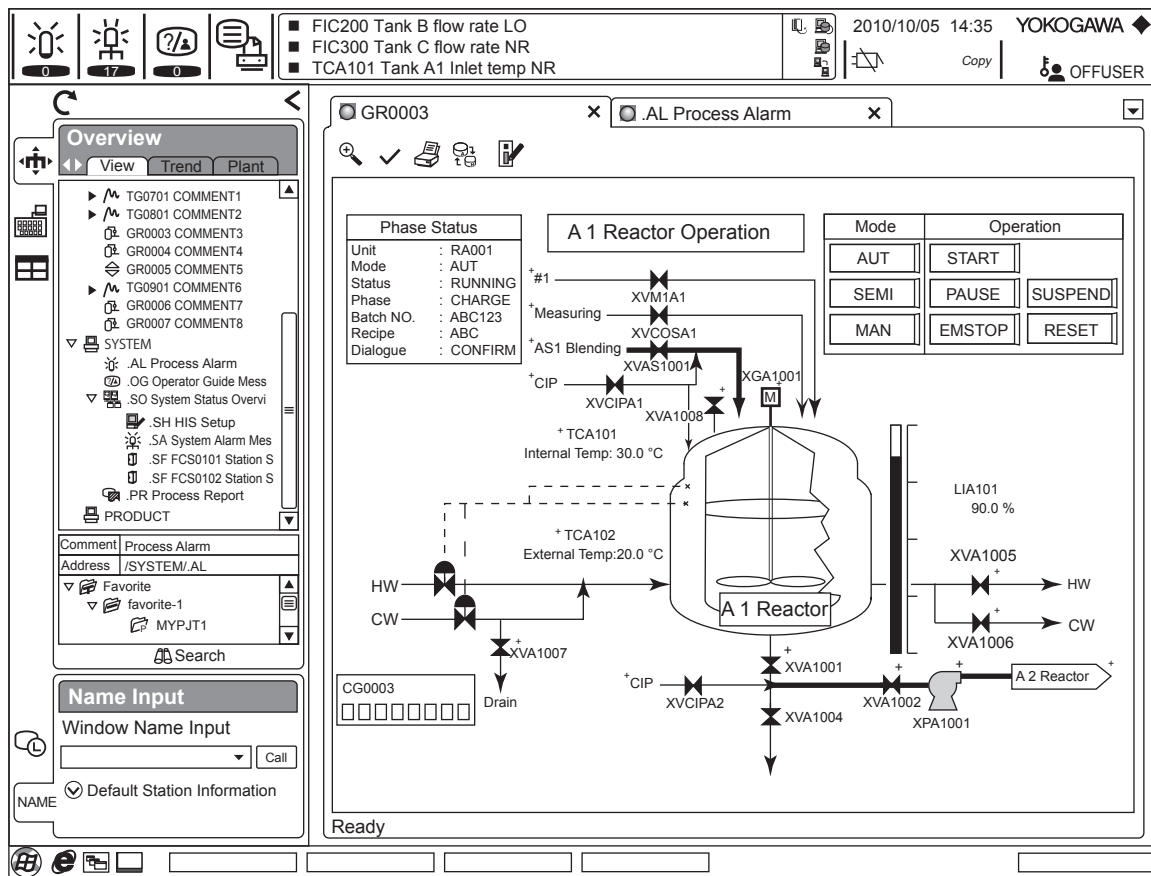*1: CAMS for HIS Message Monitor is displayed in case Consolidated Alarm Management Software (CAMS for HIS) is enabled with integrating operator guide messages.
*2: CAMS for HIS Message Monitor is displayed in case Consolidated Alarm Management Software (CAMS for HIS) is enabled.
*3: CAMS for HIS Historical Viewer is displayed in case Consolidated Alarm Management Software (CAMS for HIS) is enabled.

Figure Product Control View Windows

- Product Overview
  Displays batch status for each recipe group/train.
- Product Control view
  Displays status of each recipe.
  The operation of all the batches or individual unit recipes can be carried out. The window can be customized by the Graphic Builder.
- Recipe Procedure view
  Displays the recipe unit procedure (SFC) and the recipe operation procedure (SFC) of the specified control recipe.
- Recipe Unit Procedure view
  Displays the recipe unit procedures of a selected control recipe.
- Recipe Operation Procedure View
  Displays the recipe operation procedures of a selected control recipe.
- Operation Formula dialog box
  Displays/sets the formula applied to a selected Operation.
- Unit Formula dialog box
  Displays/sets the formula commonly applied to a selected unit.
- Formula dialog box
  Displays/sets the formula of the specified control recipe.
- Recipe Header dialog box
  Displays the recipe header of the specified control recipe.
- Recipe Selection dialog box
  Displays a list of master recipes for each recipe group.
- Batch Setup dialog box
  Generates a control recipe by converting the master recipe selected from the Recipe Selection dialog box by adding a batch ID, assigning a unit and setting actual volumes.
- Control Recipe Copy dialog box
  Duplicates a selected control recipe to create a new control recipe.
- Server Switch dialog box
  Give commands to switch server stations by the recipe group.
- Formula Export dialog box
  Exports formula data of a selected control recipe to a CSV format file.
- Train Selection dialog box
  Switch trains within the recipe group.
- Operator Memo dialog box
  Inputs descriptions of the specified control recipe for operators.
- Equipment Requirement dialog box
  Displays/sets the equipment requirement of the specified control recipe.

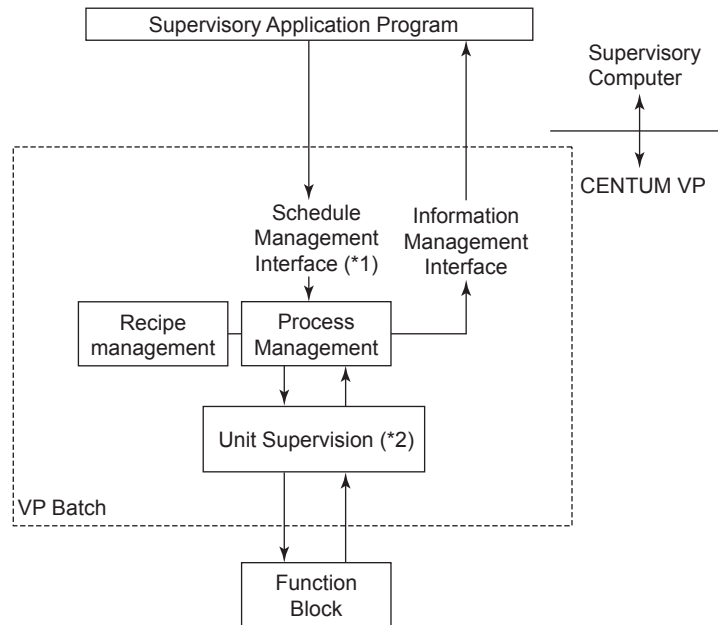The operation and monitoring of the unit status can be carried out by the graphic view.

Figure Example of a view

● **External Interface**

External interfaces can be used to exchange information with external packages or programs, as shown below.

• Schedule Management Interface (*1)
• Information Management Interface

These interfaces are positioned in between the application programs in a supervisory computer and recipe management/ production planning and scheduling/production information management, as shown below.

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Figure External Interface

Schedule Management Interface (*1)
A schedule information file (containing a batch ID, recipe name, formula, and equipment specifications for each batch except for the procedure and header information) generated by the schedule management in a supervisory system can be downloaded to the process management.

Information Management Interface
Batch information (parameters, result data, historical messages, and others) can be supplied to other systems by the OPC interface, not by a batch- dedicated interface. To use this interface, the Process Management Package and VP6H2411 Exaopc OPC Interface Package (for HIS) must be installed in a single HIS (server or client).

*1:   Included in the Process Management Package.
*2:   The Unit Supervision is included in the Standard FCS Control Functions.

● CENTUM VP/CENTUM CS 3000/CENTUM CS Connection

In CENTUM series production control systems engineering data for FCS and HIS generated by using Standard Engineering Function is called as a "project." With VP6H4450 Multi Project Connection Package (for CENTUM VP), integration of operation and monitoring of multiple projects can be performed among VP Batch, CS Batch 3000, and CS Batch can be performed when CENTUM VP/CENTUM CS 3000 projects are defined in upper-level. For details, refer to GS 33J05K20-01EN Multi Project Connection Package.
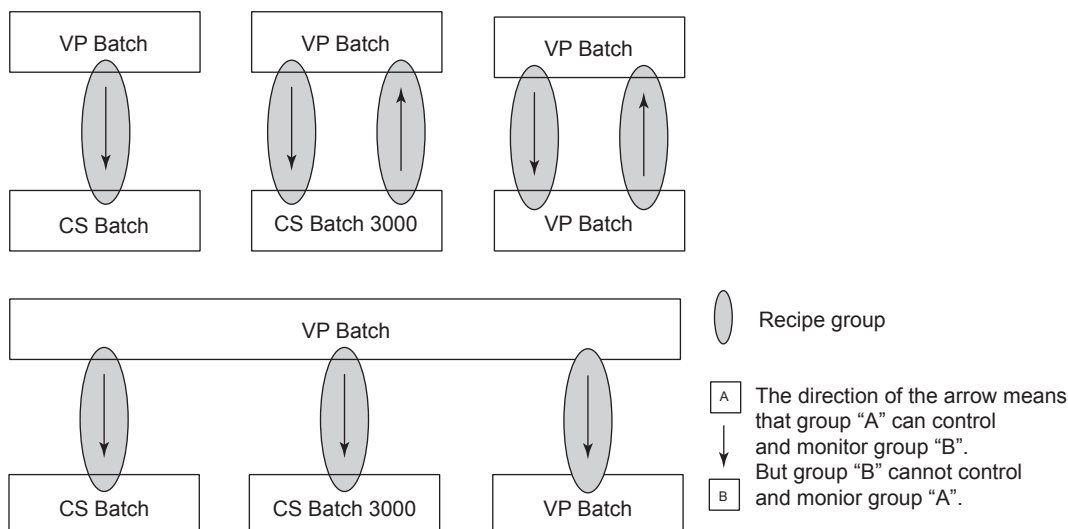
Available Functions

An HIS in an upper-level project can perform functions of client stations in a lower-level project. It means CENTUM VP HIS in the upper-level can reserve and load recipes in the lower-level project. However, the HIS in the upper-level cannot take up the server station function for the lower-level project.

Lower-level project	Upper-level project			
	XL Batch	CS Batch	CS Batch 3000	VP Batch
XL Batch	—	—	—	—
CS Batch	—	—	X	X
CS Batch 3000	—	—	X	X
VP Batch	—	—	X	X

X: Supported.   —: Not supported

Recipe Group Configuration

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Note: For operation and monitoring multiple lower-level projects from an upper-level project, all the recipe group numbers must appear to be unique for the upper-level project.

Number of Clients

Lower-level project	Upper-level project
	VP Batch
CS Batch	Up to 8 clients per recipe group for the sum of lower- and upper-level projects
CS Batch 3000	Up to 14 clients per recipe group for the sum of lower- and upper-level projects
VP Batch	Up to 14 clients per recipe group for the sum of lower- and upper-level projects

Software Packages required for Multiple Project Connections
In order to perform the aforesaid "Available Functions," ensure that each CENTUM system is equipped with the following packages.

VP Batch
VP6H6660, LHS6660 Process Management Package
VP6E5165, LHS5165 Batch Builder
VP6E5166, LHS5166 Recipe Management Package

CS Batch 3000
LHS6600 CS Batch 3000 Process Management Package
LHS5160 CS Batch 3000 Builder
LHS5161 CS Batch 3000 Recipe Management Package

CS Batch
SIH6610/SIU6610 CS Batch Process Management Package
SIH6600/SIU6600 CS Batch Recipe Management Package
SHW5160 CS Batch Recipe Management Builder
SHW5161 CS Batch Process Management Builder

> Note: The following packages are not applicable for multiple project connection.
> • SIH6662/SIU6662 CS Batch Production Planning and Scheduling Interface
> • SIH6663/SIU6663 CS Batch Production Information Management Interface
> • SIH6690/SIU6690 Standard Batch Report Package
> • SHW5170 CS Batch Self-Documentation
> • SHW6661 CS Batch Recipe Management Interface

● **21 CFR Part11 Compliant**
Using VP6E5170 Access Administrator Package to the computer with VP6E5166 Recipe Management Package, the CENTUM system is made to support FDA: 21 CFR Part 11 regulations. Access Control Function and Audit Trail Management Function for complying with FDA: 21 CFR Part 11 compliant are provided as a management tool for recipe engineers (Recipe Management Function).

For details, refer to GS 33J10D40-01EN VP6E5170 Access Administrator Package (FDA:21 CFR Part 11 compliant).

■ APPLICATION CAPACITY

	Item	Maximum
Recipe Management	Recipe groups/project	16
	Number of recipe operation/project	1000
	Number of master recipes/recipe group	1000
	Number of unit recipes/master recipe	32
	Number of trains/recipe group	16
	Number of paths/trains	64
	Number of recipe unit procedure steps	Total 1000 steps/ unit recipe
	Number of recipe operation procedure steps	

	Item	Maximum
Process Management	Number of server stations/recipe group	2
	Number of client stations/recipe group	14
	Number of client stations/server station	48
	Number of control recipes/recipe group	999
	Number of control recipes/project	999
	Number of control unit recipes/project	4000
	Number of common blocks/project	3000
	Number of common blocks/master recipe	256
	Number of common block data items/common block	256 (*1)
	Data check pattern/common block	255

*1: An entire array is counted as 1. Data area size must be smaller than 32KB. Up to two-dimension (999, 999) array up to 10000 of array elements are available.

As for the number of ACTIVE control recipes/project is categorized into three types depending on the process scales and their complications.

	Item	Project Scale	Type - A	Type - B	Type - C
Process Management	Number of ACTIVE control recipes/project	Large Scale Project	10	50	999
		Small/Middle Scale Project	4	10	999

■ OPERATING ENVIRONMENTS

● VP6H6660 Process Management Package

Hardware Requirement
Conforms to the operating environment of VP6H1100 Standard Operation and Monitoring Function

Software Requirements
Conforms to the operating environment of VP6H1100 Standard Operation and Monitoring Function
Required Software:
   VP6H1100 Standard Operation and Monitoring Function

● VP6E5165 Batch Builder

Hardware Requirement
Conforms to the operating environment of VP6E5100 Standard Engineering Function

Software Requirements
Conforms to the operating environment of VP6E5100 Standard Engineering Function
Required Software:
   VP6E5100 Standard Engineering Function

● VP6E5166 Recipe Management Package

Hardware Requirements
Conforms to the operating environment of VP6E5100 Standard Engineering Function

Software Requirements
Conforms to the operating environment of VP6E5100 Standard Engineering Function.
When a recipe view refers to engineering data, VP6E5100 is required.

● Control Function

Unit Operation Instrument and Recipe Operation Procedure work on the following control functions.
   VP6F1700 Control Function for Field Control Station (for AFV30□/AFV40□)
   VP6F1800 Control Function for Field Control Station (for A2FV50□)
   VP6F1900 Control Function for Field Control Station (for A2FV70□)

■ MODELS AND SUFFIX CODES

Process Management Package

			Description
Model	VP6H6660		Process Management Package
Suffix Codes	-V		Software license
	-E		For Expansion
	1		Type-A (Software license)
	2		Type-B (Software license)
	3		Type-C (Software license)
		1	English version
		N01	For Small/Middle Scale Project (Logical I/O points are 4000 or less)
		N03	For Large Scale Project (Logical I/O points are 4001 or more)
		N13	For Project Scale Expansion

Note : When ordering this license newly, be sure to select '-V', and 'N01' or 'N03' as a project scale in the suffix codes.
Note : When expanding the project scale, select '-E' and 'N13' in the suffix codes.
Note : As for the suffix code (1, 2, 3), there is a limit in the number of ACTIVE recipes.

Batch Builder

		Description
Model	VP6E5165	Batch Builder
Suffix Codes	-V	Software license
	1	Always 1
	1	English version

Note : VP6E5100 Standard Builder Function is required.

Recipe Management Package

		Description
Model	VP6E5166	Recipe Management Package
Suffix Codes	-V	Software license
	1	Always 1
	1	English version

Note : This package runs without other software.

■ ORDERING INFORMATION
Specify model and suffix codes.

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