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SIMATIC

BRAUMAT/SISTAR Classic Batch processing

Function Manual

BRAUMAT/SISTAR Classic V6.0 SP2

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Preface

Preface

Purpose of this manual

This manual describes the planning, creation, and production of batches with BRAUMAT/ SISTAR Classic V6.0 and gives you an overview of the following topics:

- Connection between recipe and batch
- Control recipe generation
- Control recipe editor
- Batch data

This manual is intended for those responsible for configuring, commissioning, and servicing automation systems.

Scope of the manual

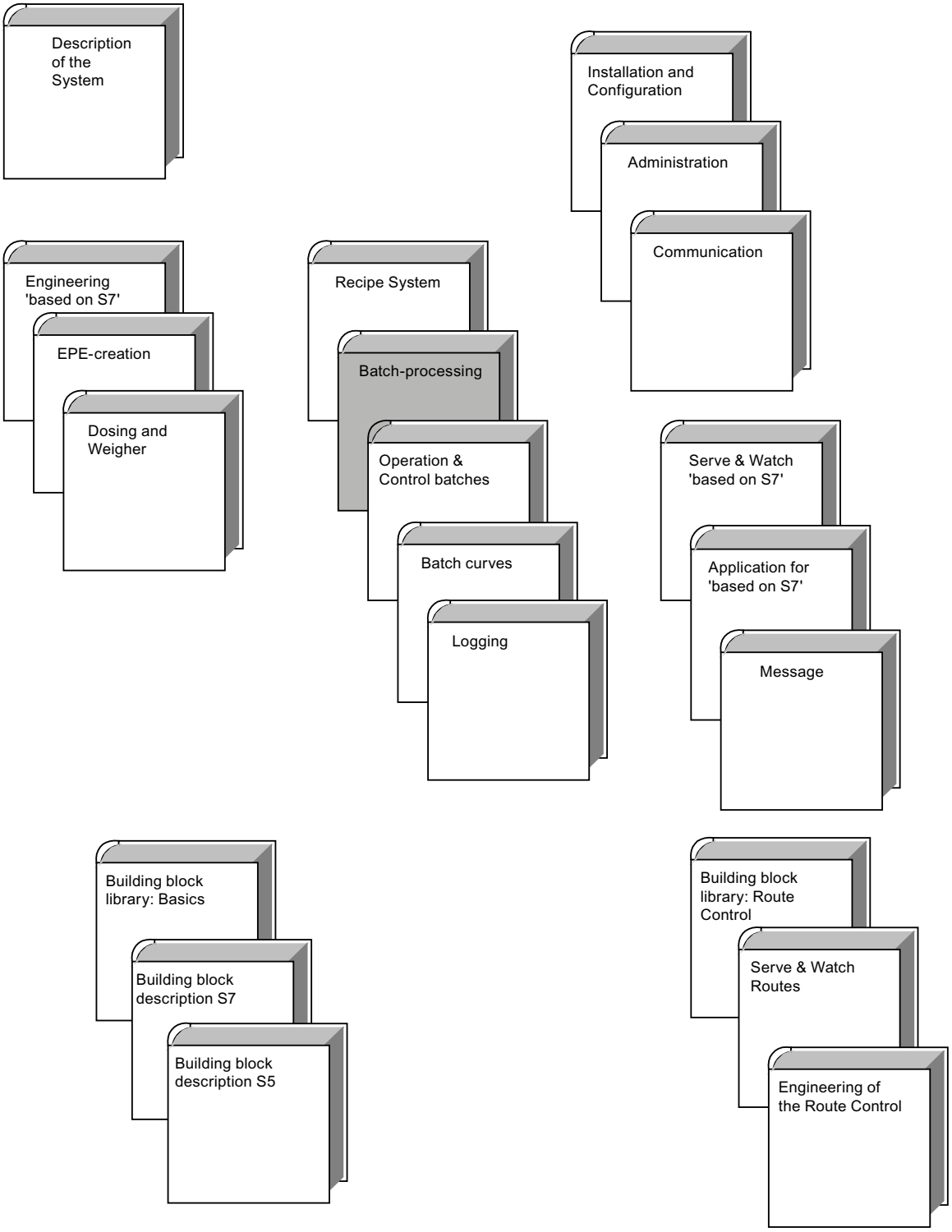
This manual is valid for the software package BRAUMAT/SISTAR *Classic* from Version V6.0.

The offered electronic manual is most largely identical with the contents of the on-line help. Due to a technically necessary editorial deadline for the generation of electronic manuals occasionally smaller deviations can give up opposite the on-line helps. The statements in the on-line helps are primary to those of the manual.

Position in the information landscape

This manual forms part of the BRAUMAT/SISTAR Classic V6.0 documentation package. The following schematic of the document architecture shows the individual manuals as well as their thematic grouping within the entire program package:

Document structure



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- A forum in which users and experts from all over the world exchange ideas and experiences.
- Your local Automation & Drives representative.
- Information about local service, repairs, spare parts. The "Services" section offers even more options.

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General

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1.1 Overview

In this manual an overview of the execution and processing of batch jobs is given. The elementary terms are defined in brief again for this overview.

1.1.1 Recipe

Recipe categories

BRAUMAT/SISTAR Classic V6.0 organizes the master recipes in recipe categories. It is possible to create one order type for any recipe category. Basic recipes of the same category have the same process parameter definition and the same order type definition.

Master recipe

The master recipe is the description of how to produce a product. This description consists of header data, process parameters, and process inputs for BRAUMAT/SISTAR Classic V6.0. The master recipe has a reference on a recipe procedure.

Process input list

All process inputs that are necessary for this recipe are defined in the list. For BRAUMAT/ SISTAR Classic V6.0 only the material and the amount are defined in the list. The storage location is defined by the time of the batch generation via the storage location administration.

Process parameters

All master recipes of a category have the same process parameter definition.

Recipe procedures

The units that are necessary for production and the sequence of steps are defined in the recipe procedure.

Recipe unit procedure

Description of the step sequence within a unit.

1.1.2 Batch

A batch is the conversion of a master recipe.

Batch list

Sequence of batches that shall be processed.

Control recipe

When the process of batch production is started the recipe unit procedures are converted (i.e., their formal parameters are substituted by the actual ones, the dosing operations are expanded according to the amount of configured material) into control recipes that are executed in the PLC.

Process parameters

The process parameters are not copied or stores into the batch data. They can serve as default values for the order parameters as well.

Process input list

When creating the batch the component list is copied in the control recipe. The storage locations are determined by the storage location administration and entered in the control recipe at this time. There is a process input for each batch that can be modified individually until the batch processing of this batch starts.

Order parameters and batch parameters respectively

The values of the order parameter can be entered in the dialog for creating batches. The order parameters can be preset with either fixed numerical values or process parameters.

Control recipe for recipe unit procedure

BRAUMAT/SISTAR Classic V6.0 creates the control recipes at recipe unit procedure resolution. This means that the control recipe is created for each recipe unit procedure at that time of starting the sequence.

All formal parameters of the recipe unit procedure are substituted by their actual values at this time. These are process parameters, order parameters, and process inputs.

Dosing

Dosing operations for all materials from the master recipe’s process input list are generated from the Dosing-ROPs when generating the control recipes.

1.1.3 Batch data

The data that is generated when creating and processing batches is recorded for each batch individually by BRAUMAT/SISTAR Classic V6.0.

- Batch header data (number, basic recipe, point of time)
- Batch parameters
- Batch-related process input
- Batch history (start and end time of the batch)
- Step protocol (starting and ending time, duration, and process values of each step executed)
- Messages
- Curve recording
- Plant-specific protocols of the batch

Job system 2

2.1 Description of processing sequence

In the IOS a list of batch orders is stored.

One recipe and one line are assigned to each batch order so that a starting sequence is determined implicitly.

The processing of the order begins with starting this sequence. The start is implemented via the CAS-block (‘ChargenAuftragsStart’, the German word for Batch Order Start) in the PCU. This CAS-block has a data record. The order system supplies the data records of the CAS.

As soon as the CAS has started the start sequence, a message is sent to the order system. If more batch orders are available for this start sequence, the new job is loaded immediately into the CAS-block. The CAS waits until the sequence is released and starts the next order.

As long as the batch order is loaded into the CAS and the batch hasn't been started yet, the batch is in the status 'Ready to start'.

There are different starting-modes for the starting of batches:

- ‘As soon as possible’ (start as soon as sequence is released)
- ‘By time’ (start after time runs out and sequence is released)
- ‘By time with automatic time correction’ (delay of a previous batch is considered in the start times of the sequential batches)
- 'By event' (an event is created in the SIMATIC);
  S5: a bit must be set in the CAS data record
  S7: for S7 the user function block CAS_USR_FB (FB1205) is called in CAS_FB; in this FB, the user can determine the event; when RLO = 1, the sequence is started

On the IOS there exists a file listing all orders(windcs\Bali\Bali.dbf). The processing occurs in the sequence of input and by starting time. Locked batches are simply skipped.

A batch order stays listed as long as it has not been processed. The user program in the PCU must create the batch end message. This happens automatically when processing the ‘END’-ROP.

Note

The batch process values can be sent to the IOS with the help of ‘free protocols’. As they are stored as dBase-files, a corresponding program, e.g., MS-Access, should be used for the evaluation.

2.2 Connection Recipe - Order

The order system has the task of processing batch orders.

Order types are defined, whereby each order type is assigned to a definite recipe type. For the configured order types batch orders can be entered then.

A batch order produces a single batch according to a determined recipe.

A recipe has to be defined before the batch order is given.

Special parameters can be defined for a order type. The values of these parameters influence the execution of the control recipe.

Master recipe

This is the aggregation of the

- **Process parameter list**
  A list of parameters specific for each master recipe that influence the execution of a control recipe.
- **Process input list**
  A list of materials that are necessary for producing the recipe; this list can be different from batch to batch.
- **Recipe procedure**
  Consists of the assigned RUPs that in turn consist of sequences of recipe operations with setpoints that are necessary for producing the recipe on a technical plant. In the recipe procedure setpoints can be defined as placeholders for values that are filled from the process parameter list, order/batch parameters or from the process input list. Furthermore setpoints can be configured to be scaled with the batch size.
  - One recipe procedure can be assigned to many master recipes of the same recipe category.
  - If a master recipe is selected for the production of a batch, always the combination of master recipe header data, process parameters, process input list, and recipe procedure is meant.
  - The recipe procedure is transformed into a batch-dependent control recipe at runtime. Due to the recipe request (order number, batch number, sequence number) of the PCU:
  - The corresponding recipe procedure will be determined.
  - The order system is queried for the batch size.
  - All setpoints in the recipe procedure which are to be scaled with the batch size are converted.
  - All setpoints which are supposed to be substituted by a batch parameter are processed.
  - All setpoints which are supposed to be substituted by a process parameter are processed.
  - All dosing-ROPs are expanded into the appropriate number of dosing and emptying operations for the materials found in the sequence.
  - The recipe which is adapted in the described way is called ‘control recipe’ and transferred into the PCU where it is executed.

2.3 Batch generation on the IOS

The order system generates the batches on the IOS.

Order and batch numbers must be unique within a year and recipe type. Due to this fact batch numbers cannot be allocated unrestrictedly by the user.

Before the first batch is generated, the order system must determine the number of batches that is necessary and which batch numbers are allocated.

Batch start

The starting mode for the batches is determined, too.

The starting modes that can be used with a certain order type are selected when the order type is configured. The checkbox for the starting mode of an order type can be found in the dialog ‘Project planning > Order type’ by pressing the ‘Start mode’-button.

Taking over batch parameters

With the generation of the batches all order parameters with the exception of the sum parameters are copied into the batch data.

A sum parameter is a part of an order parameter that is proportional to the size of a single batch. It is calculated following the given equation:

- Parameter (batch) = parameter(order) / size(order) * size(batch)
- An order parameter is configured as a sum parameter when the order type is defined. The sum parameter checkbox can be found in the dialog “Project planning > Order types’ by pressing the ‘Order parameters’-button.

2.4 Order parameters

Every batch order can include parameters.

The number of the parameters and their definitions need to be configured.

The configuration can be different for every order type.

2.5 Job list

There is no independent order list on the IOS-level.

However, an order view based on the batch list is offered.

In this deduced order list all batches of the same order number are summarized and represented in a line.

2.6 Batch start list

The batch start list determines the start sequence for the different lines (the entries are line-related).

Every line has a start sequence. The data is stored on parameterized disk drives redundantly.

The data is accessed via a DLL (BALIDATA) with the following functions:

- The interfaces for plant-specific expansions are exposed.
- The corresponding CAS and the start sequence are determined from the line number and the recipe when an order is created.

2.7 Batch monitoring

The batch monitoring displays the batch. The state is determined from the IOS-copies of the CAS and the sequence image.

In every line a batch is shown with the sequences that have already been running, the sequences that are running, and the following sequences according to the unit recipe (in different colors).

The sequences are combined in the application batch monitoring. The sequences processing-sequence is stored line-dependently.

The sequence image is updated via a general request at system startup.

The sequence control sends the current copy for all sequences after the general request has been received. Otherwise a telegram will be sent to the IOS only if a sequence’s state changes.

2.8 Batch parameters

The batch parameters are transferred in the control recipes instead of the placeholders in the recipe procedure (substitute by batch parameter).

In the order system application (BALIedit.exe), you can display batches and their parameters in the form of a table. Each line represents one batch and its associated parameters. Consequently, it is only possible to display batches of the same type.

The editor does not distinguish between future, present or past.

Procedure processing 3

3.1 Division between PCU and IOS

3.1.1 IOS-Functions

- Creates control recipes for recipe unit procedures and loads them into the PCUs
- Executes synchronizations
- Executes alternatives
- Sequence image
- Processes and stores step protocols

3.1.2 PCU-Functions

- Processes sequences
- Controls technical operations
- Controls the transitions in a PLC-cycle
- Executes jumps
- Updates sequence images
- Operating modes

3.1.3 Sequence image

When processing the recipe procedures, any change of a sequence's state is signaled to the IOS. A copy of the image data is kept by the application 'PCU_SERVER'. At system start the server requests the data by sending a 'general request'.

The copy is updated by the PCU. The PCU sends telegrams of type 13 to signal a change in state.

The IOS recipe control uses the sequence image.

Visualization

The sequence image can be monitored in the recipe server monitoring window of the PCU_SERVER.

See also: Operation and Control of Batches Sequence image

3.2 Synchronizations

3.2.1 Processing synchronization

Processing in the PCU

If the transition of a step is met (RLO = 1) and the step following is a synchronization operation then:

- The transition to the next operation is delayed; this is shown in the sequencer data record,
- a sequence state (type 13) is sent to the IOS,
- the equipment operation preceding the synchronization is processed although its transition is met until the synchronization is completed.
- The message 'Synchronization achieved' can also be withdrawn again (operation is not exited if ROL = 1). The sequence is described in section Loss of the "VKE=1" of an operation before synchronization (Page 20).

Processing in the IOS

The recipe control creates a synchronization object after receiving the type 13 telegram.

This object is identified by synchronization number, year, recipe type, order, and batch number. Any further messages for the batch and the synchronization are stored and evaluated in this object.

With termination of the batch all synchronization objects are deleted for this batch.

In the object the states of the sequence that are waited for and that should be started are stored and evaluated.

If the synchronization is completed (all sequences that are waited for have reached their synchronization, all sequences that are to be started are free), all participating sequences are released. Sequences that need to be started with the synchronization are started by the recipe control.

Visualization

In the sequence control application the state 'Sequence waits at synchronization' is displayed as '='.

As an expanded possibility of diagnosis the state of the synchronization can be visualized via the application 'diagnosis batch control'.

 See also:  Operation and Control of Batches  Diagnosis Batch Control

Messages

If the synchronization contains a sequence that cannot be started, a message will be created (exception: The sequence is busy with another batch).

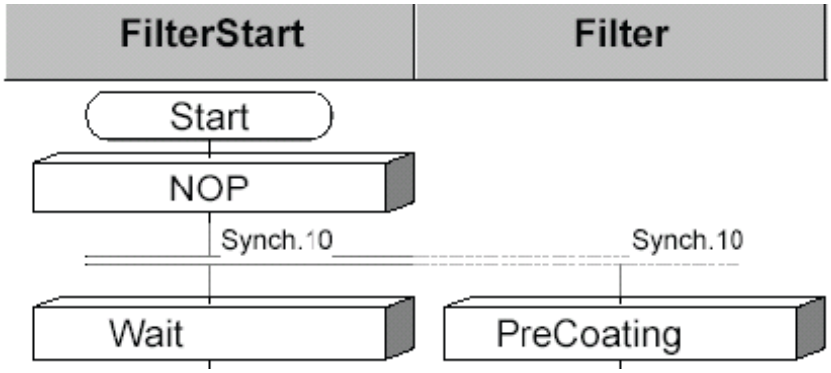
3.2.2 Completing a synchronization

If all sequences which are to be started have sent positive feedback, the transition is completed. The transitions of all sequences which participate in the synchronization are set. This is displayed in the sequence data record (relative address in the record D 28.13 with SIMATIC S5, D 52.5 with SIMATIC S7). The sequence processing continues and executes the next step.

3.2.3 Non-blocking synchronization

Non-blocking synchronization can only be used for starting sequences.

Function



If the synchronization 10 is met by processing the sequence 'FilterStart', it will be attempted to start the sequence filter. If this sequence is busy, in manual mode or the preselection hold is active, the start will be stored and executed later. The processing of the sequence 'FilterStart' is continued.

The processing at the synchronization 10 would stop and wait for the sequence 'filter' for a blocking synchronization.

All stored starts are deleted with batch end independent of whether they have been executed or not.

Note

In order to use the non-blocking synchronizations, these must be enabled explicitly in "windcs \recipe\project\plant.ini" by setting "EnableNonBlockingSync=1" in the section "[Version4.60]".

3.2.4 Loss of the "VKE=1" of an operation before synchronization

Step condition, "Standard"

With two successive EOPs ("TOP A" and "TOP B"), the FCs are executed in the PCU as follows:

- *Cycle n:*
  Start of TOP A execution ("GSTA" is set)
  ...
- *Cycle m:*
  TOP A execution, step condition is met ("VKE"=1)
  Last cycle of TOP A ("GSTO" is set)
  First execution of TOP B ("GSTA" is set)
- *Cycle m+1:*
  TOP B processing

Step sequence with synchronization

When the EOP is followed by a synchronization, the operating principle is the same, though the last EOP cycle with set "GSTO" is not executed unless the subsequent synchronization condition is met.

If the EOP step condition is not met within the time the synchronization condition is met, the synchronization is discarded!

- *Cycle n:*
  Start of EOP A execution ("GSTA" is set)

  ...
- *Cycle m:*
  EOP A execution, step condition is met ("VKE"=1)
  Verification of the synchronization condition by the recipe control function of the IOS

  ...
- *Cycle m+k:*
  Synchronization condition is met (**this also implies**: EOP A step condition is still met)
  Last cycle of EOP A ("GSTO" is set)
  Start of EOP B execution ("GSTA" is set)

Note:

In the second example above, if the step condition for EOP A is lost, the synchronization condition is also discarded, execution of the EOP is not started with "GSTO", and it is terminated.

If technological aspects allow a single positive signal edge (e.g., temperature reached, step condition is met when the process value of the temperature drops below the setpoint again), the step condition should be first saved to a flag and then be reset with "GSTO".

3.3 Alternatives

3.3.1 Processing alternatives

Processing in the PCU

The equipment operation preceding the alternative (‘Alternative destination producer’) transfers the alternative result into the global byAlterResult variable (S7: UDT 725 byte 59).

If the transition (RLO=1) is met and if the next step is an alternative operation then:

- the transition is delayed; this is displayed in the sequence data record (relative address in the data record D 28.13 with SIMATIC S5, D 52.5 with SIMATIC S7),
- a sequence state (type 13) is sent to the IOS,
- the recipe operation before the alternative is processed, in spite of RLO=1 as long as the alternative hasn't been completed.

Processing in the IOS

When the telegram type 13 is received, an alternative object is created in the recipe control (IOS).

This object is identified by its alternative number, year, recipe type, order, and batch number. Any further messages for the batch and alternative are stored and evaluated in this object.

If the ‘End’-operation is processed in the PCU, all alternative objects of this batch are deleted.

Visualization

In the sequence control application the state 'Sequence waits at alternative' is shown as '_'.

As an expanded possibility of diagnosis the state of the alternative can be visualized via the application 'diagnosis batch control'.

See also: Operation and Control of Batches Diagnosis Batch Control

Messages

If the alternative contains a sequence that cannot be started, a message will be created (exception: The sequence is busy with another batch).

3.3.2 Completing an alternative

If the sequence which is to be started has sent positive feedback, the transition is continued. The transitions of two sequences participating in the alternative are set, this is displayed in the sequence data record (relative address in the record D 28.13 with SIMATIC S5, D 52.5 with SIMATIC S7).

The sequence processing in the PCU goes on to the next step.

3.4 Jump Operation

The operation preceding the jump determines a jump destination before a jump is processed. This has to be implemented in the equipment operation. In the recipe editor the possible jump destinations are configured. The jump destination needs to be transferred to flag byte MB100 as well as to the global variable u.byAlterResult in DB 725.

Jumps in the recipe unit procedure can only be inserted following a jump destination producer.

If a jump is processed, the RUP is searched for a corresponding jump destination. Searching starts at the first step and is conducted sequentially.

If a corresponding jump destination is found, execution is branched to this step. If no corresponding destination is found, the sequence processing proceeds as if no jump operation was met.

The step is changed in the PLC-cycle.

3.5 General description of processing

The task of the recipe system can be divided into three units.

These are:

- the recipe-load-function,
- the recipe control
- and the recipe editor.

The PCU processes the sequence of operations. If a synchronization or alternative is reached, this will be signaled and the processing remains in this position. The processing will be enabled from the recipe control again, if the conditions are met.

Via synchronization any further sequences are started. Every sequence requests a recipe from the recipe-load-function before the processing starts.

The recipe processing ends with the last equipment operation of the last sequence. This is a special operation of ‘End’-type usually and it signals ‘End of batch’ to the IOS.

3.5.1 Recipe load function

In the IOS a list of batch orders is stored. One recipe and one line are assigned to each batch order The start sequence can be determined from the recipe procedure header due to that.

A batch order is loaded from the order control in the CAS-Block of the PCU. This block starts the sequence.

Before the processing of the sequence starts, it requests a control recipe from the IOS. In the IOS the master recipe is determined by the recipe header.

Order parameters, process parameters, and dosing operations are incorporated in the recipe procedure.

This batch-dependent recipe procedure (=control recipe) is transferred to the PCU. The recipe control in the PCU processes the sequence of unit operations.

If there is a dosing-operation in the recipe procedure, it will be inserted as often as materials from the process input list can be dosed by this unit. Dosing operations are inserted only if the sequence ID (weigher-unit) and the dose group (order of dosing) correspond.

If the process input list yields an empty sequence input list, the system usually omits the resulting empty sequence, but a different behavior is possible if desired.

See also: Weighers and Dosing Reaction to empty list

3.5.2 Determine start sequence

When an order is entered, it is determined with which master recipe and on which line the order should be processed.

The order control needs the starting sequence for the CAS in order to start a batch job.

The recipe procedure number is found in the master recipe header data.

The starting sequence is determined from the recipe procedure header.

If the line has the identification 'reference line', the determined sequence is the start sequence.

If the line has the identification 'parallel line', the start sequence must be determined via the sequence assignment table.

3.5.3 Connection of Process Input List and Recipe

In the process input list materials are stored for an individual master recipe.

A process input list is always needed if a recipe procedure contains dosing operations.

This list can come from a CIS. For every batch a list exists. The list (from the CIS) consists of CIS-process-input-ID and quantity.

In the IOS the CIS input list is supplemented with

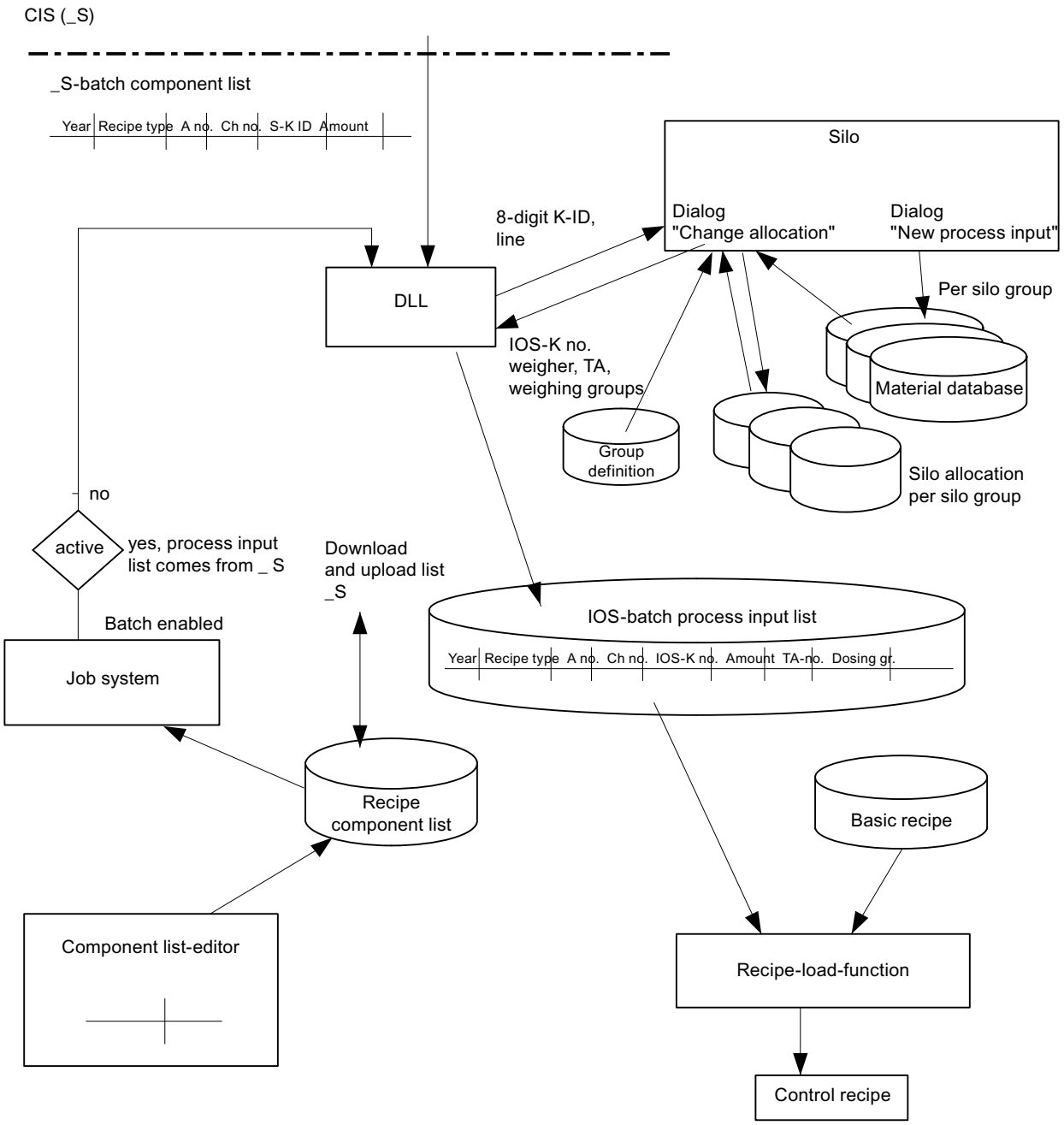
- IOS – process-input-ID,
- Sequence number (weigher),
- Dosing group (to determine the dosing-sequence)

and yields the IOS process input list

To supplement the CIS-process-input list the system needs to access the data stored in the material database (tank silo management, see also: Dosing and Weighers). All materials that are used must be in the IOS material database.

Without a superpositioned CIS the master recipe process input list is transformed into the IOS batch process input list.

All materials are scaled to the actual batch size before they are stored in the batch list. The list has to be supplemented with the data from the material database as well.


CIS (_S)
_S-batch component list
Year Recipe type A no. Ch no. S-K ID Amount
Silo
Dialog "Change allocation"
Dialog "New process input"
8-digit K-ID, line
DLL
Per silo group
IOS-K no. weigher, TA, weighing groups
Material database
Group definition
Silo allocation per silo group
no
active
yes, process input list comes from _ S
Download and upload list _S
IOS-batch process input list
Year Recipe type A no. Ch no. IOS-K no. Amount TA-no. Dosing gr.
Batch enabled
Job system
Recipe component list
Basic recipe
Component list-editor
Recipe-load-function
Control recipe

Batch data 4

4.1 Batch data

Starting the application

To start the application, select:

Main menu -> Process monitoring \ Batch list

Data input

This data is entered via the dialog 'New order' of the order system. The data can also be generated by a CIS.

Visualization and print

Data of all running and scheduled batches can be visualized and printed in the batch list view. All processed batches can be printed via the history view of the order system.

These views display

- Batch header data (number, basic recipe, point of time)
- Batch parameters
- Batch history (start and end time of the batch)

4.2 Step protocol

Recording

The step protocol is recorded by the system automatically. The following data is stored for every step:

- Start time (year, month, day, hour, minute, second)
- Batch identification (year, recipe category, order and batch number)
- Recipe name,
- PCU and sequence name,
- Scheduled and actual running time of the step and
- At the end of each step, for each setpoint the setpoint name, dimension, setpoint, and process value will be logged.

Visualization and print

The application 'step protocols' should be used for the visualization and printing.

4.3 Messages

Recording

All messages are recorded batch-related.

Visualization

Messages can be visualized via

- Message archive
- Message faceplate (individual filters for each process image)
- Message view in the PCU-Server.

Printing

It is possible to print messages via the application 'message archive'.

4.4 Curve recording

In BRAUMAT/SISTAR Classic V6.0 the curve recording is integrated by batch curves.

See also: Batch trending

4.5 Plant-specific protocols

Plant-specific protocols can be created besides the data that are created in the system. The user program can determine the structure, the time, and the data that should be recorded.

See also: Logging Free definable logs