PM-QUALITY

Order/Batch-oriented Archiving and Reporting

System Description Version 10

Standard, Professional

Edition: 09/01/2016

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1. Overview

1.1 General information

The quality level of industrially produced goods gains more and more relevance in the increasingly intensive competition. Consequently, the acquisition of relevant production parameters is an important part of the quality control and the quality certification for a comprehensive quality management and is essential for the competitiveness of a company.

Data like

- Process and production data
- Fault and operational messages
- Laboratory and analysis data

from various sources ranging from WinCC, PCS7, WinCC Runtime Professional and over OPC/DA and text import from WinCC Runtime Advanced / Comfort can be combined into meaningful reports and long term archived.

In combination with SIMATIC WinCC, the WinCC option SIMATIC Logon and additional written process instructions from the customer, PM-QUALITY fulfills the requirements of 21 CFR Part 11.

Whether seamlessly integrated into the WinCC operator screens or as a standalone application, PM-QUALITY provides the required transparency.

The trend display that can also show data from several batches in comparison is combined with the overlay of additional information like alarms, event triggered readings, process phase transitions and annotations forming a full blown analysis tool with high usability.

1.2 One system for simple and complex plants

The field of application for PM-QUALITY covers not only very simple applications, e.g. in mechanical engineering, but also complex applications in process-control or manufacturing production plants.

This means: from the batch-related acquisition of production data (temperature, pressure, quantities, speeds, etc.) of a machine or an apparatus through to the batch-related data acquisition of several[1] production lines or production units.

PM-QUALITY can be used either as a single-user system or as a multi-user system in client/server technology.

PM-QUALITY supports different plant configurations depending on the edition (Standard, Professional).

1.2.1 One production unit, line, machine

PM-QUALITY acquires and archives current process data (temperatures, pressures, etc.) for the active batch as well as set points (e.g. planned quantities, recipe parameters, etc.) together with alarms and audit trail messages.

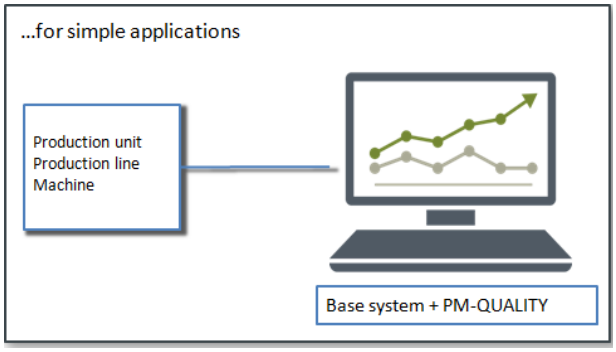

Figure 1: PM-QUALITY Standard edition

1.2.2 Multiple independent production units, lines, machines

This configuration is only supported by the PM-QUALITY *Professional* edition.

PM-QUALITY acquires and archives current process data (temperatures, pressures, etc.) for multiple active batches in parallel as well as set points (e.g. planned quantities, recipe parameters, etc.). This provides independent and parallel data acquisition and archiving for up to 100 production units.

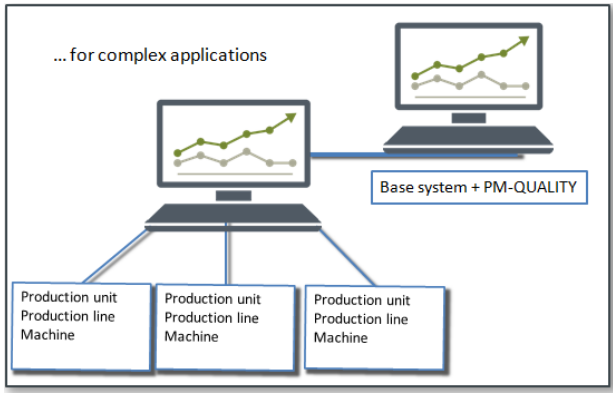

Figure 2: PM-QUALITY Professional edition

[1] Systempaket Typ S Professional

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1.2.3 Multiple linked production units, lines, machines

This configuration is only supported by the PM-QUALITY Professional edition.

Each aggregate (e.g. proportioning unit/mixer, oven or filling unit) is modeled as a production unit. These individual production units are combined in the PM-QUALITY Topology Manager to form a logical unit (linked) which is called a plant section.

The product batch is produced on a plant section and contains multiple batches which are produced on the appropriate production units. PM-QUALITY acquires and archives all relevant process data like temperatures, pressures, set points, alarms, audit trails etc. for the individual batches. The data for each single batch is combined and presented in the product batch report.

Linked production units allow several unit batches from different product batches to run on the same plant section at the same time.

Multiple plant sections can operate in parallel.

The following figure shows three batches being processed concurrently on the plant section:

- On production unit 1 (Mixer) runs the PU 1-batch from product batch Product 3.
- On production unit 2 (Stirrer) runs the Batch PU 2-batch from product batch Product 2.
- On the production unit 3 (Oven) runs the Batch PU 3-batch from product batch Product 1.

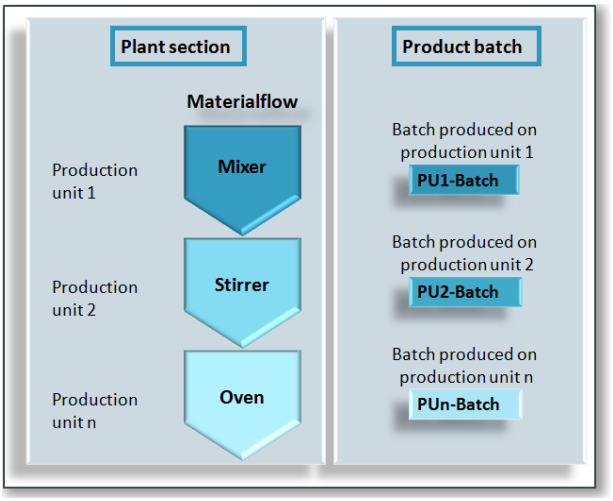

Figure 3: Linked production units I

A more complex plant topology may also be realized by using PM-QUALITY. For example, plant sections can be designed for several product groups with different combinations of production units. A production unit may be linked into several plant sections.

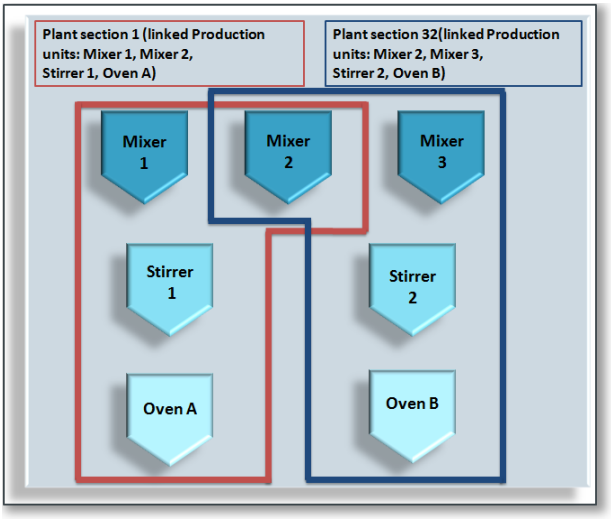

Figure 4: Linked production units II

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1.3 Performance characteristics

The high flexibility of PM-QUALITY is based on a consistent, modular construction and on a refined, comfortable engineering technology.

Archived batch data can be retrieved by individually configurable filters at any time quickly and easily. The integrated report editor allows the creation of multiple different views over the archive data. This allows the creation of reports according to existing reporting design guidelines.

PM-QUALITY is available in the editions

- Standard
- Professional

It provides a decisive contribution towards an economical solution.

All archive data is saved in a relational database and can be read via the documented PM-QUALITY interface, for example with Visual Basic Script.

The combination of PM-QUALITY with the PM-CONTROL recipe and order control system represent an integrated and innovative solution for a broad field of applications in order / campaign / lot / batch-oriented production plants.

1.3.1 Characteristics Standard

- Plant configurations: one production unit, line or machine (refer to Section: 1.2.1)
- Order/batch-oriented or shift-based or time-based archiving of relevant production data
- Cyclical acquisition of current process data (temperatures. filling levels, pressures etc.)
- Event-controlled acquisition of actual data such as after batch start, bevor batch end or for phase change
- Event-controlled acquisition of set points (recipe parameters, etc.) e.g. after batch start, before batch end or at phase transitions
- Transfer of fault, operational, operator, system messages, etc. archived in the connected base system into the order/batch-oriented archive of PM-QUALITY with assignment to a batch
- Direct acquisition or transfer of the archived process values from the connected base systems into the order/batch archive of PM-QUALITY with assignment to a batch
- Manual archiving, for example laboratory and analysis data, but also process data that could not be recorded automatically
- Graphical display of recorded batch data in trend diagrams with the PM-QUALITY.TrendCurve control
- Recording and evaluation of operating modes/states from single aggregates up to complete plan sections with graphical display in trend diagrams
- Calculations over recorded production data e.g. statistic evaluations and calculation indicators
- Individual creation of batch reports to output data on the screen, a printer export as HTML
- Automatic or manual output of reports on configurable printers
- Automatic export of archived data to external media in database format or as HTML or XML files for backup
- Manual output of particular reports on screen
- Evaluation of the time duration for particular messages or for states of a state model
- Transmission of calculated data via Email or into a file
- Manual release / lock function for batch data in connection with an electronic signature (SIMATIC Logon)
- Excel Add-in for the creation of individual reports and data analysis over multiple batches

1.3.2 Characteristics Professional

In addition to the performance characteristics described for Standard, the Professional edition provides:

- Plant configurations: multiple independent production units, lines or machines (refer to Section: 1.2.2).
- Plant configurations: multiple linked production units, lines, or machines (refer to Section: 1.2.3).
- Automatic and manual creation of product batch reports and output on the screen or on arbitrary printers

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1.4 Easy connection to base systems

WIth the integrated component PM-SERVER, PM-QUALITY is open for an easy connection to different base systems for process visualization. The connection is made either to a local system or via a LAN (TCP/IP).

In base systems like SIMATIC WinCC™ or SIMATIC PCS7™ the PM-AGENT together with the PM-SERVER takes over the transmission of process values, archive values, alarms and permissions to PM-QUALITY.

The PM-AGENT is designed to be used with SIMATIC WinCC versions 7[2] and 13[2]

Process values can be read into PM-QUALITY from the base system WinCC RT Advanced / Comfort, WinCC flexible or other base systems (e.g. SIMATIC S7) via the integrated OPC UA/DA interface in PM-SERVER. Alarms and Audit Trails are imported via text files in this case.

PM-QUALITY therefore provides a flexible, upgradeable archiving solution for the process control engineering tasks in batch processes.

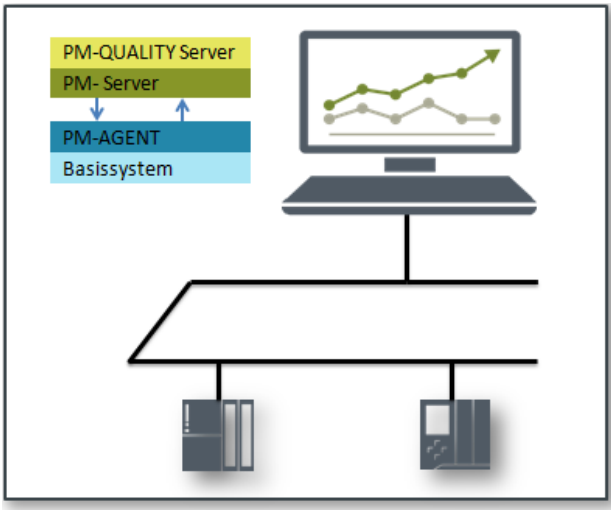

Figure 5: PM-QUALITY in a local System

[2] For the released base system versions please refer to the release notes of PM-QUALITY.

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2. System configuration

2.1 PM-QUALITY single-user system

The PM-QUALITY system software can be installed on a standalone base system system and runs on the 32/64 Bit versions of Windows 7/8.1 and the 64 Bit versions of Windows 10, Windows Server 2008 R2, Windows 2012 R2 Server, Windows Server 2016 and Windows Server 2019[3].

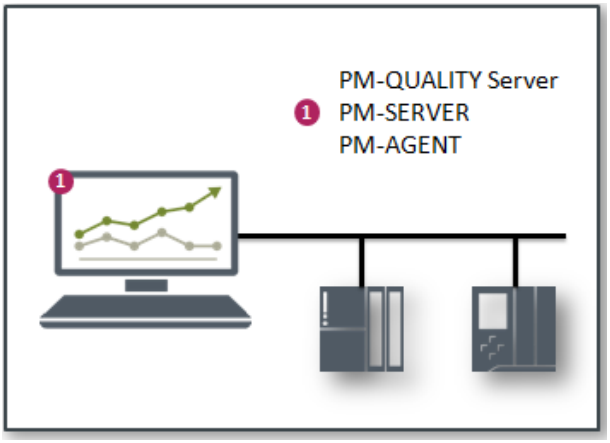

Figure 6: PM-QUALITY single-user system on a local base system

2.2 PM-QUALITY multi-user system

The PM-QUALITY system software can be installed within a multi-user system on the base system server. A PM-QUALITY multi-user system consists of

- one PM-QUALITY server (System package Type S)
- one or more PM-QUALITY clients (System package Type C).

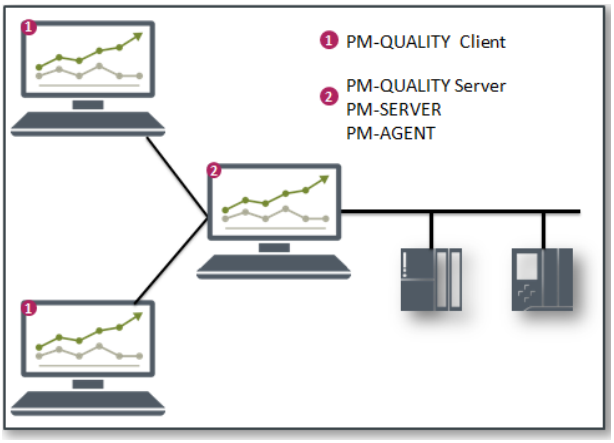

Figure 7: PM-QUALITY multi-user system

The PM-QUALITY server is installed on the server of the base system or on a separate computer and is used for the central acquisition and archiving within a PM-QUALITY multi-user system. The complete configuration of PM-QUALITY using the Topology Manager is done on the PM-QUALITY server.

The visualization of the process and production data is possible on both the server and on the clients that are connected using a LAN.

The PM-QUALITY client is installed on the base system client or on a separate computer.

[3] For the released operating system versions please refer to the release notes of PM-QUALITY.

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2.3 PM-QUALITY Client multi-user system in a distributed system

The PM-QUALITY system software can be installed within a distributed system on any computer.

A PM-QUALITY multi-user system consists of

- one PM-QUALITY server (Type S system package)
- one or more PM-QUALITY clients (Type C system package).

The PM-QUALITY server is used for the acquisition and archiving within a distributed system. The complete configuring of PM-QUALITY using the Topology Manager is always done on the PM-QUALITY server.

The visualization of the process and production data is possible on both the server and on the clients that are connected using a Windows network (LAN).

The PM-QUALITY client is installed on the base system clients or on any computer in the LAN.

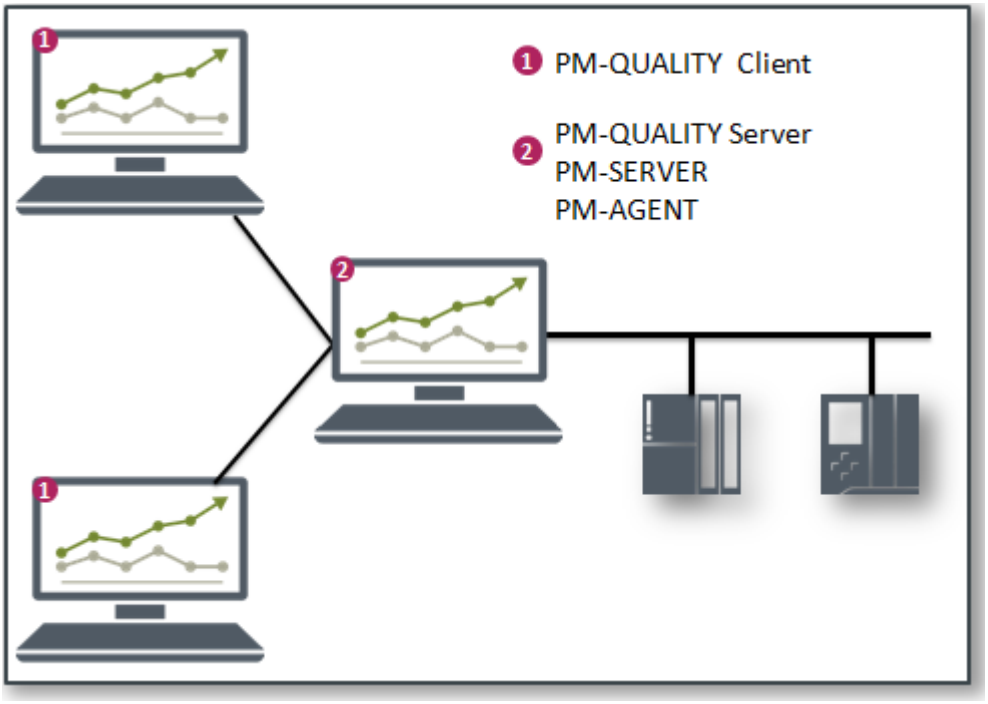

Figure 8: PM-QUALITY in a distributed system

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3. Operation

3.1 General Information

A significant advantage of PM-QUALITY is the separation into multiple software modules:

- Topology Manager
- Report Editor
- Data Logging
- Data View
- PM-QUALITY.BatchTable
- PM-QUALITY.TrendCurve
- PM-QUALITY Data Center (redundancy option)

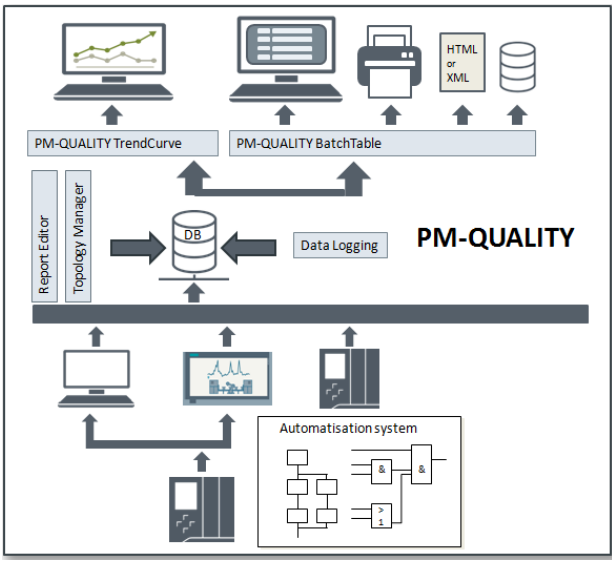

Figure 9: Functional schema

3.2 Configuring the Topology Manager

The main configuration of PM-QUALITY is performed in the Topology Manager.

- Definition of the production data that are to be acquired and archived by PM-QUALITY
- Connection to the automation level by assigning the corresponding process tags
- Planing and configuration of the access rights within PM-QUALITY

This step, right in the beginning of the plant conception, defines the data volume and acquisition modes to be used.

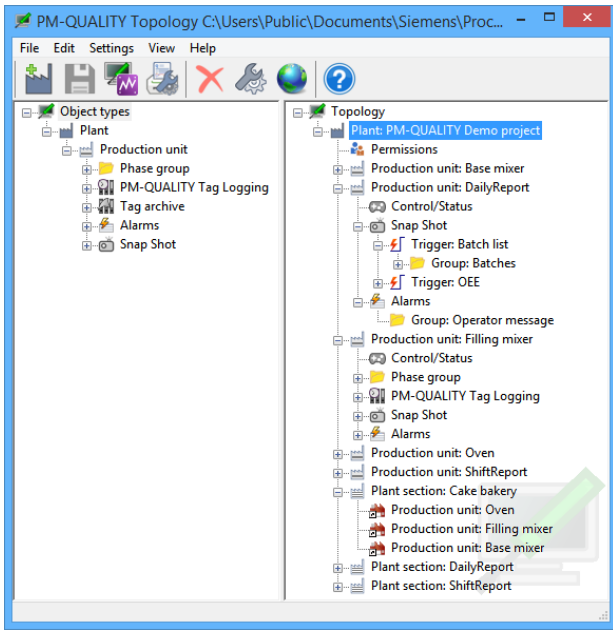

Figure 10: PM-QUALITY Topology Manager

3.3 Configuring report layouts with the Report Editor

Before batch data can be printed or exported, the report layout must be configured. All layouts are created with the software modul Report Editor. The report layout specifies which batch data should be displayed in which format. Different layouts can be configured for the export to HTML, the automatic and manual printout.

A report layout is assigned either to a production unit or to a plant section in the operating mode Linked production units.

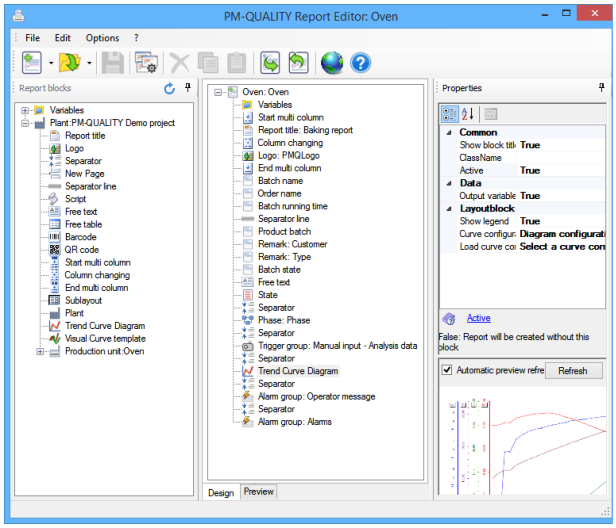

Figure 11: PM-QUALITY Report Editor

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3.4 Data Acquisition and archiving with Data Logging

The software modul Data Logging automatically performs the batch-oriented or shiftbased data acquisition and archiving in the background.

The data logging does

- the cyclic acquisition of process values (temperatures, pressures, flow rates, filling levels, etc.) for the display in trend diagrams
- the event-triggered acquisition of process values or set points (planned quantities, actual quantities, recipe parameters, etc.) e.g. at batch begin, batch end or phase transitions for the display on batch reports.
- the acquisition of process values from the process value archives for the display in trend diagrams
- the archiving of alarms from the alarm archives
- the archiving of operation states.

The Data Logging module is also responsible for the communication (handshake) with the automation system.

All relevant actions such as batch start, phase transition, reading of event-triggered data (snapshot), etc. are chronologically displayed in the logbook.

The Data Logging is started from the startup list of the integrated PM-SERVER.

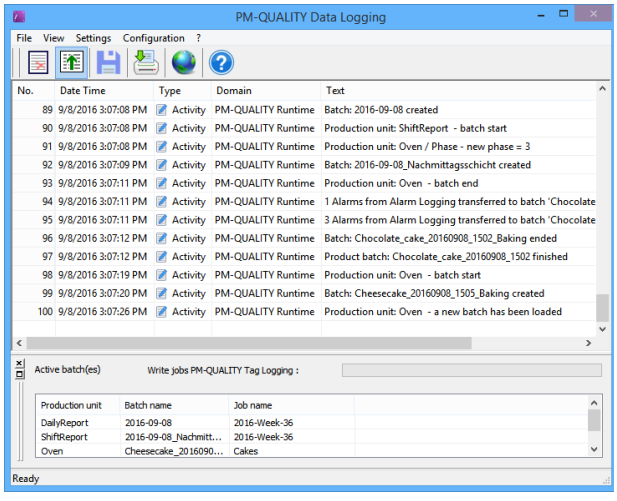

Figure 12: Data Logging logbook

3.5 Batch data display with the Data View

The software module Data View is used to display the recorded batch data.

The Batch list register displays header information like batch name, start- and end time etc. of all recorded batches stored in the current runtime database or an historical export database in a table.

The Trend Curve register is used to display the archived batch data as trends in various ways. Cyclically archived data, as well as event triggered recordings can be viewed together with batch phases and alarms.

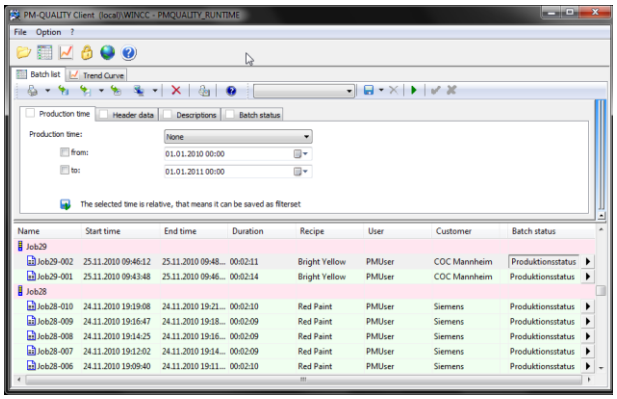

Figure 13: PM-QUALITY Data View

PM-QUALITY.BatchTable Control

The PM-QUALITY.BatchTable Control corresponds to the Batch list register in the Data View. It can be used to operate PM-QUALITY from within an operator screen. All relevant data like job- or batch name, batch start and end time, phases, snap shorts, alarms and operator messages can be viewed as a batch report from the control. The report may be viewed on demand on screen or printed. If required, the report may also be exported into an export database, as an html file or in xml format.

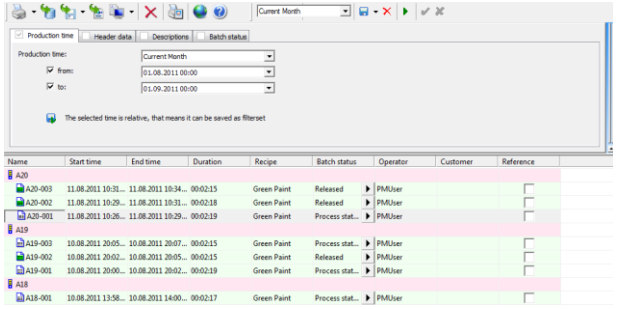

Figure 14: PM-QUALITY.BatchTable Control

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PM-QUALITY.TrendCurve Control

The PM-QUALITY.TrendCurve Control corresponds to the TrendCurve register in the Data View. It displays batch data from one or multiple batches in a trend diagram. All data recorded during the batch like continuously recorded curves, event triggered recordings of snap shots, phases, alarms and operator messages can be displayed within the diagram. Detail information is shown as tooltips or additionally displayed in a table below the diagram. With the comfortable zooming functionality sections of interest can be easily enlarged for detailed analysis.

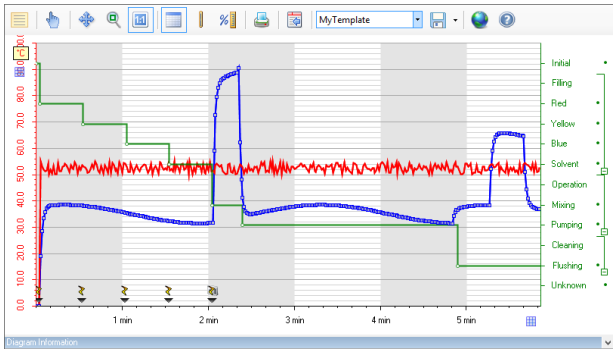

Figure 15: PM-QUALITY.TrendCurve Control

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4. Topology Manager

4.1 General Information

The topology is a model of the plant structure with all process values be acquired (temperatures, pressures, etc.) as well as set points (planned quantities, recipe parameters, etc), alarms and operator messages.

The complete data acquisition configuration of PM-QUALITY is defined in the Topology Manager:

- Definition of which production data is to be acquired
- Time definitions when data shall be acquired
- Combination of the production data to be acquired with the corresponding tags
- Alarms and operator messages which shall be displayed in the report
- Access rights within PM-QUALITY

Before the configuration in the Topology Manager starts, the relevant base systems are set up as stations in PM-SERVER. Process tags, archive tags, alarm blocks and permissions are imported via the PM-AGENT from the base systems SIMATIC WinCC / WinCC RT Professional / PCS7 to the PM-SERVER and are then available for configuration in the Topology Manager.

To connect to SIMATIC WinCC RT Advanced / Comfort, WinCC flexible or other base systems an OPC connection can be configured. CSV-archives from SIMATIC WinCC RT Advanced / Comfort or WinCC flexible like alarm logs and audit trails are imported as text files into the PM-SERVER. All configuration data configured in PM-SERVER is available in the PM-QUALITY Topology Manager.

The Topology Wizard guides the user when a new plant is created. All configured objects are displayed in the main window in a hierarchical tree structure. Detailed information can be displayed at any time using the appropriate tables.

Complete production units, lines, and machines can be copied within the topology tree.

Individual object structures and also complete plant configurations can be exported to the PM-LIBRARY. The exported elements can be reused in other PM-QUALITY projects by using the import function.

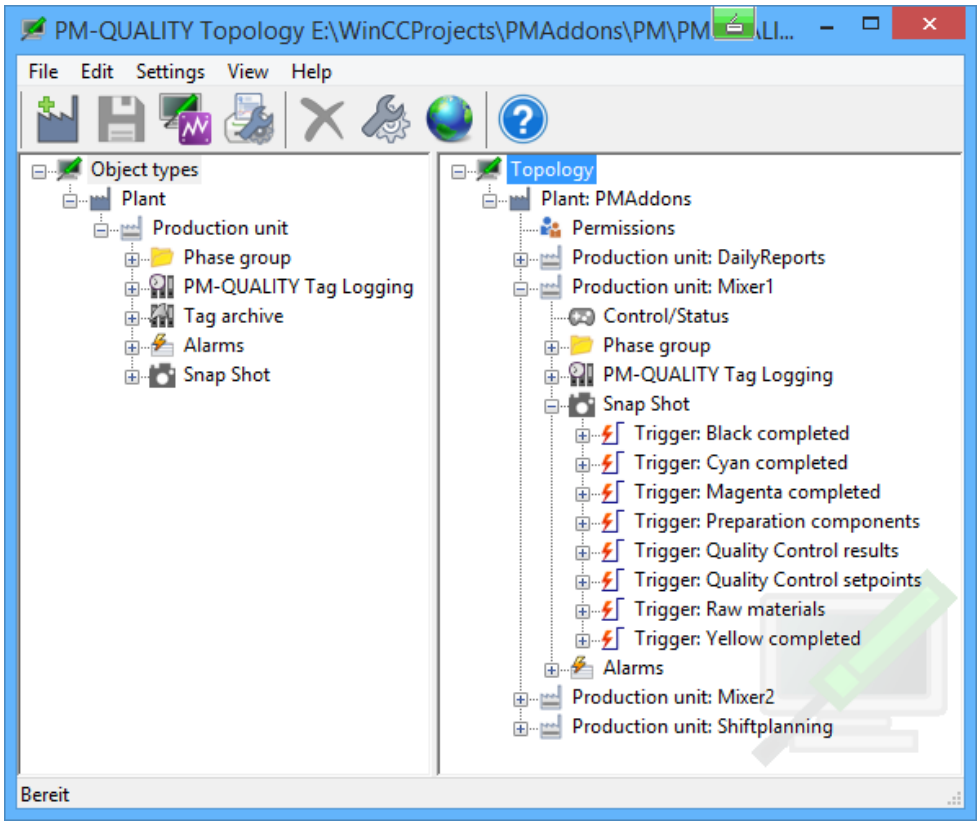

Figure 16: Main window of the Topology Manager

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4.2 Configuring: Acquisition of the process and production Data

PM-QUALITY can acquire the process and production data differently depending on the process requirements.

4.2.1 Cyclical acquisition

The display of process data in trend diagrams can be based on a cyclical acquisition. This process data is configured in the PM-QUALITY Tag Logging folder of the topology tree. Up to ten different acquisition cycles can be defined. The individual trends can be assigned to a descriptive name and linked to a process tag.

Optionally during the batch runtime, the start and end of the acquisition for each individual measured value can be triggered using tags, for example, to acquire the process and production data only within specific phase sections.

A unit of measure and the number of decimal places to be displayed can be configured for each trend. If the lower and upper limit value for the trending are already known they may also be defined here. Otherwise the trend may also use automatic scaling based on the values to display.

4.2.2 Event triggered acquisition

Those process values to be acquired only at specific times are configured in the Snapshot folder. A configurable tag initiates (triggers) the recording.

This functionality of PM-QUALITY permits the acquisition and archiving of planned data (like recipe parameters, planned quantities, etc.) vs. actual data, for example after batch start, bevor batch end or at phase changes. The process data acquired here is displayed in tables or within trend diagrams either online or on the batch report.

The unit of measure, number of decimal places and the lower and upper limit value can also be configured.

4.3 Configuration: Automatic data transfer from alarm archives of base systems

Messages that have been configured in the alarm archive of the base system (WinCC / PCS7 / WinCC RT Advanced / Comfort) can be automatically transferred into the order/batch-oriented archive of PM-QUALITY. The data to be transferred is configured in the Alarm archive folder of the Topology tree. The associated dialogs can be used to filter relevant messages.

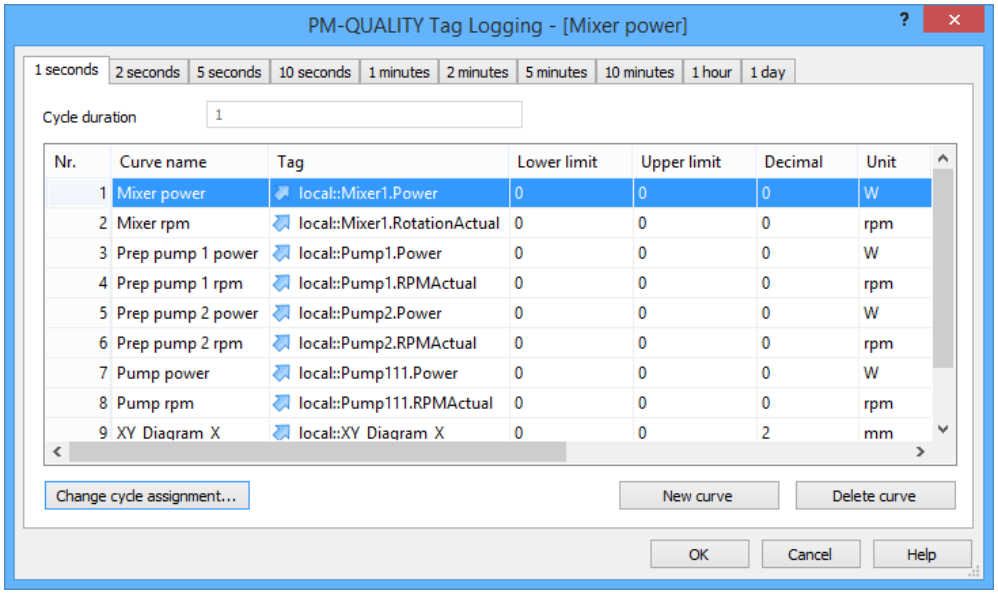

Figure 17: Configuration PM-QUALITY Tag Logging

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4.3.1 Collection of phases

Phases of a production process can be transferred to PM-QUALITY in the form of a tag. In the trend diagram the phases can be displayed as a vertical line labeled with the name of the process phase.

See figure in chapter 5.3 Previewing reports.

The application PM-SERVER supports the configuration of state models for depicting the different operating states of a plant. PM-QUALITY picks up the state models, which have been configured in the PM-SERVER, as phases and shows the time duration of the particular operating states in a trend diagram.

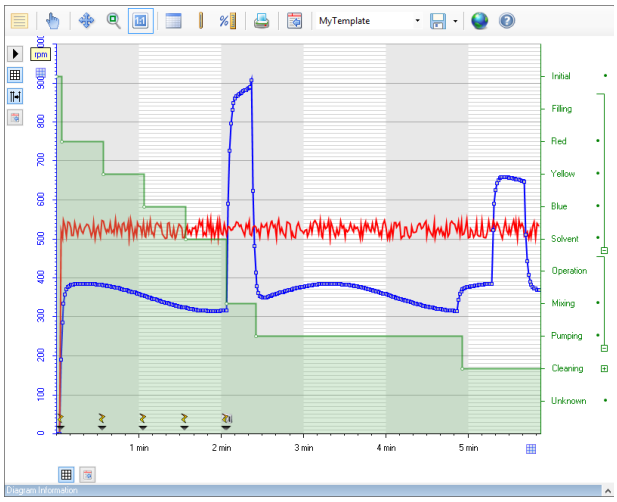

Figure 18: Phases display

4.3.2 Analysis of process values

The application PM-SERVER offers a wide selection of function blocks for calculation and analysis of the collected values, e.g.:

- Statistical values (Standard deviation, Integral, Average, etc.)
- Performance indicators like e.g. Availability, Utilization, Performance rate (etc.)

The necessary algorithms for the calculation are create in a graphical user interface. The function blocks are added and connected by drag&drop. Input- (archive- or onlinetags) and output-pins will be linked with tags from the PM-SERVER.

Calculation results can be added to the batch report or displayed on HMI screens.

Amongst others the following function blocks are available:

- Simple arithmetical functions (Add, Subtract, Multiply, Divide)
- Bitwise and binary functions: And, Or, Not, Shift Left/Right
- Logical binary functions: And, Or, Not, Compare (<,=,>)
- Counter: Duration Counter, Slope Counter, Overflow Counter
- Statistics: Average, Integral, Maximum, Minimum, Range, Time Categorizer
- Format for the automatic generation of texts like e.g. a batch name
- Searching within a string
- Send E-mails, write text files
- Determining the time stamp at the beginning and end of an interval during the execution via a schedule
- Determine the number of used bytes in a specified directory, monitoring of disk space on a hard drive

By creating one or multiple calculation instances from the calculation schema, the connection of the pins to process tags are made. The execution of the individual instances can be either based on tag changes on the inout side or also be triggered by an execution schedule.

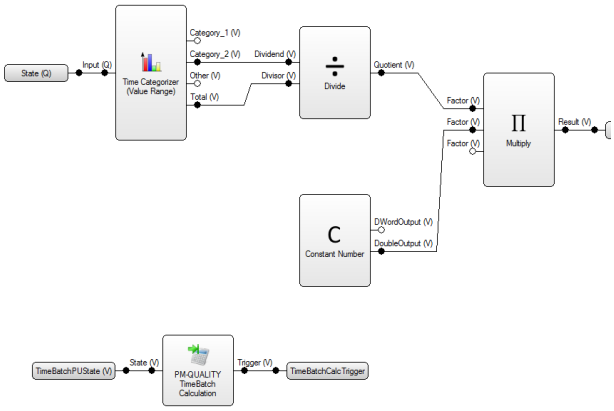

Figure 19: PM-SERVER: Calculation Schema

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The following function blocks extend the functionality of PM-QUALITY:

- *PM-QUALITY TimeBatch* for the creation of calendar based (day, week, month) or shift-based reports
- *PM-QUALITY Cyclic Schedule Trigger* allows to execute snapshots cyclically, also with sliding intervals
- *PM-QUALITY TimeBatch Calculation* to add calculation results to calendar or shift-based reports
- *PM-QUALITY DeferBatchEnd* triggers a snapshot at the end of a batch
- *PM-QUALITY Dynamic Schedule Trigger* triggers a snapshot with calculated values at the end of a batch, which has been started and stopped in the process

These function blocks are also configured in the PM-SERVER and control the start/end of a batch or the collection of snapshots in PM-QUALITY.

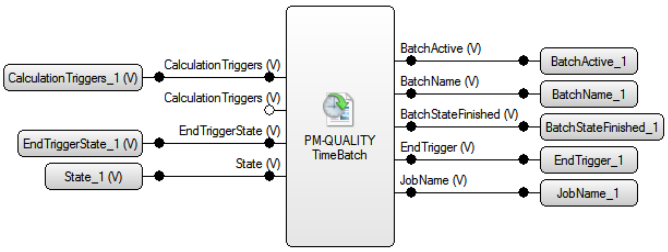

Figure 20: Example: Calculation Schema with function block PM-QUALITY TimeBatch

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4.4 PM-LIBRARY

The library PM-LIBRARY is a central library for saving and administrating object structures, which have been configured project-specifically in the topology manager.

The term *Object Structure* describes the selected object and all subordinate objects of the user-specific created equipment-topology. This can be the whole structure of the equipment-topology as well as a part of the equipment-topology, e.g. a production unit including all subordinate objects or only a single set point without subordinate objects.

Selected object structures are transferred from the Topology Manager into the library via an export function and are clearly arranged there. The import function can be utilized to transfer these object structures back from the library into the tree structure of the Topology Manager. This makes it possible to reuse project data in the Topology Manager of a project. Object structures in the library are also available as templates in other projects.

The functionality of the PM-LIBRARY library supports a comfortable, cross-project configuration of user projects.

A further advantage is the support of a version history. Each entry to the PM-LIBRARY library automatically gets a new version number.

The use of filter criteria makes searching of entries easier.

4.4.1 Data storage in general

The PM-LIBRARY manages the object structures in a separate Microsoft SQL server database. By installing the PM-QUALITY server, the product PM-LIBRARY is also automatically installed. The PM-LIBRARY library can also be installed standalone on a separate central server. The access to the data base is done either from the local computer or from a computer in the network. The software modules PM-LIBRARY Client and PM-LIBRARY Management show and administrate the library structure.

4.4.2 Exporting and importing object structures

A wizard supports the export as well as the import functionality.

During the export selected object structures are transferred from the topology manager to the library.

When storing in the library, an object structure can be either directly assigned to an object type, e.g. a production unit or a category (description), e.g. mixer 1. Categories serve to structure the data storage and increase the clear arrangement of the library.

During the import object structures can be transferred again from the library to the tree structure of the Topology Manager.

Therefore according to the hierarchy of the selected object in the equipment topology object types, belonging to the tree structure one level below, are offered for the import.

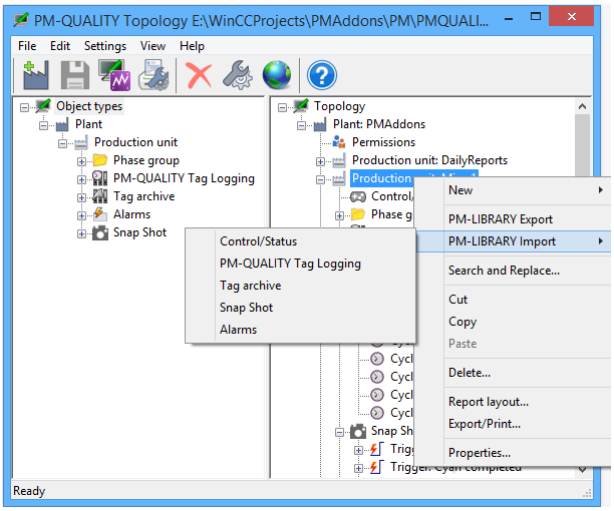

Figure 21: Example data import

The example shows all object types available for import that are arranged below a production unit.

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The import action automatically opens the PM-LIBRARY client. The view presented by the PM-LIRBRARY client is filtered to show only objects of the requested type.

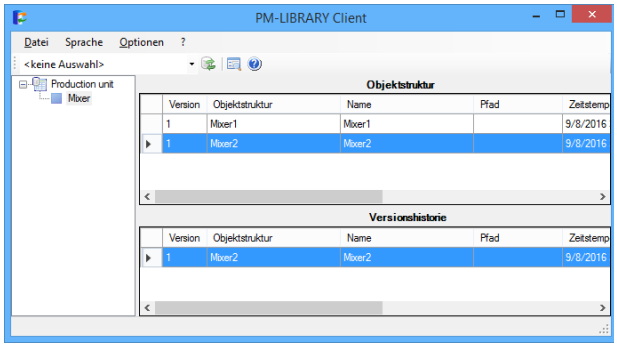

Figure 22: Example for importing a snap shot

After the object structure to import has been selected, all contained sub objects that have been stored with the record are shown:

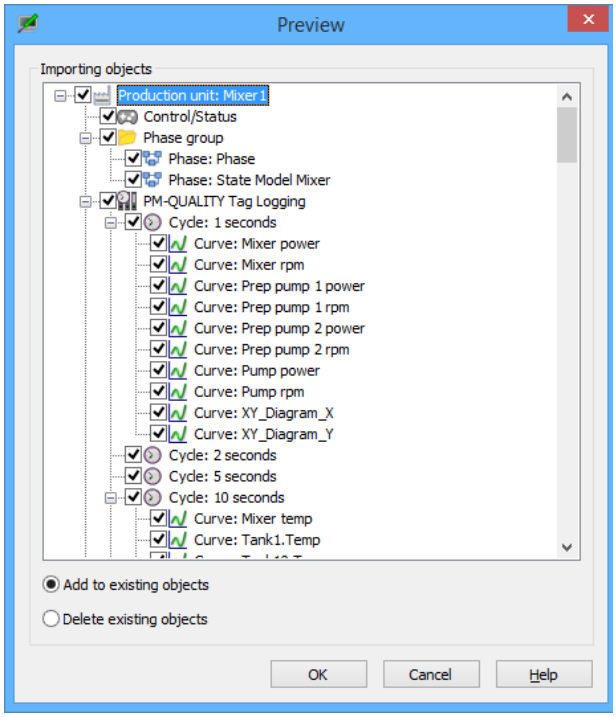

Figure 23: Example for importing a production unit

If not all contained sub objects shall be imported, the corresponding check box can be unchecked.

Fehler! Verwenden Sie die Registerkarte 'Start', um Heading 1 dem Text zuzuweisen, der hier angezeigt werden soll.

5. Report Editor

5.1 General information

Before batch data can be printed or exported, the report layout must be configured. The report layout specifies which parts of the recorded batch data is to be displayed and how it shall be laid out. Different layouts can be configured for the export to HTML, automatic and manual protocol printout. Each layout can be assigned to specific printers.

5.2 Configuring report layouts

Report layouts are designed in the software module Report Editor. Depending on the mode of operation a report layout is either assigned to a production unit (for independent production units) or to a plant section (for linked production units). For each production unit or plant section respectively multiple different layouts can be defined.
The report editor can be started multiple times during configuration. This allows the comfortable editing of multiple layouts in parallel.
The structure of a report layout consists of multiple report blocks of various types, where each block represents a specific block of batch data within the report. During report design, the required blocks are simply arranged in the design view via drag and drop. Afterwards the formatting properties of each block can be edited if a different appearance from the default is desired. The following list shows the available report blocks. Content and complexity of the information contained in each available report block depends on the configuration made in the Topology Manager.

- General Batch/Product batch header data
  - Plant data
  - Production unit data
  - Plant section data
  - Header information of the batch or product batch (e.g. batch name, job name, production times, accompanying texts)
- Process- and production data
  - Batch state
  - Phases
  - Alarm groups containing messages from the alarm archives.
  - Snapshot data (e.g. manual input, current values and set points)
  - Diagram
- Report structure
  To define the structure of the report layout the following bocks are available.
  - Protocol header
  - Company logo
  - Separator
  - Page break
  - Separator line
  - Multi column display with begin of multi column area, new column and end of multi column area elements
  - Sub layout
- Report blocks to display specific formats or calculated information
  - Barcode
  - QR-Code
  - Generic text
  - Generic table
  - Script
- Global variables
  - Table variable
  - Text variable

Several report blocks display the recorded batch data in tabular form. By using the Table variable and the Generic table elements individual table structure can be created. This could be for example the side by side comparison of set point versus actual values.

The report block Script allows specific evaluations of the recorded batch data based on VB-Script. Custom code templates can be stored and reused multiple times. The report editor can be opened in parallel for the editing of report layouts and global report scripts side by side.

Fehler! Verwenden Sie die Registerkarte 'Start', um Heading 1 dem Text zuzuweisen, der hier angezeigt werden soll.

By using the report blocks for multi column display the information from different report elements can be viewed side by side.

The Sub report block allows the grouping of information that is to be used multiple times.

PM-QUALITY offers different design templates based on style sheet sets for the display formatting of the report layouts.

The integrated set of style sheets can be easily extended with custom style sheet files.

Each protocol can carry a company specific logo.

While editing a specific block in the report, the preview window in the lower right reflects configuration changes immediately.

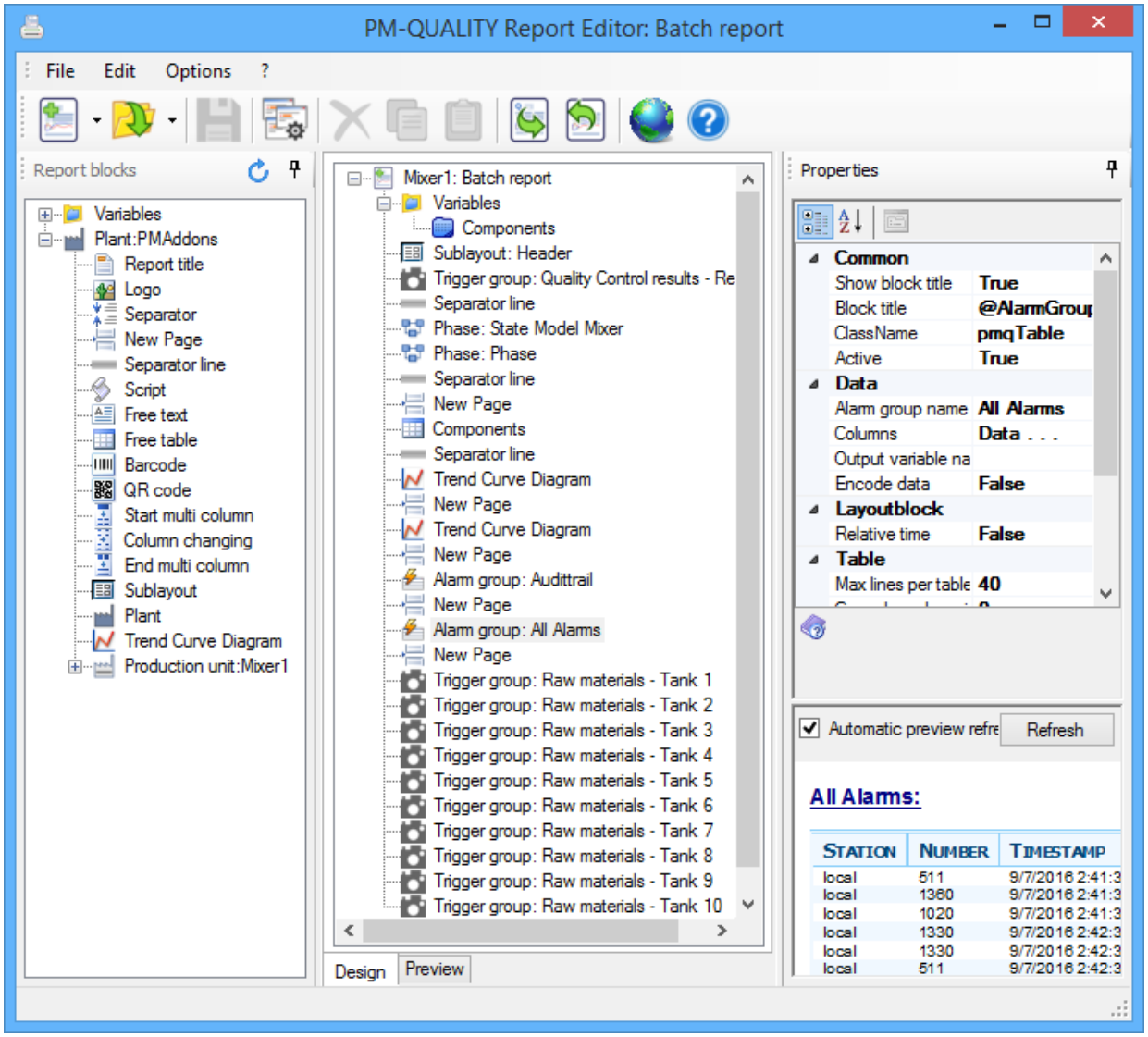

Figure 24: Report Editor: Configuring a report layout

Fehler! Verwenden Sie die Registerkarte 'Start', um Heading 1 dem Text zuzuweisen, der hier angezeigt werden soll.

5.3 Previewing reports

A preview of the currently edited report layout can be displayed in the preview tab. The desired batch to be displayed is selected from the database of recorded batches and the display of the contained data is updated according to the layout of the report.

Only the batches / product batches that have been recorded on the corresponding production unit / plant section where the report layout is assigned to are available for preview.

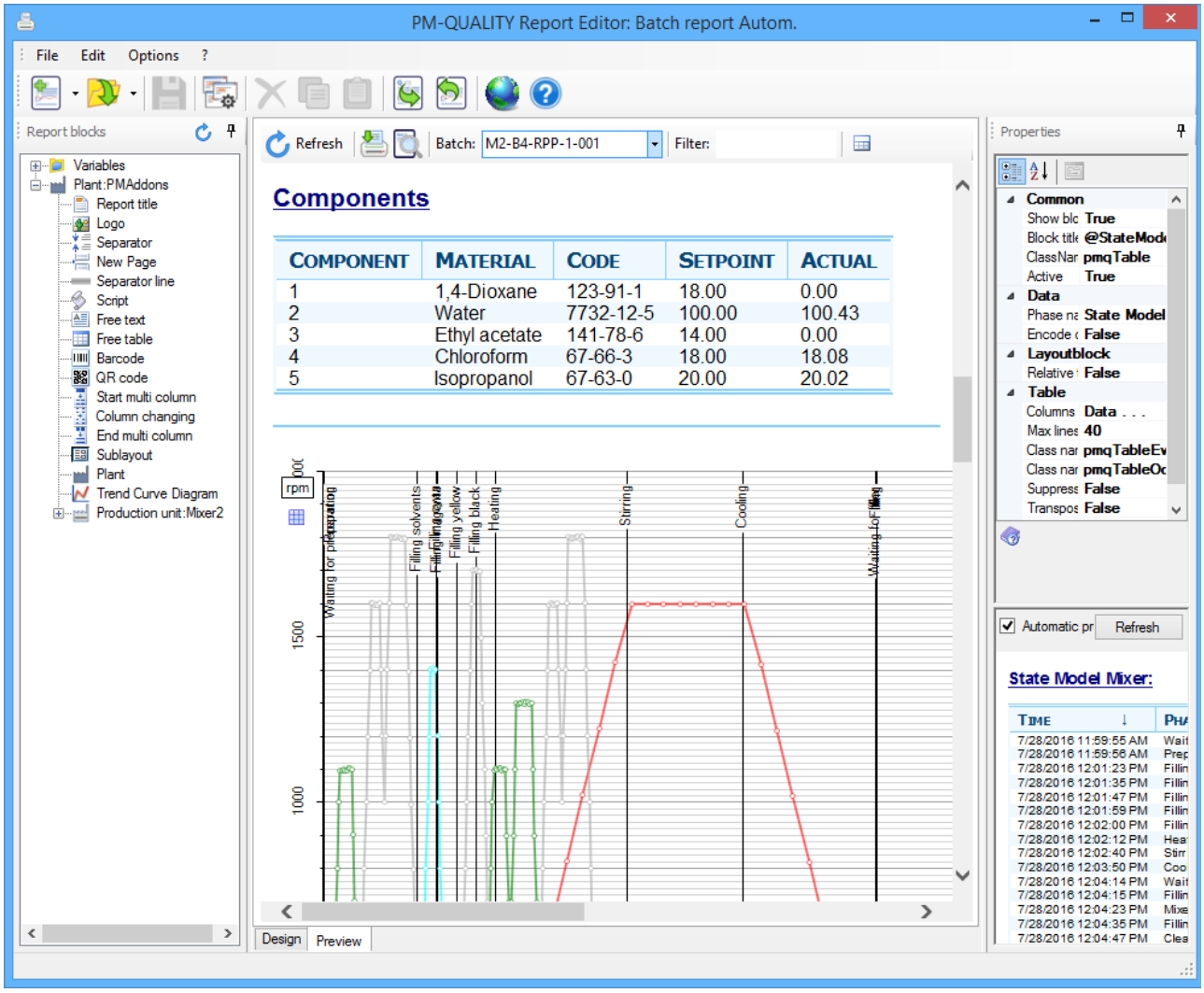

Figure 25: Report Editor: Protocol preview

6. Data Acquisition and Archiving (Data Logging)

6.1 General information

The software module Data Logging automatically performs the data acquisition and batch-oriented archiving in the background. The process and production data is acquired and archived in parallel for plants that consist of several production units, lines or machines.

This software module uses the corresponding process tags configured in the Topology Manager to perform the complete communication with the automation systems: process data acquisition, batch start, batch end, phase change, batch/order designation, batch stopped, triggers for event-controlled acquisition (snap shot), etc. At the end of the batch, the alarms and operator messages recorded during the batch are transferred to the PM-QUALITY runtime database. Optionally the alarms recorded immediately before and after the batch can also be stored by defining time frames for overlaps at begin and end of the batch.

6.2 Acquisition and Archiving of Process and Production Data, Fault and Operational Messages, Laboratory and Analysis Data

The configuring is made in the Topology Manager as to which data is to be acquired, how and when:

- Cyclically
- Event-controlled
- Transferred from the Process value archives
- Transferred from the Alarm archives

These various acquisition mechanisms are realized using the Data Logging functions

- PM-QUALITY Tag Logging
- Snapshot
- Process value archive
- Alarm archive

Process values from process values archives and messages from alarm archives of all linked base systems (WinCC / PCS7 / WinCC RT Professional / RT Advanced / Comfort) can be configured in the PM-SERVER. The data for acquisition in PM-QUALITY is chosen from these archives.

6.2.1 PM-QUALITY Tag Logging

The associated process and production data (temperatures, pressures, flow rates, speeds, etc.) is acquired in the cycles that were configured in the Topology Manager, archived in a batch-oriented way and made available to the PM-QUALITY.TrendCurve software module to be displayed in trend diagrams.

6.2.2 Snapshot

The data points, for which the values are only of interest at specific times, are acquired based on trigger events and archived for the corresponding batch. These values include, for example, planned quantities, actual quantities or recipe parameters that were loaded into the automation system at the start or end of a batch, or at phase change, or were calculated by a plc.

The Snapshot is initiated when there is a change or change to a defined value of an associated tag, and, if necessary, acknowledged using another tag.

A further application of the Snapshot functionality is the acquisition of manual input values, such as **laboratory and analysis** data. The additional specification of the batch designation permits the subsequent storage of manually entered data into the associated batch-oriented archive.

The archived production data is shown on the batch report in tabular form. The graphical display of the Snapshot data is realized with trend diagrams.

6.2.3 Process value archive

The process data archived in the PM-SERVER process value archive is automatically transferred to the PM-QUALITY order/batch-oriented archive and can be displayed by the PM-QUALITY.TrendCurve software modules in curve diagrams.

The archive tags to be transferred are configured by PM-QUALITY in the Topology Manager. The recording of this process and production data occurs in the base system (WinCC / PCS7 / WinCC RT Professional / RT Advanced / Comfort). All relevant data for archiving in PM-QUALITY is loaded into PM-SERVER from the base systems, included in process value archives and made available to the Topology Manager for configuration.

A considerable advantage of this function is that archive data from process value archives of different base systems in PM-SERVER can be consolidated in new, configurable process value archives.

6.2.4 Alarms

Alarms from the alarm archive of PM-SERVER are carried over to the PM-QUALITY archive.

In PM-SERVER the alarm blocks from the base systems (WinCC / PCS7 / WinCC RT Professional / RT Advanced / Comfort) are imported and organized into new alarm archives. In this way user defined alarm configurations of the various base systems in PM-SERVER are organized into a uniform alarm structure. The alarms recorded in the different base systems can then be archived in the PM-SERVER alarm archive.

The alarms from the PM-SERVER alarm archives which are relevant for archiving in PM-QUALITY are specified in the Topology Manager via an easy to use filter function.

6.3 Data Logging logbook

The logbook of the Data Logging software module is not only helpful during the commissioning of a plant, but also provides useful information about the current activities of the PM QUALITY Data Logging during operations: batch start/end, phase change, snap-shot trigger, etc.

The logbook is built as a cyclical buffer and can be saved as a text file or output in paper form to the printer at any time.

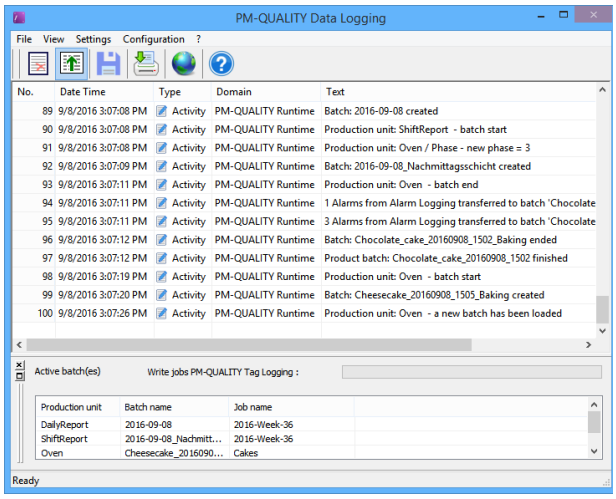

Figure 26: PM-QUALITY Data Logging

6.4 Automatically exporting/printing/deleting

When a batch has finished, PM-QUALITY can trigger

- an automatic export into a database
- an automatic export in HTML format
- an automatic export in XML format and / or
- an automatic report output on a printer.

When a batch is exported into an export database for long term archiving it can be automatically finalized. This setting prevents subsequent changes to the data contained in the batch.

Archive data can be structured by the use of a dynamically constructed filename when exporting the batches.

Export path samples with wildcards:

@OrderName(X)@	Job name
@LineName(X)@	Production unit name
@BatchStart:MM@	Batch start time
@BatchEnd:MM@	Batch end time

In the following example configuration PM-QUALITY exports all batches of one year in a separate directory:

c:\Export@BatchEnd:YYYY creates the export file c:\Export2016.mdf

In conjunction with a pdf printer driver the automatic print function can be used to generate a pdf file that contains the batch report.

Fehler! Verwenden Sie die Registerkarte 'Start', um Heading 1 dem Text zuzuweisen, der hier angezeigt werden soll.

7. Data View

7.1 General Information

The software module Data View is used to display recorded batch data from the current runtime database or an historical export database. The desired database to browse is simply opened at startup in the same way like opening a file.

The Batch list view lists all contained batches with batch name, batch start and end, batch state etc. The Data View also allows the viewing and printing of batch reports in one of the configured report layouts. Buttons for printout, manual export into a database, an XML or HTML file are conveniently located in the toolbar at the top.

By using the curve diagrams provided by the TrendCurve register tab curve diagrams containing further detailed information can be generated. This includes for example snap shot values, phases, comments and alarms.

Intelligent filters provide fast overview over the recorded batches. Filter settings may be saved under a comprehensive name and can be reused later at any time.

The software module Data View represents the functionality of the PM-QUALITY client. It contains the PM-QUALITY.BatchTable and PM-QUALITY.TrendCurve controls that are described in the following sections in more detail.

The different views are organized in tabs.

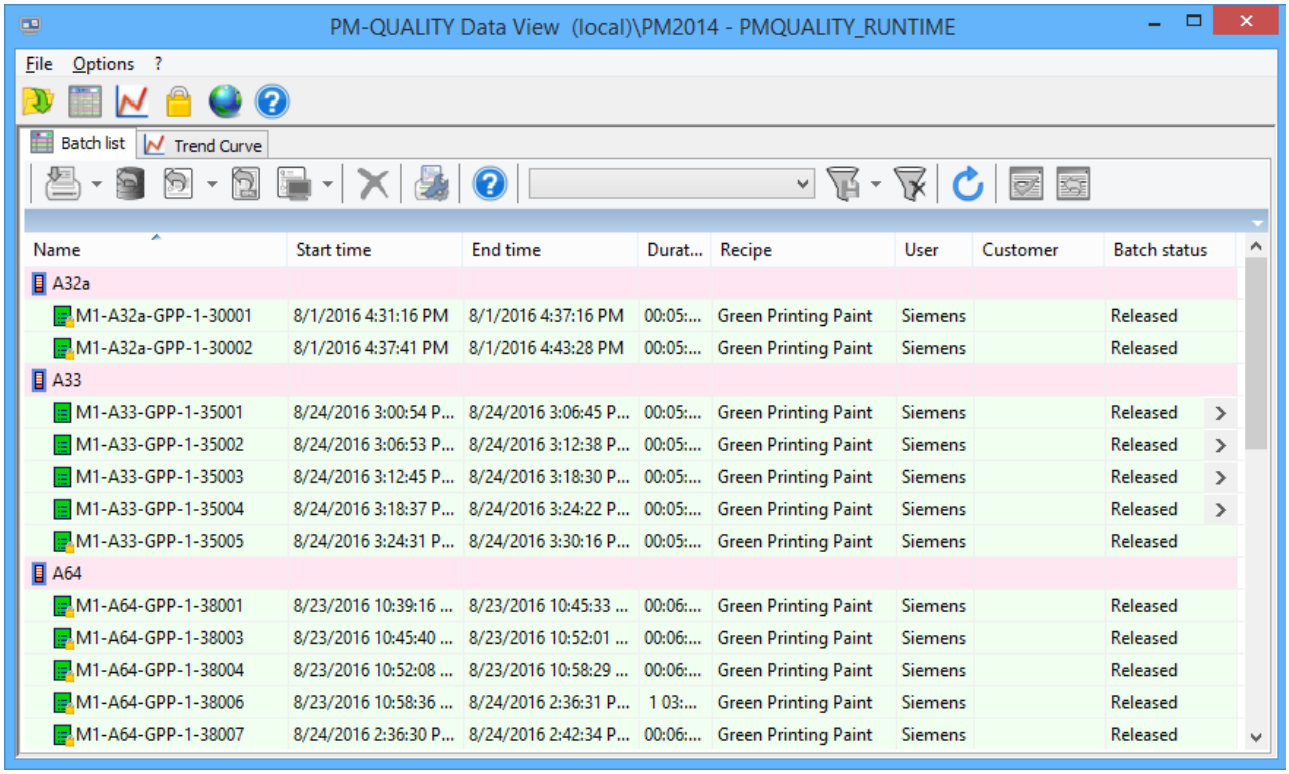

Figure 27: PM-QUALITY Data View

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8. Batch Reporting (PM-QUALITY.Batchtable)

8.1 General Information

The concept for PM-QUALITY placed major importance on the operator being able to access the archived process and production data with a minimum of effort.

PM-QUALITY.BatchTable Control (batch list) is the module for the manual operation of PM-QUALITY. All relevant data such as product/job/batch name, product batch/batch start or end, phase start/end, process data and status changes can be:

- Displayed as a batch report on the screen
- Printed as a batch report
- Exported in database format
- Exported as HTML file
- Exported as XML file

The PM-QUALITY.BatchTable control is implemented as an ActiveX-Control and can be integrated into HMI screens from WinCC, PCS7, WinCC RT Professional und RT Advanced. The batches are listed in a table.

All archived batches in the batch list are displayed in a table below an order folder. A powerful filter function permits a selection of the batches according to the batch duration time, order/batch designation, name of the production unit and other freely-definable criteria, such as grade, customer, quality, etc.

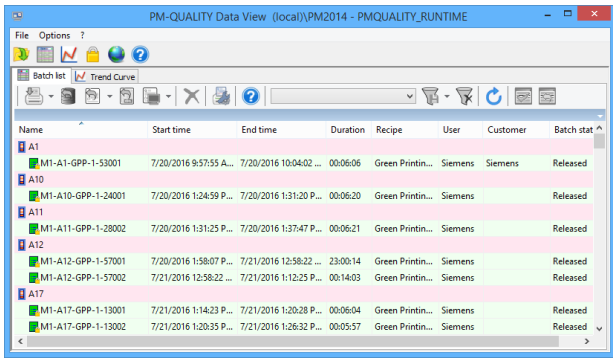


Figure 28: Batch list displayed with the PM-QUALITY.BatchTable control

8.1.1 Manual export

The possibility to store the batch reports in HTML/ XML files allows the display of batch reports by a web browser, such as Internet-Explorer, Firefox or others.

Another possibility for data backup is to write the batch archives in the database format. All archive data is stored in a Microsoft SQL server database and can be comfortably viewed with the PM-QUALITY Data View. The documented Interface allows further processing of the data for example with Visual Basic Script.

Fehler! Verwenden Sie die Registerkarte 'Start', um Heading 1 dem Text zuzuweisen, der hier angezeigt werden soll.

8.1.2 Manual batch report

The report of the selected batch can be previewed on the screen or alternatively printed. The report editor allows the creation of multiple report layouts that can be assigned to different actions. E.g. a specific layout may be selected for an automatic batch report whereas another more detailed layout is used for on screen display.

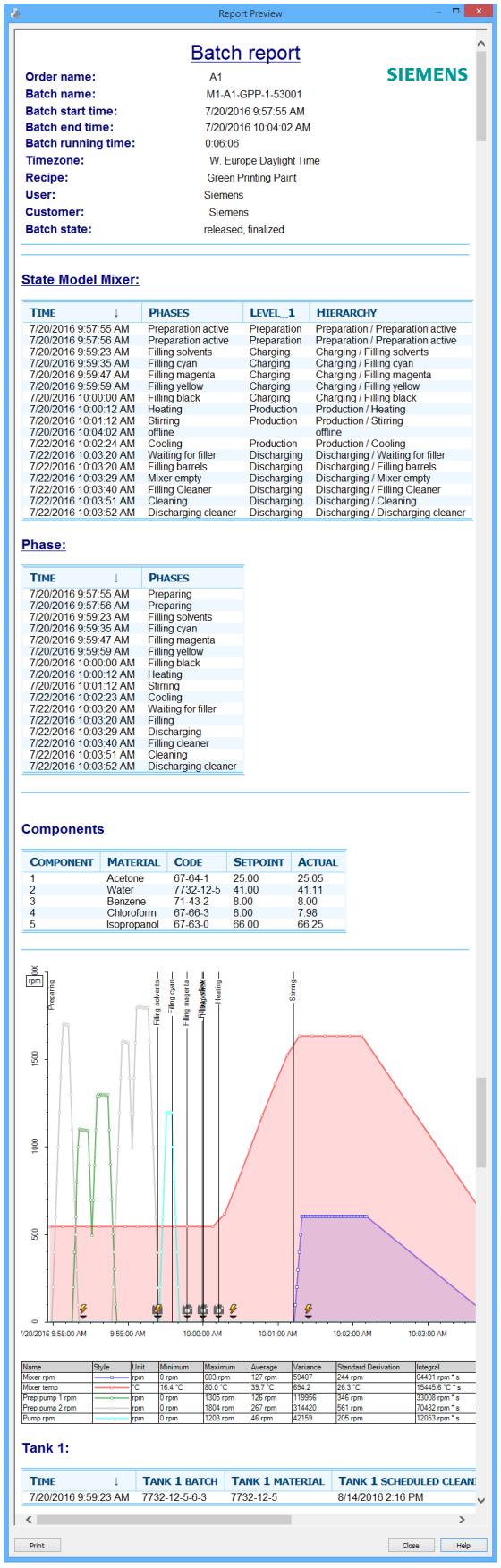


Figure 29: Sample batch report

Fehler! Verwenden Sie die Registerkarte 'Start', um Heading 1 dem Text zuzuweisen, der hier angezeigt werden soll.

9. Trend Diagrams (PM-QUALITY.TrendCurve)

9.1 General information

The PM-QUALITY.TrendCurve control allows the display of the continuously archived data from the Data Logging as batch trends. The number of simultaneously displayable trends is only limited by available system resources. Snap shots, alarms and phases that have been recorded during the batch can additionally be displayed as events within the graphical curve display.

For an appealing design and comfortable usage the control offers a large set of functions.

The following list represents a selection of the available functionality:

- **Flexible time range selection for the x-axis**
  The time range for the display of f(t) curves can be defined in various ways. The range that is to be displayed may be the whole batch runtime, a starting point plus a time span or an end point minus a time span. Also the phase transitions recorded during the batch may be used as start and end points. Multiple batch trends can be displayed within one diagram allowing the comparison of e.g. the currently running batch with a historical one from the archive.
- **Common time / value axis**
  The utilization of jointly used time and/or value axis provides more space for the actual trend display. Cycling through multiple axes is done by a single button click. The alignment (left, right, top, bottom) and also the writing direction of the graph (from the left, from the top, from the right, from the bottom) is individually configurable.
- **Showing and hiding grid lines**
  Grid lines can be displayed as main and additionally as sub division grid lines for each configured axis. Showing and hiding grid lines projected from axis is accomplished with a single button click in the PM-QUALITY.TrendCurve control.
- **Tooltips**
  The position of the mouse cursor within the diagram is shown on the x and y axis for improved readability. An overlaying tooltip displays the detailed information about the object under the current position like e.g. measuring point, recorded snapshot value, recorded alarm etc.
- **Curve diagram detail information**
  A window holding additional details about the displayed trends may optionally be displayed below the diagram. The events that have been recorded during the batch like alarms, phases, snapshots or comments can be displayed in a table. When the ruler is enabled, information about the current ruler position is also displayed.
- **Statistical information**
  In order to calculate statistical values from the curves, the range to evaluate can be selected by using two independent rulers. Besides the information about the current positions of the rulers the range in between is evaluated and the statistical figures like minimum, maximum, average, standard deviation, variance and integral are calculated.
- **Annotations**
  Specific events or unusual deviations can be annotated within an f(t) curve diagram. Adding annotation is possible as long as the batch has not been locked. The annotations are stored together with the batch data and can also be displayed on reports.
- **Axis scaling**
  The scaling of the batch trends is either done automatically or controlled by the upper and lower limits that have been configured in the topology manager. Trends where values are distributed over extremely large ranges can be logarithmically scaled.
- **Comparing batch trends**
  The parallel display of trends from different batches allows a direct comparison. The integrated zooming functionality enables the precise evaluation of individual data points. By moving the individual x and y axis deviations can be immediately spotted.
- **F(x) Trends**
  Besides the f(t) trend display over time, the PM-QUALITY.TrendCurve control can also be used to display two dimensional relations as f(x) curves. In this display mode, curve points are displayed as pairs with a configurable time correlation.

Fehler! Verwenden Sie die Registerkarte 'Start', um Heading 1 dem Text zuzuweisen, der hier angezeigt werden soll.

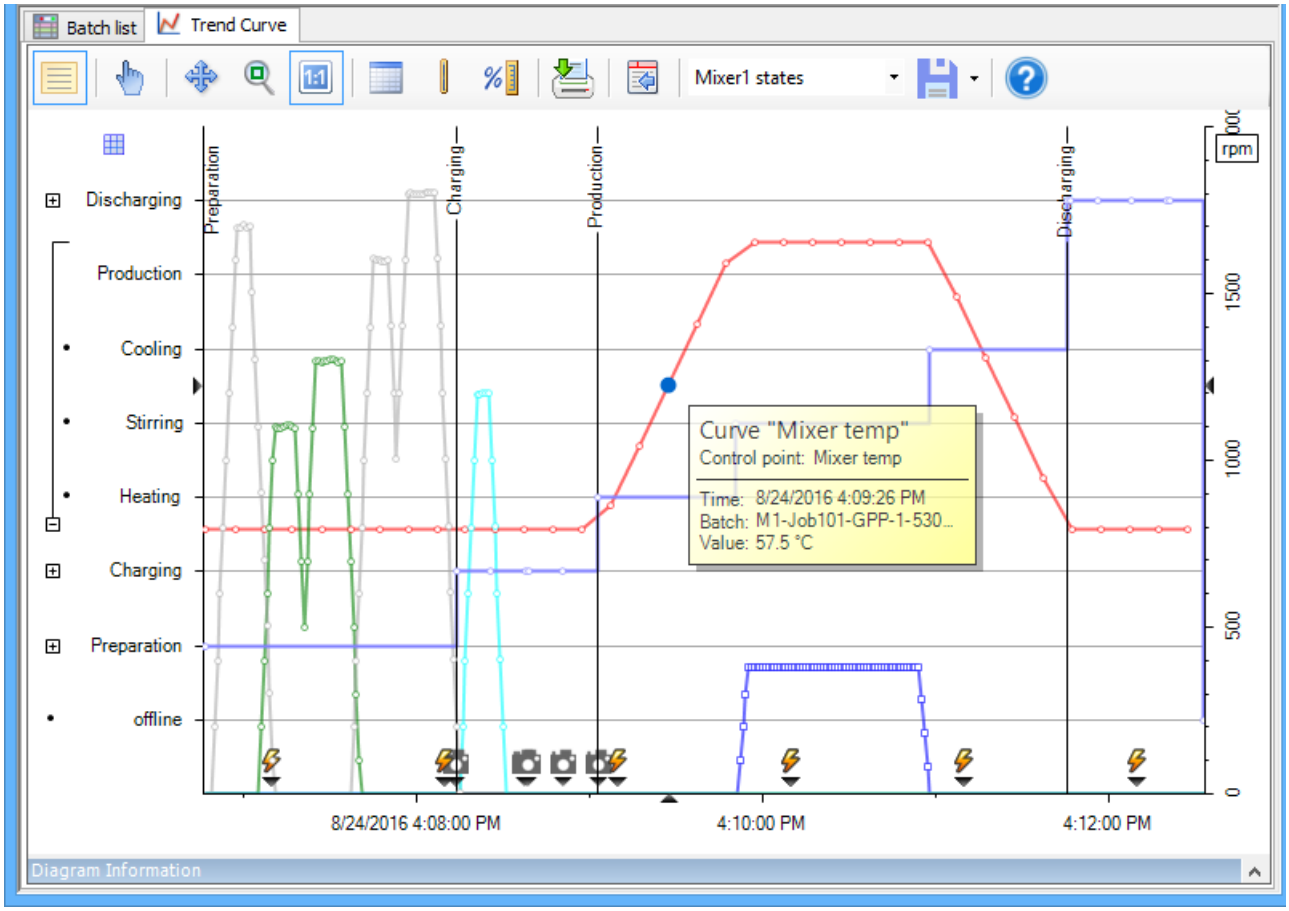


Figure 30: PM-QUALITY.TrendCurve control with overlaying tooltip

9.2 Configuring curve diagrams

The selection of the curves and events to display is done in a configuration dialog.

Besides the curve measurements, event like snapshots, alarm and operator messages and annotations can be selected for display.

Within one so called batch group multiple consecutive batches may be used as the source for display. E.g. the currently active and the previous batch. Comparing multiple batches can be accomplished by defining multiple batch groups.

Data point selection is supported with a selection list that is filtered with the relevant data types. E.g. for curve selection only curve measurements and snap shots are shown.

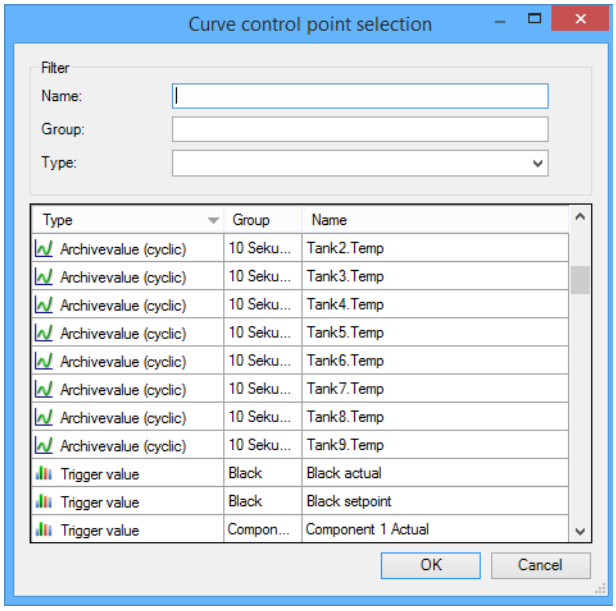


Figure 31: Selecting curve measurement data points

Fehler! Verwenden Sie die Registerkarte 'Start', um Heading 1 dem Text zuzuweisen, der hier angezeigt werden soll.

The configuration dialog consists of multiple registers that are grouped by corresponding subject guiding the user directly towards which function is configured where.

In order to simplify the handling the dialog is already filled with default values providing most of the settings. These settings include for example the database connection to be used, the default curve type f(t), x- and y-axis definitions etc. Of course all given presets can be changed and customized according to individual requirements.

For a f(x) curve display, the base curve type is changed from f(t) to f(x). In this case the dialog reflects the different configuration possibilities the next time it is opened.

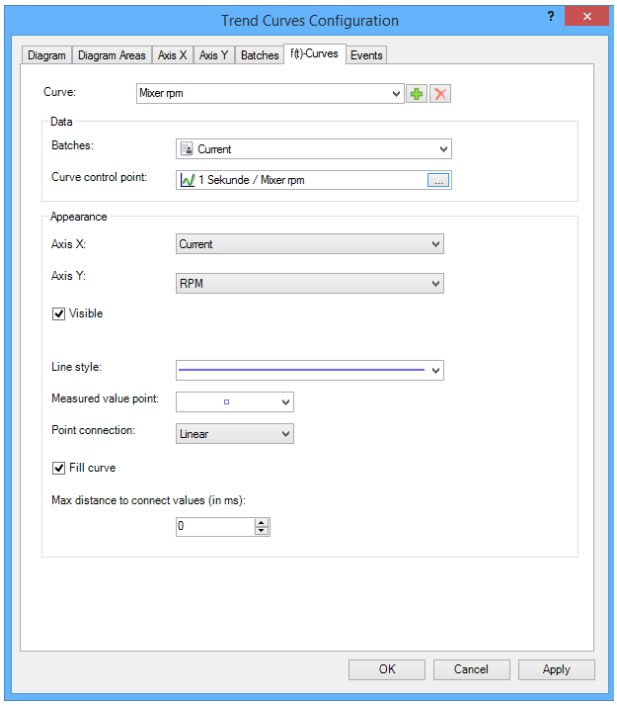


Figure 32: Configuration dialog TrendCurve

The following list shows a brief selection of the possible configuration settings available:

- The curve line style is determined by color, transparency, pattern and width
- Measurement point can be highlighted by a configurable graphical marker.
- Grid lines are available for x- and y- axis separately and are dividable into main and sub grid ranges.
- Axis labels can be rotated according to the use writing direction of the curve diagram
- Scaling of the y- axis scaling is either done automatically from the measured values or taken from the settings in the topology manager.
- Labels along the time axis are either displayed as absolute timestamps or as a relative time span measured from the start of the batch

9.2.1 Saving configuration templates

Configuration settings can be saved under a comprehensive name as a template. Those templates can be easily selected from a list later on either in the PM-QUALITY.TrendCurve control and also in a report layout in the report editor. That way the most frequently used configurations sets for curves are always conveniently available.

Fehler! Verwenden Sie die Registerkarte 'Start', um Heading 1 dem Text zuzuweisen, der hier angezeigt werden soll.

10. Manual data input

10.1 General information

Manual data input (e.g. laboratory results, analysis figures) can be recorded with the snapshot function of PM-QUALITY.

10.2 Configuration of manual input values

The analysis values are assigned to a batch by means of the batch name. The PM-QUALITY.BatchTable control which is embedded in a hmi screen contains a list of all batches. The batch list can be filtered by job, production unit, customer, time range etc. Configured filters can be saved under a unique filter name.

The recording of the manual input values is configured in the topology manager as a snapshot. Data input is performed in a standard hmi screen via IO fields where the values are connected to process tags. In the example below the snapshot is triggered by a simple button click. In this case the input values are transferred to the batch that is selected in the list and the batch data is released or locked according to the user setting.

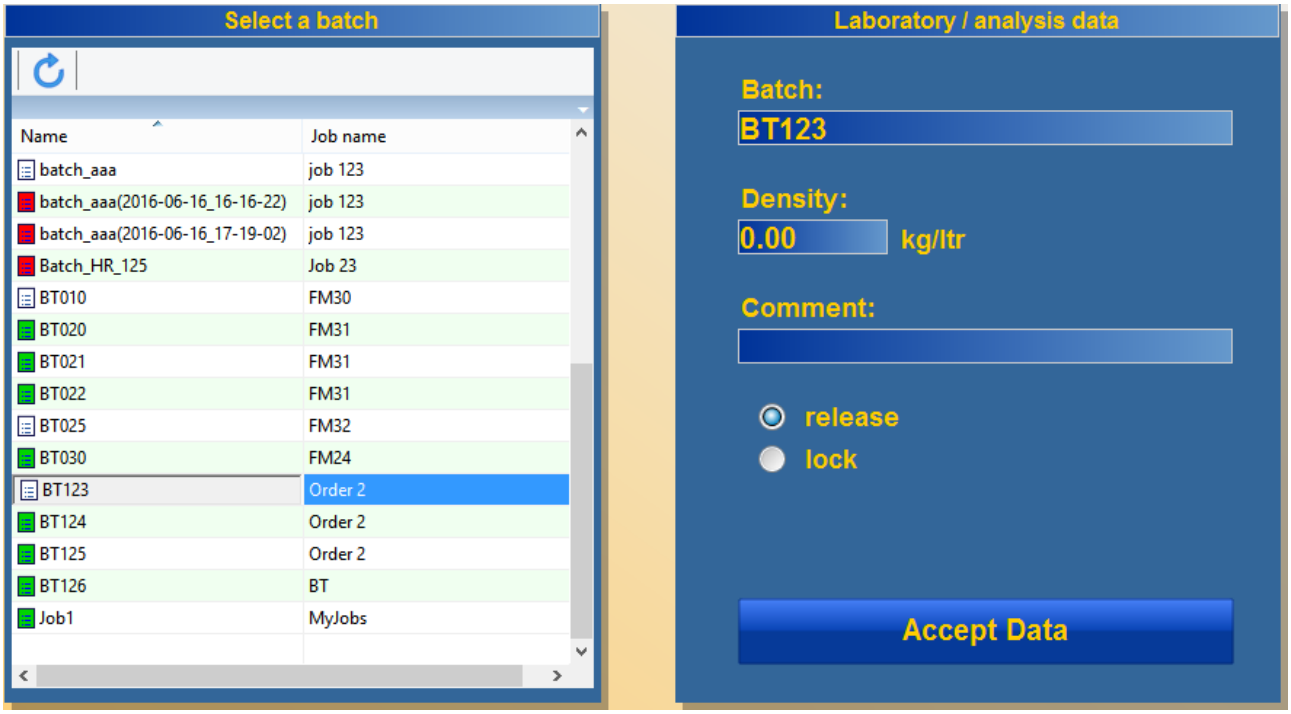


Figure 33: Screenshot from the PM-QUALITY demo project

11. Microsoft Excel Add-In

11.1 General information

With the Microsoft Excel Add-In, PM-QUALITY offers the possibility to create batch reports by using the tools from Microsoft Excel.

All necessary files are installed with the setup of the PM-QUALITY. The Add-In is not automatically integrated in Excel by the setup, and can be activated manually as needed.

After successful activation, the ribbon bar in Excel has been extended with two custom PM-QUALITY tabs: PM-QUALITY batch data and PM-QUALITY time based data.

11.2 PM-QUALITY batch data

This tab offers the following tools:

- Filter options to select the desired batch data
- Selection of data types to display in the report (batch header data, phases, snapshot data, trends, alarms)
- Function set to aggregate measured value series in configurable intervals and output in a table
- Report view for the selected batch

11.3 PM-QUALITY time based data

This tab is used to create time oriented reports over multiple batches. The following toolset is offered:

- Selection of the data type to display in the report (snapshots, trends, alarms)
- Definition of a timespan with start- and end timestamp

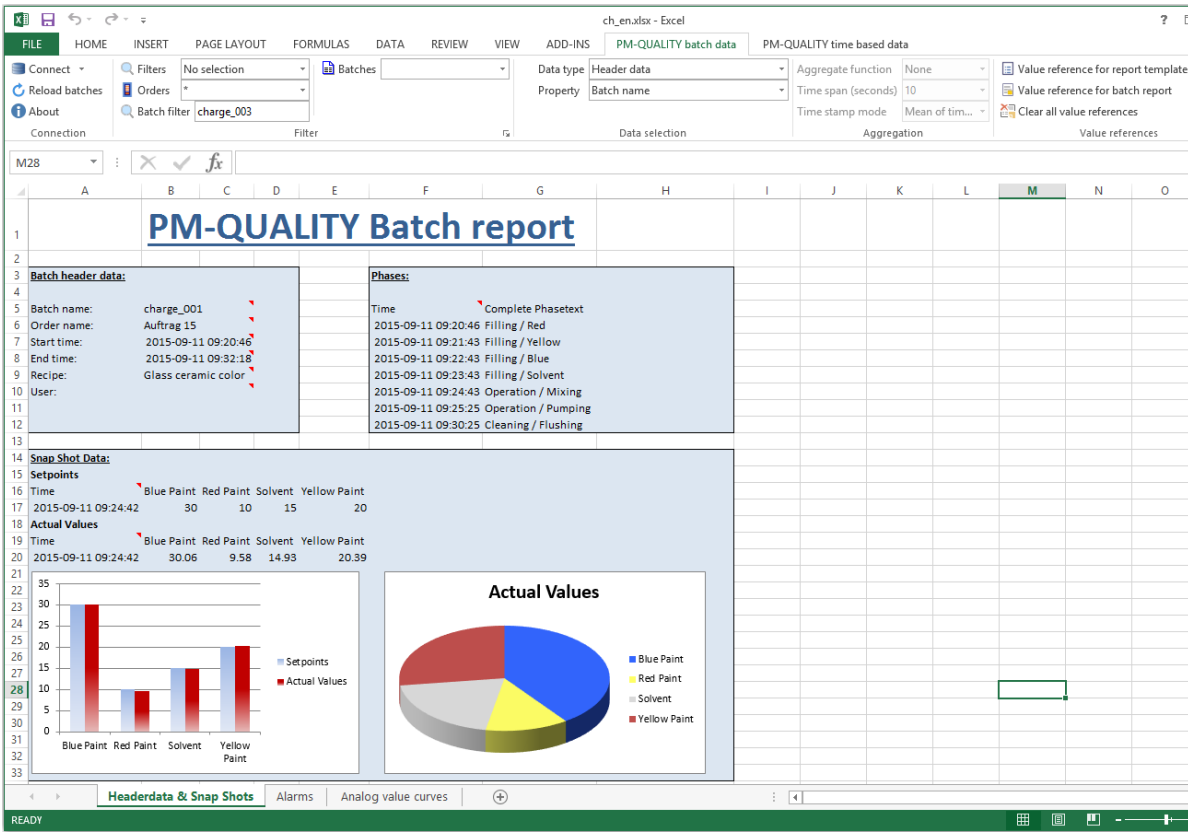


Figure 34: PM-QUALITY Excel Add-In

12. PM-QUALITY Data Center

12.1 General information

The PM-QUALITY Data Center is designed for the use in redandant systems. With PM-QUALITY Data Center Batch data saved in two different databases in redundant systems is merged into one database.

12.2 PM-QUALITY batch data

PM-QUALITY Data Center checks cyclically if both databases of the redundant PM-QUALITY Servers contain new batches.

When the redundant PM-QUALITY Servers are available and a new batch is detected, the export of the batch data into the export database is started. The export database is always located on the computer on which *PM-QUALITY Data Center* is installed.

In the export of the batch data, it is checked for every data type such as Snaphot, Tag Logging, Alarms, etc. if data from both databases must be merged. For this, the timestamp of the existing data is evaluated and checked for existing valid values.

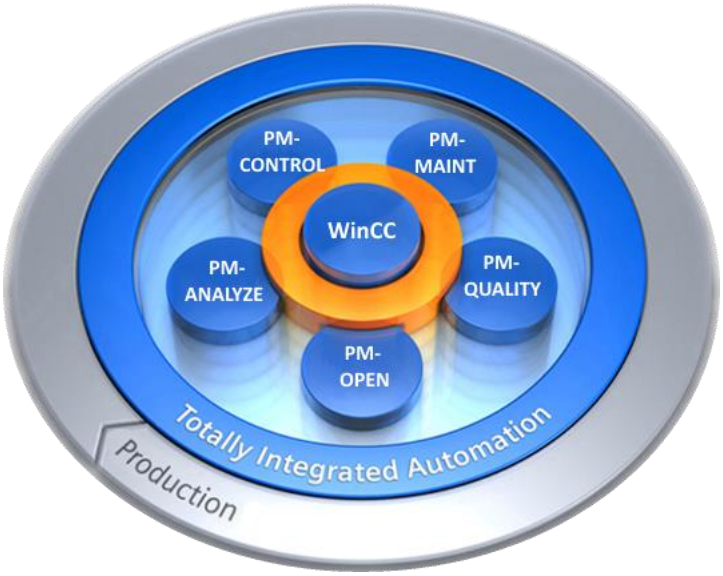
With exporting the batch data into the export database PM-QUALITY offers the possibility to finalize the batch. This prevents subsequent changes to the batch data.

The PM-QUALITY Data View is used to display the batch data from the created export database. Archive data can be structured by the use of a dynamically constructed filename when exporting the batches.

After the export, the batch data in the runtime databases of the redundant servers is marked as exported. The swapped out batches can then be removed from the runtime databases by means of the deleting procedure on the PM-QUALITY Servers at a later point of time.

Process Management System

Economical Automation with Standard Software



PM-CONTROL
Recipe/Product Data Management, Job Control

PM-QUALITY
Job/Batch-oriented Archiving and Recording

PM-MAINT
Intelligent Maintenance Management System

PM-ANALYZE
Analysis of Alarms and Process Data

PM-OPEN
Solutions for Communication and Integration

Further technical information?

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