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High Performance Process Control Approach

(leading the brewer to faster and more reliable actions in critical situations)

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Fast Determination of Process Conditions

In this poster guidelines and best practices are described for the design of the Human Machine Interface (HMI) for process and machine automation in a way that makes supervisory control easier and more reliable, operator reactions faster and more efficient.

Typical challenges for an operator are:

- Follow a variety of parallel processes
- Control different areas of the brewery
- React fast, reliable and correct

The automation solution must support this with:

- Supply of clear and complete overviews
- Support the decision process with context information
- Indicate clearly any process condition needing intervention
- Give guidance how to react – follow uniform principles

Operational Structure

A 4-level approach for the visualization of a process plant has proven feasible and is widely recommended[1].

Level 1 – Area overviews

In a brewery this level shows typically the following:

- Brewhouse incl. Malt, CIP and related Dosings, Auxiliaries
- Cellars with Yeast
- Filtration and BBT area

Guiding principles

- Complete overview with all units on one screen
- Present only a limited amount of details
- Use very condensed means of transporting information

Give answer to the following questions fast and reliable:

- What is currently going on in this area?
- Are all processes running as they should?

Level 2 – Line view and functional arrangements

In breweries examples for Level 2 displays are:

- Brewline
- Cellar transfer with source, destination and related equipment
- Filtration line with surrounding equipment

This level is the most important layer of the visualization for standard process operation and follows the following principles:

- Designed to reflect process flows and functionality
- Independency from the physical structure of the plant
- One click leads to the detail display in case of problems.

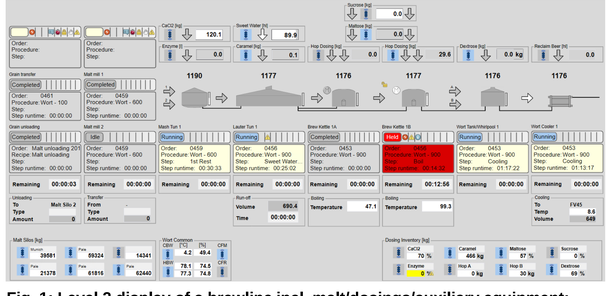

Fig. 1: Level 2 display of a brewline incl. malt/dosings/auxiliary equipment; process fault is clearly visible and actions can be taken

Level 3 – P&ID like detail screens

This level is the standard representation that is traditionally still used exclusively in a lot of plants:

- Show every automated equipment on the screen
- Mimic follows the P&ID of the physical layout, not the process
- Details allow to handle exceptions
- Analyze processes in depth for optimization

Disadvantages for regular process control are:

- Overview is hard to achieve
- A lot of screens need to be observed for one process

To reach the necessary overview often a lot of neighboring equipment is drawn on these screens making them overloaded and unclear.

Level 4 – Specific Information for further Analysis

This level supplies special faceplates for deeper analysis of processes or presents data in a specific context.

General Design Principles

Colors

Colors play a significant role in any process visualization. In high performance representation the demands are:

- Clear and consistent meaning behind any use of colors – same color, same information
- Regardless of the context (screen, message, status, etc.)
- Red (e.g.) is an alarm wherever it appears
- No bright colors for regular process conditions

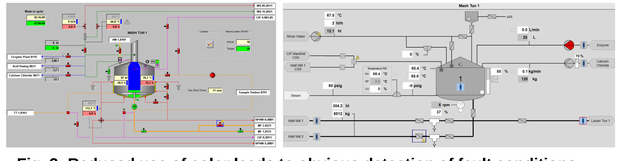

Fig. 2: Reduced use of color leads to obvious detection of fault conditions

Reduction of unessential details

Any shading, 3D-like representation, moving pictures or detailed sketches of technical equipment are not needed. They distract the operator without addition of useful information. Graphics shall be:

- As schematic as possible
- Calm and colorless
- Focus: are there problems?
- Is intervention needed?

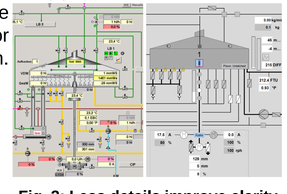

Fig. 3: Less details improve clarity

Data and information

Often the operator has to decide with a quick glance on the process if a reaction is needed or not. A good HMI will support this with:

- data is set into context of location, currently running process, process state, product etc.
- Definition of boundaries for warning and alarm levels
- History of values gives decision support

See figure 4 were a value in scenario a) moves towards the warning limit whereas in b) it is already moving towards uncritical conditions.
With this information the decision is clear to stay alert in case a) whereas b) is uncritical.

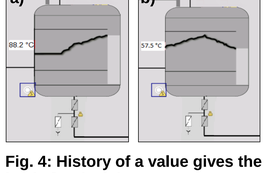

Fig. 4: History of a value gives the basis for decision support

Automation guidelines

Alarm handling

A key element of high performance automation in process industries is the alarm management:

- Consistent implementation throughout the whole plant
- A field device alarm (visible on L3 screen) must lead to an alarm representation on all upper level screens
- Generic approach inherent in the used system is necessary

Alarm propagation:

- Control module has an alarm state
- Connection to Object Control Matrix
- Relation to the units (e.g. a tank)
- Alarm reaches top level of visualization

Alarm management:

- Alarms of different areas shall show up in a central place
- Filters allow adjustment of alarm display
- Avoid unnecessary alarms and messages

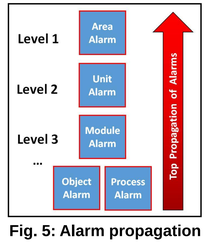

Fig. 5: Alarm propagation

Status management

A good way for the support of a consistent determination of critical process conditions is the definition of states that are followed in the whole plant.

Status information can as an example be separated in:

- Procedural State (Idle / Running / Held / Paused / Complete)
- Equipment State (Production / Used / Cleaning / Clean etc.)
- Process State

Silos	Process Unit	Utilities	CIP Plant
Ready	Waiting	Ready	Water
Filling	Filling	Service	Media Change
Emptying	Processing	Dosing	Caustic circ.
Empty	Emptying	Emptying	Acid circ.
	CIP	CIP	Heating

These definitions supply the basis for a plant wide approach to handle everything as similar as possible. They are often customer related.

Style Guide

An essential part of a consistent layout of the automation is the definition of standards. In a style guide document the usage will be laid out of:

- Colors and their meanings
- Pictures
- Status informations etc.

Without this definitions document a uniform approach over all the different areas of the brewery will hardly be possible.

[1] Hollifield, Oliver, Nimmo, Habibi , The high performance HMI Handbook, PAS, 2008

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