Technical Standard

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DCS AND MCS PROGRAMMING

Contents

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ABBREVIATIONS

brown field	rebuilt
DCS	Distributed Control System
e.g.	exempli gratia, for example
EU	European Union
FAT	Factory Acceptance Testing
green field	new process areas
H-limit, HH-limit	High limit, High-high limit
I/O	Input/Output
IEC	International Electro technical Commission
L-limit, LL-limit	Low limit, Low-low limit
MCC	Motor Control Center
MCS	Machine Control System
PIC	Peripheral Interface Controller
PID	Proportional Integral Derivative

1 GENERAL

This standard gives general guidelines for appearance of user interface for process control and machine control.

1.1 Codes and Regulations

The equipment and installation shall comply with the following standards, regulations and instructions:

- Local authorities' regulations and recommendations
- Laws and regulations currently in force in the current country
- EU norms and directives
- Project instructions
- Mill instructions
- IEC recommendations

1.2 References

MEIA0009 Implementation Procedure for Control Systems (DCS, MCS) FAT

2 DCS AND MCS SCREENS

The DCS supplier follows the operator display proposal and matches them to the DCS display pages using the colors agreed in the project.

Generally speaking all measurements, actuators and motors what are shown on PI-diagrams, electrical diagrams and hydraulic diagrams should be shown also in DCS screen.

3 DCS DISPLAY COLORS

On the brown field (rebuilt) projects the existing colors shall be used.

On the green field (new process areas) project display colors shall be decide by Purchase in each project. DCS Supplier has their own color palette which could be use. Colors could be example like this:

Flow substance	**Color**
Water	Green
Air	Blue
Steam	Red
Oil, Combustible liquid	Brown
Gas	Yellow Ochre
Chemicals	Orange
Acids and Alkalis	Purple
Process Effluents	Black
Fire quenching fluid	Not used

4 TYPICALS

The typical circuits described in this chapter are examples and shall be agreed with the Purchaser on a project-by-project basis.

All interlockings and functions must be programmed based on the functional descriptions/functional diagrams and interlocking diagrams with agreement the Purchaser.

4.1 Motors

– **List of Typical**

One direction motor with interlock

Two direction motor with interlock

One direction motor with interlock and speed control

Two direction motor with interlock and speed control

– **General**

The inputs (winding temp.) are connected through max selector blocks when Pt100 with transmitters are used.

Thermistor input is not in engineering units. Signal has to be connected through linearization block for converting to engineering units.

When Pt100 temperature elements are used the loops will be tagged as main motor loops. The signal is in engineering units. Current measurement shall be in %.

The auxiliary inputs are available as tags for long term trending purposes.

Speed guards tagged as main motor loops. Logic and alarm will be made inside the motor logic.

– **Operation Modes**

Manual: operator can start individually the motor. Interlocks are normally not valid (With exception e.g. big motors).

Auto: group start, sequence start or automatic start. Interlocks are valid.

Local: The motor is operated from a local panel in the field. The local push-buttons (start/stop) on the panel are blocked if the motor is running in remote mode. The panel has also local-remote selector switch. Selection possible when motor running. The process interlocks are valid.

Local start pushbutton-normally open, local stop pushbutton-normally closed. Local position selected-normally closed and remote selected-normally open. Binary inputs into DCS to be used.

– **Process/Electrical Interlocks**

Interlocks will be divided to fault and interlock functions. Both will stop the motor. Faults are shown in faceplate and the process interlocks are shown in process help. First cause will be indicated with red arrow. Turns to green when state comes healthy. Other valid interlocks are indicated with steady yellow triangle.

Interlock/fault is active when signal is “0”.

After interlock or fault signal becomes healthy = “1”, in auto mode the valve follows automatic function commands

Interlocks:

Interlocks are shown in process help.

Interlocks stops motor

Alarm is not activated

– **Action**

Mode is not changed to manual (F-type interlocking, e.g. low level/pump)

Mode shall change to manual (R-type interlocking e.g. speed guard/conveyor)

Hardware faults:

General fault (Simocode & communication) stops the motor

Field fault (safety switch or emergency stop) stops the motor

MCC starter fault stops the motor

– **Action**

All hardware faults stop the motor and alarm is activated

Mode shall be changed to manual

Start interlocks (process values) will be done with free logic outside the motor block.

4.2 Group Start/Stop Sequence

Group starts and stops will be implemented as sequences

All groups and sequences have “quick stop”-function. “Quick stop” stops all motors and all sub-sequences in the group without delays. (Function is like emergency stop)

4.2.1 Group Start

Group start has auto and manual modes. In auto mode the group start is activated automatically and in manual mode the group start is activated by the operator.

Group start is ready to start, when each item (Motors and on-off valves) is alternatively:

- In auto mode and no faults
- in manual mode and running
- In manual mode and running status simulated
- Simulated start condition

Start interlocks. Implemented with free outside logic

Possible to set time between steps in the application program. Time adjustment from the display only in special cases.

Possible to halt group start and continue

Group start shall stop (sequence on hold) if step time is elapsed and warning will be generated. Group start continues automatically, when conditions of step are O.K.

4.2.2 Group Stop

Group stop mode is defined with the corresponding group start mode. In auto mode the group stop is activated automatically and in manual mode the group stop is activated by the operator.

Item can be removed from group stop by switching it from auto to manual

Possible to set time between steps in the application program. Time adjustment from the display only in special cases.

Possible to halt group stop and continue

Group stop shall stop (sequence on hold) if step time is elapsed and warning will be generated. Group stop continues automatically, when conditions of step are O.K.

4.2.3 Sequence

Sequence has auto and manual modes. In auto mode the sequence is activated automatically and in manual mode the sequence is activated by the operator. Automatic mode change is also possible (by logic)

Start interlocks. Implemented with free outside logic

Possible to set time between steps in the application program. Time adjustment from the display only in special cases.

Possible to halt the sequence and continue

Sequence shall stop (sequence on hold) if step time is elapsed and warning will be generated. Sequence continues automatically, when conditions of step are O.K.

From hold it shall be possible either to reset and start from the beginning or continue the sequence.

Possibility to have manual forward stepping without interlocks. Manual stepping will be defined case by case.

4.3 On-Off valve

– **List of Typical**

Manual operated valve

Manual valve, only limit switches

Open/close valve without limit switches

Open/close valve with “open/close” feedback signal.

Open/close valve with positioner and with “open/close” feedback signal.

Motor controlled valve with “open/close” feedback signal (mA-signal)

Open/close motor controlled actuator (bus)

Motor operated valves can have different typical depending upon the actuator selected (feeder version with inbuilt contactor functions in the actuator or MCC contactor version).

– **Operation Modes**

Manual*:* valve is operated manually from the display.

Auto*:* valve is controlled by the application program.

The mode can be changed with operator or outside logic

The modes can be changed with outside logic. The remote mode change signal can be master when static signal is used (operator cannot change the mode). When mode change signal is pulse type the operator can change the mode.

– **Process/Electrical Interlocks**

Interlock signal is active when signal is “0”. Valve is forced to safe position.

After interlock or fault signal becomes healthy = “1”, in auto mode the valve follows automatic function commands

Open/close limit switches cause alarm if the valve is not on the limit after a preset time. Output will stay in controlled position

The following interlocking types shall be included:

Type	Interlocking becomes active, interlocking signal = 0	Interlocking disappears, interlocking signal = 1
VI1	Valve closes, Valve block switches to manual. Mode cannot be changed, valve cannot be opened.	Valve stays closed; Valve block stays in manual and can be operated.
VI2	Valve closes, Valve block freezes, mode is kept; mode can be changed during interlocking. In manual mode valve can be opened.	In manual mode valve stays closed. In auto mode valve follows normal process commands

4.4 Controller

– **List of Typical**

Controller with I/O interlocking

Controller with I/O interlocking and split range outputs

Cascade control: Master

Closed-loop cascade control: Slave

Ratio control

– **Operation Modes**

Manual: the operator can adjust the control output value between 0 -100%.

Auto: the output value is calculated using a PID algorithm and the setpoint is determined by operator.

Remote Auto (E1): the output value is calculated using a PID algorithm and the setpoint is determined by an external signal

The modes can be changed with outside logic. The remote mode change signal can be master when static signal is used (operator cannot change the mode). When mode change signal is pulse type the operator can change the mode.

– **Interlocks**

In case of a controller the interlock is called a forced control. This means that controllers output will be forced to a certain predefined value which normally is 0% (closed). If the controller is in manual mode the valve shall be interlocked with pulse.

The following interlocking types shall be included:

Type	Interlocking becomes active, interlocking signal = 0	Interlocking disappears, interlocking signal = 1
CI1	Valve closes, controller switches to manual. Mode cannot be changed, valve cannot be opened.	Valve stays closed; Controller stays in manual and can be operated.
CI2	Valve closes, controller freezes, mode is kept; mode can be changed during interlocking. In manual mode valve can be opened.	In manual mode valve preset value stays. In auto mode valve opens to pre-interlock value with ramp, controller is released after a time period.
CI3	Valve closes; controller freezes, mode is kept; mode can be changed during interlocking. In manual mode valve can be opened.	In manual mode valve preset value stays. In auto mode valve opens with ramp until measurement has reached setpoint-constant, controller is released for operation.
CI4	Valve closes; controller freezes, mode is kept, and mode can be changed during interlocking. In manual mode valve can be opened.	In manual mode valve preset value stays. In auto mode controller starts controlling from actual position.
CI5	Output goes to predefined value, controller freezes, mode is kept, and mode can be changed during interlocking.	In manual mode predefined value stays. In auto mode the controller starts to control from predefined value.

4.5 Manual Station

– **List of Typical**

Hand station

Hand station with interlock

Hand station with interlock, ratio control

Hand station with interlock, open close limits

– **Operation Modes**

Manual: the operator adjusts directly the output. This does not affect the set point value which can also be changed without any affect on the output.

Auto: the operator adjusts the set point for the output

Remote Auto: the set point is defined by external reference.

The modes can be changed with outside logic. The external mode change signal can be master when static signal is used (operator cannot change the mode). When mode change signal is pulse type the operator can change the mode.

– **Interlocks**

In case of a controller the interlock is called a forced control. This means that controllers output will be forced to a certain predefined value which normally is 0% (closed). If the controller is in manual mode the valve shall be interlocked with pulse.

The following interlocking types shall be included:

Interlocks for HC valves

Type	**Interlocking becomes active, interlocking signal = 0**	**Interlocking disappears, interlocking signal = 1**
HCI1	Valve closes. Controller is forced and frozen to manual mode. Valve cannot be opened. Possibility to adjust the auto-sp.	Valve stays closed mode stays in manual, valve can be operated, mode can be changed.
HCI2	Valve closes. Mode is kept. Mode can be changed, in manual mode the valve can be opened.	The mode from the interlocking is kept. In manual mode valve position from the interlocking stays. In Auto and REMOTE-AUTO the valve will open to the set point value.
HCI3	Valve closes. Mode is kept. Valve cannot be opened.	Mode is kept. In manual the valve stays closed, valve can be operated. In Auto and AUTO-EXT the valve will open to the set point value.

4.6 Analog Input

– **List of typical**

Display with or without alarm/warning functions

Measurement wit temperature and pressure compensation

Software measurement

– **Brief Description**

The typical has the function to monitor analogue signals (measurements) and to monitor whether the signal violates limit values. The measurement value can be simulated. Further, a simulation value can be entered with the correct password. In some special cases when measured value is incorrect than latest acceptable value shall be copied to the actual value. Measurement failure gives normal hardware failure alarms.

4.7 Analogue Output

– **List of Typical**

Analogue output

– **Brief Description**

The typical converts an input value of specified range into an analogue output value of specified range.

4.8 Digital Input

– **List of Typical**

Binary signal without I/O

Binary input signal with alarm and for interlocking

– **Brief Description**

This typical has the function to monitor digital signals (measurements) from the peripheral signal.

4.9 Digital Output

– **List of Typical**

Binary output signal

– **Brief Description**

This typical has the function to convert a binary reference status (setpoint) in the input value of a digital output module.

5 ALARMING

Only events, that requires operator actions an alarm is taken to the process control system. If not otherwise required, the operator cannot change the alarm limits. Alarm hysteresis is by default 1% and an alarm delay is by default 0 s.

Alarms, alarm limit values and control limit values are shown in the alarm- and control limit lists. Same limit codes (HH, LL…) are used in the interlocking diagrams.

Analog measurements and PIC controller's measurements HH-, H-, L- and LL-limits are used for alarms. HH- and LL-limits can also be used for interlocks, if more interlocking limits are required HH1, LL1 etc. are used. Limits H1, H2, L1, L2, etc. are used for control values, without alarms.

Alarm masking of signals will be done according to basic data and are shown in the functional description in the section "Function". E.g. flow and pressure measurements after a pump; a low alarm is enabled when pump has been running for 20 s.

Alarms can be priorized e.g. to four priority levels, depending on features of supplied control system as follows:

Safety alarms (P1):

An event, that causes danger of people or critical loss of production. This event requires immediately reaction of operator. Priority (P1) alarms can be limited in amount of one operators operating area. P1 priority alarms are e.g. safety showers and emergency stops. Operator cannot hide this priority alarms. Color of P1 alarms can be e.g. magenta.

Critical alarms (P2):

An event, that causes danger of people or critical loss of production. This event requires immediately reaction of operator. Priority (P2) alarms can be limited in amount of one operators operating area. Operator cannot hide this priority alarms. Color of P2 alarms can be e.g. red.

Normal alarms (P3):

An event, that causes loss of production or quality weakening. This event requires reaction of operator. Operator could hide this priority alarms when necessary. Color of P3 alarms can be e.g. orange.

Warnings (P4):

An event related to runnability and production optimizing. This event can causes loss of production or quality weakening. This event requires reaction of operator e.g. order for maintenance. Operator could hide this priority alarms. In normal situation, priority (4) alarms can be in separate event list. Color of P4 alarms can be e.g. yellow.

6 FACTORY ACCEPTANCE TEST

Factory Acceptance Testing (FAT) shall be done according to the MEIA0009 (Implementation Procedure for Control Systems (DCS, MCS) FAT).