

GENERAL SPECIFICATION

INSTRUMENTATION

GS EP INS 197

Process Standard Functions

04	09/2012	Update following the EP reorganization, March 2011
03	01/2011	Revised as per marking
02	10/2008	Revised as per marking
01	10/2007	Revised as per marking
00	10/2005	First issue
Rev.	Date	Purpose of the revision

Owning entity: DEV/TEC	Managing entity: DEV/TEC/INS
------------------------	------------------------------

General Specification		GS EP INS 197
Process Standard Functions		
Rev.: 04	Effective date: 09/2012	Page: 2 of 118

Contents

1. Scope	3
2. Reference documents.....	3
Chapter 1 PID Standard Function	4
Chapter 2 Pressure/Temperature Compensated Flow Standard Function - GCF -	20
Chapter 3 Total Flow Standard Function - TOT -	31
Chapter 4 Low Voltage Motor, High Voltage Motor Standard Function - MOT -	36
Chapter 5 Pump Unit Standard Function - PU -	51
Chapter 6 Duty/Back-up/Stand-by Standard Function - D/B/S -	79
Chapter 7 ON/OFF Process Valve Standard Function - XV -	102
Chapter 8 Hand Valve with two limit switches Standard Function - HV -	113

General Specification		GS EP INS 197
Process Standard Functions		
Rev.: 04	Effective date: 09/2012	Page: 3 of 118

1. Scope

The purpose of this document is to define a set of Standard Functions for most common process functions.

It includes the following functions with some options:

- PID
- Low voltage and high voltage motor
- Centrifugal pump unit
- Duty/Back-up/Standby unit
- ON/OFF process valve
- ON/OFF manual valve
- Pressure/temperature compensated flow
- Total flow.

2. Reference documents

The reference documents listed below form an integral part of this General Specification.

External Documents

Unless otherwise stipulated, the applicable version of these documents, including relevant appendices and supplements, is the latest revision published at the effective date of this document.

Reference	Title
Not applicable	

Total General Specifications

Unless otherwise stipulated, the applicable version of these documents, including relevant appendices and supplements, is the latest revision published in the applicable yearly collection.

Reference	Title
GS EP INS 150	Design method for system configuration - Standard functions

General Specification		GS EP INS 197
Process Standard Functions		
Rev.: 04	Effective date: 09/2012	Page: 4 of 118

Chapter 1 PID Standard Function

1. Scope	5
2. General description of functions	5
2.1 List of main functions	5
2.2 Functional scheme	6
3. Interfaces description	7
4. Detailed description of functions.....	8
4.1 CASCADE/AUTO/MANUAL mode	8
4.2 Output value handling	8
4.3 Process shutdown.....	9
4.4 Maintenance inhibit of associated measurement.....	9
4.5 Analogue output fault status.....	9
4.6 Measurement fault	9
4.7 Specific features when interlocked with RAI standard	9
4.8 Status of automatic switching to MANUAL mode	9
4.9 PID_MR / PID_SR Option: Cascaded controllers (Master/Slave)	10
4.10 PID_RD Option: PID controller with redundant valves.....	11
4.11 PID_SPR Option: split range PID controller	13
4.12 PID_ON/OFF Option: PID controller with flip/flop analogue output.....	14
4.13 PID_1DC Option: PID controller with a digital output.....	15
5. Standard tuning parameters and variables.....	16
6. Representation and animation description (HMI).....	16
6.1 Events and values to be recorded.....	16
6.2 Alarms handling	16
6.3 Control display	17
6.4 Miscellaneous	19

General Specification		GS EP INS 197
Process Standard Functions		
Rev.: 04	Effective date: 09/2012	Page: 5 of 118

1. Scope

The purpose of this document is to define the Standard Function of PID controller.

In order to assist in understanding, the document should be read in conjunction with **GS EP INS 150**.

This Standard Function shall be used in conjunction with the AI standard and potentially with the RAI (Redundant analogue inputs) and GCF (Pressure and temperature compensated flow) Standard Functions as well.

The analogue output is part of this Standard Function.

The following options are available:

- PID: Standard functions
- PID_MR/PID_SR: Cascaded controllers (Master/Slave)
- PID_RD: PID controller with redundant valves
- PID_SPR: Split range PID controller
- PID_ON/OFF: PID controller with flip/flop analogue output
- PID_1DC: PID controller with digital output

2. General description of functions

2.1 List of main functions

- Control function using PID algorithm
- Process shutdown (in function of associated SDV position)
- Maintenance inhibit of measurement (from AI standard)
- Analogue input and output fault.

Process Standard Functions

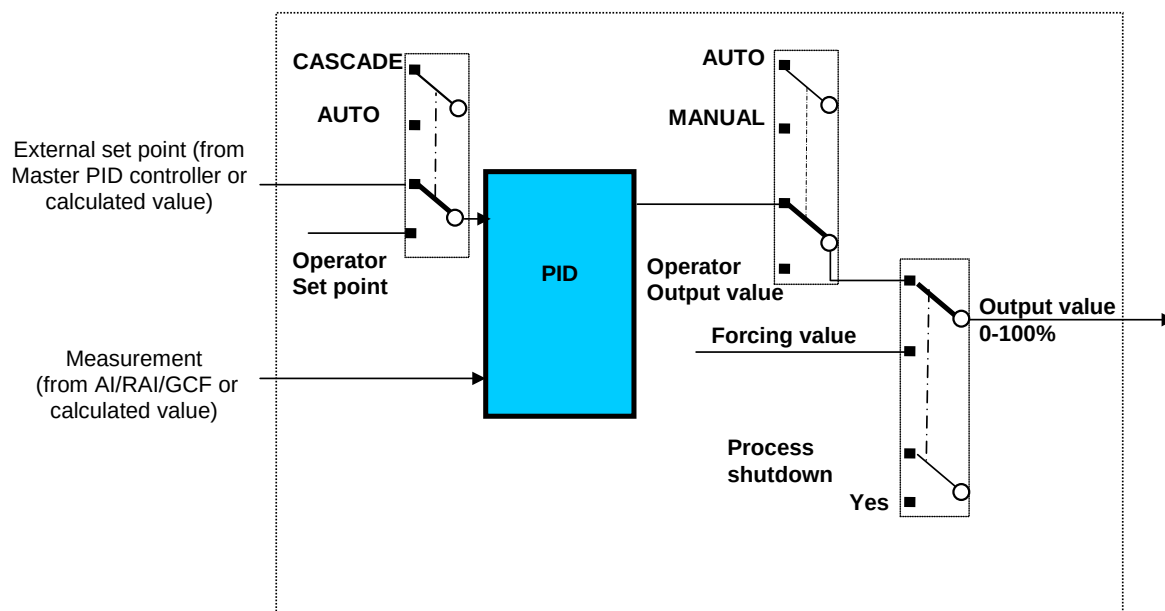
Rev.: 04

Effective date: 09/2012

Page: 6 of 118

Chapter 1

2.2 Functional scheme



3. Interfaces description

This document is the property of TOTAL S.A., it contains confidential information which may not be disclosed to any third party, reproduced, stored or transmitted without the prior written consent of TOTAL S.A.
The information contained in this document does not substitute to the applicable laws and regulations.

General Specification		GS EP INS 197
Process Standard Functions		
Rev.: 04	Effective date: 09/2012	Page: 8 of 118

4. Detailed description of functions

4.1 CASCADE/AUTO/MANUAL mode

4.1.1 Specific description

4.1.1.1 Definitions

- **MANUAL:** PID algorithm is stopped and the output value is set by the operator
- **AUTO:** PID algorithm runs with an operator set point
- **CASCADE:** PID algorithm runs with the set point set by a higher level automatic control (external set point)

Auto and cascade mode may be interlocked by a higher level standard.

4.1.1.2 Set point handling

The last set point entered by the operator is memorised and displayed (e.g. on a dedicated summary mimic).

When the PID controller is in MANUAL, the set point tracks the measurement.

When the PID controller is in AUTO, the external set point tracks the operator set point.

When the PID controller is in CASCADE, the operator set point tracks the external set point.

4.1.1.3 CASCADE/AUTO ↔ Manual transitions

- CASCADE/AUTO → MANUAL transition

The output value does not change because the HMI output value is aligned with the last calculated value.

- MANUAL → CASCADE/AUTO transition

The output value does not change because the initial calculated output value is aligned with the HMI value (and set point = measurement).

4.1.1.4 FREE ↔ CASCADE transitions

- AUTO → CASCADE transition

The external set point is aligned with the operator set point.

A set point change will be required by the higher level automatic control only after CASCADE mode status checking.

- CASCADE → AUTO transition

The operator set point is aligned with the external set point.

4.2 Output value handling

The output value range is from 0 to 100%.

General Specification		GS EP INS 197
Process Standard Functions		
Rev.: 04	Effective date: 09/2012	Page: 9 of 118

4.3 Process shutdown

Process shutdown function is performed when the corresponding internal input is initiated (e.g. from the associated SDV closed status).

Upon initiation, actions will be safety trip animation and output value forced to the forcing value.

4.4 Maintenance inhibit of associated measurement

When the corresponding measurement is inhibited, the PID algorithm is stopped and the output value is frozen to the last calculated output value. The operator can not change the set point.

The operator can set the PID controller to MANUAL mode and change the output value.

If the PID controller is switched back to AUTO or CASCADE modes, the output value will not change and is frozen again.

4.5 Analogue output fault status

This status is active when the loop is open-circuit or when the corresponding card is faulty.

4.6 Measurement fault

When the associated measurement is in fault, the CASCADE/AUTO/MANUAL mode is forced to MANUAL.

4.7 Specific features when interlocked with RAI standard

When the switching from PSS measurement to PCS measurement is active, the PCS transmitter inhibit will not affect the PSS transmitter, which is currently utilised by the PCS: the measurement is not frozen.

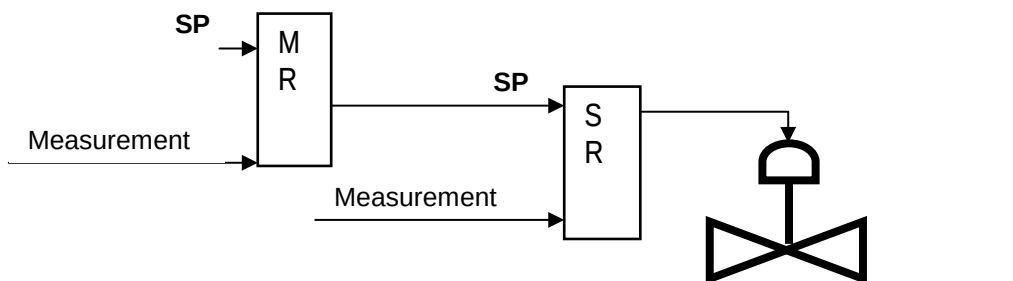
If a discrepancy alarm is active at the switching time, the PID controller will be forced to MANUAL, in order to avoid process upset. In this case, the discrepancy detection has to be considered at time t-1, while the fault detection is considered at time t.

4.8 Status of automatic switching to MANUAL mode

This status is active when the PID controller is forced to MANUAL upon measurement or analogue output fault or upon a situation as defined within the above paragraph; it will be reset after acknowledgement.

General Specification		GS EP INS 197
Process Standard Functions		
Rev.: 04	Effective date: 09/2012	Page: 10 of 118

4.9 PID_MR / PID_SR Option: Cascaded controllers (Master/Slave)



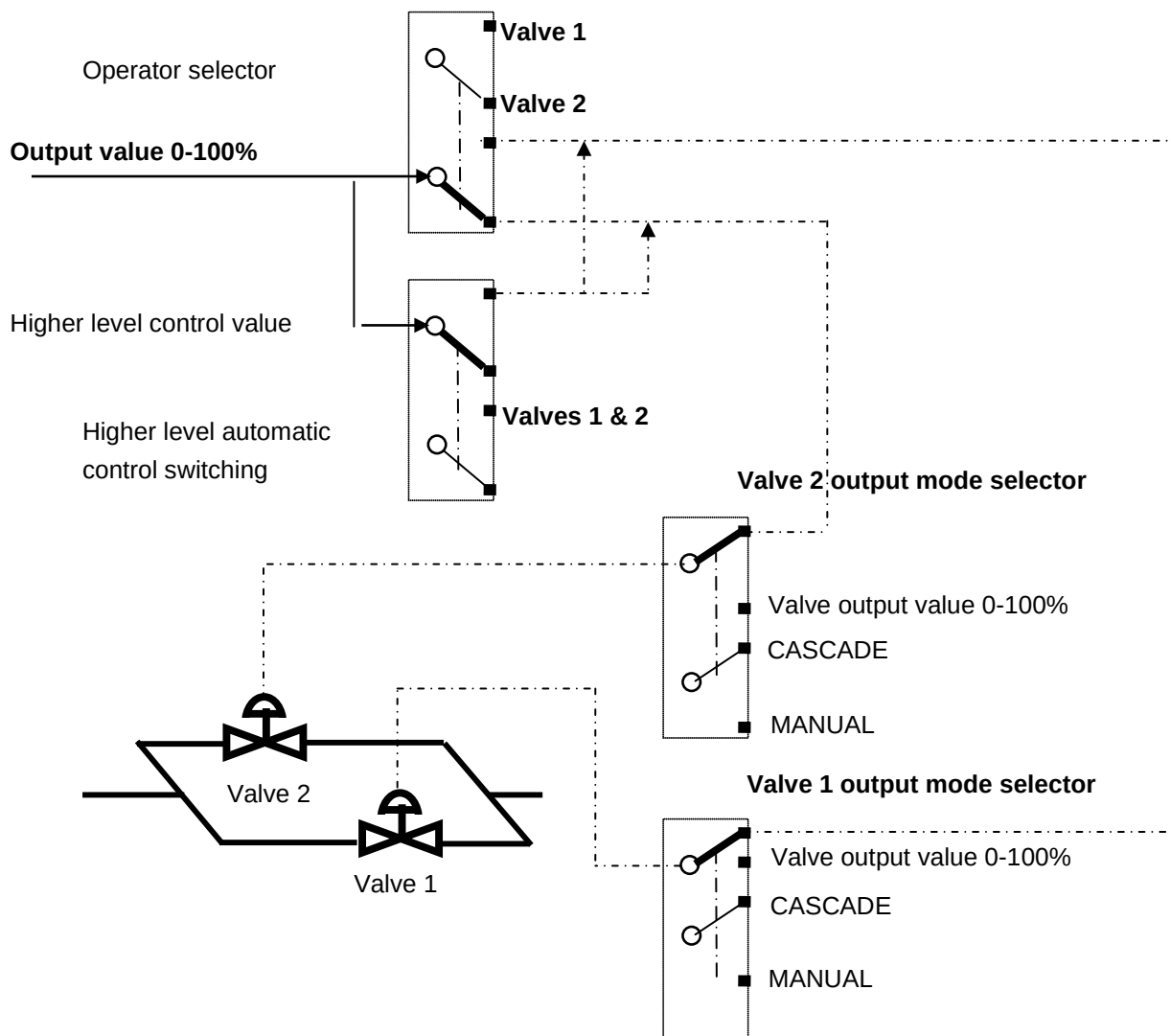
MR: Master PID controller

SR: Slave PID controller

When the Slave controller is set to MANUAL or AUTO mode, the Master controller is forced to MANUAL mode with its output value tracking the operator set point of the Slave regulator. The operator can not change this output value.

The status of the automatic switching to MANUAL mode is active.

4.10 PID_RD Option: PID controller with redundant valves



4.10.1 Normal situation

The operator can select the valve to be operated, the other valve is considered as a backup valve.

The selected valve is controlled by the PID controller output value, while the backup valve is set to 0%.

Upon valves change over, a ramp may be implemented as necessary. Control of both valves by a higher level automatic control is available.

When the higher level control switching is active, both valves are controlled by the output value of the PID controller; the operator can not change the valve selector.

The last position of the manual switch is memorised and the normal control resumes with the last selected valve when the command of the higher level automatic control is no longer active.

General Specification		GS EP INS 197
Process Standard Functions		
Rev.: 04	Effective date: 09/2012	Page: 12 of 118

4.10.2 Individual control of both valves in maintenance access

The maintenance operator has the possibility to control individually each valve by means of the output control block no matter the CASCADE/AUTO/MANUAL mode status of the PID. The access will be possible from the corresponding group mimic including both faceplates of the output control blocks. The group mimic is directly linked from the process mimic by means of a "soft key".

Both output control blocks may be set in CASCADE (normal situation) or MANUAL mode. When in MANUAL mode the output value can be changed.

The operator has to switch back output control to CASCADE mode in order to resume PID control.

4.10.2.1 Handling of CASCADE/AUTO/MANUAL mode of PID controller

The PID controller is forced to MANUAL when the output control block of the selected valve is in MANUAL. The operator can set the PID controller in AUTO/CASCADE when the output control block of the selected valve is in CASCADE.

The PID controller is forced to MANUAL when both output control blocks are in MANUAL during the control of both valves by a higher level automatic control. The operator can turn back the PID controller to AUTO/CASCADE when one of the output control blocks is set to CASCADE mode.

4.10.2.2 MANUAL ↔ CASCADE transitions of the output control blocks

4.10.2.2.1 CASCADE → MANUAL transition

The output value of the output control block does not change because the HMI output value is aligned with the last calculated value.

4.10.2.2.2 MANUAL → CASCADE transition

The output value of the PID controller is aligned with the value of the output control block of the selected valve, or with the value of the first output control block turned back to CASCADE mode in the case of control of both valves. Therefore, the output value of the concerned output control block does not change.

Concerning the backup valve, or the second valve in case of control of both valves, the calculated value (0% or output value of the PID controller) may be reached by means of a ramp if necessary (as per § 4.10.1).

4.10.3 Limitation of output value of the PID controller

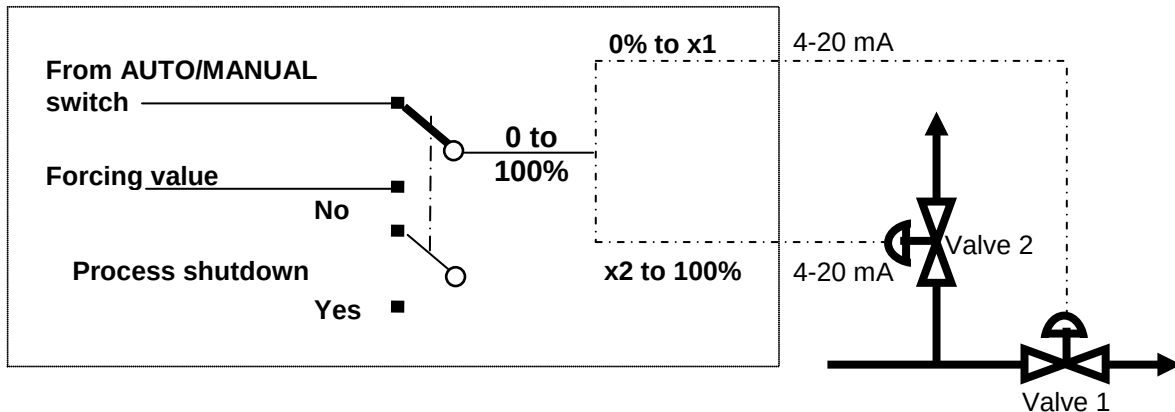
The output value of the PID controller will be limited by thresholds of the output control blocks, effective when PID mode is in AUTO or CASCADE:

- Limited if both output control blocks have reached a limit, when both output control blocks are in CASCADE
- Limited if the remaining output control block in CASCADE has reached a limit.

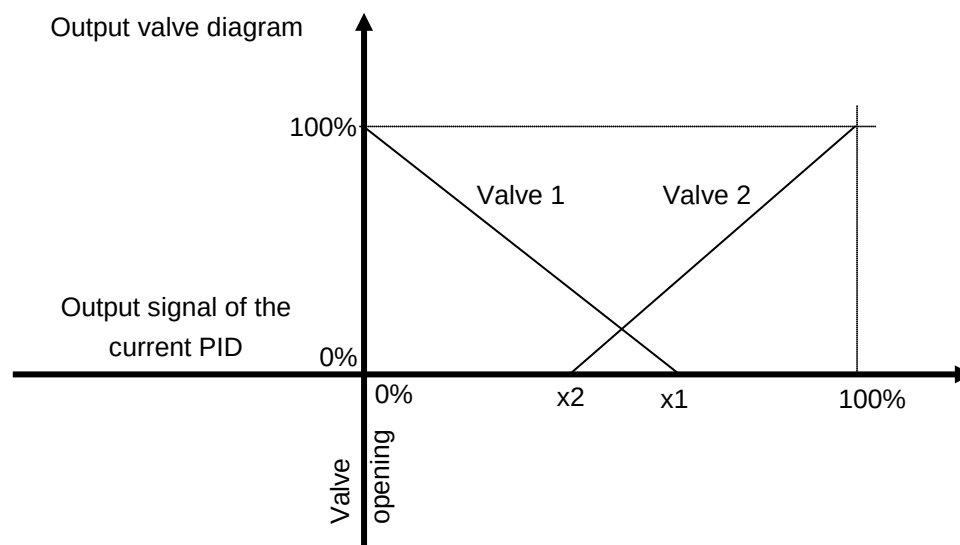
4.10.4 Process shutdown

The mode of the output control blocks (MANUAL/CASCADE) is not locked.

4.11 PID_SPR Option: split range PID controller



Example of a SPLIT RANGE:



4.11.1 General points

The Output value of the PID controller is split to two control valves. Each valve has its own 4-20 mA signal.

4.11.2 Individual control for both valves

The maintenance operator has the possibility to control individually each valve.

4.11.2.1 Access

The maintenance operator has the possibility to control individually each valve by means of the output control block, no matter the CASCADE/AUTO/MANUAL mode status of the PID. The access is possible from the corresponding group mimic including both faceplates of output control blocks. The group mimic is directly linked from the process mimic by means of a "soft key".

General Specification		GS EP INS 197
Process Standard Functions		
Rev.: 04	Effective date: 09/2012	Page: 14 of 118

Both output control blocks may be set in CASCADE (normal situation) or MANUAL mode. When in MANUAL mode the output value can be changed.

The operator has to switch back output control block to CASCADE mode in order to resume PID control.

4.11.2.2 Handling of CASCADE / AUTO / MANUAL mode of PID controller

The PID controller is set and locked in MANUAL when the output control block of the selected valve is in MANUAL. The operator can set the PID controller in AUTO/CASCADE when the output control block of the selected valve is in CASCADE.

4.11.2.3 MANUAL $\leftrightarrow$ CASCADE transitions of the output control blocks

4.11.2.3.1 CASCADE $\rightarrow$ MANUAL transition

The output value of the output control block does not change because the HMI output value is aligned with the last calculated value.

4.11.2.3.2 MANUAL $\rightarrow$ CASCADE transition

The output value of the PID controller is aligned with the value of the first output control block turned back to CASCADE mode. Therefore the output value of the concerned output control block does not change.

Concerning the second valve, the calculated value (output value of the PID controller) may be reached by means of a ramp if necessary (as per § 4.10.1).

4.11.3 Limitation of output value of the PID controller

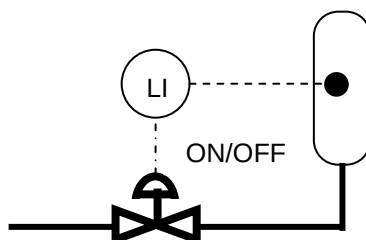
The output value of the PID controller will be limited by thresholds of the output control blocks, effective when PID mode is in AUTO or CASCADE:

- Limited if both output control blocks have reached a limit, when both output control blocks are in CASCADE
- Limited if the remaining output control block in CASCADE has reached a limit.

4.11.4 Process shutdown

The mode of output control blocks (MANUAL/CASCADE) is not locked.

4.12 PID_ON/OFF Option: PID controller with flip/flop analogue output



4.12.1 General points

The regulator modifies its output upon exceeding the maximum allowed deviation between the measurement and the set point (defined by the dead band parameter in engineering units).

General Specification		GS EP INS 197
Process Standard Functions		
Rev.: 04	Effective date: 09/2012	Page: 15 of 118

Chapter 1

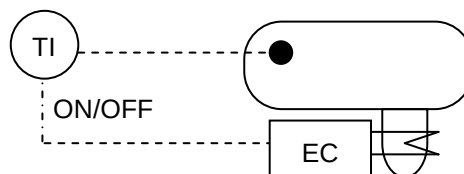
The action of this regulator is configured with an infinite gain, to quickly obtain the minimum or the maximum of the output value of the PID controller.

When the PID controller is in MANUAL, the operator controls the output value in the same way as with a standard PID controller.

4.12.2 MANUAL → CASCADE/AUTO transition

The output value does not change until the deviation (measurement - set point) becomes greater than the dead band.

4.13 PID_1DC Option: PID controller with a digital output



4.13.1 General points

The PID controller operates a digital output instead of an analogue output (e.g. electrical heater start/stop).

The output value turns from 0 (e.g. stop) to 1 (e.g. start) upon exceeding the maximum allowed deviation between the measurement and the set point (defined by the dead band parameter in engineering units).

When the PID controller is in MANUAL, the operator can change the output value.

4.13.2 CASCADE/AUTO → MANUAL transition

The output status does not change because the HMI output value tracks the last calculated value.

4.13.3 MANUAL → CASCADE/AUTO transition

The output value is set to 0 or 1 according to the HMI output value. The output status does not change until the deviation (measurement - set point) exceeds the dead band.

4.13.4 Process shutdown

The output value is forced to 0.

After a process shutdown reset, the output status does not change until the deviation exceeds the dead band.

General Specification		GS EP INS 197
Process Standard Functions		
Rev.: 04	Effective date: 09/2012	Page: 16 of 118

5. Standard tuning parameters and variables

Parameters	Access level
Valve type (FC or FO)	Engineer
Direct or Reverse controller	Engineer
P, I, D (parameters of controller)	Maintenance
Set point limits (High and Low) or thresholds	Maintenance
Output limits (High and Low)	Maintenance
Dead band (PID_ON/OFF & PID_1DC)	Maintenance
Set point ramp (if required)	Maintenance
Sampling period	Engineer

6. Representation and animation description (HMI)

6.1 Events and values to be recorded

6.1.1 Events

- CASCADE/AUTO/MANUAL command
- Output fault status
- MANUAL automatic setting status
- CASCADE/MANUAL command of output control blocks (PID_RD, PID_SPR).

6.1.2 Values

- Operator Set point
- Operator output value
- Dead band.

6.2 Alarms handling

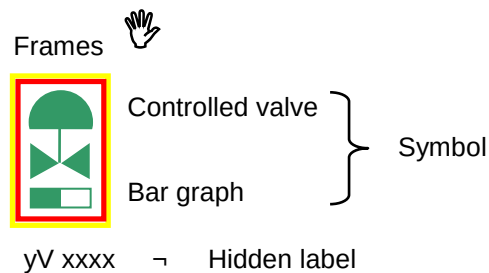
Alarm Description	Priority
Output fault alarm	Level 1
MANUAL automatic setting alarm of PID controller	Level 1
MANUAL automatic setting alarm of valve output control blocks (PID-RD, PID-SPR)	Level 1

General Specification		GS EP INS 197
Process Standard Functions		
Rev.: 04	Effective date: 09/2012	Page: 17 of 118

6.3 Control display

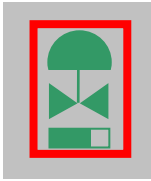
The hereafter description gives examples of representation. However, they may be amended dependant on the DCS features.

6.3.1 Controlled valve representation



- yV xxxx instrument label appears upon operator request (soft key)
- Symbol and yV xxxx instrument label are used as target area for the PID controller faceplate display.

6.3.2 Animation of the controlled valve (Symbol and Frames)

Display description	Display	Valve and bargraph	Frames
Opening > 5%		Fluid colour	NA
Opening ≤ 5%		White	NA
Safety trip		as above	External frame: White
Output fault		as above	Internal frame: Red flashing before acknowledgement Red steady after acknowledgement
Communication or system fault		White	External frame: Magenta

The bar graph represents the opening percentage of the valve. This information is transmitted via the command signal or via the position transmitter if it exists.

The events which drive these frame displays may not be mutually exclusive. Therefore, the precedence on the display, from most to least important, shall be: magenta, white, blue, yellow.

6.3.3 Animation of the “hand” symbol

6.3.3.1 General points

- An empty yellow “hand” symbol appears near the valve when the operator has no access to the set-point (generally when the controller is in AUTO)
- This empty yellow “hand” is not displayed when the associated measurement is in maintenance inhibit
- A full yellow “hand” symbol appears near the valve when output value is available for the operator (generally when the controller is in MANUAL)

- There is no “hand” symbol displayed during the process shutdown
- PID controller “MANUAL automatic setting” status is shown by means of a yellow frame around the “hand” symbol (with the alarming handling: flashing yellow /steady yellow).

6.3.3.2 Specificity of cascade regulators PID_MR, PID_SR option

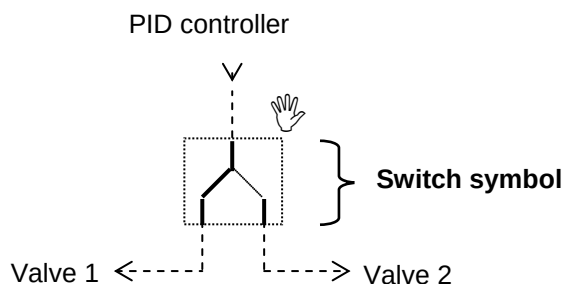
The yellow frame with the “hand” symbol in white is displayed for the Master controller when the Slave controller is not in CASCADE.

6.3.3.3 Specificity of PID_RD & PID_SPR options

A complete “hand” symbol animation with frame is implemented for valve output control blocks. The full yellow “hand” animation is shown when the output control block has been set in MANUAL by the maintenance operator.

6.3.4 Specific animation of PID_RD option: switching display of valves

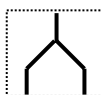
The switching status is displayed on the corresponding process mimic by means of a switch symbol:



This symbol is used as a target area to access the switch selector.

Operator valve switching possibility is shown by a full yellow “hand” symbol displayed near the switch symbol. This “hand” symbol is hidden during the monitoring of both valves by a higher level automatic control.

During the control of both valves by a higher level automatic control, the animation of the switch is:



6.4 Miscellaneous

Specific access to the PID controller faceplate display for cascade regulators PID_MR /PID_SR option:

Symbol and the yV xxxx instrument label are used as target areas to access a group mimic showing a summary of both controllers. The operator can then call up the faceplate of a PID controller by clicking on the corresponding dedicated target (faceplate is directly displayed).

General Specification		GS EP INS 197
Process Standard Functions		
Rev.: 04	Effective date: 09/2012	Page: 20 of 118

Chapter 2 Pressure/Temperature Compensated Flow Standard Function - GCF -

1. Scope	21
2. General Description of Functions.....	21
2.1 List of main functions	21
2.2 Functional scheme.....	22
3. Interface description	23
4. Detailed description of functions.....	23
4.1 General points.....	23
4.2 Instantaneous corrected flow formula for flow measured by vortex system (linear)	24
4.3 Instantaneous corrected flow formula for flow measured by differential pressure (square root extraction, GCF_sq option)	24
4.4 Handling of thresholds	25
4.5 Maintenance inhibit of the corrected flow	25
4.6 Corrected flow fault	25
4.7 Handling of fall-back values	25
5. Tuning parameters and variables	26
6. Representation and animation description (HMI).....	26
6.1 Events and values to be recorded.....	26
6.2 Alarm handling	27
6.3 Control display	27
6.4 Thresholds displays	30
6.5 Trend curves and Bar graph.....	30

General Specification		GS EP INS 197
Process Standard Functions		
Rev.: 04	Effective date: 09/2012	Page: 21 of 118

1. Scope

The purpose of this document is to define the Standard Function used to compensate the gas flow in function of the pressure and temperature.

In order to assist in understanding, this document should be read in conjunction with **GS EP INS 150**.

This Standard Function includes two options:

- GCF: raw flow measured directly by means of a flowmeter
- GCF_SQ: raw Flow measured by means of a differential pressure measurement.

The acquisition of process flow value is achieved directly from corresponding analogue input.

The acquisition of process pressure and temperature numerical values are achieved through AI or RAI Standard Functions.

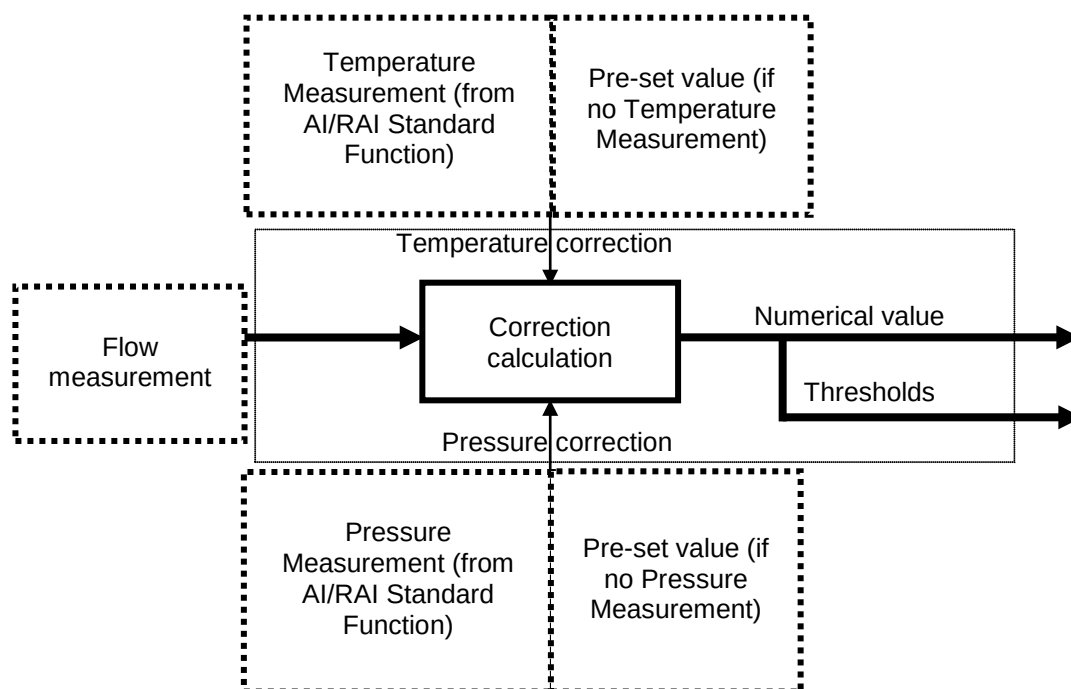
This Standard Function may be used in relationship with other Standard Functions (e.g. PID, TOT (flow totalizer).

2. General Description of Functions

2.1 List of main functions

- Acquisition of the three numerical values
- Calculation of the flow corrected by pressure and temperature measurements
- Input fault detection
- Maintenance inhibit

2.2 Functional scheme



3. Interface description

INPUTS					OUTPUTS		
Field	HMI	Internal			Internal	HMI	Field
				Standard function GCF			
●			Raw Flow value		Value in engineering unit	●	●
		●	Pressure value		Control thresholds	●	●
		●	Temperature value		Alarm thresholds		Alm
		●	Maintenance inhibit status of flow input		Input fault status (corrected flow)	●	Alm
	Opt	●	Maintenance inhibit status of pressure input		Maintenance inhibit status	●	●
	Opt	●	Maintenance inhibit status of temperature input				
		●	Flow input fault				
	Opt	●	Pressure input fault				
	Opt	●	Temperature input fault				
			Threshold values				
		●	Z/K coefficient				
	Opt	●	Pressure fall-back value				
	Opt	●	Temperature fall-back value				
		Opt	Automatic threshold masking				
					Opt = Optional (if the measure exists, for P & T) Alm = Alarm		

4. Detailed description of functions

4.1 General points

The compensated Flow in pressure/temperature is calculated from three numerical values:

- The raw flow measured from an analogue input (a differential pressure measurement or a flow measurement according to the used analogue value)

General Specification		GS EP INS 197
Process Standard Functions		
Rev.: 04	Effective date: 09/2012	Page: 24 of 118

- The pressure from either an analogue input or a pre-set value
- The temperature from either an analogue input or a pre-set value.

Flow, Temperature and Pressure values association shall be specified in functional analysis.

The corrected value will be used instead of the flow measurement by other Standard Functions (e.g. TOT, etc.).

4.2 Instantaneous corrected flow formula for flow measured by vortex system (linear)

The PTZ Flows will be converted by the PCS in accordance with the following formula, in which the PI is indicated in absolute bars and the TI in °K:

$$Q = Q_i \times \frac{PI \times T_0}{P_0 \times TI} \times K$$

- Q_i = measured flow at actual conditions (Am^3/h)
- Q = flow converted to standard conditions (Sm^3/h)
- $K = \frac{Z_0}{Z}$ (K is a coefficient which is entered by method people)
- PI = measured pressure in bara (to convert barg to bara, add 1.01325)
- TI = measured temperature in degrees Kelvin (to convert degC to degK, add 273)
- $T_0 = 288,15 \text{ °K}$ = temperature at standard conditions
- $P_0 = 1,01325 \text{ bar (a)}$ = pressure at standard conditions
- $Z_0 = 1$

Z is the gas average Z value under process condition (modifiable variable on the Flow meter parameter display). This variable may differ depending on the corrected Flow.

Each Z value will be calculated by Method Specialist, taking into account the start up simulation phase data. A default value of "1" will be used during FAT.

4.3 Instantaneous corrected flow formula for flow measured by differential pressure (square root extraction, GCF_sq option)

The flow will be corrected by the DCS as per the following formula, where the differential pressure (PDI) is indicated in Pa, the pressure (PI) in absolute bars and the temperature (TI) indicated in °K:

$$PI = PI \text{ measurement} + 1,01325$$

$$Q = K * \sqrt{PDI} * \sqrt{\frac{PI}{TI}}$$

K is a coefficient which is calculated by Method specialist.

General Specification		GS EP INS 197
Process Standard Functions		
Rev.: 04	Effective date: 09/2012	Page: 25 of 118

4.4 Handling of thresholds

Handling of thresholds is similar to threshold handling for one analogue input (AI). The corresponding treatment applies to the corrected flow value.

4.5 Maintenance inhibit of the corrected flow

The corrected flow is considered in maintenance inhibit status when the raw flow measure is in maintenance inhibit.

Numerical value	Control thresholds	Alarm thresholds
HMI shows actual value of the corrected flow (in engineering unit). Used corrected value is the last healthy value (before inhibit). Associated PID controller calculation is stopped with last calculated output. Automatic control sequences still run (with the used corrected value).	xCL and xCH are deactivated and forced to their <i>NORMAL</i> state	xAL and xAH are deactivated and forced to their <i>NORMAL</i> state

The corrected flow input fault is no more alarmed when Maintenance inhibit is active.

4.6 Corrected flow fault

The corrected flow is considered in fault when the flow input is in fault.

Input value	Signal status	Displayed value
Signal < 0.8 mA	<i>In fault</i>	-20%
0.8 mA ≤ signal ≤ 23.2 mA	<i>Healthy</i>	Current value
Signal > 23.2 mA	<i>In fault</i>	120%
Card fault	<i>In fault</i>	Last value

INPUT VALUE is the value of raw flow analogue input.

DISPLAYED VALUE is the value of corrected flow.

-20% and 120% values concerns the corrected flow scale.

4.7 Handling of fall-back values

There is a fall-back value for the Pressure and Temperature measurements.

This value replaces the measurement when the corresponding analogue input is considered in fault or in maintenance inhibit (when pre-set values of pressure and temperature are used, input fault and maintenance inhibit handling for the pressure and temperature do not apply).

General Specification		GS EP INS 197
Process Standard Functions		
Rev.: 04	Effective date: 09/2012	Page: 26 of 118

Calculated fall-back values are available to the operator in method access level, who may change them within corresponding sensor scale limits.

4.7.1 Fall-back value of pressure measurement

The fall-back value is the last healthy slide average.

The slide average is normally calculated during one hour, with a sampling period of two minutes (30 value memorised). The slide average is only calculated if the corresponding measurement is healthy and not in maintenance inhibit.

Upon next activation of the healthy status and removal of the maintenance inhibit, the slide average is initialised: all memorised values are loaded with the new healthy measurement.

Note: Number of memorised values and sampling time are adjustable (in method access level).

4.7.2 Fall-back value for temperature

The fall-back value is the last healthy value.

5. Tuning parameters and variables

Parameter	Access level
Alarm threshold FAH in engineering unit	Method
Alarm threshold FAL in engineering unit	Method
Fall-back value for temperature measurement	Method
Fall-back value for pressure measurement	Method
Time duration for pressure slide average	Method
Scale minimum value	Engineer
Scale maximum value	Engineer
Control threshold (FCH) in engineering unit	Method
Control threshold (FCL) in engineering unit	Method
Threshold hysteresis	Engineer
K coefficient (or Z gas coefficient)	Engineer
Pre-set value for temperature (if no available measurement)	Engineer
Pre-set value for pressure (if no available measurement)	Engineer

6. Representation and animation description (HMI)

6.1 Events and values to be recorded

6.1.1 Events

Alarm thresholds

Corrected flow input fault

Maintenance inhibit command.

6.1.2 Analogue values

Corrected value in engineering unit.

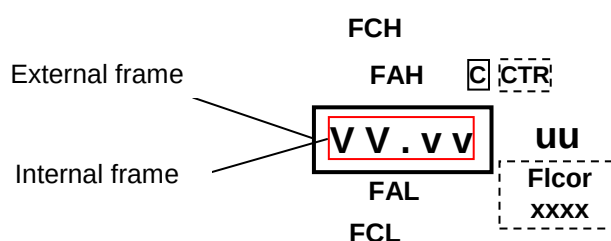
6.2 Alarm handling

Alarm description	Priority
Alarm thresholds (FAH, FAL)	Level 1
Corrected flow input fault	Level 1

6.3 Control display

This description gives examples of representation. However, they may be amended dependant on the DCS features.

6.3.1 Displayed data representation



V V . v v = Numeric value (in engineering unit)

Target area for the corrected flow face plate display (alarm thresholds tuning)

uu = Engineering unit (KSm³/j)

CTR = Process control (only appears on operator request by means of a soft key)

Target area for the corrected flow face plate display (control thresholds tuning)

Fcor xxxx = Corrected flow tag name (only appears on operator request)

Target area for the maintenance inhibit command of flow transmitter

FCH = High control threshold activated

(can be also displayed near the associated equipment)

FAH = High alarm threshold activated

FAL = Low alarm threshold activated

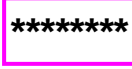
FCL = Low control threshold activated

(can be also displayed near the associated equipment)

As a basis, control thresholds shall not be displayed on process views.

All existing threshold (s) on process views are displayed in white colour on operator request (hidden if not active).

6.3.2 Analogue value display

Internal data	Display	Text	Frame
Symbol  Numeric value = <i>NORMAL</i> Label + CTR Units	 CTR VV.VV uu Flcor	White/hidden Green White/hidden White	NA
Numeric value = <i>ALARM</i>	VV.VV uu	Colour steady (depending on alarm priority level)	NA
Maintenance inhibit = <i>INHIBITED</i>	 uu	As above	External frame: Steady Yellow
Flow input fault = <i>IN FAULT</i> And unacknowledged	 uu	Steady Red	Alarm frame (internal): Flashing Red
Flow input fault = <i>IN FAULT</i> And acknowledged	 uu	Steady Red	Internal frame: Steady Red
Flow input fault occurred after Maintenance inhibit activation	 uu	Steady Red	External frame: Yellow Alarm frame (internal): Red
Communication fault = <i>ACTIVATED</i>	 uu	White	External frame: Steady Magenta

The events which drive these frame displays may not be mutually exclusive. Therefore, the precedence on the display, from most to least important, shall be: magenta, white, blue, yellow.

Symbol  is used as target area for the Detailed display.

6.3.3 Detailed display

Flow measured by Vortex system (linear):

Raw flow	Corrected flow	Correction Pressure	Fall-back pressure	Correction Temperature	Fall-back temperature	Coefficient K/Z
FT xxxx  Km ³ /j	Fcor xxxx  KSm ³ /j	PT xxxx  bar		TT xxxx  °C		ZZ.ZZ

Flow measured by differential pressure (GCF_SQ option):

Differential pressure	Corrected flow	Correction pression	Fall-back pressure	Correction temperature	Fall-back temperature	Coefficient K
PDT xxxx  mbar	Fcor xxxx  KSm ³ /j	PT xxxx  bar		TT xxxx  °C		KK.KK

 Target area on raw value (FT in Km³/j or PDT in mbar) for the loop face plate display of raw measurement (the raw measurement is a differential pressure measurement or a flow measurement).

 Target area on pressure (PT) value for the loop face plate display.

 Target area on pressure fall-back value for changing the fall back value (in method access level).

 Target area on temperature (TT) value for the loop face plate display.

 Target area on temperature fall-back value for changing the fall-back value (in method access level).

The formula coefficient (K) is only displayed (not entered).

6.4 Thresholds displays

6.4.1 Alarm thresholds display

Internal data	Display	Text	Frame
Alarm threshold = <i>NORMAL</i>		Hidden	NA
Alarm threshold = <i>ALARM</i> And unacknowledged		Flashing Yellow	NA
Alarm threshold = <i>ALARM</i> And acknowledged		Steady Yellow	NA

6.4.2 Control thresholds display

Internal data	Display	Text	Frame
Control threshold = <i>NORMAL</i>		Hidden	NA
Control threshold = <i>ACTIVE</i>		Green	NA

6.5 Trend curves and Bar graph

Similar to AI Standard Function.

General Specification		GS EP INS 197
Process Standard Functions		
Rev.: 04	Effective date: 09/2012	Page: 31 of 118

Chapter 3 Total Flow Standard Function - TOT -

1. Scope	32
2. General description of functions	32
2.1 List of main functions	32
3. Description of interfaces	32
3.1 General description	32
4. Detailed description of functions.....	33
4.1 Totalizing formula.....	33
4.2 TOT_AV Option: average flow	33
4.3 Reset of totalizer	33
4.4 Maintenance inhibit	33
4.5 Input fault.....	33
4.6 Maintenance inhibit or input fault handling	33
5. Tuning parameters and variables	34
6. Representation and animation description (HMI).....	34
6.1 Values to be recorded	34
6.2 Control display	34

General Specification		GS EP INS 197
Process Standard Functions		
Rev.: 04	Effective date: 09/2012	Page: 32 of 118

1. Scope

The purpose of this document is to define the Standard Function for a **Totalized Flow**, with **Average Flow** as an option.

In order to assist in understanding, this document should be read in conjunction with **GS EP INS 150**.

The acquisition of Flow value is done through the following Standard Functions:

- AI Analogue Input
- RAI Redundant Analogue Input
- GCF Pressure and Temperature compensated Flow

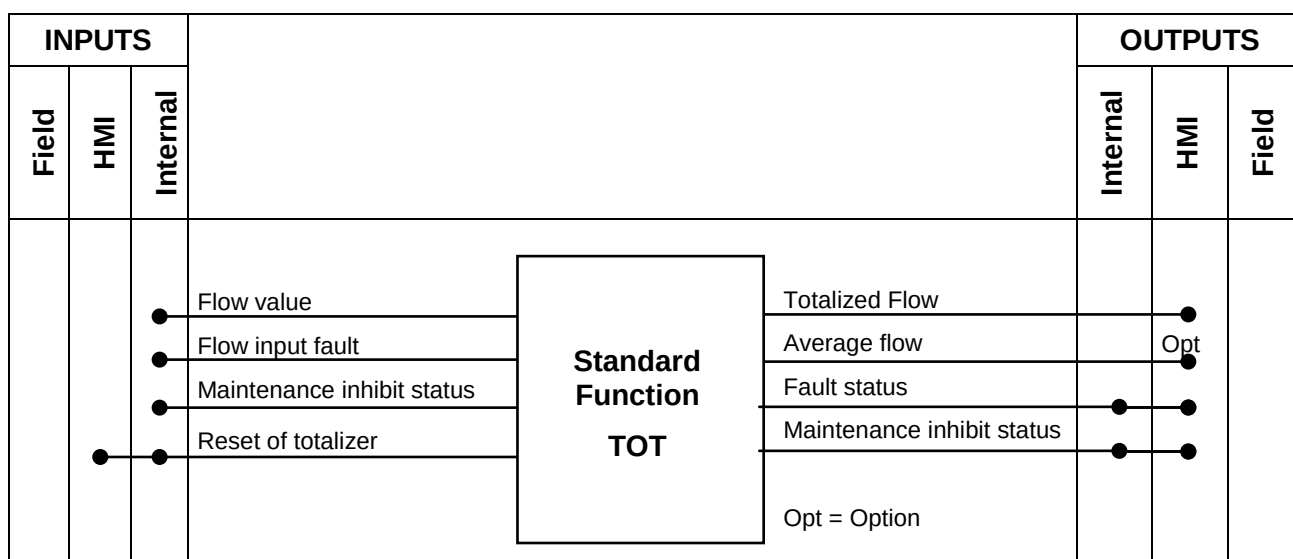
2. General description of functions

2.1 List of main functions

- Acquisition of the flow value
- Totalized flow
- Daily reset
- Input fault of associated flow measurement
- Maintenance inhibit of associated flow measurement.

3. Description of interfaces

3.1 General description



General Specification		GS EP INS 197
Process Standard Functions		
Rev.: 04	Effective date: 09/2012	Page: 33 of 118

4. Detailed description of functions

4.1 Totalizing formula

$$FQI_{(n)} = FI * \frac{T_s}{T_k} + FQI_{(n-1)}$$

Where:

FI = Value to add up in engineering unit

FQI_(n) = Current adding up value (in totalizing unit)

FQI_(n-1) = Previous adding up value

T_s = Sampling period (in seconds)

T_k = Time scale conversion variable according to engineering unit

4.2 TOT_AV Option: average flow

The average flow formula is:

$$AV = \frac{FQI_{(n)}}{N}$$

Where:

AV = Average flow

FQI_(n) = Current adding up value

N = Adding up of samples

4.3 Reset of totalizer

Automatic report is performed each day and just after, the adding up value is recorded (and averaged if requested) and automatically reset.

The reset of totalizer is also available to the operator in method access level.

4.4 Maintenance inhibit

The totalized flow is considered in maintenance inhibit when the associated flow measurement is in maintenance inhibit.

4.5 Input fault

The totalized flow is considered in fault when the associated flow measure is in fault.

4.6 Maintenance inhibit or input fault handling

When the totalized flow is considered in maintenance inhibit or in fault, the last healthy value of flow and corresponding time are recorded to be restored in a daily report, the current adding up value being frozen.

During this state, the reset of adding up is still possible.

General Specification		GS EP INS 197
Process Standard Functions		
Rev.: 04	Effective date: 09/2012	Page: 34 of 118

Upon next activation of the healthy status and removal of maintenance inhibit, the new healthy value of flow and corresponding time are recorded to be restored in a daily report.

5. Tuning parameters and variables

Parameter	Access level
Reset of totalizer	Method

6. Representation and animation description (HMI)

6.1 Values to be recorded

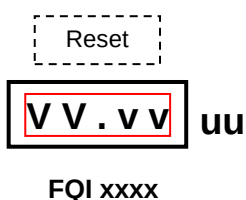
- Last healthy value of low before maintenance inhibit or fault
- Duration of activation of maintenance inhibit or fault status
- New healthy value of flow after maintenance inhibit or fault removal
- Time of activation of healthy status or removal of maintenance inhibit.

6.2 Control display

This description gives examples of representation. However, they may be amended dependant on the DCS features.

6.2.1 Displayed data representation

Adding up and average current values representation are:



V V . v v = Numerical value (in engineering unit)

uu = Engineering unit (m^3/km^3)

FQI xxxx = Tag name (only appears on operator request)

 Reset symbol is used as a target area for the display of the pop-up dedicated to the reset command

General Specification		GS EP INS 197
Process Standard Functions		
Rev.: 04	Effective date: 09/2012	Page: 35 of 118

Chapter 3

6.2.2 Analogue value display

Display description	Display	Text	Frame
Numeric value = <i>NORMAL</i> Units Label	VV.VV uu FQI xxxx	Green White White/Hidden	NA
Maintenance inhibit = INHIBITED	VV.VV uu	Yellow until reset of totalling	External frame: Steady Yellow
Input fault = Alarm (Input fault occurred before maintenance inhibit)	VV.VV uu	Red until reset of totalizer	Internal frame: Red flashing before acknowledgement Red steady after acknowledgement
Communication fault = <i>ACTIVE</i>	***** uu	White	External frame: Steady Magenta

The events which drive these frame displays may not be mutually exclusive. Therefore, the precedence on the display, from most to least important, shall be: magenta, white, blue, yellow.

General Specification		GS EP INS 197
Process Standard Functions		
Rev.: 04	Effective date: 09/2012	Page: 36 of 118

Chapter 4 Low Voltage Motor, High Voltage Motor Standard Function - MOT -

1. Scope	37
2. General description of functions	37
2.1 List of main functions	37
3. Description of interface	38
3.1 General description	38
3.2 Specific description of field interface	39
4. Detailed description of functions.....	39
4.1 Modes and commands.....	39
4.2 Status definition	40
4.3 Start command and running time counters.....	40
5. Tuning parameters and variables	41
6. Representation and animation description (HMI).....	41
6.1 Events and values to be recorded	41
6.2 Alarm handling	41
6.3 Control display	41
7. MOT_BK option: high voltage motor with circuit breaker (P > 1500 kW).....	44
7.1 Specific feature	44
7.2 Description of interface	45
7.3 Detailed description of functions.....	46
8. Option: MOT_ST: motor status	46
8.1 Specific features	46
8.2 List of main functions	46
8.3 Description of interface	46
8.4 Events to be recorded	47
8.5 Representation and animation description (HMI).....	48

General Specification		GS EP INS 197
Process Standard Functions		
Rev.: 04	Effective date: 09/2012	Page: 37 of 118

1. Scope

The purpose of this document is to define the Standard Function for a MOTOR.

Motors may be operated by both operator or automatic control function (PCS) and tripped by the PSS.

The following options are available:

- **MOT:** Low voltage motor and High voltage motor with fuse contactor ($P \leq 1500$ kW)
This option corresponds to standard functionality
- **MOT_BK:** High voltage motor with circuit breaker ($P > 1500$ kW)
This option is described in Chapter 7
- **MOT_ST:** Motor status only
This option is described in Chapter 8.

In order to assist in understanding, the document should be read in conjunction with **GS EP INS 150**.

This Standard Function is a fundamental building block. It may either be used standalone, or integrated with other standard functions to create a more complex function, e.g. with the Pump Unit Standard Function (P.U.).

2. General description of functions

2.1 List of main functions

- Handling of field inputs and outputs with status and discrepancy detection
- Interface with higher level Standard Function (e.g. P.U.): status and fault, open/close command, standalone/cascade mode
- Use of Operator commands: Start/Stop, maintenance inhibit
- Maintenance monitoring (running time, start-up counter) (in option as per project specifications).

3. Description of interface

3.1 General description

INPUTS				OUTPUTS			
Field	HMI	Internal		Internal	HMI	Field	
			<i>Interface with higher level automatic control (e.g.: PU)</i>				
				Standard function MOT	Status (running/stopped)		
			Standalone/Cascade mode				
			Start/Stop command (in Cascade Mode only)				

General Specification		GS EP INS 197
Process Standard Functions		
Rev.: 04	Effective date: 09/2012	Page: 39 of 118

3.2 Specific description of field interface

Corresponding field interface are:

MXSL (1 DO): Safety Stop command: **0 = Stop**

MXXHL (1 DO): Start/Stop operating command: **0 = Stop**

MYHL (1 DI): Status (running/stopped): **1 = Running**

MY (1 DI): Available: **1 = Available**

Available input reports the healthy and no tripped status of the electrical drawer, as per project specifications.

This Standard Function is based on hardwired links between ICSS and Motor Control Centres (MCC). However digital links may be selected to communicate with smart MCC depending on the Project Interface philosophy. However safety related stop command shall be hardwired.

4. Detailed description of functions

4.1 Modes and commands

4.1.1 Specific description

4.1.1.1 Standalone/Cascade mode

Standalone/cascade mode is set by higher level automatic control (e.g. "pump unit" standard function).

When this control is not implemented, standalone/cascade mode is forced to standalone.

4.1.1.2 Start/Stop command

Start/Stop command is available to the operator from pump control display when the motor is in Standalone mode.

Start/Stop command is issued from the higher level automatic control when the motor is in cascade mode.

Start/Stop command is forced to stop upon:

- Open status of the suction valve not active
- Safety trip
- Discrepancy status
- Unavailable status.

4.1.1.3 Maintenance inhibit

Maintenance inhibit command is available to the operator in maintenance access level.

Maintenance inhibit status is active if maintenance inhibit command is set.

General Specification		GS EP INS 197
Process Standard Functions		
Rev.: 04	Effective date: 09/2012	Page: 40 of 118

When the maintenance inhibit is active:

- Status input (running/stopped) is no more considered in internal status handling
- Discrepancy is no longer active.

4.2 Status definition

4.2.1 Operating command status

Operating command status is aligned with the Start/Stop command.

4.2.2 Motor Status

HMI motor status is aligned with the status input (running/stopped).

Internal Status is active when:

- The status input is active and the maintenance inhibit status not active
or
- The operating command status and the maintenance inhibit status are active.

4.2.3 Available status

Available status is aligned with the available input, which is active in normal situation: i.e. no electrical fault, no safety trip and no local emergency stop and withdrawable electrical drawer connected.

4.2.4 Discrepancy status

Discrepancy status is active when:

- (Operating command status in start) and (motor status not in running) and (discrepancy timer elapsed) and (maintenance inhibit status not active)
or
- (Operating command status in stop) and (motor status not in stopped) and (discrepancy timer elapsed) and (maintenance inhibit status not active)

Discrepancy timer is launched upon status change of the operating command.

Discrepancy is no longer active when the motor is not available.

4.2.5 Input/Output fault status

This status will report a hardware fault related to an associated I/O cards (field inputs/outputs).

4.3 Start command and running time counters

Dedicated counters will report the number of changes of the operating command status (from stop to start), as well as the running time.

The counter reset commands will be issued manually by the operator from the HMI (a dedicated pop-up window at maintenance access level).

Note this monitoring function may be implemented into the Process Data Server by means of a supervisory tool, as per the project specifications.

General Specification		GS EP INS 197
Process Standard Functions		
Rev.: 04	Effective date: 09/2012	Page: 41 of 118

5. Tuning parameters and variables

Parameter	Access level
Discrepancy timer pre-set value	Method

6. Representation and animation description (HMI)

6.1 Events and values to be recorded

6.1.1 Events

- Start/Stop command (operator)
- Maintenance inhibit command
- Operating command Status
- Available status
- Discrepancy Status
- Input/output fault status

6.1.2 Values

- Running time (option)
- Running operating number (option)

6.2 Alarm handling

Alarm Description	Priority
Available status	Level 1
Discrepancy Status	Level 1
Input fault Status	Level 2

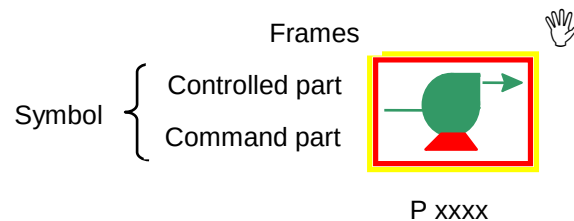
6.3 Control display

The hereafter description gives examples of representation. However, they may be amended dependant on the DCS features.

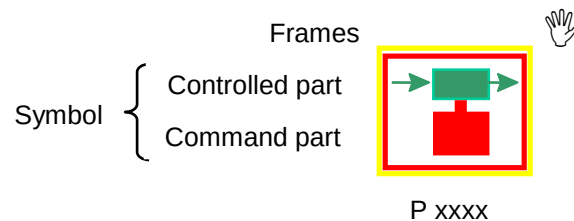
General Specification		GS EP INS 197
Process Standard Functions		
Rev.: 04	Effective date: 09/2012	Page: 42 of 118

6.3.1 Pump representations

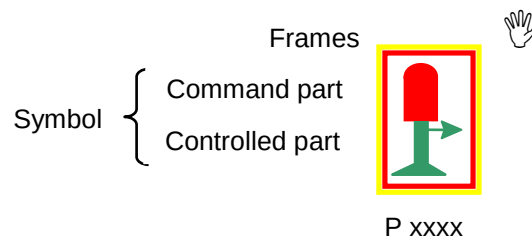
6.3.1.1 Centrifugal pump



6.3.1.2 Reciprocating pump



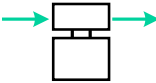
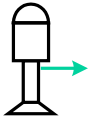
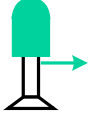
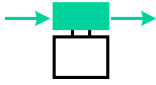
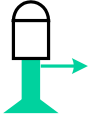
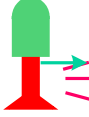
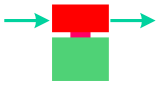
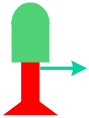
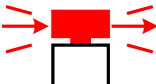
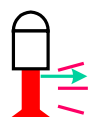
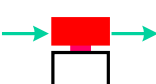
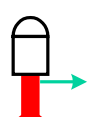
6.3.1.3 Immersed pump



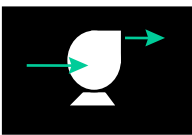
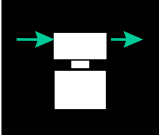
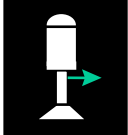
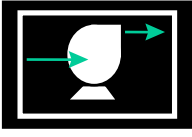
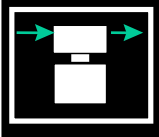
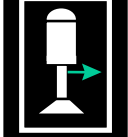
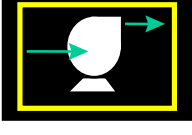
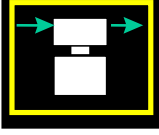
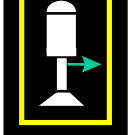
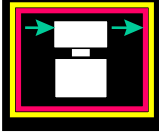
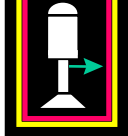
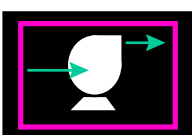
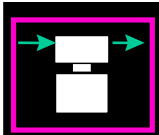
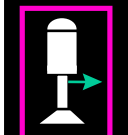
6.3.2 Miscellaneous

- P xxxx equipment label is permanently displayed
- P xxxx equipment label is used as a target area for the maintenance inhibit command
- A “hand” symbol (full yellow) appears near pump when Start/Stop command is available to the operator.

6.3.3 Animation of the symbol

Display description	Display for Centrifugal	Display for Reciprocating	Display for Immersed	Colour of tag on safety logic display
Stopped or communication or system fault				White
Start-up command but stopped				White
Running				Blue
Stop command but running				Blue
Discrepancy (upon Start-up command or unavailable) before acknowledgement and no maintenance inhibit				Red flashing
Discrepancy (upon Start-up command or unavailable) after acknowledgement Or (unavailable and maintenance inhibit active)				Red
Discrepancy (upon Stop command or unavailable) before acknowledgement and no maintenance inhibit				Red flashing
Discrepancy (upon Stop command or unavailable) after acknowledgement Or (unavailable and maintenance inhibit active)				Red

6.3.4 Animation of the Frames

Display description	Display	Display	Display	Frames
Normal status				
Safety trip				External frame: White
Maintenance inhibit				External frame: Yellow
Input/output fault (and maintenance inhibit)				Internal frame: Red flashing before acknowledgement Red steady after acknowledgement
Communication or system fault				Signaling frame: Magenta

The events which drive these frame displays may not be mutually exclusive. Therefore, the precedence on the display, from most to least important, shall be: magenta, white, blue, yellow.

7. MOT_BK option: high voltage motor with circuit breaker (P > 1500 kW)

7.1 Specific feature

MOT_BK motor requires two pulse outputs (DO):

- One for start-up
- One for stop.

Process Standard Functions

Rev.: 04

Effective date: 09/2012

Page: 45 of 118

Chapter 4

7.2 Description of interface

7.2.1 General description

INPUTS				OUTPUTS		
Field	HMI	Internal		Internal	HMI	Field
			<u>Interface with higher level automatic control (e.g.: "PU")</u> Standalone/Cascade mode Start/Stop command (in Cascade Mode only)			
			Standard function MOT-BK	Status (running/stopped) Discrepancy Status		
				Operating command status Status (running/stopped) Available status Discrepancy status Input/output fault status Maintenance inhibit status Running time Running operating number		
					Alm	
					Alm	
					Alm	
					Opt	
					Opt	
			<u>Interlock</u> Suction valve open status Safety trip (from safety bar)			
			Status (running/stopped) (DI) Available (DI)	Start operating command (DO) Stop operating command (DO)		
				Opt = Option Alm = Alarm		

General Specification		GS EP INS 197
Process Standard Functions		
Rev.: 04	Effective date: 09/2012	Page: 46 of 118

7.2.2 Specific description of field interface

Corresponding field interface are:

MXSL (1 DO):	Safety Stop command:	0 = Stop
MXXH (1 DO):	Start command:	1 = Start (pulse)
MXXL (1DO):	Stop command:	1 = Stop (pulse)
MYHL (1 DI):	Status (running/stopped):	1 = Running
MY (1 DI):	Available:	1 = Available

Available input reports the healthy and no tripped status of the electrical drawer.

7.3 Detailed description of functions

Special feature (compared with above MOT description):

7.3.1 Available status

Available status is aligned with the available input, which is active in normal situation: no electrical fault, no safety trip, no local emergency stop, local/remote selector set to remote position and withdrawable electrical drawer connected.

7.3.2 Start/Stop operating commands

- The pulse of the start operating command is activated upon start activation of the Operating command status
- The pulse of the stop operating command is activated upon stop activation of the Operating command status.

8. Option: MOT_ST: motor status

8.1 Specific features

Such motors are operated locally only, with monitoring by the PCS, but tripped by the PSS.

8.2 List of main functions

- Handling of field inputs with status and discrepancy detection
- Maintenance inhibit command
- Maintenance monitoring (running time, start-up counter) (in option as per project specifications).

8.3 Description of interface

Compared with the above MOT description.

Process Standard Functions

Rev.: 04

Effective date: 09/2012

Page: 47 of 118

Chapter 4

8.3.1 General description

INPUTS				OUTPUTS		
Field	HMI	Internal		Internal	HMI	Field
			Standard function MOT_ST	Status (running/stopped)		
	●	Maintenance inhibit command		Available status	●	Alm
				Input fault status		Alm
				Maintenance inhibit status		●
		● Safety trip		Running time		Opt
●		Status (running/stopped) (DI)		Running operating number		Opt
●		Available (DI)				
				Opt = Option Alm = Alarm		

8.3.2 Specific description of field interface

Corresponding field interface are:

MXSL (1 DO): Safety Stop command: **0 = Stop**

MYHL (1 DI): Status (running/stopped): **1 = Running**

MY (1 DI): Available: **1 = Available**

Available input reports the healthy and no tripped status of the electrical drawer, as per project specifications.

8.4 Events to be recorded

- Maintenance inhibit command
- Status (running/stopped)

General Specification		GS EP INS 197
Process Standard Functions		
Rev.: 04	Effective date: 09/2012	Page: 48 of 118

- Available status
- Input fault status

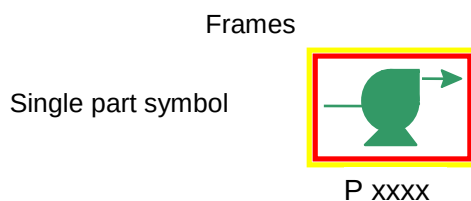
8.5 Representation and animation description (HMI)

8.5.1 Control display

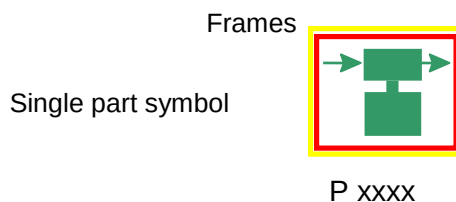
The hereafter description gives examples of representation. However, they may be amended dependant on the DCS features.

8.5.1.1 Pump representations

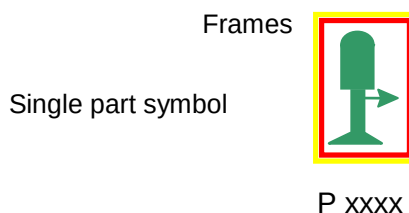
- Centrifugal pump



- Reciprocating pump



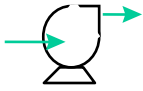
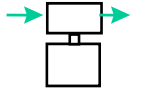
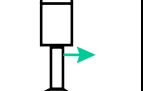
- Immersed pump



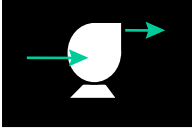
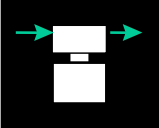
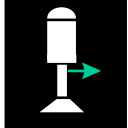
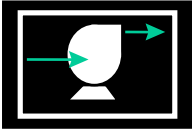
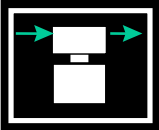
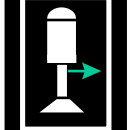
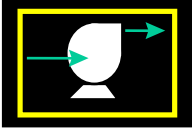
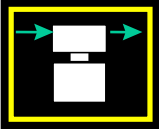
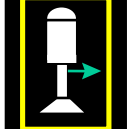
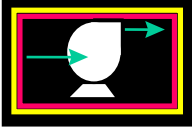
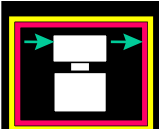
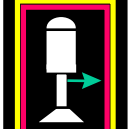
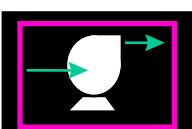
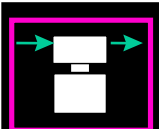
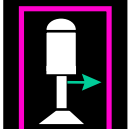
8.5.1.2 Miscellaneous

- P xxxx equipment label is permanently displayed
- P xxxx equipment label is used as target area for maintenance inhibit command.

8.5.1.3 Animation of the symbol (controlled parts)

Display description	Display for Centrifugal	Display for Reciprocating	Display for Immersed	Symbol	Colour of tag on safety logic display
Stopped or communication or system fault				White	White
Running				Fluid	Blue
Unavailable before acknowledgement if not maintenance inhibit				Red flashing	Red flashing
Unavailable after acknowledgement or Both unavailable and maintenance inhibit status active				Red	Red

8.5.1.4 Animation of the frames

Display description	Display	Display	Display	Frames
Normal status				
Safety trip				External frame: White
Maintenance inhibit				External frame: Yellow
Input fault (and maintenance inhibit)				Internal frame: Red flashing before acknowledgement Red steady after acknowledgement
Communication or system fault				External frame: Magenta

The events which drive these frame displays may not be mutually exclusive. Therefore, the precedence on the display, from most to least important, shall be: magenta, white, blue, yellow.

General Specification		GS EP INS 197
Process Standard Functions		
Rev.: 04	Effective date: 09/2012	Page: 51 of 118

Chapter 5 Pump Unit Standard Function - PU -

1. Scope	52
2. General Description of functions.....	52
2.1 List of main functions	52
2.2 Start/Stop sequence description for a Centrifugal pump unit (PU_CENT)	52
2.3 Start/stop sequence description for a Centrifugal pump unit with SDV only (PU_CENT_1SDV).....	53
2.4 Start/stop sequence description for a Centrifugal pump unit with XV only (PU_CENT_1XV)	53
2.5 Start/stop sequence description for a Centrifugal pump unit with XV suction and discharge valves (PU_CENT_2XV).....	53
2.6 Start/stop sequence description for Reciprocating pump unit (PU_RECIP)	53
3. Interface description	55
3.1 General description.....	55
3.2 Status description (status).....	57
4. Detailed description of functions.....	57
4.1 Modes and commands.....	57
4.2 Sequential function chart generalities.....	58
4.3 Sequential chart of centrifugal pump unit (PU_CENT).....	59
4.4 Sequential chart of Centrifugal pump unit with SDV only (PU_CENT_1SDV).....	61
4.5 Sequential chart of Centrifugal pump unit with only XV (PU_CENT_1XV).....	64
4.6 Sequential chart of centrifugal pump unit with XV Suction and Discharge valves (PU_CENT_2XV)	68
4.7 Sequential chart of Reciprocating pump unit (PU_RECIP)	73
5. Tuning parameters and variables	75
5.1 Centrifugal pump unit.....	75
5.2 Reciprocating pump unit	75
6. Representation and animation description (HMI).....	76
6.1 Events and values to be recorded	76
6.2 Process control display (operating level display)	76
7. Appendix: handling of status in case of centrifugal pump unit (PU_CENT)....	78

General Specification		GS EP INS 197
Process Standard Functions		
Rev.: 04	Effective date: 09/2012	Page: 52 of 118

1. Scope

The purpose of this document is to define the Standard Function of a Pump Unit (PU), allowing the control of a pumping run, including motor, suction and discharge valves when available.

In order to assist in understanding, the document should be read in conjunction with **GS EP INS 150**.

This standard may be interlocked with:

- Lower level Standard Functions:
 - MOT
 - XV
 - SDV.
- Higher level Standard Function: Duty/Back-up/Stand-by (D/B/S).

It includes five options:

- Centrifugal pump unit with SDV and XV discharge valve (PU_CENT)
- Centrifugal pump unit with SDV only (PU_CENT_1SDV)
- Centrifugal pump unit with XV only (PU_CENT_1XV)
- Centrifugal pump unit with XV suction and discharge valves (PU_CENT_2XV)
- Reciprocating pump unit (PU_RECIP).

2. General Description of functions

2.1 List of main functions

- Pump unit start/stop sequence
- Interface with D/B/S Standard Function:
 - Status and fault, start/stop
- Interface with SDV, MOTOR, XV Standard Functions:
 - Status and fault, start/stop, open/close, standalone/cascade mode
- Use of Operator commands: Manual/Auto/Cascade and Start/Stop
- Pump unit status (faults, interlock, available)

2.2 Start/Stop sequence description for a Centrifugal pump unit (PU_CENT)

Start sequence is launched upon start command.

Stop sequence is launched upon stop command or equipment fault or safety bar trip.

2.2.1 Start sequence

- Pump start-up
- XV open after check of pump start-up and a time delay

General Specification		GS EP INS 197
Process Standard Functions		
Rev.: 04	Effective date: 09/2012	Page: 53 of 118

2.2.2 Stop sequence

- Pump stop and XV close

2.3 Start/stop sequence description for a Centrifugal pump unit with SDV only (PU_CENT_1SDV)

2.3.1 Start sequence

- Pump start-up

2.3.2 Stop sequence

- Pump stop

2.4 Start/stop sequence description for a Centrifugal pump unit with XV only (PU_CENT_1XV)

2.4.1 Start sequence

- Pump start-up
- XV open after check of pump start-up and a time delay

2.4.2 Stop sequence

- Pump stop

2.5 Start/stop sequence description for a Centrifugal pump unit with XV suction and discharge valves (PU_CENT_2XV)

2.5.1 Start sequence

- Suction XV open
- Pump start-up after check of XV open
- Discharge XV open after check of pump start-up and a time delay

2.5.2 Stop sequence

- Pump stop and discharge XV close
- Suction XV close after check of discharge XV close

2.6 Start/stop sequence description for Reciprocating pump unit (PU_RECIP)

2.6.1 Start sequence

- XV open
- Pump start-up after check of XV open

Process Standard Functions

Rev.: 04

Effective date: 09/2012

Page: 54 of 118

Chapter 5**2.6.2 Stop sequence**

- Pump stop
- XV close after check of pump stop and a time delay.

Process Standard Functions

Rev.: 04

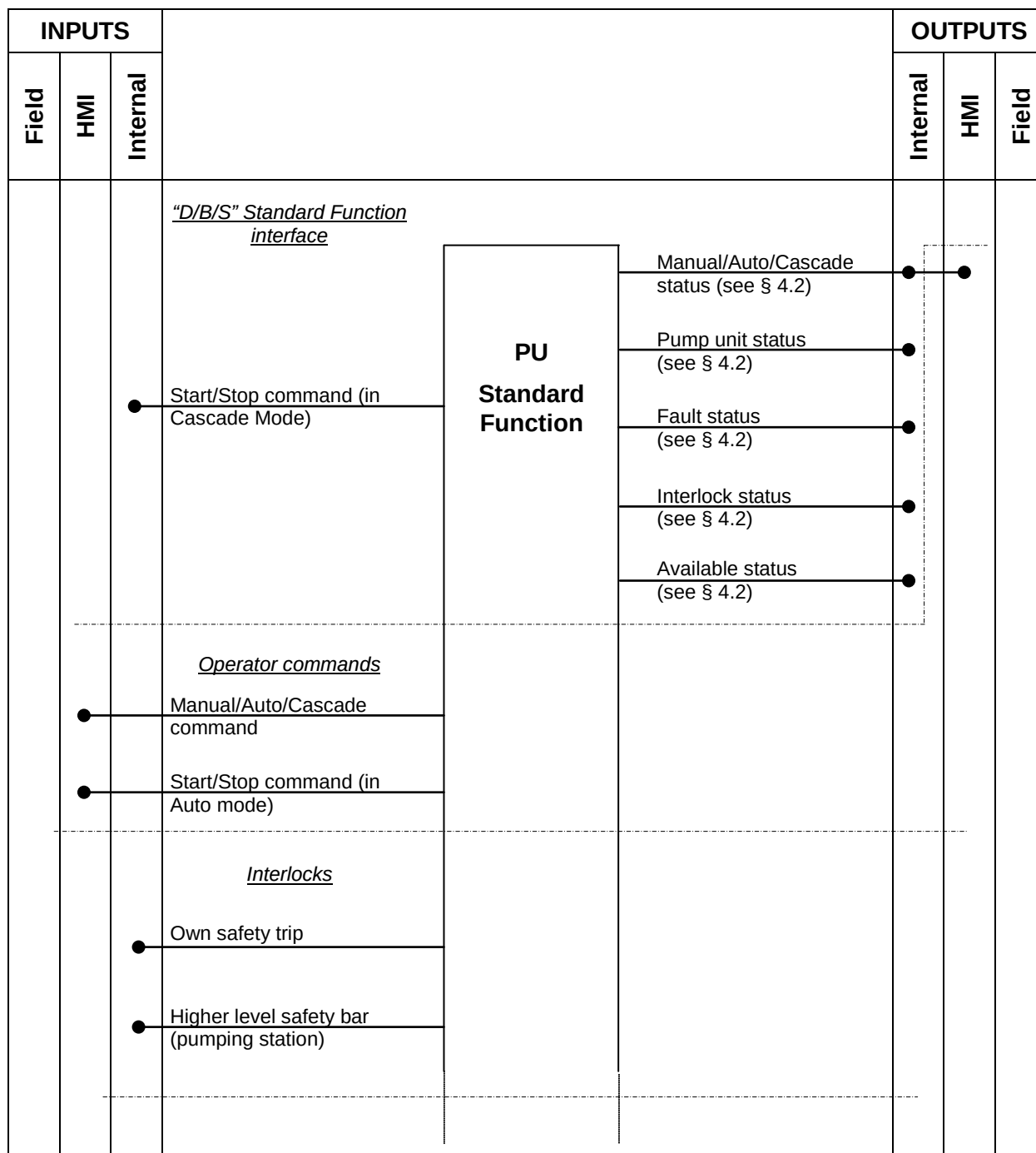
Effective date: 09/2012

Page: 55 of 118

Chapter 5

3. Interface description

3.1 General description



Process Standard Functions

Rev.: 04

Effective date: 09/2012

Page: 56 of 118

Chapter 5

This document is the property of TOTAL S.A., it contains confidential information which may not be disclosed to any third party, reproduced, stored or transmitted without the prior written consent of TOTAL S.A.
The information contained in this document does not substitute to the applicable laws and regulations.

General Specification		GS EP INS 197
Process Standard Functions		
Rev.: 04	Effective date: 09/2012	Page: 57 of 118

3.2 Status description (status)

These data are used to handle the "D/B/S" Standard Function.

3.2.1 Pump unit status

- Unavailable stopped

SDV status <> open, XV discrepancy, MOTOR unavailable or MOTOR discrepancy

- Available stopped

SDV status = open, MOTOR stopped, XV closed and no safety trip

- Start-up

MOTOR started and XV not yet open

- Running

MOTOR started and XV open

3.2.2 Fault status

To report a faulty equipment (SDV, MOTOR, XV):

SDV status <> open, XV discrepancy, MOTOR unavailable or MOTOR discrepancy.

3.2.3 Interlock status

- Own safety bar tripped
- High level safety bar tripped.

3.2.4 Manual/Auto/Cascade status

To report if pump unit is interlocked with the D/B/S Standard Function.

3.2.5 Available status

To report if pump unit is available for start-up or stop sequences:

Active when Cascade status and (Available stopped, start-up or running status) are active

4. Detailed description of functions

4.1 Modes and commands

4.1.1 Specific description

4.1.1.1 Manual/Auto/Cascade mode

The Manual mode does not allow to launch the start /stop sequence.

The Auto mode allows the operator to launch the start/stop sequence.

The Cascade mode allows this sequence to be launched by the D/B/S Standard Function only.

General Specification		GS EP INS 197
Process Standard Functions		
Rev.: 04	Effective date: 09/2012	Page: 58 of 118

Upon own pump unit safety bar tripped (or pump unit fault when in cascade mode), Manual/Auto/Cascade mode is forced to Auto mode (Manual and cascade commands are no longer available to the operator).

Discrimination with a trip issued from a higher level safety bar is also required, since in this case Manual/Auto/Cascade mode is not changed (discrimination can be done through the first-up initiator analysis for the own pump unit safety bar).

Cascade mode is not available if the "D/B/S" function is not implemented.

4.1.1.2 Start/Stop command

Start/Stop command is available to the operator when pump unit is in Auto.

Start/Stop command is initiated by "D/B/S" Standard Function when pump unit is in Cascade.

Start/Stop command is forced to Stop upon:

- Pump unit fault
- Pump unit safety bar trip.

4.2 Sequential function chart generalities

4.2.1 Conventions

Term used	Description
OPEN(CLOSE) XV	Valve XVnnnnl open (close)
OPEN(CLOSE) XV with checking	Valve XVnnnnl open (close) with status feedback checking (xZH/L)
START(STOP) MOTOR	Pump Pnnnnl start-up (stop)
START(STOP) MOTOR with checking	Pump Pnnnnl start-up (stop) with status feedback checking (MYH/L)
START-UP TIMER Tln	Timer, initiated with preset value (seconds)

4.2.2 Term description

Timer Tro (XV open): XV discharge valve open time delay after pump start-up

Timer Tfm (fault masking): fault masking time upon an equipment (SDV, MOTOR, XV) fault detection

Timer Txc (XV close): XV discharge valve close time delay after pump stop

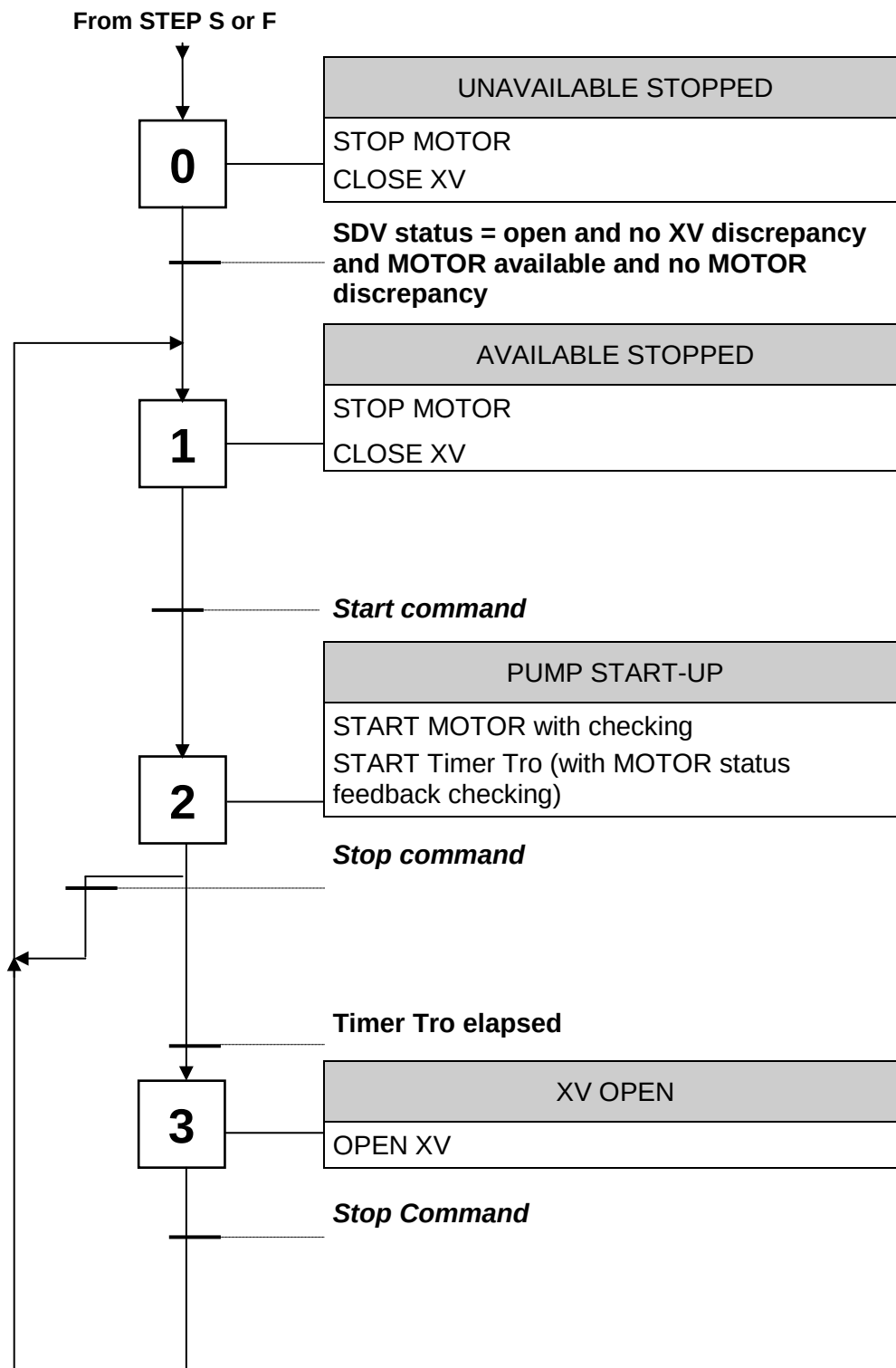
Timer Tsxc (XV close): XV suction valve close time delay after pump stop.

4.2.3 Initial chart step and mode

Sequential function chart is set to Step MANUAL and Manual/Auto/Cascade command is set to Manual.

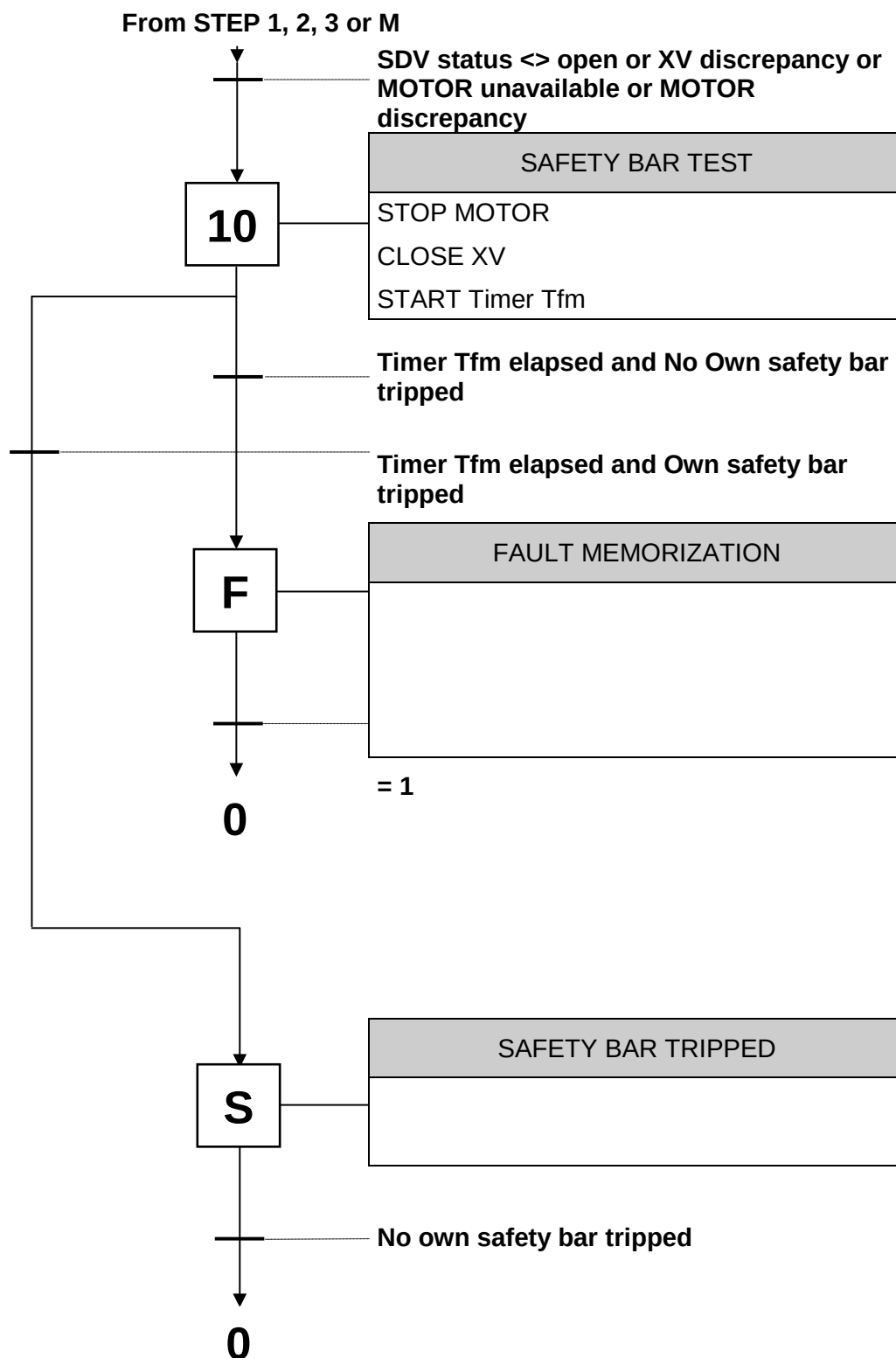
4.3 Sequential chart of centrifugal pump unit (PU_CENT)

4.3.1 Start/Stop chart



4.3.2 Safety Bar tripped or fault chart

4.3.2.1 Chart



4.3.2.2 Purpose of STEP 10

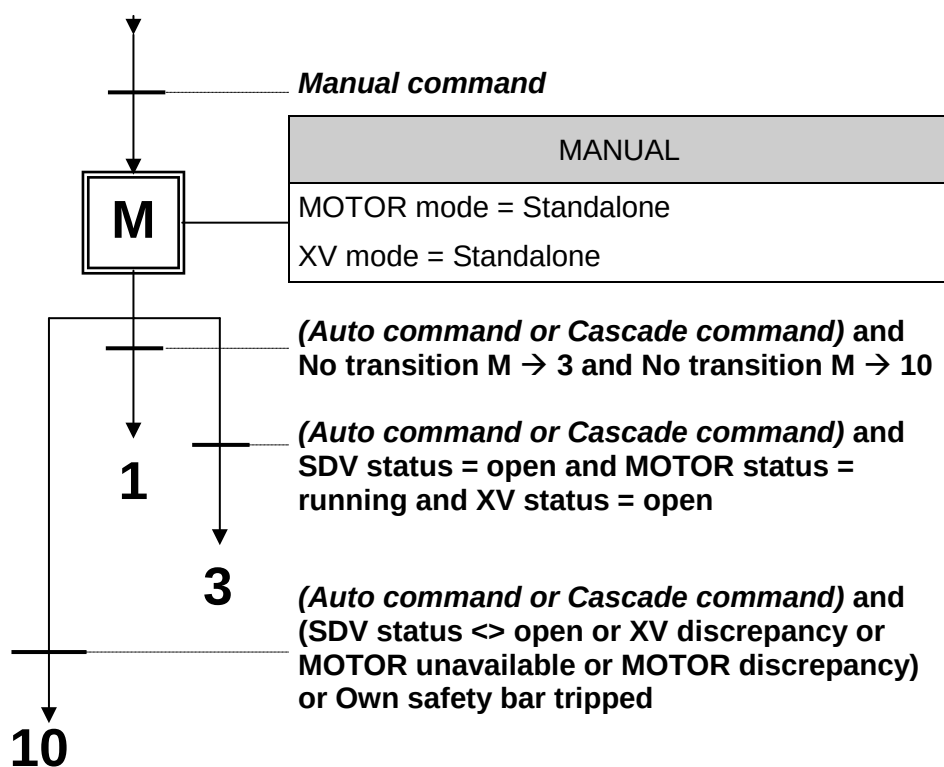
Safety Stop order of the motor (generally from the PSS) and own pump unit fault (Emergency stop or electric fault) will affect the available status of the motor.

The discrimination between a Safety Stop command and a own fault is required for the correct progress of the sequential chart: Upon an equipment fault detection (e.g. motor in unavailable status), the Sequential Function Chart is set to STEP 10 to wait the necessarily time to determine the cause of the trip: own pump unit fault or safety bar (whose status is updated by means of the network, after a communication time delay).

When the time is elapsed, the Sequential Function Chart will be set to F step (in case of own fault) or to S step (in case of Safety bar tripped).

4.3.3 Auto/Manual chart

From STEP 0, 1, 2 or 3



4.4 Sequential chart of Centrifugal pump unit with SDV only (PU_CENT_1SDV)

4.4.1 Status description

4.4.1.1 Pump unit status

- Unavailable stopped

SDV status <> open, MOTOR unavailable or MOTOR discrepancy

General Specification		GS EP INS 197
Process Standard Functions		
Rev.: 04	Effective date: 09/2012	Page: 62 of 118

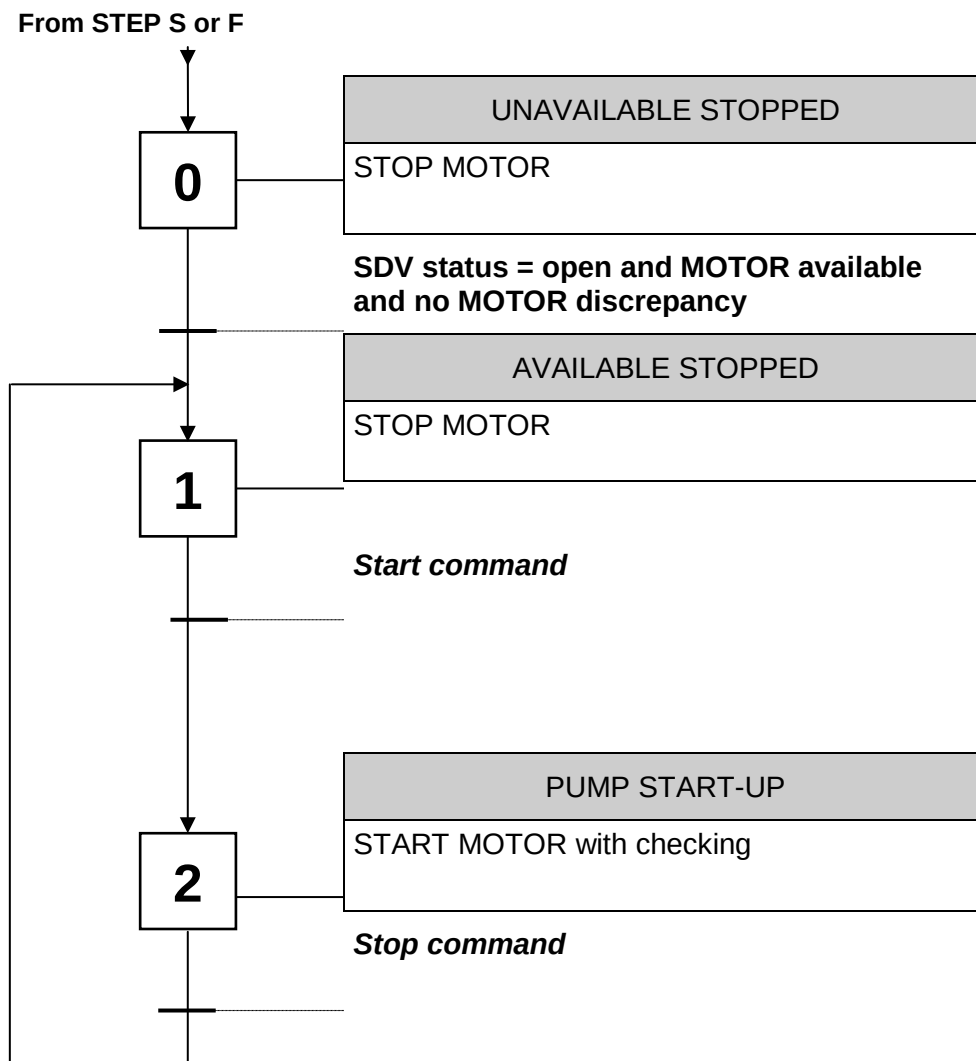
- Available stopped
SDV status = open, MOTOR stopped and no safety bar tripped
- Running
MOTOR started

4.4.1.2 Fault status

To report a faulty equipment (SDV, MOTOR):

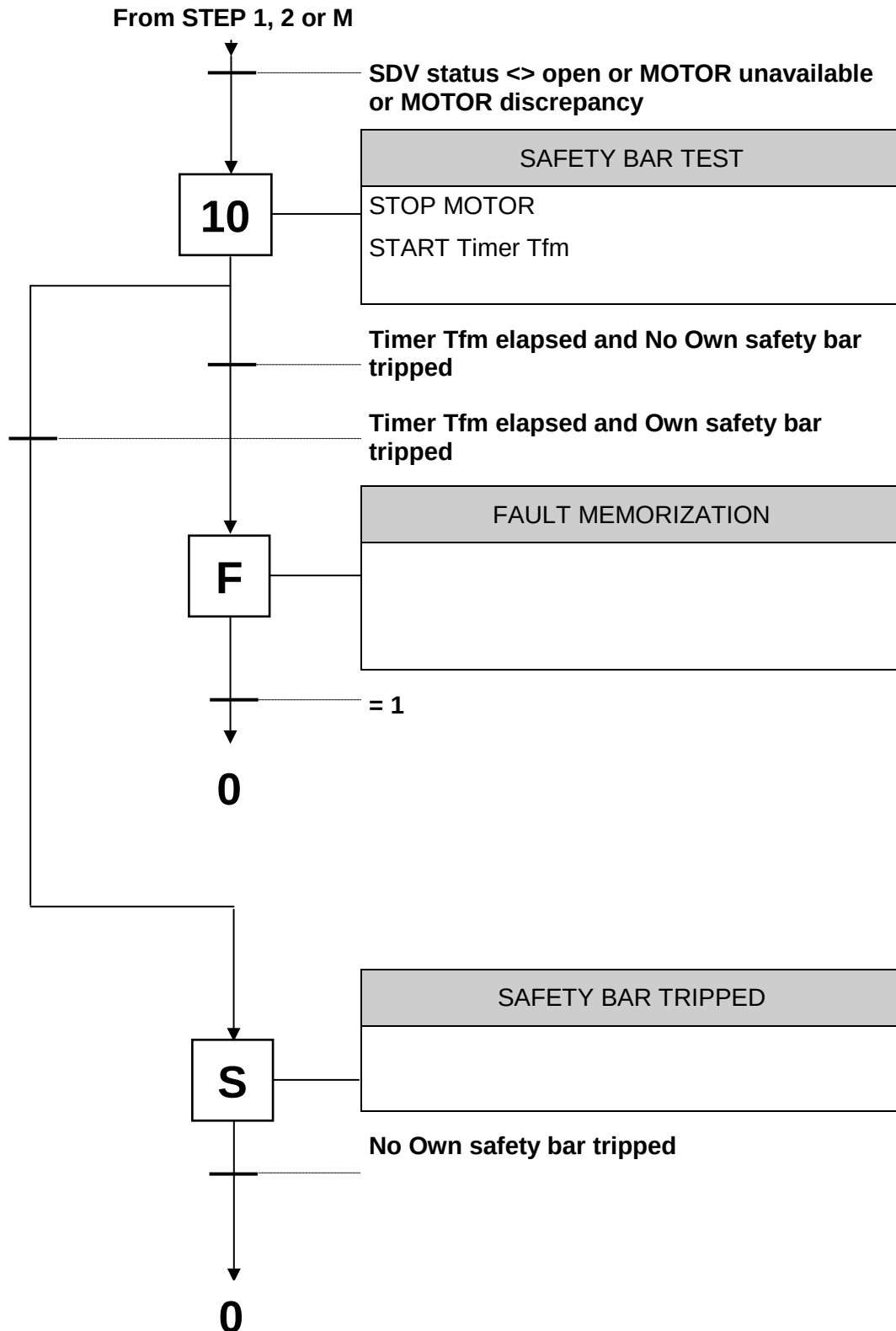
SDV status <> open, MOTOR unavailable or MOTOR discrepancy.

4.4.2 Start/Stop chart



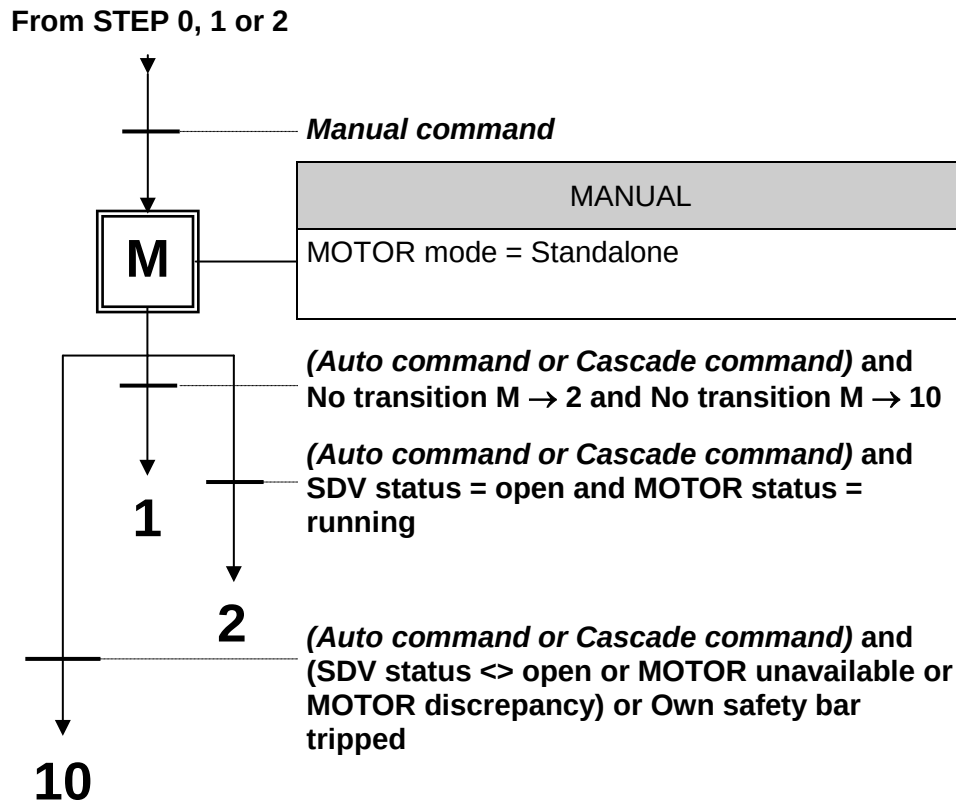
General Specification		GS EP INS 197
Process Standard Functions		
Rev.: 04	Effective date: 09/2012	Page: 63 of 118

4.4.3 Safety Bar tripped or fault chart



General Specification		GS EP INS 197
Process Standard Functions		
Rev.: 04	Effective date: 09/2012	Page: 64 of 118

4.4.4 Auto/Manual chart



4.4.5 Miscellaneous

There is no Timer Tro (XV open).

4.5 Sequential chart of Centrifugal pump unit with only XV (PU_CENT_1XV)

4.5.1 Status description

4.5.1.1 Pump unit status

- Unavailable stopped
XV discrepancy, MOTOR unavailable or MOTOR discrepancy
- Available stopped
XV closed, MOTOR stopped and no safety bar tripped
- Start-up
MOTOR started and XV closed
- Running
MOTOR started and XV open



General Specification		GS EP INS 197
Process Standard Functions		
Rev.: 04	Effective date: 09/2012	Page: 65 of 118

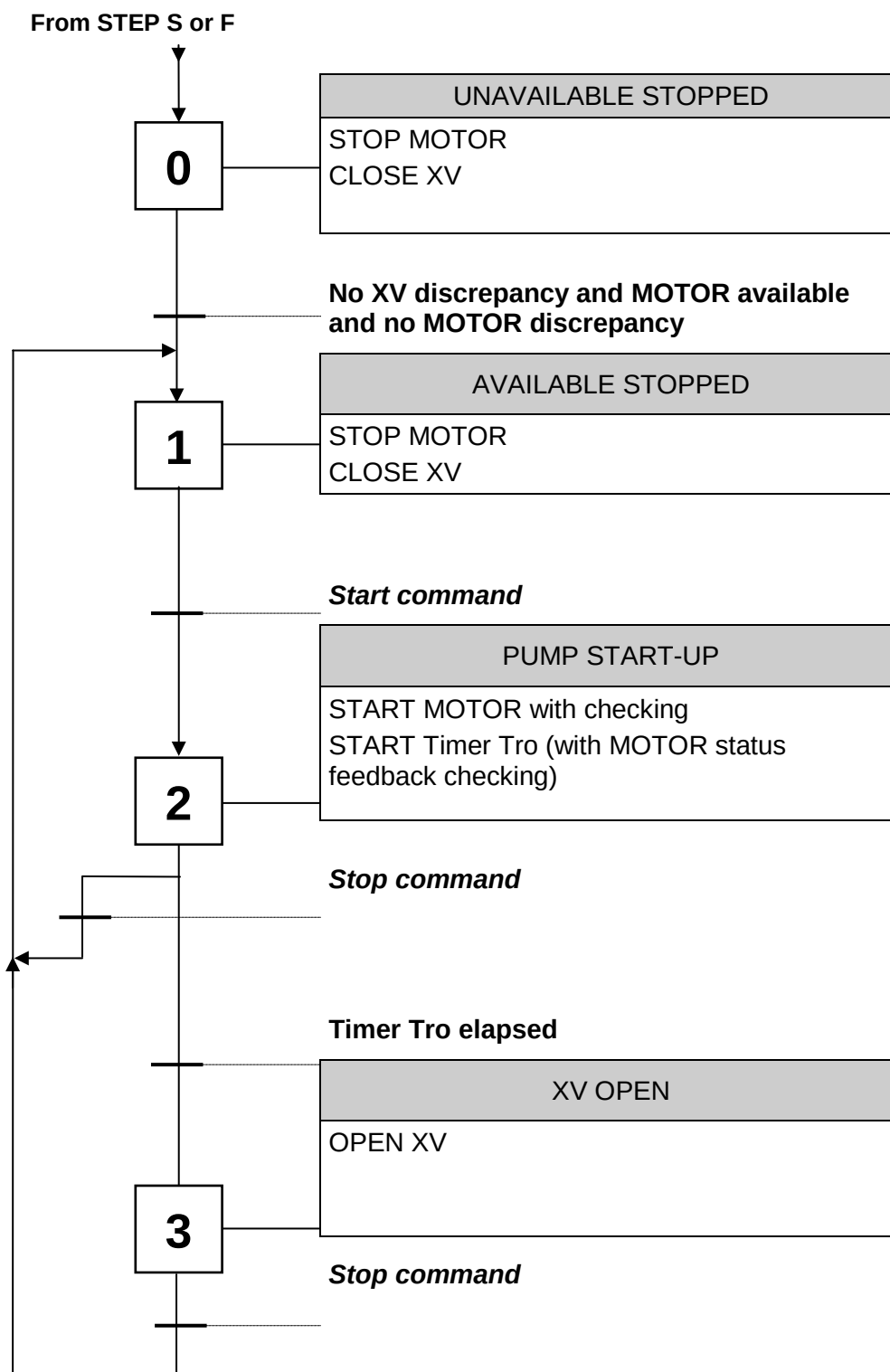
Chapter 5

4.5.1.2 Fault status

To report a faulty equipment (XV, MOTOR):

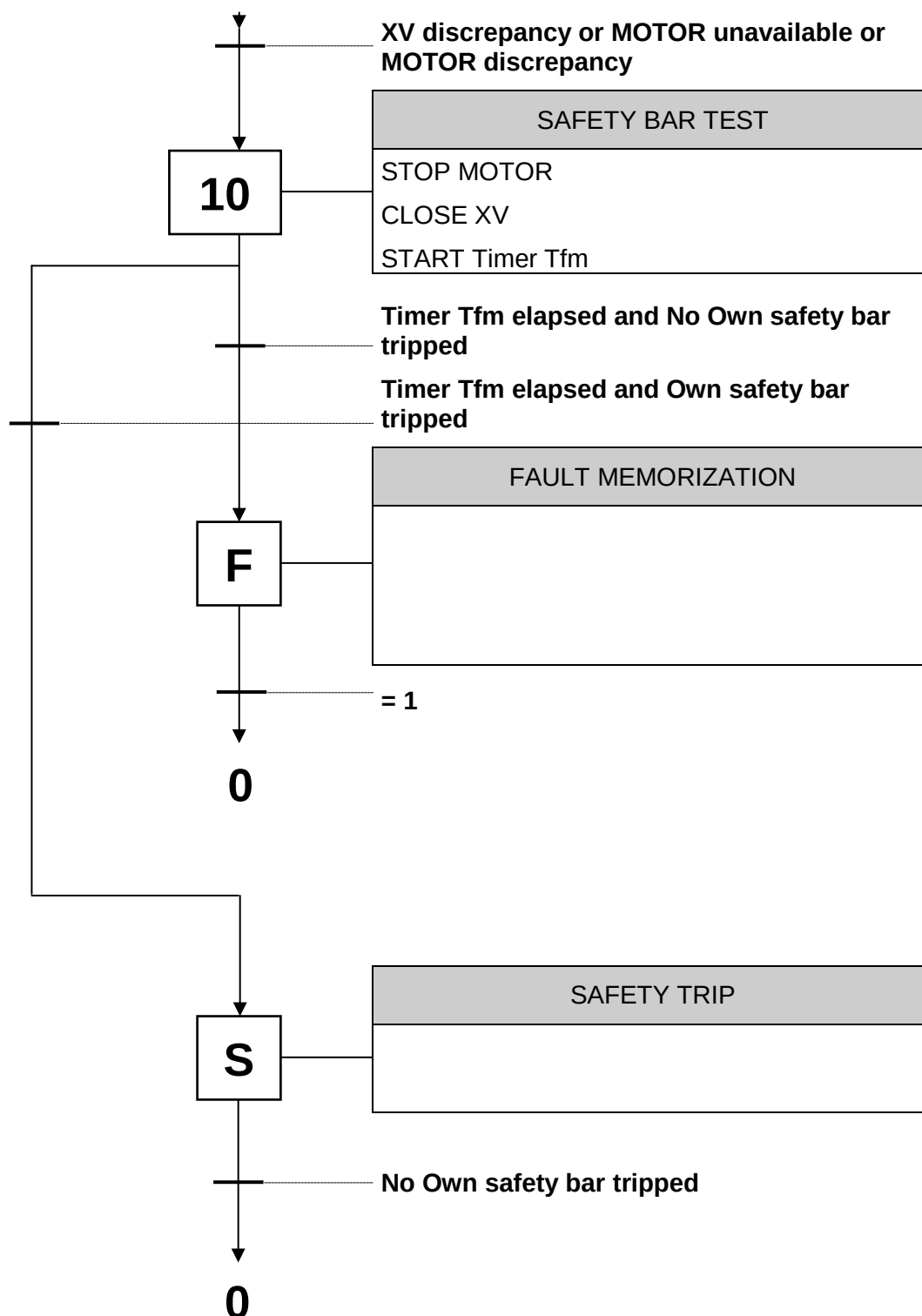
XV discrepancy, MOTOR unavailable or MOTOR discrepancy.

4.5.2 Start/Stop chart



4.5.3 Bar tripped or fault chart

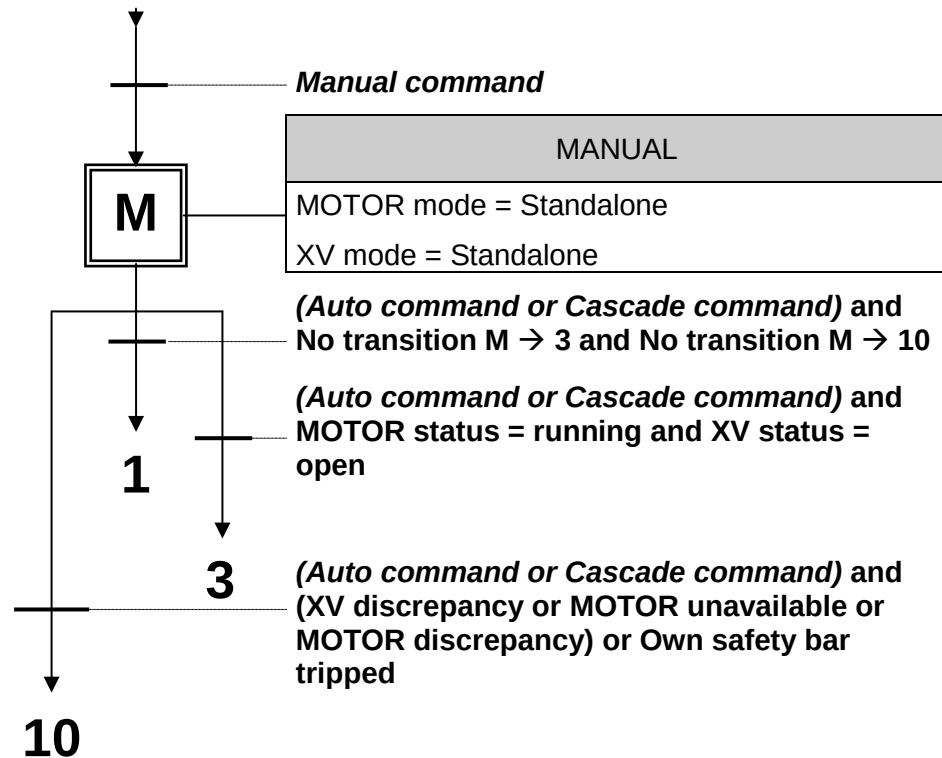
From STEP 1, 2, 3 or M



General Specification		GS EP INS 197
Process Standard Functions		
Rev.: 04	Effective date: 09/2012	Page: 68 of 118

4.5.4 Auto/Manual chart

From Step 0, 1, 2, 3 or 4



4.6 Sequential chart of centrifugal pump unit with XV Suction and Discharge valves (PU_CENT_2XV)

4.6.1 Status description

4.6.1.1 Pump unit status

- Unavailable stopped
Suction XV discrepancy or Discharge XV discrepancy or MOTOR unavailable or MOTOR discrepancy
- Available stopped
Suction XV closed, Discharge XV closed, MOTOR stopped and no safety bar tripped
- Start-up
MOTOR started and Discharge XV closed
- Running
MOTOR started and Discharge XV open

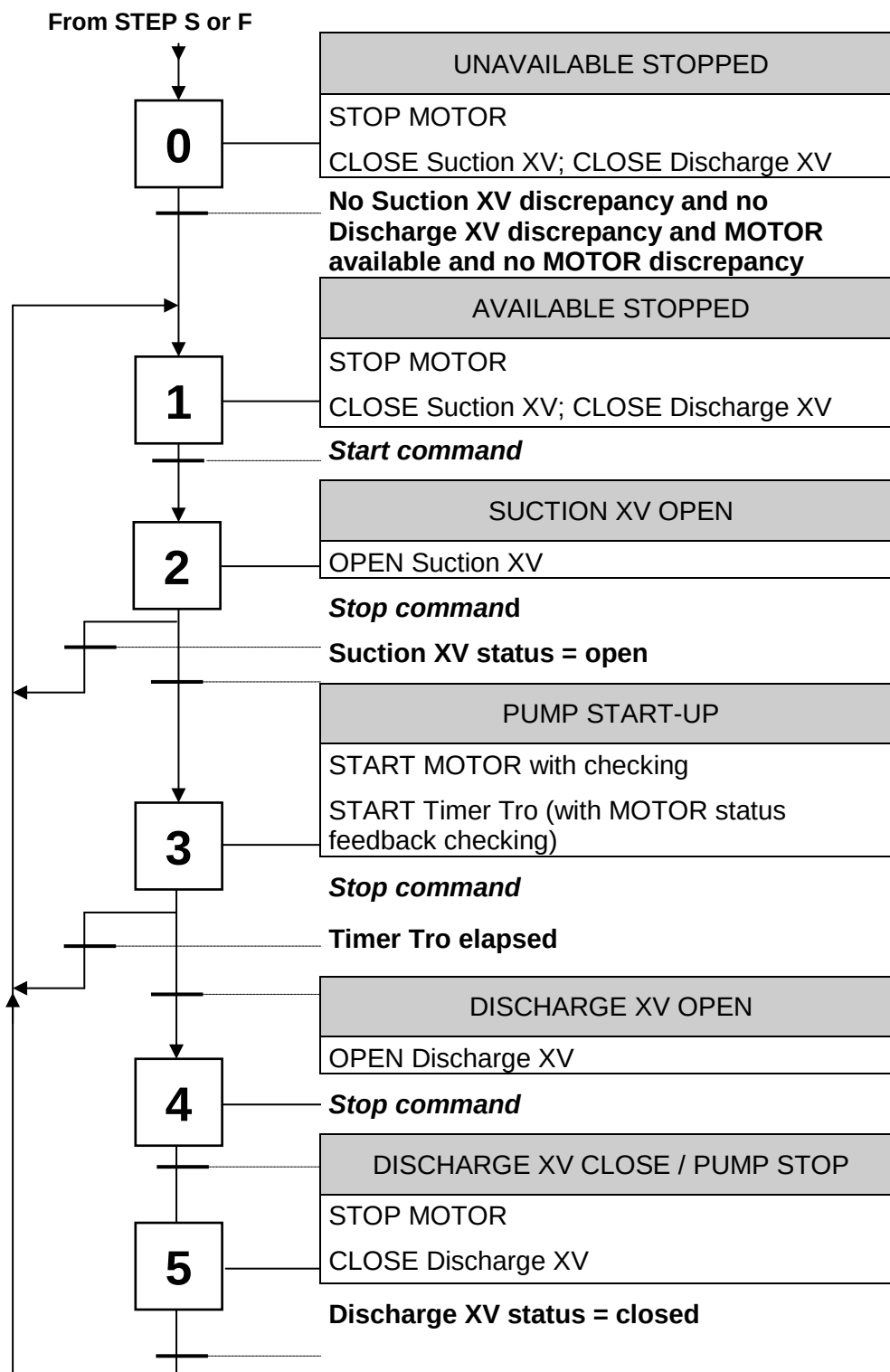
General Specification		GS EP INS 197
Process Standard Functions		
Rev.: 04	Effective date: 09/2012	Page: 69 of 118

4.6.1.2 Fault status

To report a faulty equipment (XV, MOTOR):

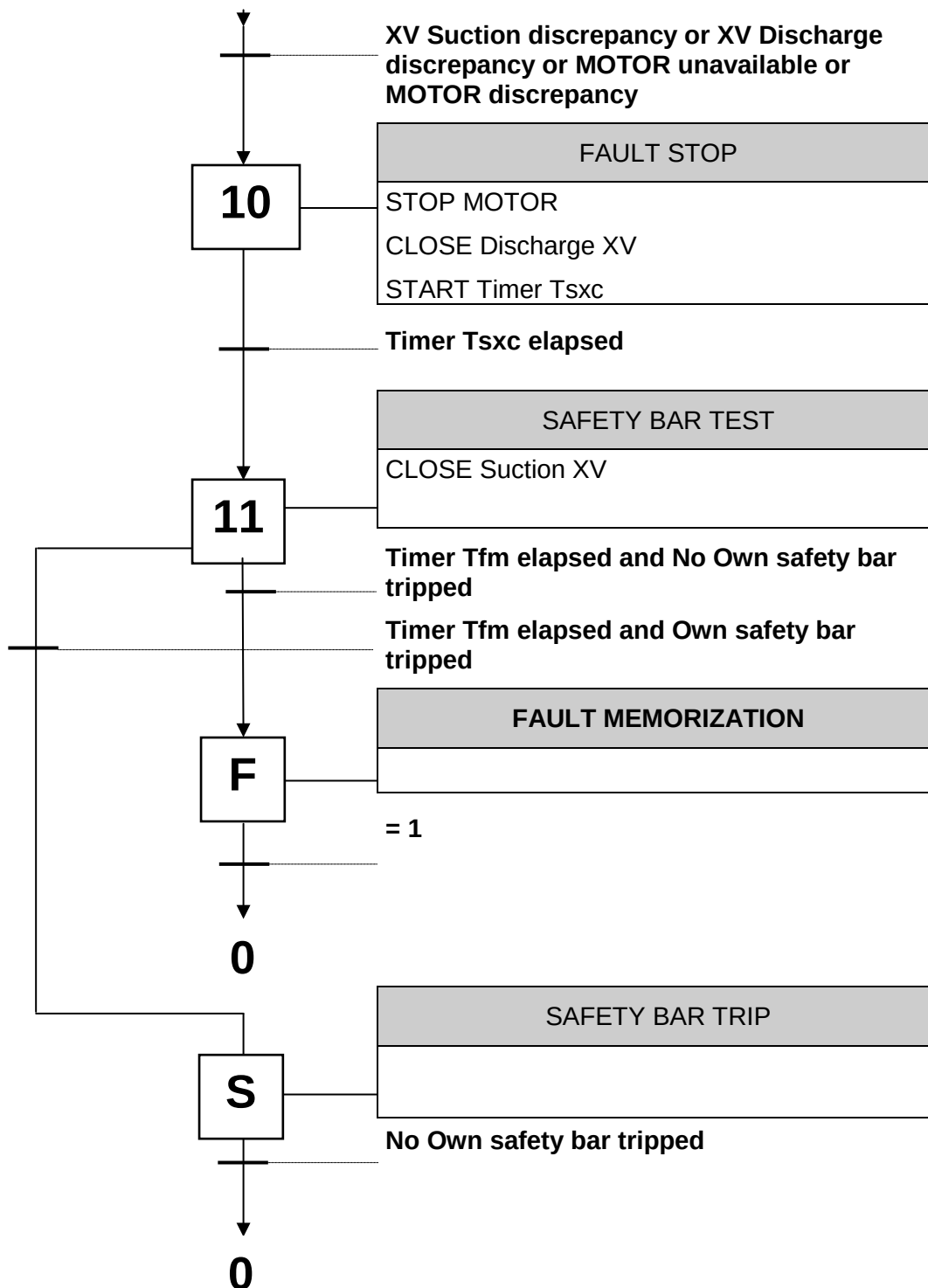
Suction XV discrepancy, Discharge XV discrepancy, MOTOR unavailable or MOTOR discrepancy.

4.6.2 Start/Stop chart



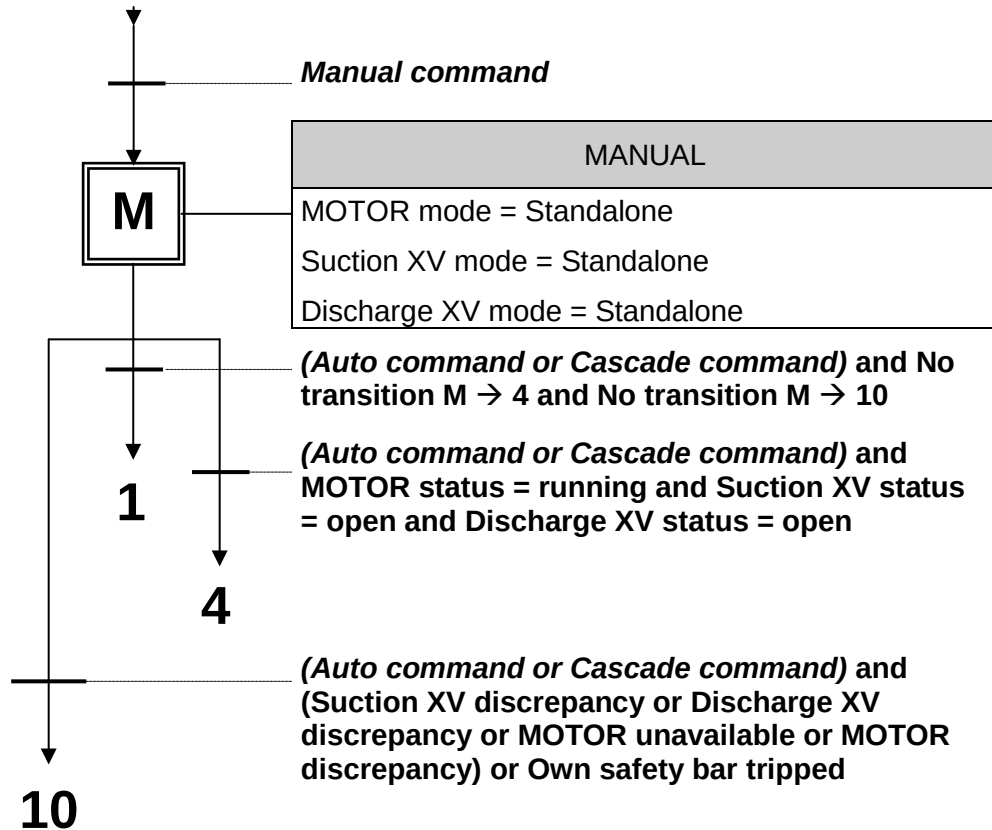
4.6.3 Bar tripped or fault chart

From STEP 1, 2, 3, 4, 5 or M



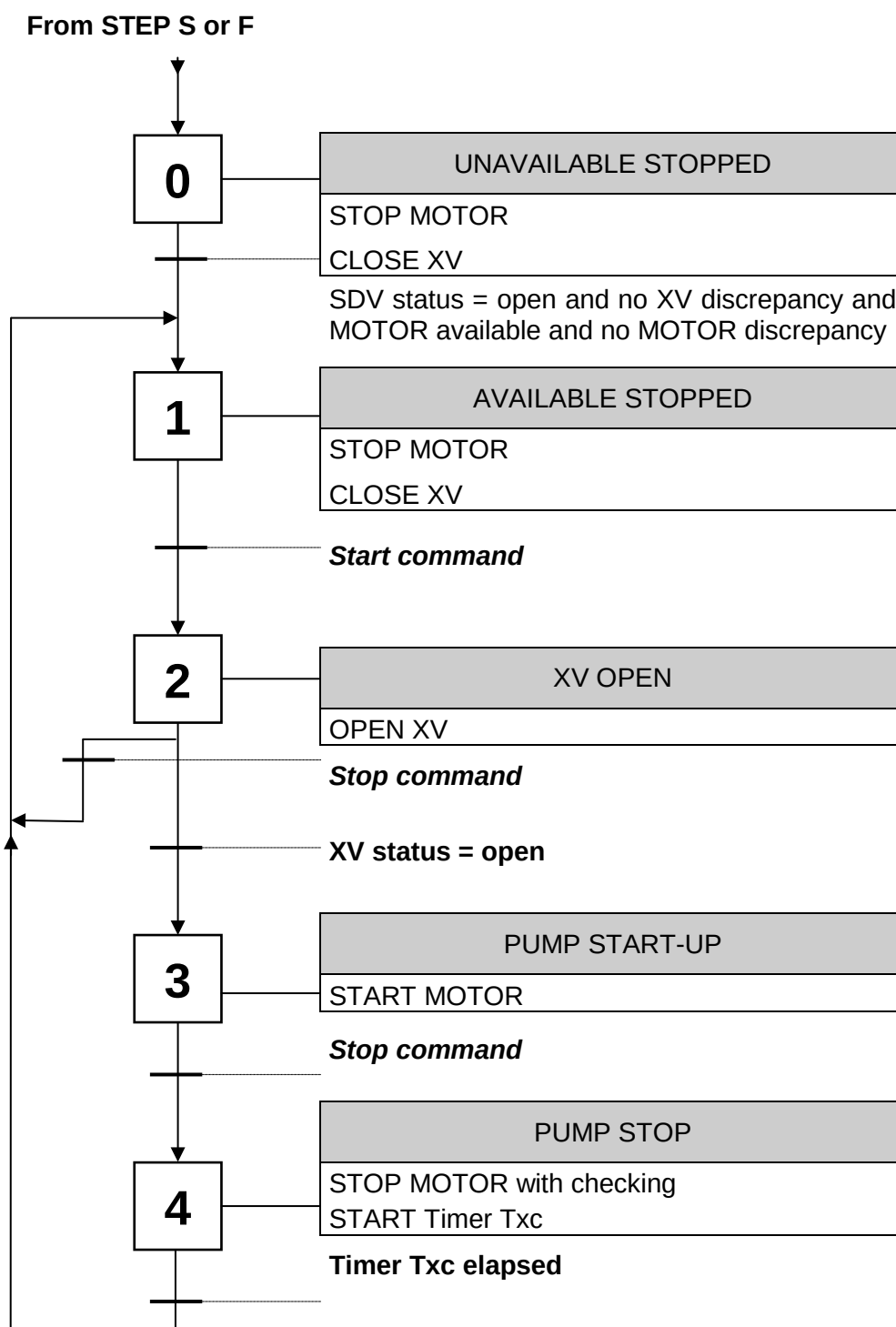
4.6.4 Auto/Manual chart

From STEP 0, 1, 2, 3, 4 or 5

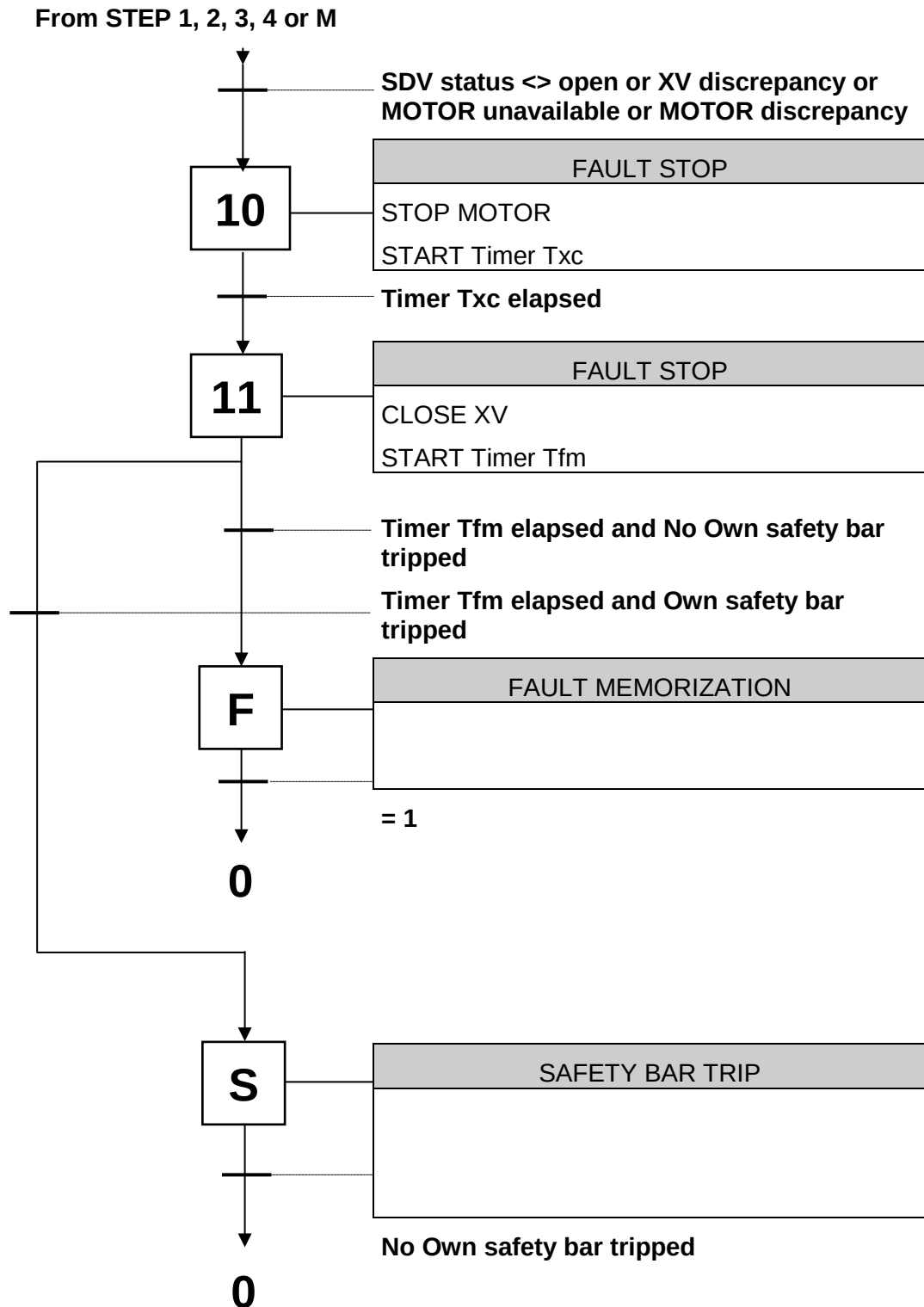


4.7 Sequential chart of Reciprocating pump unit (PU_RECIP)

4.7.1 Start/Stop chart

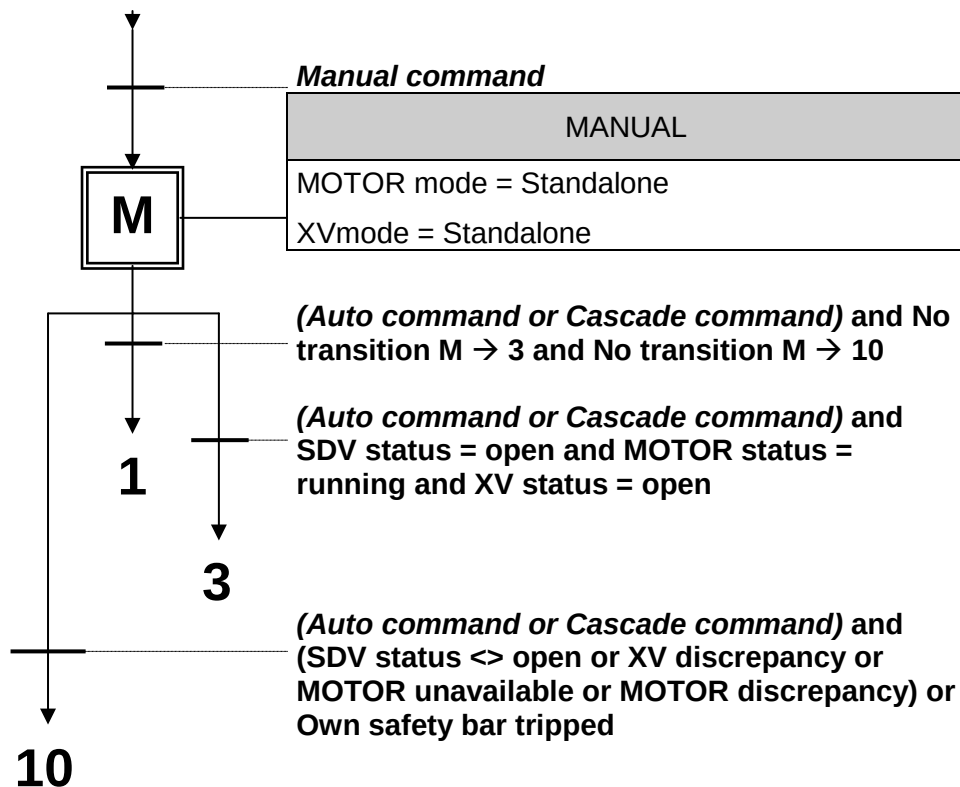


4.7.2 Bar tripped or fault chart



4.7.3 Auto/Manual chart

From STEP 0, 1, 2, 3, 4



5. Tuning parameters and variables

5.1 Centrifugal pump unit

Parameter	Access level
Timer Tro preset value	Method
Timer Tfm preset value	Method
Timer Tsvc preset value (PU_CENT_2XV)	Method

5.2 Reciprocating pump unit

Parameter	Access level
Timer Txc preset value	Method
Timer Tfm preset value	Method

6. Representation and animation description (HMI)

6.1 Events and values to be recorded

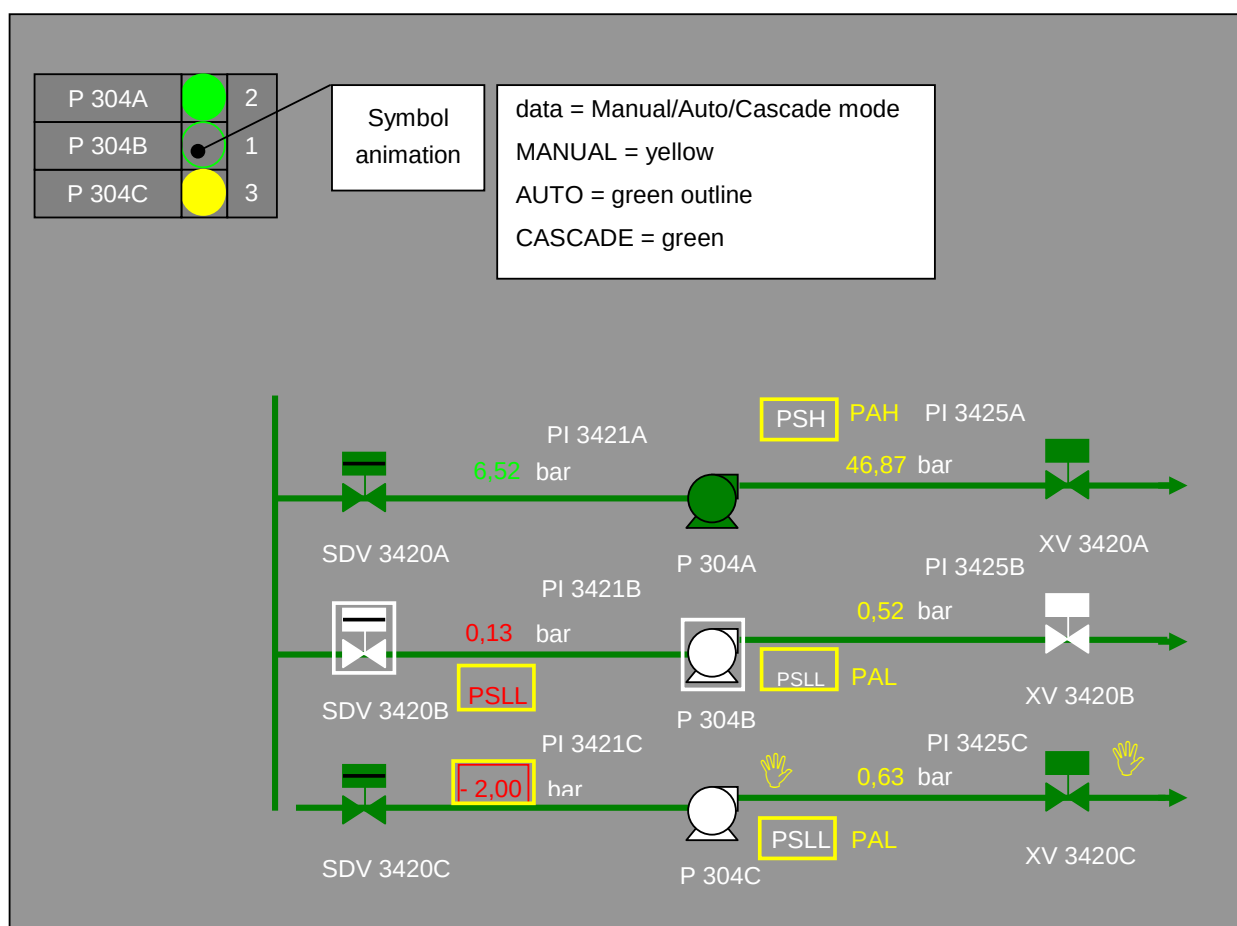
6.1.1 Events

- Manual/Auto/Cascade command
- Start/Stop command (operator).

6.2 Process control display (operating level display)

The hereafter description gives examples of representation. However, they may be amended dependant on the DCS features.

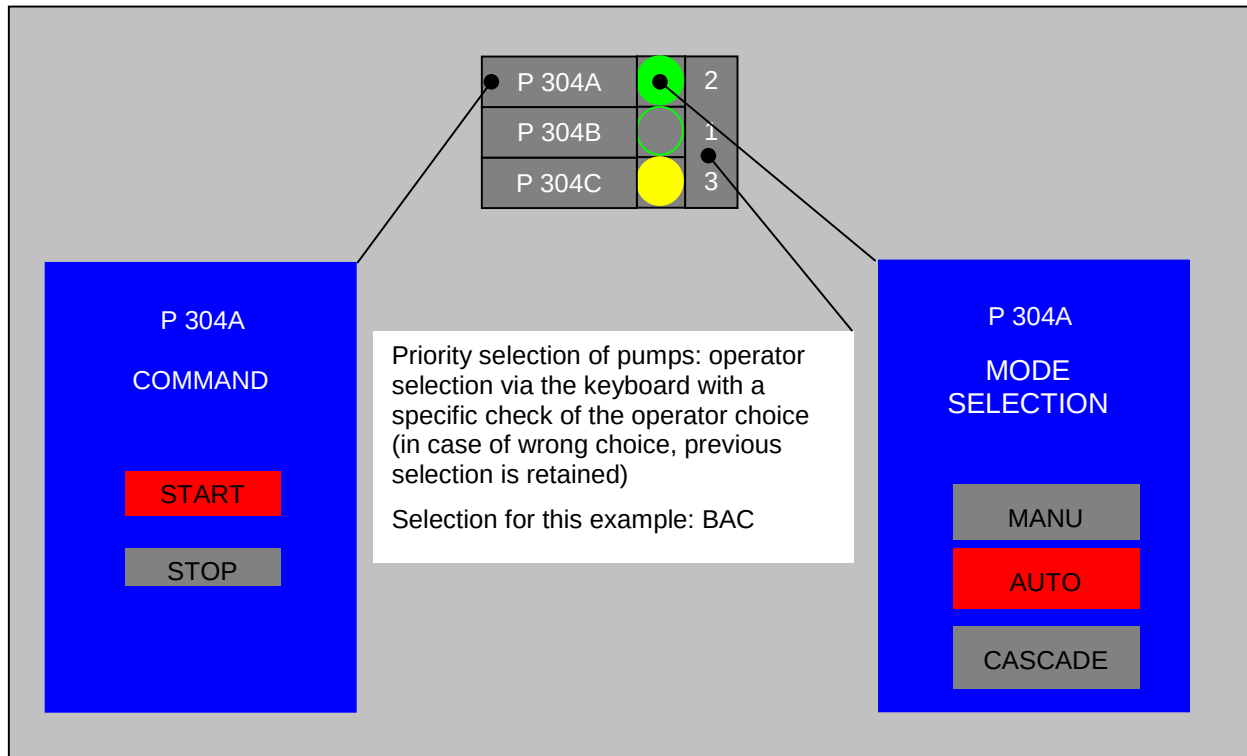
6.2.1 General description of centrifugal pump unit



6.2.2 Animation description of equipment

Concerning SDV, MOTOR and XV equipment, animation is described in corresponding equipment Standard Function.

6.2.3 Access of commands for a pump unit



Priority selection of pumps is described in D/B/S Standard Function.

General Specification		GS EP INS 197
Process Standard Functions		
Rev.: 04	Effective date: 09/2012	Page: 78 of 118

7. Appendix: handling of status in case of centrifugal pump unit (PU_CENT)

STEP CHART	Auto/Manual status	Pump unit status	Fault status	Interlock (Safety locking) status	Available status
STEP 0		= Unavailable stopped			= Unavailable
STEP 1	= Auto or = Cascade	= Available stopped	= No Fault	= Normal	= Available
STEP 2		= Start-up			= Available
STEP 3	= Auto or = Cascade	= Running (If XV status = Open)	= No Fault		= Available
STEP S	= Auto locked If own safety bar tripped Else = Auto or = Cascade	= /	= Fault If own safety bar tripped	= Upstream SB tripped If Upstream SB tripped Else = Own SB tripped	= Unavailable
STEP M	= Manual	= /			= Unavailable
STEP F		= /	= Fault		= Unavailable
STEP 10	= Auto or = Cascade	= /			= Unavailable

General Specification		GS EP INS 197
Process Standard Functions		
Rev.: 04	Effective date: 09/2012	Page: 79 of 118

Chapter 6 Duty/Back-up/Stand-by Standard Function - D/B/S -

1. Scope	80
1.1 List of main functions	80
1.2 Higher level control module	80
2. Interface description	81
2.1 General description	81
3. Detailed description of functions.....	83
3.1 Modes and commands.....	83
3.2 Pump unit (or pump) Start/Stop command in cascade mode.....	84
3.3 Sequential chart.....	86
4. Tuning parameters and variables	89
4.1 Two pump unit station: "Duty/Standby".....	89
4.2 Three pump unit station: "Duty/Backup/Standby"	89
4.3 Four pump unit station: "Duty/Backup1/Backup2/Standby".....	89
5. Representation and animation description (HMI).....	89
5.1 Events and values to be recorded	89
6. Detailed charts	93
6.1 Two pumps units: Duty/Stand-by Standard (D/S)	93
6.2 Three pump units: Duty/Back-up/Stand-by Standard (D/B/S)	95
6.3 Four pump units: Duty/Back-up 1/Back-up 2/Stand-by Standard (D/B1/B2/S)	97

General Specification		GS EP INS 197
Process Standard Functions		
Rev.: 04	Effective date: 09/2012	Page: 80 of 118

1. Scope

The purpose of this document is to define the Standard Function for a Duty/Back-up/Stand-by software module (D/B/S), dedicated to control of pumping stations.

Definitions:

One pump is considered:

- In duty when in service if one pump only is required
- In back-up when in service if additional pump is required
- In stand-by when started upon duty or back-up pump fault.

In order to assist in understanding, the document should be read in conjunction with **GS EP INS 150**.

This Standard Function is interlocked with:

- Lower level Standards
 - PU (Pump Unit) handling pump and suction and discharge valves
 - MOT (when no suction and discharge valve exist).
- Higher level automatic control.

It includes three options of pumping station:

- 2 pump runs named "Duty/Standby"
- 3 pump runs named "Duty/Backup/Standby"
- 4 pump runs named "Duty/Backup1/Backup2/Standby".

1.1 List of main functions

It includes the following main functions:

- Duty/Back-up/Standby management
- Lower level standards interface (start/stop, status, faults, standalone/cascade mode for MOT Standards only, etc.)
- Higher level control interface (number of required pumps, standalone/cascade mode)
- Operator commands interface (Start/Stop command, number of required pumps, pumps priority).

1.2 Higher level control module

Generally, this control is defined within the functional analysis; it may be based on analogue input thresholds treatment.

Its interface will be as defined hereafter:

- Inputs: Auto/Manual operator command and analogue input thresholds
- Outputs: Standalone/Cascade mode (as per Auto/Manual command) and number of required pumps.

General Specification		GS EP INS 197
Process Standard Functions		
Rev.: 04	Effective date: 09/2012	Page: 81 of 118

2. Interface description

2.1 General description

INPUTS						OUTPUTS		
Field	HMI	Internal				Internal	HMI	Field
			<u>Interface with higher level automatic control</u> Standalone/Cascade mode ● ● Number of required pumps (only in Cascade Mode)	Standard Function D/B/S				
			<u>Operator commands</u> ● Start/Stop (in Standalone mode)					
			● Number of required pumps (in Standalone mode)					
			● Priority selection					
			● Manual/Cascade mode for each Pump (1 to N) (motor standard)					

Process Standard Functions

Rev.: 04

Effective date: 09/2012

Page: 82 of 118

Chapter 6

INPUTS						OUTPUTS		
Field	HMI	Internal				Internal	HMI	Field
			<u>Interlocks</u>					
		●	safety trip (relative to pump units or pumps)					
			<u>Interface with lower level control for each "PU"</u>					
		●	Manual/Auto/Cascade status	Standard D/B/S	Standard Function: PU_CENT or PU_RECIP			
		●	Pump unit status					
		●	Fault status			Start/Stop commands (in Cascade Mode)	●	
		●	Interlock status					
		●	Available status					
			OR					
			<u>Interface with lower level control for each "MOT"</u>					
		●	Status (run/stop)		OR			
					Standard Function: MOT or MOT_BK			
					Standalone/Cascade mode	●		
		●	Discrepancy Status					
		●	Available Status			Start/Stop commands (in Cascade Mode)	●	

General Specification		GS EP INS 197
Process Standard Functions		
Rev.: 04	Effective date: 09/2012	Page: 83 of 118

3. Detailed description of functions

3.1 Modes and commands

3.1.1 Specific description

3.1.1.1 Standalone/Cascade mode

Standalone/Cascade mode is set by higher level automatic control:

- Standalone/Cascade mode is set to Cascade mode when higher level automatic control is in Auto mode
- Standalone/Cascade mode is set to Standalone mode when higher level automatic control is in Manual mode.

Standalone/Cascade mode is always set in Standalone mode if higher level automatic control is not implemented.

3.1.1.2 Number of required pumps used in Cascade mode

Higher level automatic control calculates this number, when the “D/B/S” Standard is in Cascade mode.

This number may be equal to the number of pump units.

3.1.1.3 Number of required pumps used in Standalone mode

This number can only be modified by the operator, when the “D/B/S” Standard is in Standalone mode.

This number may be set:

- Up to 2 in the case of pumping station consisting in 2 pump units
- Up to 2 in the case of pumping station consisting in 3 pump units
- Up to 3 in the case of pumping station consisting in 4 pump units.

3.1.1.4 Start/Stop command

The start/stop command is available to the operator on the “D/B/S” standard display when Standalone mode is active.

This command is forced to stop (not available to the operator) upon trip of safety bars relative to pump units or pumps.

When “D/B/S” is set in Cascade mode:

- Start/Stop command is set to Stop if Number of required pumps used in Cascade mode = 0
- Start/Stop command is set to Start if Number of required pumps used in Cascade mode is different from 0.

3.1.1.5 Priority selection of pumps

This selection gives priority for start/stop pumps and can only be modified by the operator.

General Specification		GS EP INS 197
Process Standard Functions		
Rev.: 04	Effective date: 09/2012	Page: 84 of 118

This choice concerns all the pump units of the station.

Pump in priority 1 is the Duty pump.

Pump in priority 2 is:

- The Standby pump for a 2 pumps station
- The Backup pump for a 3 pumps station
- The Backup 1 pump for 4 pumps station

Pump in priority 3 is:

- The Standby pump for a 3 pumps station
- The Backup 2 pump for a 4 pumps station

Pump in priority 4 is:

- The Standby pump for a 4 pumps station

Example:

Four pump unit station: D A C B with D as Duty, A as Backup 1, C as Backup 2 and B as Standby.

3.1.1.6 Manual/Cascade mode command (for motor Standard)

This operator command interlocks D/B/S with the motors Standard Functions (pump unit Standard Function do not apply).

Manual/Cascade command is forced to Manual mode (Cascade mode not available) upon discrepancy status or (unavailable status and associated safety bar not tripped).

3.1.1.7 Standalone/Cascade mode (for motor standard)

Standalone/Cascade mode is set to Cascade mode when Manual/Cascade command is set to Cascade.

Standalone/Cascade mode is set to Standalone mode when Manual/Cascade command is set to Manual.

3.2 Pump unit (or pump) Start/Stop command in cascade mode

This description is relative to one pump unit (or pump) and is implemented as many times as number of pump units (or pumps) they are in the pumping station.

Start/Stop command is handled only when the selected mode of the pump unit (or motor) is in cascade.

3.2.1 Pump unit (or pump) start-up

Start command can be activated only when corresponding available status of pump unit (or pump) is active.

Start command is activated when:

("D/B/S" is in Standalone mode and "D/B/S" Start command is set) Or ("D/B/S" is in Cascade mode and number of required pumps used in Cascade mode is different from 0)

General Specification		GS EP INS 197
Process Standard Functions		
Rev.: 04	Effective date: 09/2012	Page: 85 of 118

And

((pump unit (or pump) is in priority 1 (duty))

Or

(pump is in priority 2 and

(number of required pumps = 2

or number of required pumps = 1 and pump in priority 1 is Unavailable to start))

Or

(pump is in priority 3 and

(number of required pumps = 3

or number of required pumps = 2 and pump in priority 1 or 2 is Unavailable to start

or number of required pumps = 1 and pumps in priority 1 and 2 are Unavailable to start))

Or

(pump is in priority 4 and

(number of required pumps = 4

or number of required pumps = 3 and pump in priority 1 or 2 or 3 is Unavailable to start

or number of required pumps = 2 and (pumps in priority 1 and 2 are Unavailable to start Or pumps in priority 1 and 3 are Unavailable to start Or pumps in priority 2 and 3 are Unavailable to start)

or number of required pumps = 1 and pumps in priority 1 and 2 and 3 are Unavailable to start)).

Remark:

When the number of required pumps = 2 or 3 or 4, the pump, started at the second stage, will start after a specific time delay.

When the number of required pumps = 3 or 4, the pump, started at the third stage, will start after another specific time delay.

When the number of required pumps = 4, the pump, started at the fourth stage, will start after another specific time delay.

3.2.2 Pump unit (or pump) stop

Stop command is activated upon unavailable status of the pump unit (or pump) and when:

“D/B/S” is in Standalone mode and “D/B/S” Stop command is set Or “D/B/S” is in Cascade mode and Number of required pumps used in Cascade mode = 0

Or

pump is in priority 2 and number of required pumps = 1 and pump in priority 1 is Available to start

Or

pump is in priority 3 and

(number of required pumps = 2 and pumps in priority 1 and 2 are Available to start

General Specification		GS EP INS 197
Process Standard Functions		
Rev.: 04	Effective date: 09/2012	Page: 86 of 118

or number of required pumps = 1 and pump in priority 1 or 2 is Available to start)

Or

pump is in priority 4 and

(number of required pumps = 3 and pumps in priority 1 and 2 and 3 are Available to start

or number of required pumps = 2 and (pumps in priority 1 and 2 are Available to start Or pumps in priority 1 and 3 are Available to start Or pumps in priority 2 and 3 are Available to start)

or number of required pumps = 1 and pump in priority 1 or 2 or 3 is Available to start)

3.3 Sequential chart

This description is relative to one pump unit (or pump) and is implemented as many times as number of pump units (or pumps) they are within the pumping station.

3.3.1 Definition

First inter start-up timer (second pump start-up): Tst1

Time delay between first pump start-up and second pump start-up.

Second inter start-up timer (third pump start-up): Tst2

Time delay between first pump start-up and third pump start-up.

Third inter start-up timer (fourth pump start-up): Tst3

Time delay between first pump start-up and fourth pump start-up.

Overlap timer:

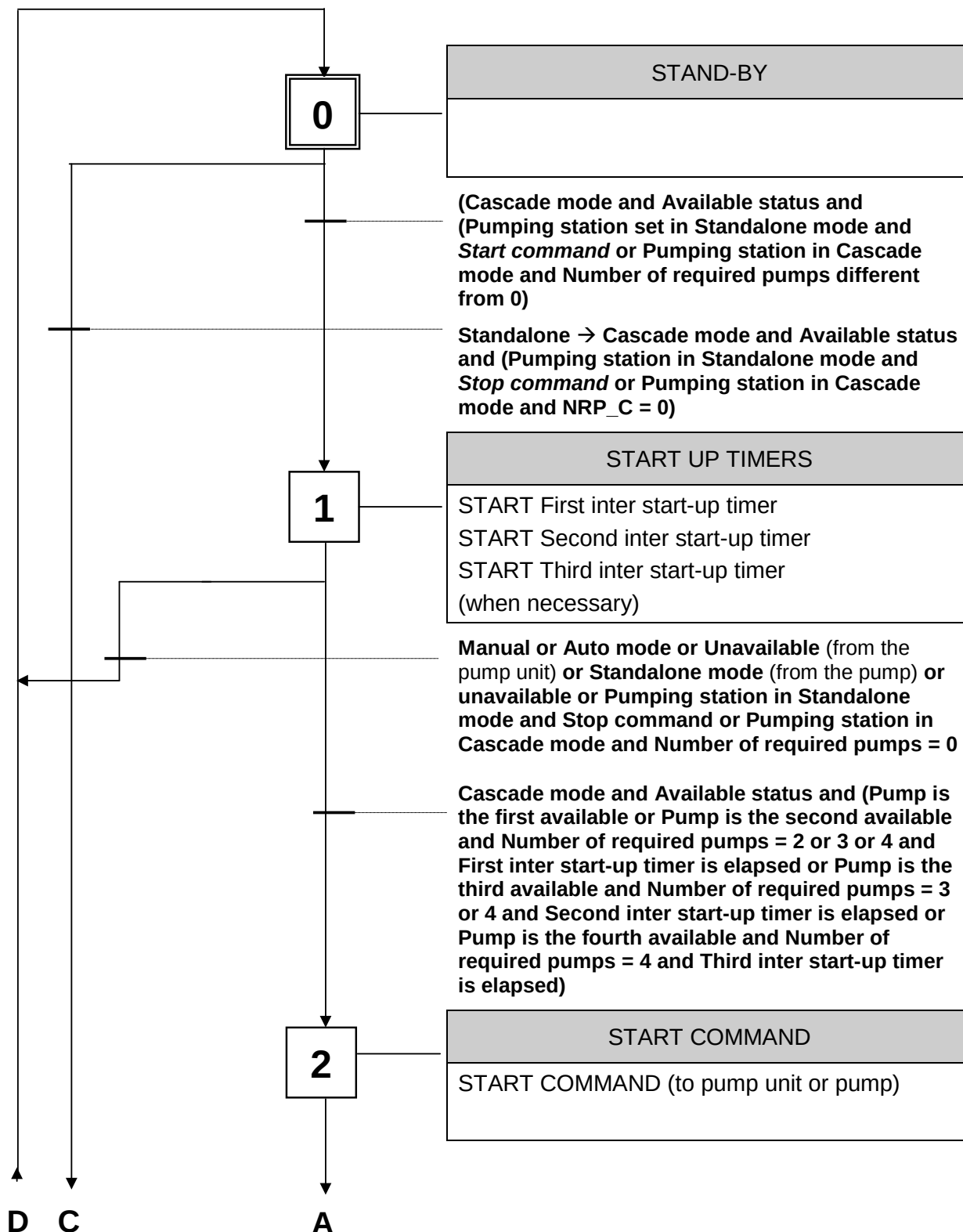
Time before stopping a pump after a pump start-up, related to pump change over.

3.3.2 Associated variables

Number of required pumps in Standalone mode (**NRP_S**)

Number of required pumps in Cascade mode (**NRP_C**).

3.3.3 General chart of a pump unit



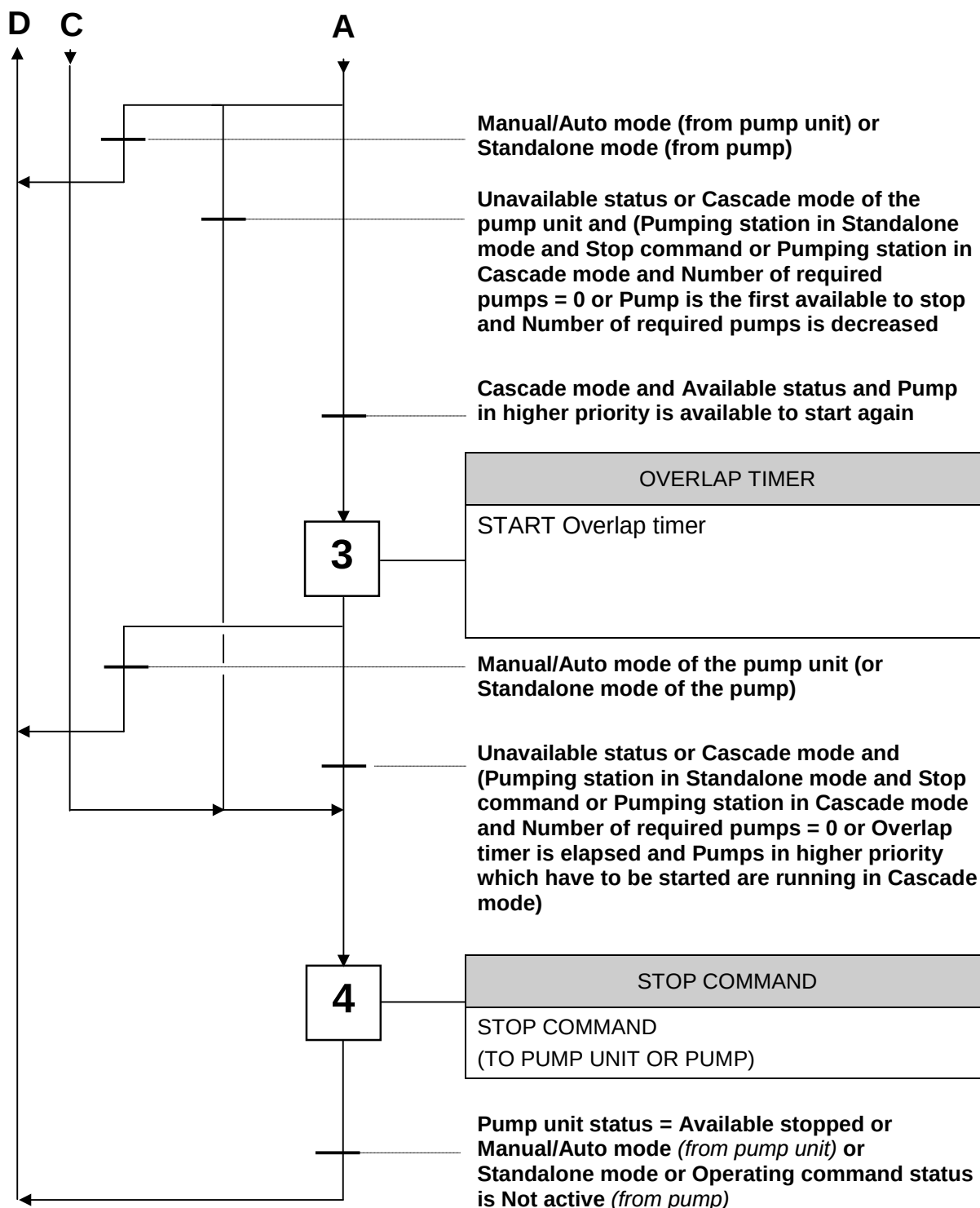
Process Standard Functions

Rev.: 04

Effective date: 09/2012

Page: 88 of 118

Chapter 6



General Specification		GS EP INS 197
Process Standard Functions		
Rev.: 04	Effective date: 09/2012	Page: 89 of 118

4. Tuning parameters and variables

4.1 Two pump unit station: “Duty/Standby”

Parameter	Access level
Pre-set value of first inter start-up timer	Method
Pre-set value of overlap timer	Method

4.2 Three pump unit station: “Duty/Backup/Standby”

Parameter	Access level
Pre-set value of first inter start-up timer	Method
Pre-set value of second inter start-up timer	Method
Pre-set value of overlap timer	Method

4.3 Four pump unit station: “Duty/Backup1/Backup2/Standby”

Parameter	Access level
Pre-set value of first inter start-up timer	Method
Pre-set value of second inter start-up timer	Method
Pre-set value of third inter start-up timer	Method
Pre-set value of overlap timer	Method

5. Representation and animation description (HMI)

5.1 Events and values to be recorded

5.1.1 Events

Start/Stop command (operator)

Manual/Cascade command for each pump (for motor only).

5.1.2 Values

Number of required pumps (in Standalone mode only)

Priority selection.

5.1.3 Process control display

The hereafter description gives examples of representation. However, they may be amended dependant on the DCS features.

Process Standard Functions

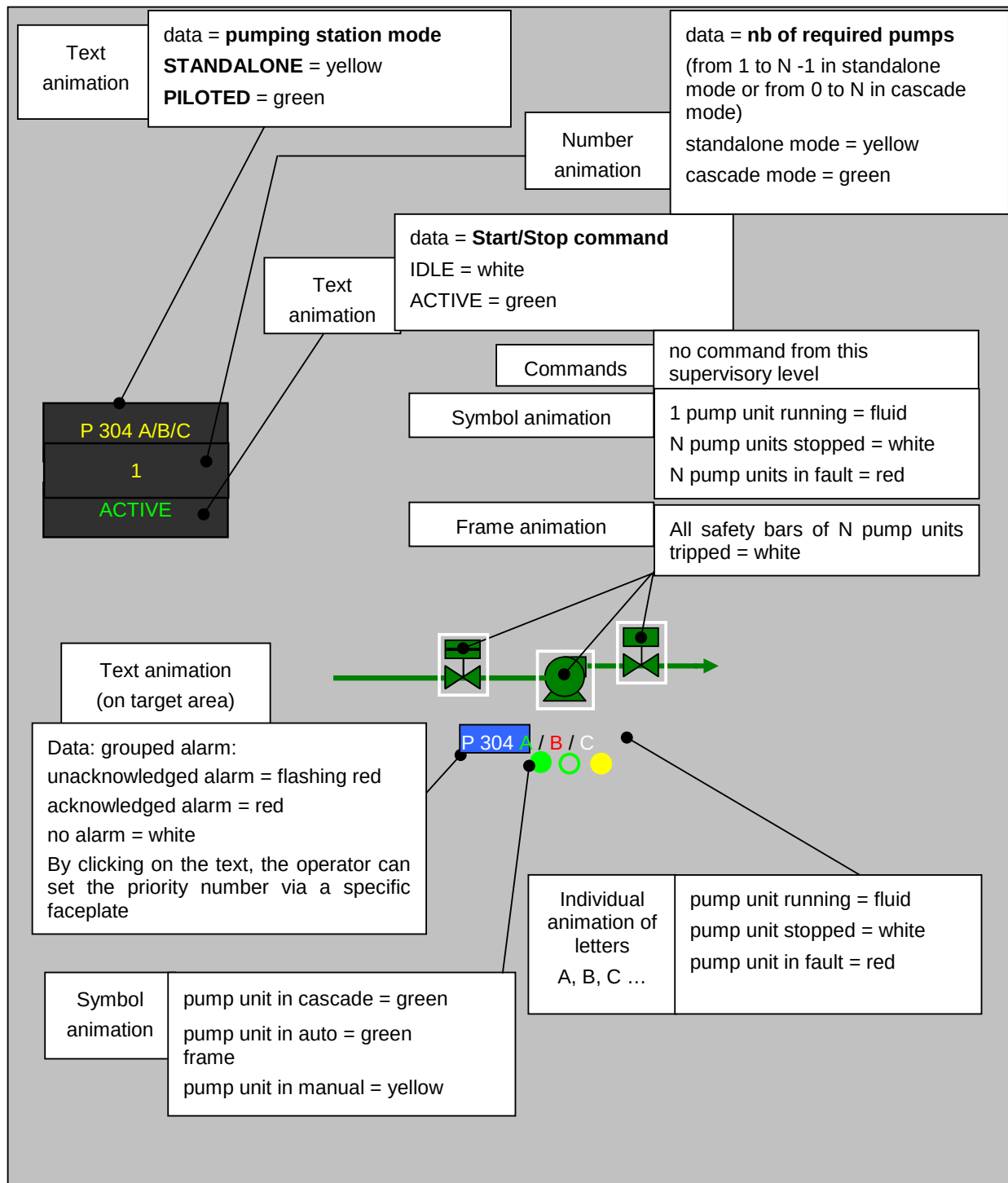
Rev.: 04

Effective date: 09/2012

Page: 90 of 118

Chapter 6

5.1.4 Supervisory level display



General Specification		GS EP INS 197
Process Standard Functions		
Rev.: 04	Effective date: 09/2012	Page: 91 of 118

5.1.4.1 Symbol animations of Pumping station

5.1.4.1.1 Pumping station

One single symbol represents the whole pumping station (including SDV, PUMP and XV) with the following status and animation:

- Running: fluid colour
- Stopped: white
- In fault: red.

Running status is active when at least one pump unit is in service.

Stopped status is active when Run is not active.

In fault status is active when all the pump units are in fault.

Pump unit is considered in running status when valves are opened and pump running (use of internal status).

Pump unit is considered to be in fault when a valve is in discrepancy or when the pump is in discrepancy or unavailable (use of internal status).

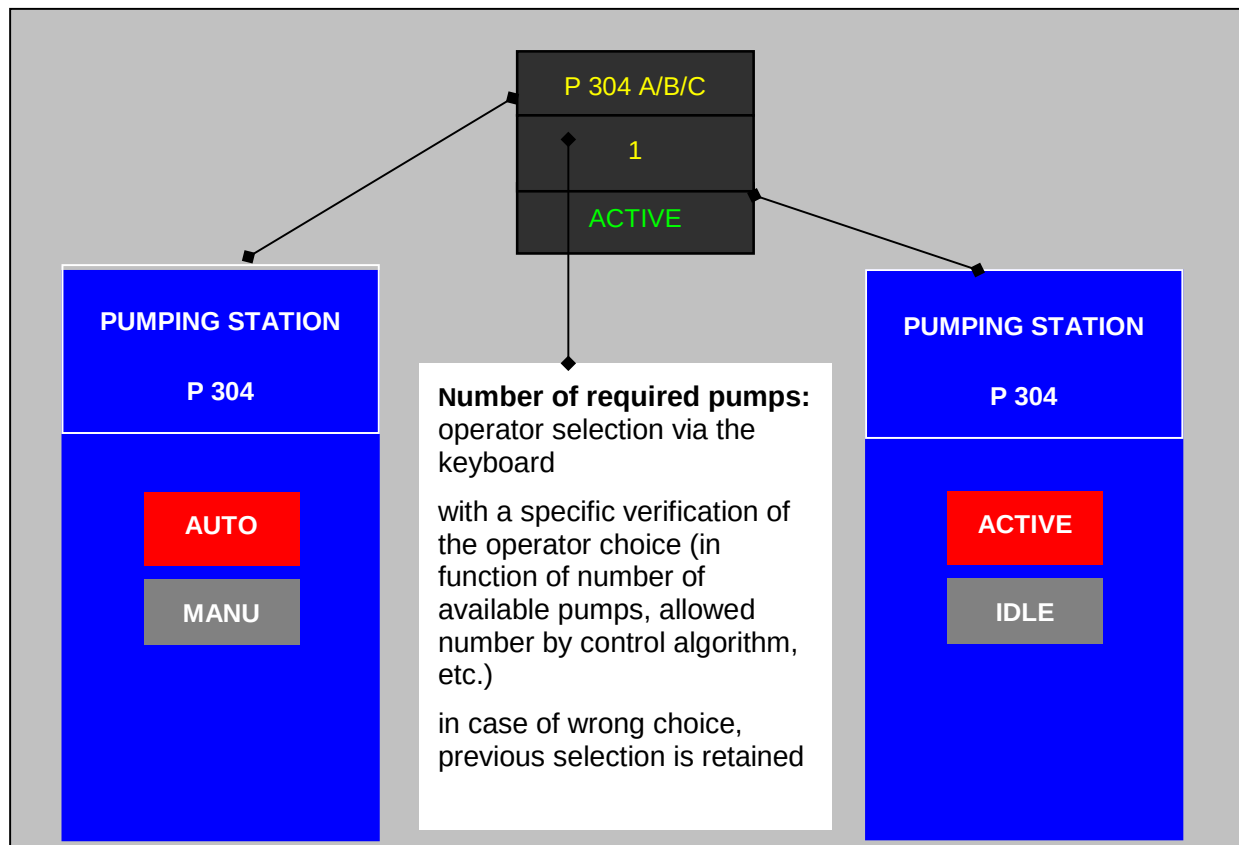
5.1.4.1.2 Safety trip

Pump unit station is tripped when safety bars relative to all pump units are tripped; corresponding animation applies to SDV, pump and XV.

5.1.4.1.3 Manual/Auto/Cascade mode of pump units

The status of this mode is shown by means of animated circle symbol located under the corresponding letter, as described in the above description.

5.1.4.2 Commands of the Pumping station



Auto/Manual command concerns the higher level automatic control (as defined per § 1.2).

When this level does not apply, command will be masked and the corresponding animation (P 304 A/B/C) is yellow, i.e. D /B /S is set in standalone mode.

5.1.5 Operating level display (refer to the representation of the Standard Function P.U.)

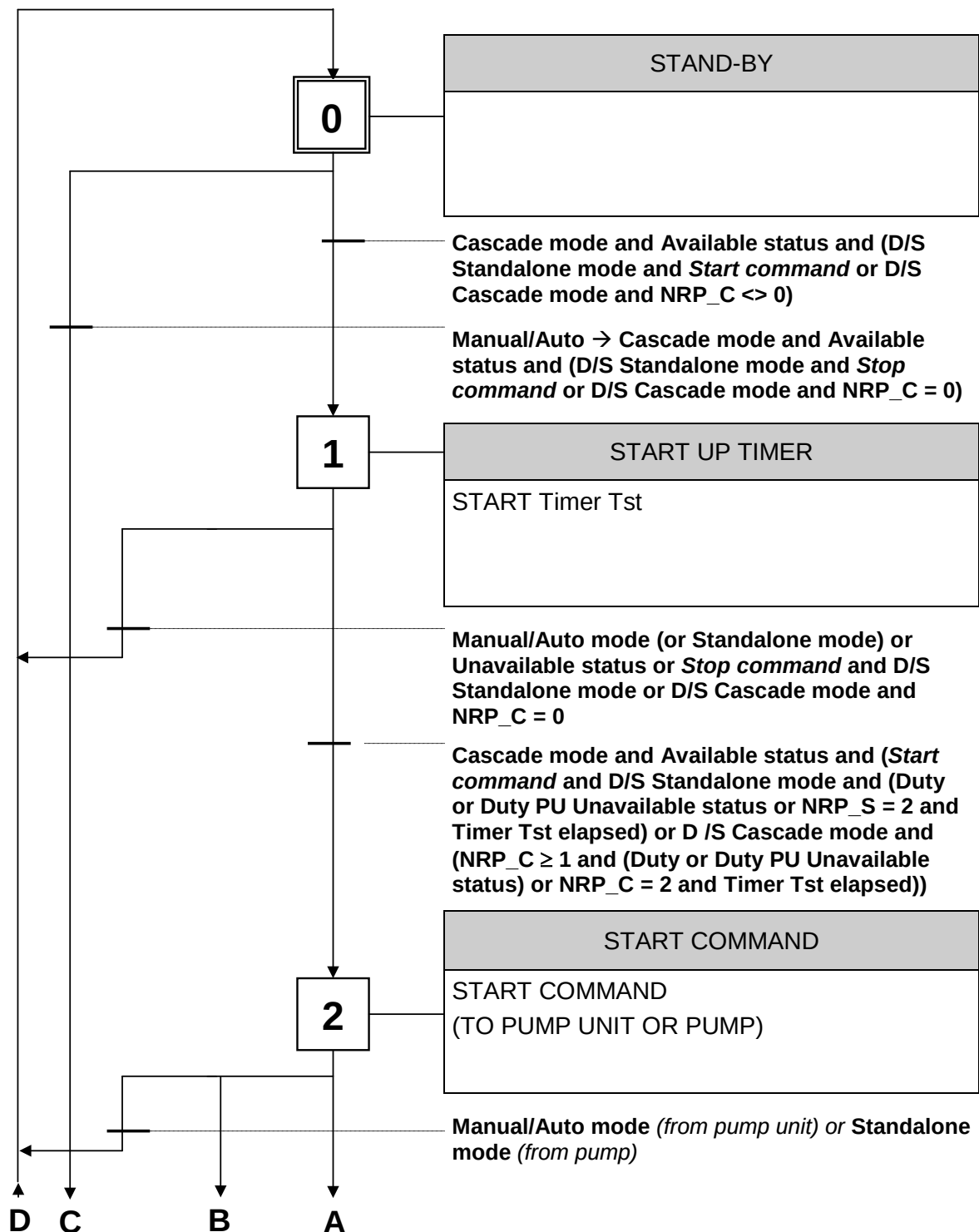
P 304 A		3
P 304 B		1
P 304 C		2

The animation is the same as described above regarding status of each pump unit.

The last column indicates the priority number of each pump unit, selected by the operator.

6. Detailed charts

6.1 Two pumps units: Duty/Stand-by Standard (D/S)



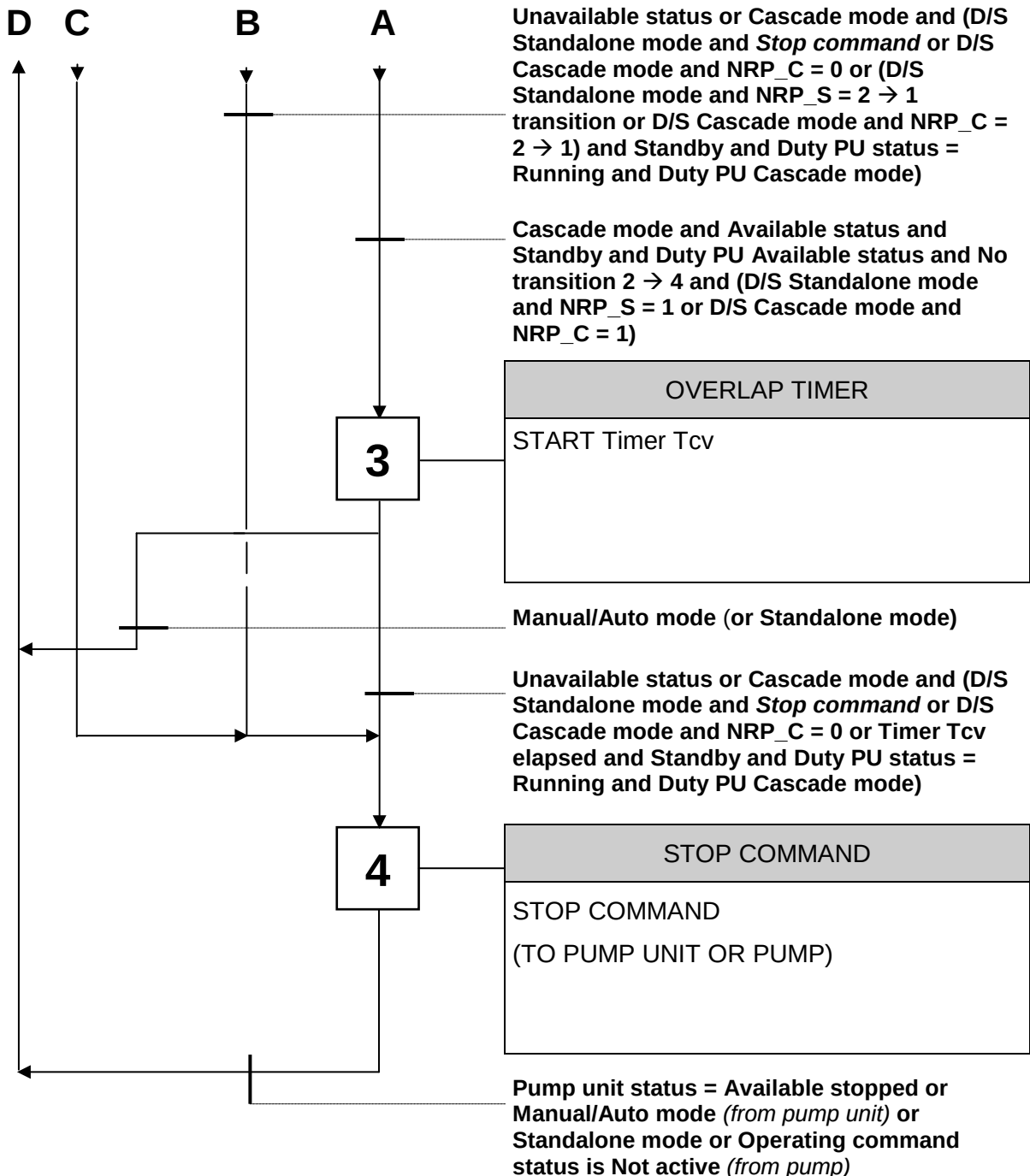
Process Standard Functions

Rev.: 04

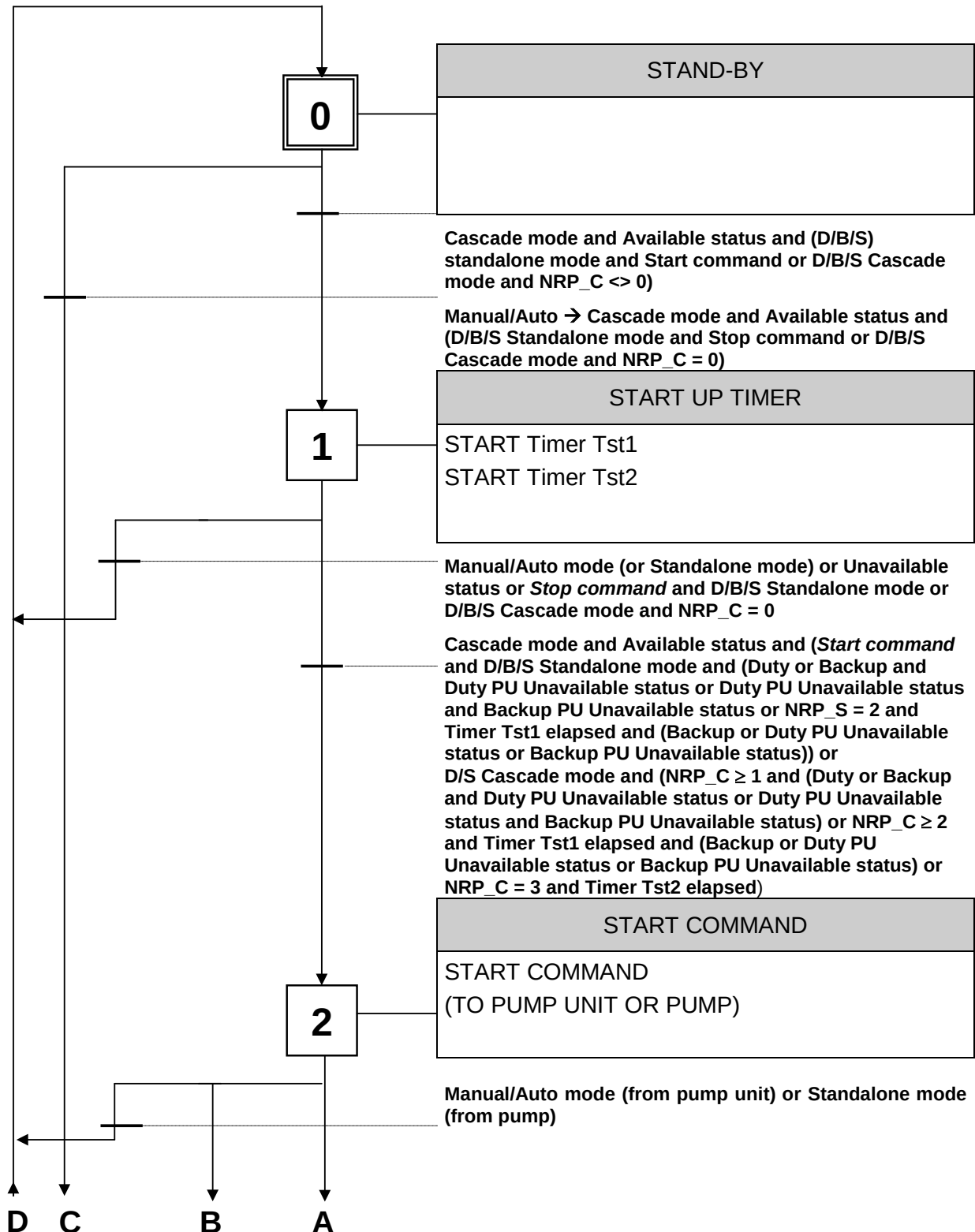
Effective date: 09/2012

Page: 94 of 118

Chapter 6



6.2 Three pump units: Duty/Back-up/Stand-by Standard (D/B/S)



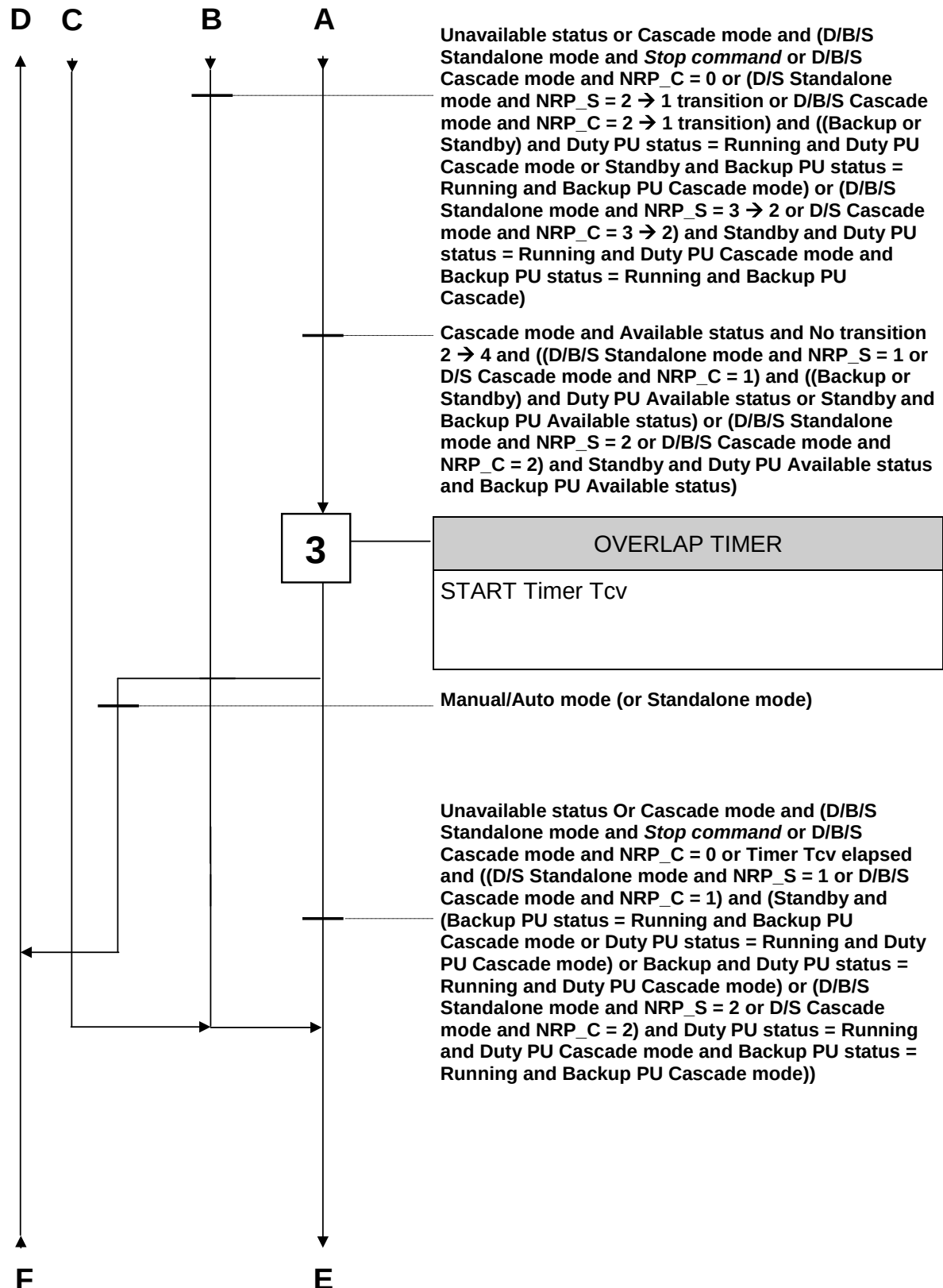
Process Standard Functions

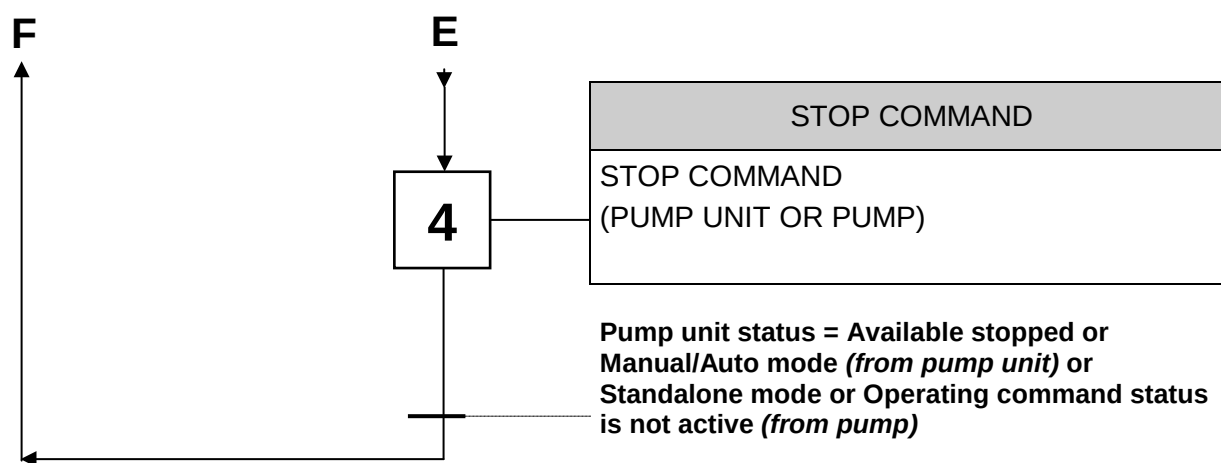
Rev.: 04

Effective date: 09/2012

Page: 96 of 118

Chapter 6





6.3 Four pump units: Duty/Back-up 1/Back-up 2/Stand-by Standard (D/B1/B2/S)

6.3.1 Conventions

D: Duty

B1: Backup1

B2: Backup2

S: Standby

DPUnSt: Duty PU Unavailable status

B1PUnSt: Backup1 PU Unavailable status

B2PUnSt: Backup2 PU Unavailable status

SPUnSt: Standby PU Unavailable status

DPAvSt: Duty PU Available status

B1PAvSt: Backup1 PU Available status

B2PAvSt: Backup2 PU Available status

SPASt: Standby PU Available status

DPSt: Duty PU status

B1PSt: Backup1 PU status

B2PSt: Backup2 PU status

SPSt: Standby PU status

General Specification		GS EP INS 197
Process Standard Functions		
Rev.: 04	Effective date: 09/2012	Page: 98 of 118

Chapter 6

DPPiMo: Duty PU Cascade mode
B1PPIMo: Backup1 PU Cascade mode
B2PPIMo: Backup2 PU Cascade mode
SPPiMo: Standby PU Cascade mode

AvStp: Available stopped
Run: Running
+: or
..: and
Tr: Transition

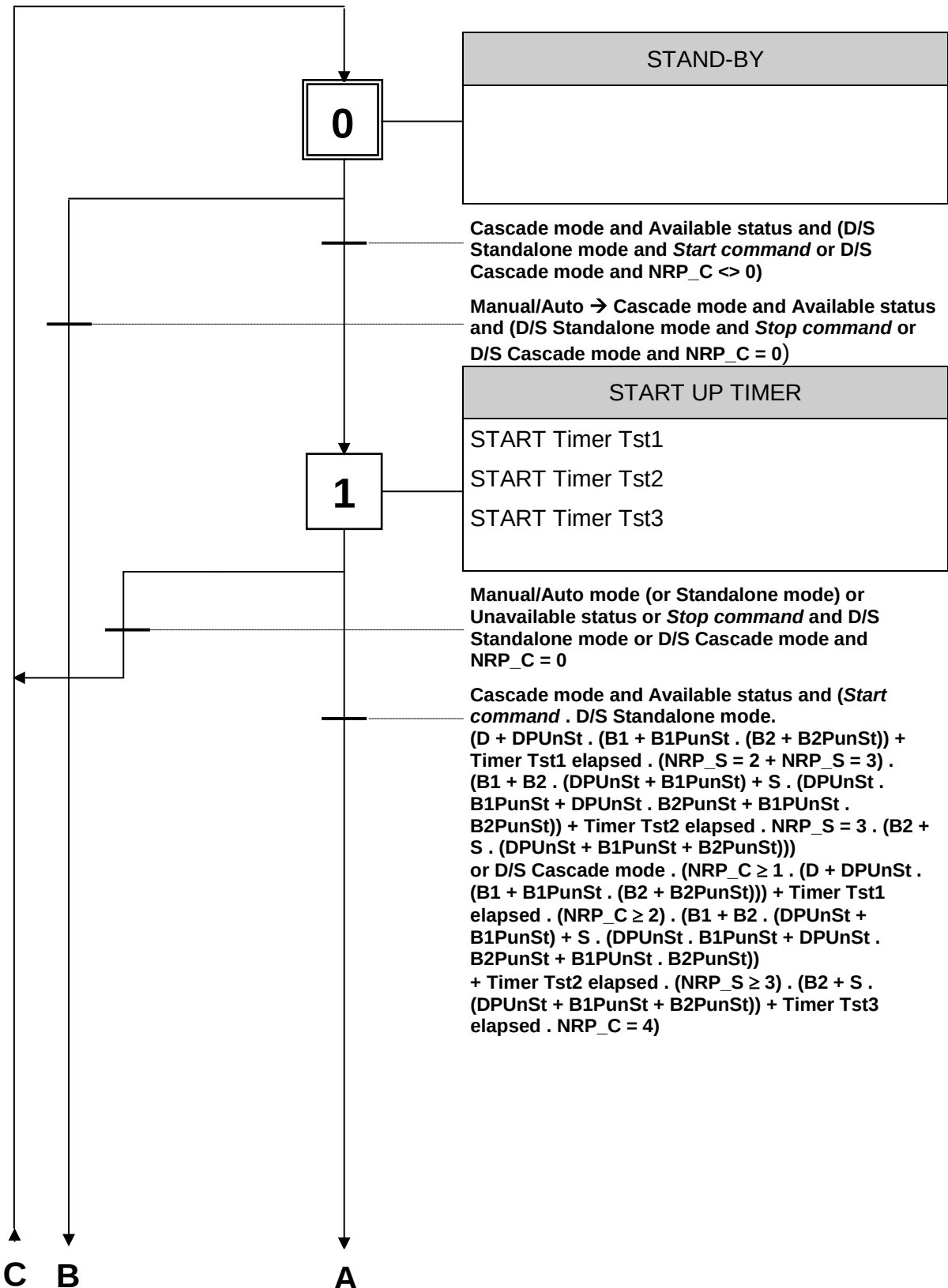
Process Standard Functions

Rev.: 04

Effective date: 09/2012

Page: 99 of 118

Chapter 6



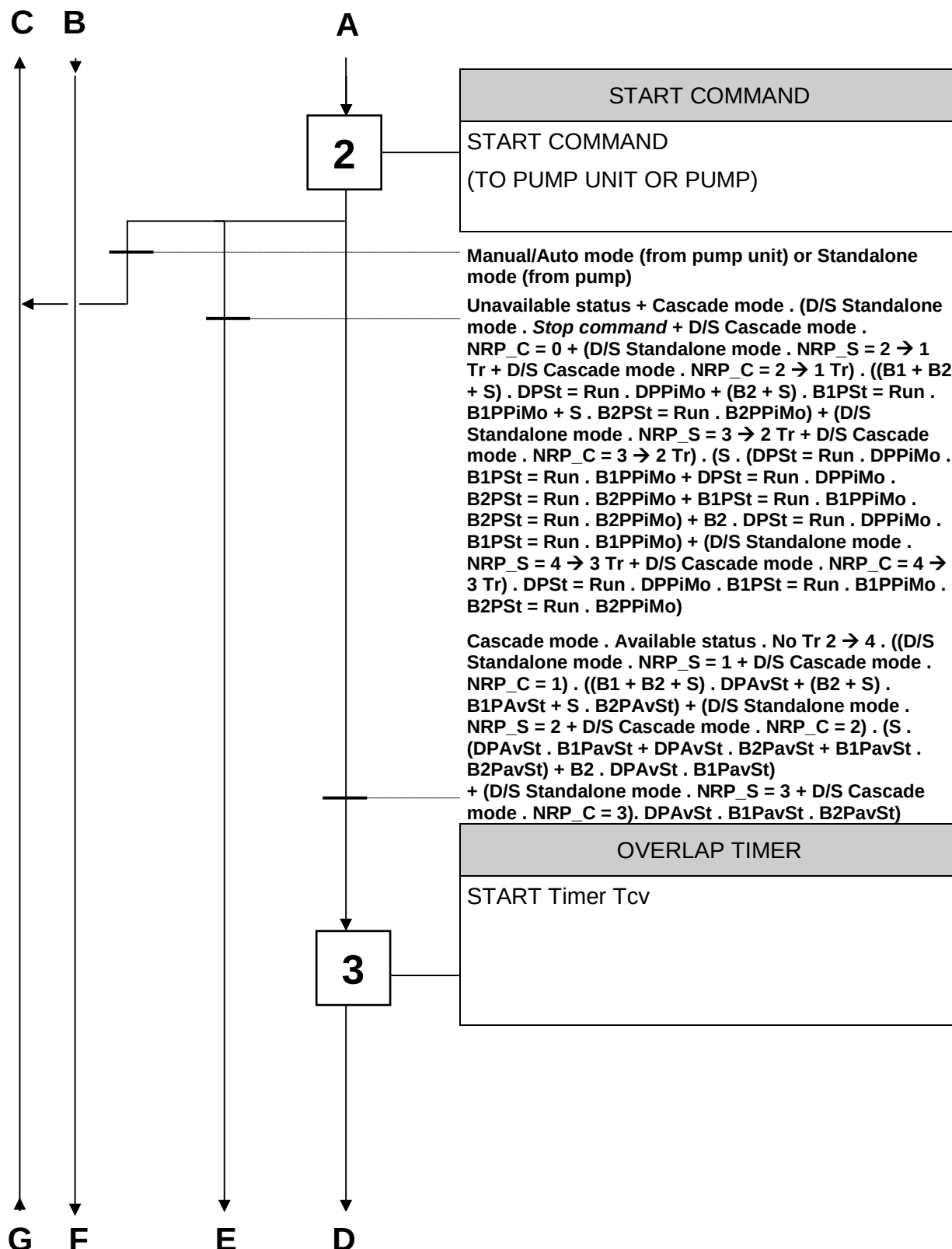
Process Standard Functions

Rev.: 04

Effective date: 09/2012

Page: 100 of 118

Chapter 6



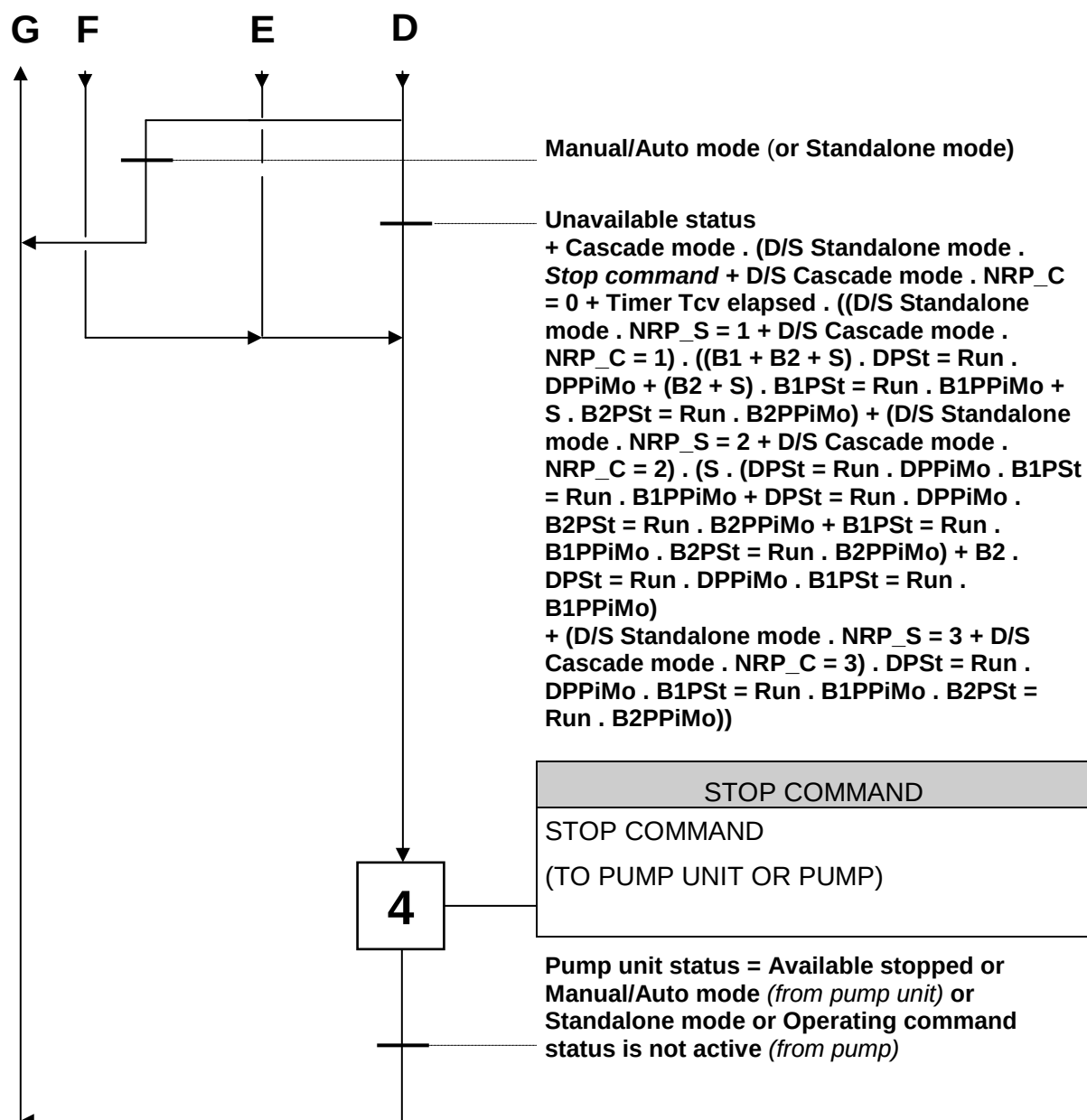
Process Standard Functions

Rev.: 04

Effective date: 09/2012

Page: 101 of 118

Chapter 6



General Specification		GS EP INS 197
Process Standard Functions		
Rev.: 04	Effective date: 09/2012	Page: 102 of 118

Chapter 7 ON/OFF Process Valve Standard Function - XV -

1. Scope	103
2. General description of functions	103
2.1 List of main functions	103
3. Interfaces description	104
3.1 General description	104
3.2 Specific description of field interfaces	105
4. Detailed description of functions.....	105
4.1 Modes and commands.....	105
4.2 Status definition	105
4.3 Operation counter	106
5. Tuning parameters and variables	107
6. Representation and animation description (HMI).....	107
6.1 Events and values to be recorded.....	107
6.2 Alarm handling	107
6.3 Control display	107
7. Option: XV_2B: XV with two digital outputs	110
7.1 General description of functions.....	110
7.2 Description of interfaces.....	111
7.3 Differences with XV description of functions.....	112
7.4 Tuning parameters and variables	112
7.5 Representation and animation description (HMI).....	112

General Specification		GS EP INS 197
Process Standard Functions		
Rev.: 04	Effective date: 09/2012	Page: 103 of 118

1. Scope

The purpose of this document is to define the Standard Function of ON/OFF Process Valve.

ON-OFF process valves, handled by the PCS, can be both operated by operator or automatic control function. These valves shall never be controlled by safety system.

In order to assist in understanding, this document should be read in conjunction with **GS EP INS 150**.

This Standard Function is a fundamental building block. It may either be used standalone, or integrated with other standard functions to create a more complex function, e.g. with the Pumping Unit Standard Function.

It covers:

- The standard type: **XV** - ON-OFF process valve with two limit switches
- The optional case: **XV_2B** - ON-OFF process valve with two limit switches and two digital outputs.

This option is described in § 7.

2. General description of functions

2.1 List of main functions

- Handling of field inputs and outputs with status and discrepancy detection
- Interfacing with higher level Standard Function (e.g. PU):
status and fault, open/close command, standalone/cascade mode
- Use of Operator commands: Open/Close, maintenance inhibit.

3. Interfaces description

3.1 General description

INPUTS				OUTPUTS		
Field	HMI	Internal		Internal	HMI	Field
			<i>Higher level Standard Function e.g.: "PU"</i> Standalone/Cascade mode Open/Close command (only in Cascade Mode)			
			Standard Function XV	Status (open/closed) Discrepancy Status		
			<i>HMI</i> Open/Close command (only in Standalone mode) Maintenance inhibit command			
				Operating command status Status (open/closed) Discrepancy status Operation in progress status Fault status Maintenance inhibit status Operation counter (opt)		Alm Alm
			Open limit switch (DI) Closed limit switch (DI)	Solenoid valve operating command (DO)		

Alm = Alarm

Opt= Optional

General Specification		GS EP INS 197
Process Standard Functions		
Rev.: 04	Effective date: 09/2012	Page: 105 of 118

3.2 Specific description of field interfaces

Corresponding field interfaces are:

- XY (1 DO): solenoid valve operating command:
1 = Open - fail close type
1 = Close - fail open type
- XZH (1 DI): open limit switch: **1 = Open**
- XZL (1 DI): closed limit switch: **1 = Closed**

4. Detailed description of functions

4.1 Modes and commands

4.1.1 Specific description

4.1.1.1 Standalone /Cascade mode

Standalone/Cascade mode is set by higher level automatic control (Pump Unit Standard Function, for example).

Standalone/Cascade mode is always set in Standalone mode when no higher level control is implemented.

4.1.1.2 Open/Close command

In Standalone mode, Open/Close command is available to operator only, from process control display.

In Cascade mode, Open/Close command is generated by the higher level Standard Function.

4.1.1.3 Maintenance inhibit

This command is available only when in maintenance level access.

When the maintenance inhibit is active:

- Limit switches are no more considered in internal Open/Closed status management
- HMI and Internal Discrepancies are no longer active
- Controlled part (valve body) is red steady when both open and closed limit switches are active; else the open or closed or operating in progress status will be displayed as defined below.

Maintenance inhibit status is active when maintenance inhibit command is set.

4.2 Status definition

4.2.1 Operating command status

It results from the Open/Close command.

General Specification		GS EP INS 197
Process Standard Functions		
Rev.: 04	Effective date: 09/2012	Page: 106 of 118

4.2.2 Open/Closed status

4.2.2.1 Open status

HMI open status is active if Open limit switch is active and Closed limit switch is not active.

Open status (internal data) is active if:

- (Operating command status = "Open") and (Open limit switch active and Closed limit switch not active)
- or
- (Operating command status = "Open") and maintenance inhibit status is active.

4.2.2.2 Closed status

HMI closed status is active if Open limit switch is not active and Closed limit switch is active

Closed status (internal) is active if:

- (Operating command status = "Close") and (Open limit switch not active and Closed limit switch active)
- or
- (Operating command status = "Close") and maintenance inhibit status is active.

4.2.3 Discrepancy status

It indicates a discrepancy between the command status and the limit switches status, after a delay time (operation in progress timer).

Discrepancy status is active when (Internal Open status) and (Internal Closed status) and (Operating in progress status) and (maintenance inhibit status) are not active.

4.2.4 Operation in progress status

Active during "operation in progress timer" counts down.

Operation in progress timer is only activated upon a status change of the operating command status.

4.2.5 Solenoid valve command (DO) status

Same status as Operating command status for fail closed type and reverse status for fail open type.

4.2.6 Fault status

Reports a hardware fault related to an associated I/O cards (field inputs/outputs).

4.3 Operation counter

Reports the number of changes of the operating command status (from close to open).

The counter reset command will be issued manually by the operator from the HMI (a dedicated pop-up window at maintenance access level).

General Specification		GS EP INS 197
Process Standard Functions		
Rev.: 04	Effective date: 09/2012	Page: 107 of 118

Note this monitoring function may be implemented into the Process Data Server by means of a supervisory tool, as per the project specifications.

5. Tuning parameters and variables

Parameter	Access level
Operation in progress timer pre-set value	Method

6. Representation and animation description (HMI)

6.1 Events and values to be recorded

6.1.1 Events

- Open/Close command (operator)
- Maintenance inhibit command
- Operating command status
- Discrepancy status
- Fault status

6.1.2 Values

- Open operating number

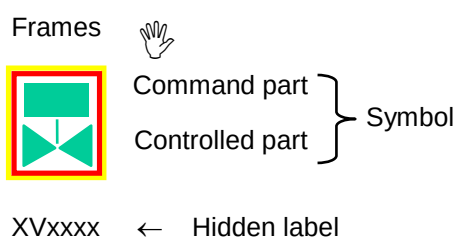
6.2 Alarm handling

Alarm Description	Priority
Discrepancy Status	Level 1
Fault Status	Level 1

6.3 Control display

The descriptions below give examples of valve representation animations. However, they may be amended depending on the DCS features.

6.3.1 XV (ON-OFF process valve) representation



General Specification		GS EP INS 197
Process Standard Functions		
Rev.: 04	Effective date: 09/2012	Page: 108 of 118

6.3.2 Miscellaneous

- XVxxxx instrument label appears on operator request (soft key)
- XVxxxx instrument label is used as target area for maintenance inhibit command
- A “hand” symbol (full yellow) appears near the valve when Open/Close operator command is allowed.

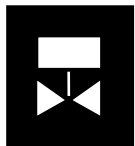
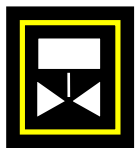
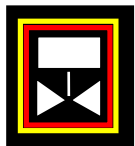
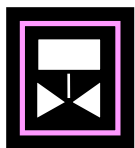
6.3.3 Animation of the symbol (command and controlled parts)

Display description	Display	Symbol
Valve closed or Communication or system fault		White White
Open command but Valve closed		Fluid White
Valve opening in progress		Fluid Fluid flashing
Valve open		Fluid Fluid
Close command but Valve open		White Fluid
Valve closing in progress		White Fluid flashing
Valve discrepancy when closing before acknowledgement (*)		White Red flashing
Valve discrepancy when closing after acknowledgement Or open and closed limit switches active and maintenance inhibit status active (*)		White Red
Valve discrepancy when open before acknowledgement (*)		Fluid Red flashing
Valve discrepancy when opening after acknowledgement Or open and closed limit switches active and maintenance inhibit status active (*)		Fluid Red

(*) Valve in an undetermined position after a time delay

General Specification		GS EP INS 197
Process Standard Functions		
Rev.: 04	Effective date: 09/2012	Page: 110 of 118

6.3.4 Animation of the Frames

Display description	Display	Frames
Normal status		
Maintenance inhibit		External frame: Yellow
Fault and maintenance inhibit		Internal frame: Red flashing before acknowledgement Red steady after acknowledgement
Communication or system fault		Internal frame: Magenta

The events which drive these frame displays may not be mutually exclusive. Therefore, the precedence on the display, from most to least important, shall be: magenta, white, blue, yellow.

7. Option: XV_2B: XV with two digital outputs

7.1 General description of functions

XV_2B valves control requires two pulse outputs:

- One for open
- One for close.

Process Standard Functions

Rev.: 04

Effective date: 09/2012

Page: 111 of 118

Chapter 7

7.2 Description of interfaces

7.2.1 General description

INPUTS				OUTPUTS		
Field	HMI	Internal		Internal	HMI	Field
			<u>Higher level Standard Function</u> Standalone /Cascade mode Open/Close command (only in Cascade Mode) Standard Function XV_2B	Status (open/closed) Discrepancy Status		
			<u>HMI</u> Open/Close command (only in Standalone mode) Maintenance inhibit command	Operating command Status Status (open/closed) Discrepancy Status Operation in progress Status Fault status Maintenance inhibit status Open operating number	Alm Alm	
			Open limit switch (DI) Closed limit switch (DI)	Open solenoid valve operating command (DO) Close solenoid valve operating command (DO)		
			Alm = Alarm			

General Specification		GS EP INS 197
Process Standard Functions		
Rev.: 04	Effective date: 09/2012	Page: 112 of 118

7.2.2 Specific description of field interfaces

Corresponding field interfaces are:

- XY_1 (1 DO): solenoid valve operating command: **pulse to 1 = Open**
- XY_2 (1 DO): solenoid valve operating command: **pulse to 1 = Close**
- XZH (1 DI): open limit switch: **1 = Open**
- XZL (1 DI): closed limit switch: **1 = Closed**

7.3 Differences with XV description of functions

- Fault status relative to 2 DO
- Solenoid valves commands (2 DO):
 Open command (DO) is activated (calibrated pulse) upon Operating command status activation
 Close command (DO) is activated (calibrated pulse) upon Operating command status de-activation.

7.4 Tuning parameters and variables

Parameter	Access level
Operation in progress timer pre-set value	Method

7.5 Representation and animation description (HMI)

Same as XV representation.

General Specification		GS EP INS 197
Process Standard Functions		
Rev.: 04	Effective date: 09/2012	Page: 113 of 118

Chapter 8 Hand Valve with two limit switches Standard Function - HV -

1. Scope	114
2. General description of functions	114
2.1 List of main functions	114
3. Description of interface	115
3.1 General description	115
4. Detailed description of functions.....	115
4.1 Modes and commands.....	115
4.2 Standard function functional behaviour	116
5. Representation and animation description (HMI).....	116
5.1 Events and values to be recorded	116
5.2 Alarm management.....	117
5.3 Control display	117

General Specification		GS EP INS 197
Process Standard Functions		
Rev.: 04	Effective date: 09/2012	Page: 114 of 118

1. Scope

The purpose of this document is to define the Standard Function for a Hand Valve (HV) with two limit switches.

In order to assist in understanding, the document should be read in conjunction with **GS EP INS 150**.

Hand valves are operated, only manually on site. These valves are not concerned by safety functionality.

2. General description of functions

2.1 List of main functions

- Maintenance inhibit
- Field inputs (DI), status and discrepancy
- Input fault detection.

3. Description of interface

3.1 General description

INPUTS				OUTPUTS		
Field	HMI	Internal		Internal	HMI	Field
			Standard Function - HV -			
		Maintenance inhibit command				
				Status (open/closed)		
				Discrepancy Status		Alm
				Operating in progress Status		Alm
				Input fault status		Alm
				Maintenance inhibit status		
		Open limit switch (DI)				
		Closed limit switch (DI)				
				Alm = Alarm		

3.1.1 Specific description of field interface

Corresponding field interfaces are:

- HZH (1 DI): open limit switch: **1 = Open**
- HZL (1 DI): closed limit switch: **1 = Close**

4. Detailed description of functions

4.1 Modes and commands

4.1.1 Specific description

4.1.1.1 Maintenance inhibit

Maintenance inhibit command is available to the operator in maintenance access level.

General Specification		GS EP INS 197
Process Standard Functions		
Rev.: 04	Effective date: 09/2012	Page: 116 of 118

On maintenance inhibit status:

- Limit switches are no longer considered with the internal Open/Closed status handling
- Discrepancy is no longer active
- Controlled part (valve body) is red steady if open and closed limit switches have the same status; else the open or closed or operating in progress status will be displayed as defined below.

Maintenance inhibit status is active if maintenance inhibit command is set.

4.2 Standard function functional behaviour

4.2.1 Status

4.2.1.1 Open status

HMI open status is active if Open limit switch is active and Closed limit switch is not active.

Internal open status is active if HMI open status or maintenance inhibit status are active.

4.2.1.2 Closed status

HMI close status is active if Open limit switch is not active and Closed limit switch is active.

Internal close status is active if HMI close status or maintenance inhibit status are active.

4.2.2 Discrepancy status

Discrepancy status is active if both Open and Close limit switches are active and maintenance inhibit status is not active.

4.2.3 Operating in progress Status

Operating in progress Status is active if both Open and Close limit switches are not active.

4.2.4 Input fault status

To report a hardware fault related to an associated DI card (field inputs).

5. Representation and animation description (HMI)

5.1 Events and values to be recorded

5.1.1 Events

- Maintenance inhibit command
- Operating in progress status
- Discrepancy status
- Input fault status.

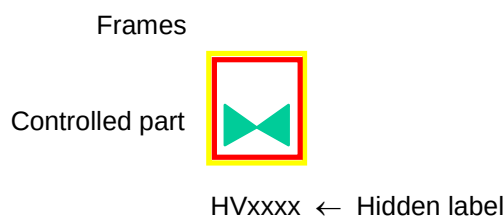
5.2 Alarm management

Alarm Description	Priority
Operating in progress status	Level 1
Discrepancy status	Level 1
Input fault status	Level 1

5.3 Control display

The descriptions below give examples of valve representation animations. However, they may be amended dependant on the DCS features.

5.3.1 HV (manual valve representation)



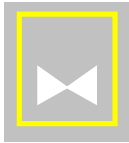
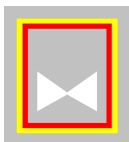
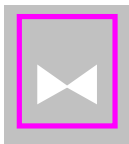
5.3.2 Miscellaneous

- HVxxxx instrument label appears on operator request (soft key)
- HVxxxx instrument label is used as target area for maintenance inhibit command.

5.3.3 Animation of the symbol (controlled part)

Display description	Display	Symbol
Valve closed or Communication or system fault		White
Valve operating in progress (after valve closed status) prior to acknowledgement		Fluid flashing
Valve open		Fluid
Valve discrepancy or operating in progress (after valve open status) prior to acknowledgement		Red flashing
Valve discrepancy after acknowledgement or (both limit switches have the same status and maintenance inhibit active)		Red

5.3.4 Animation of the Frames

Display description	Display	Frames
Normal status		
Maintenance inhibit		External frame: Yellow
Input fault (and maintenance inhibit)		Internal frame: Red flashing before acknowledgement Red steady after acknowledgement
Communication or system fault		External frame: Magenta

The events which drive these frame displays may not be mutually exclusive. Therefore, the precedence on the display, from most to least important, shall be: magenta, white, blue, yellow.