



Exploration & Production

GENERAL SPECIFICATION

INSTRUMENTATION

GS INS 169

**Duty / Back-up / Stand-by
standard function
- D / B / S -**

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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 INS 150**, Design Methods for System Configuration Standard Functions.

This Standard Function is interlocked with :

- lower level Standards :
 - P.U. (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 "

2. Reference documents

The reference documents listed below form an integral part of this General Specification. Unless otherwise stipulated, the applicable version of these documents, including relevant appendices and supplements, is the latest revision published at the EFFECTIVE DATE of the CONTRACT.

Standards

Reference	Title
Not applicable	

Professional Documents

Reference	Title
Not applicable	

Regulations

Reference	Title
Not applicable	

Codes

Reference	Title
Not applicable	

Other documents

Reference	Title
Not applicable	

Total General Specifications

Reference	Title
GS INS 150	Design Method for System Configuration Standard Functions

3. General description of functions

3.1 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,...)
- Higher level control interface (number of required pumps, standalone/cascade mode)
- Operator commands interface (Start/Stop command, number of required pumps, pumps priority)

3.2 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

4. Interface description

4.1 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)				

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

5. Detailed description of functions

5.1 Modes and commands

5.1.1 Specific description

5.1.1.1 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.

5.1.1.2 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.

5.1.1.3 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

5.1.1.4 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

5.1.1.5 Priority selection of pumps

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

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 :

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

5.1.1.6 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).

5.1.1.7 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

5.2 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.

5.2.1 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)

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.

5.2.2 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

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)

5.3 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.

5.3.1 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 :

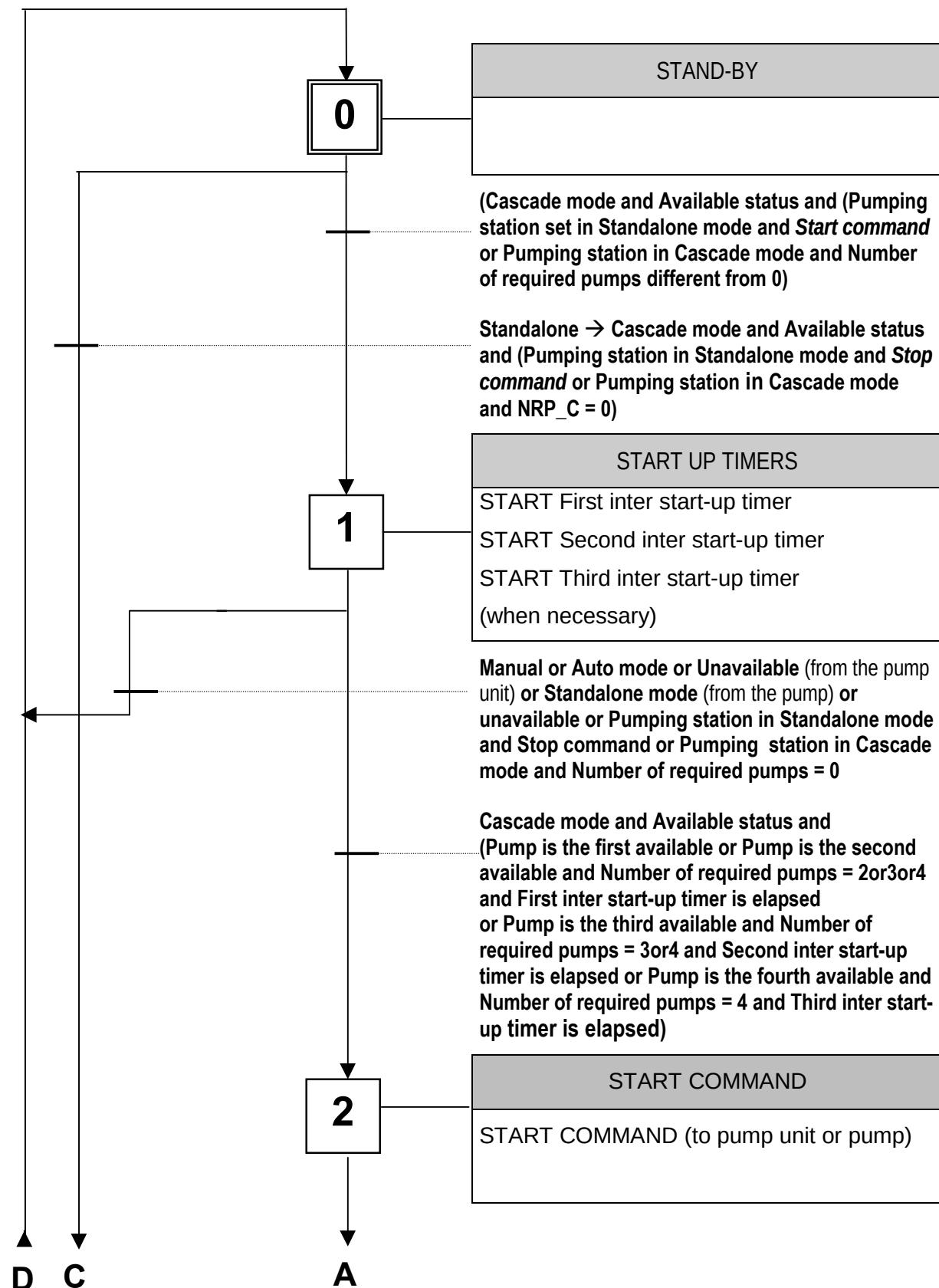
Time before stopping a pump after a pump start-up, related to pump change over

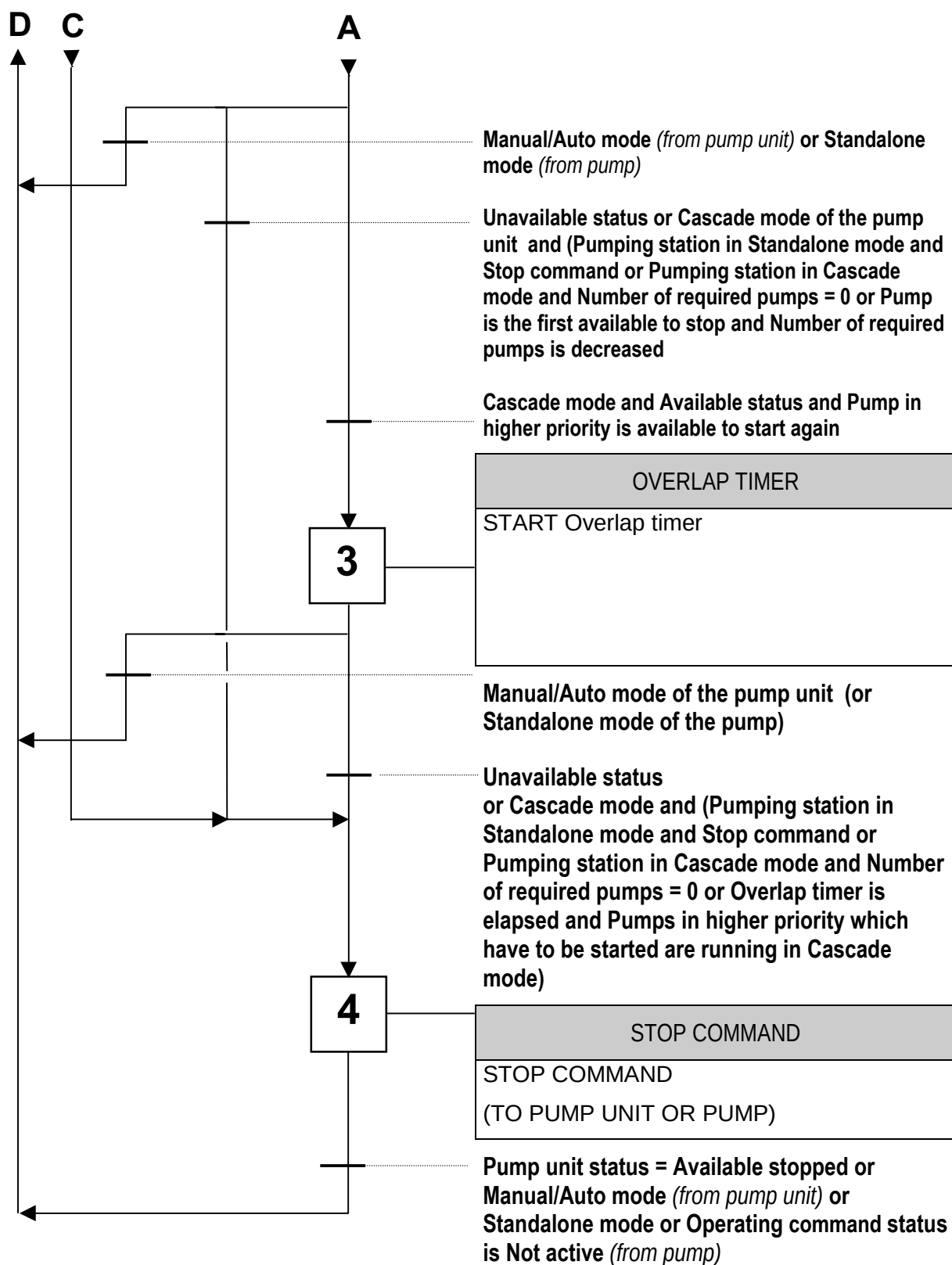
5.3.2 Associated variables

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

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

5.3.3 General chart of a pump unit





6. Tuning parameters and variables

6.1 2 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

6.2 3 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

6.3 4 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

7. Representation and animation description (HMI)

7.1 Events and values to be recorded

7.1.1 Events

Start/Stop command (operator)

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

7.1.2 Values

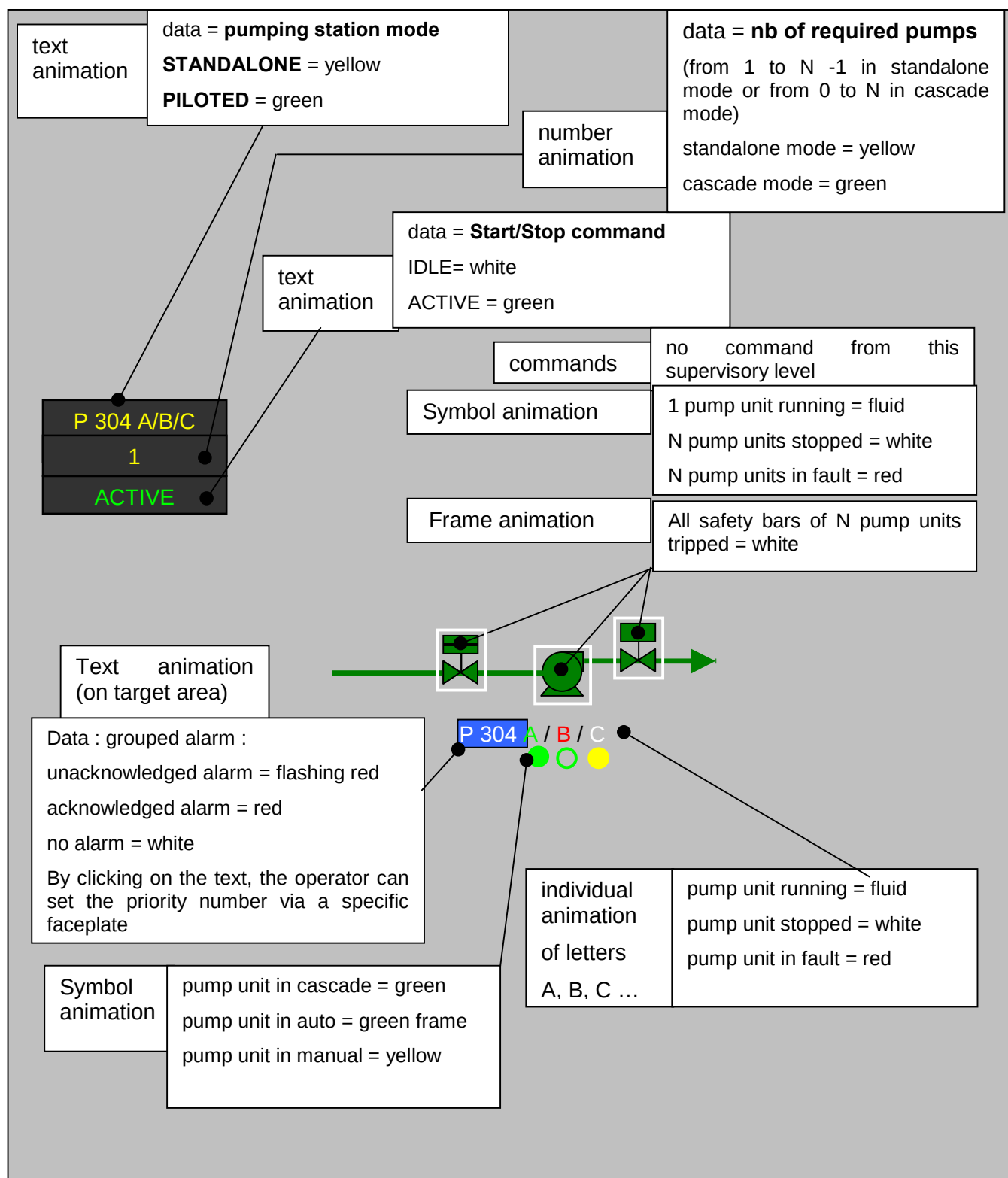
Number of required pumps (in Standalone mode only)

Priority selection

7.2 Process control display

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

7.2.1 Supervisory level display



7.2.1.1 Symbol animations of Pumping station

7.2.1.1.1 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)

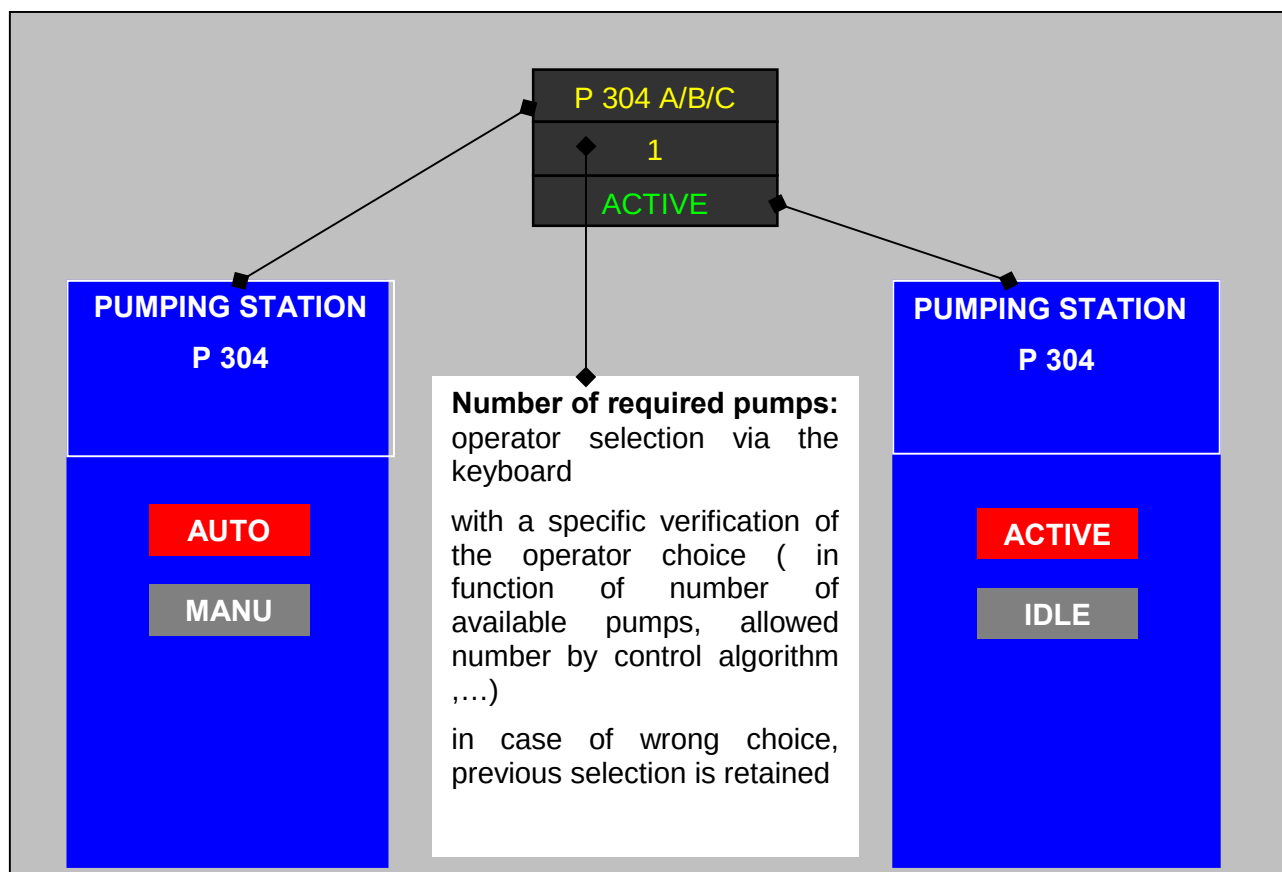
7.2.1.1.2 Safety trip

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

7.2.1.1.3 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.

7.2.1.2 Commands of the Pumping station



Auto/Manual command concerns the higher level automatic control (as defined per §3.2).

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.

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

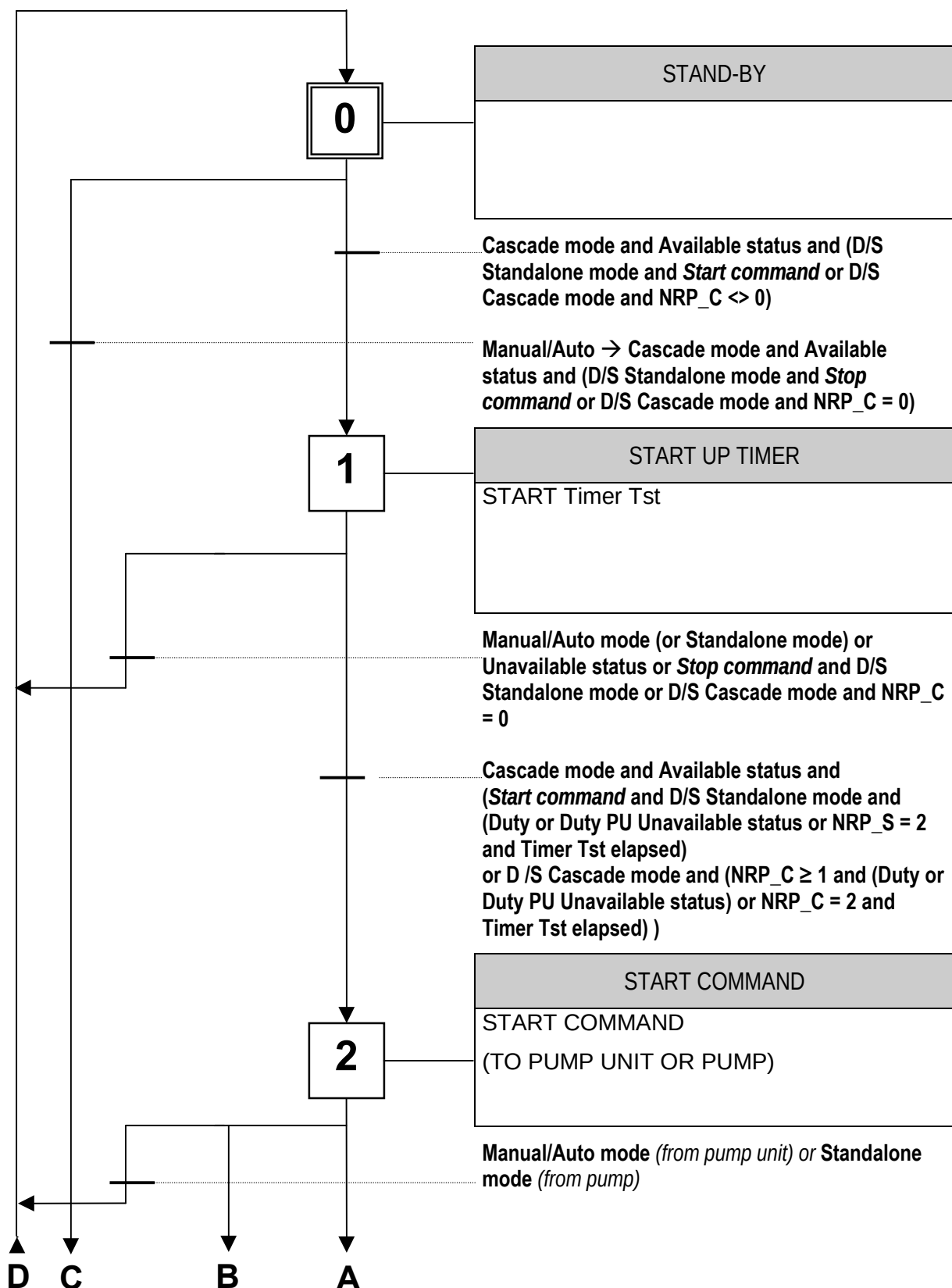
P 304 A	●	3
P 304 B	○	1
P 304 C	●	2

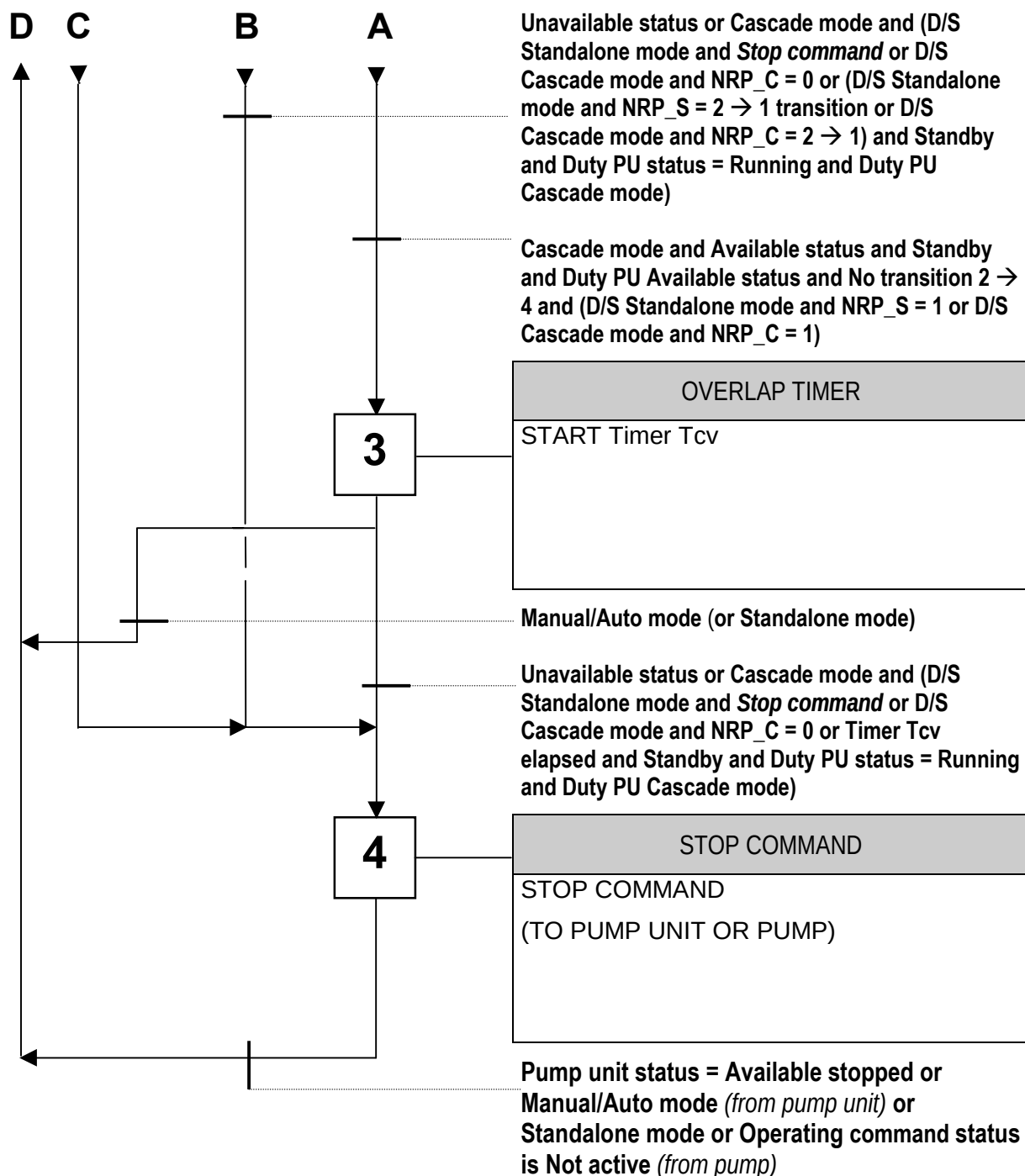
The animation is the same as described above regarding status of each pump unit .

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

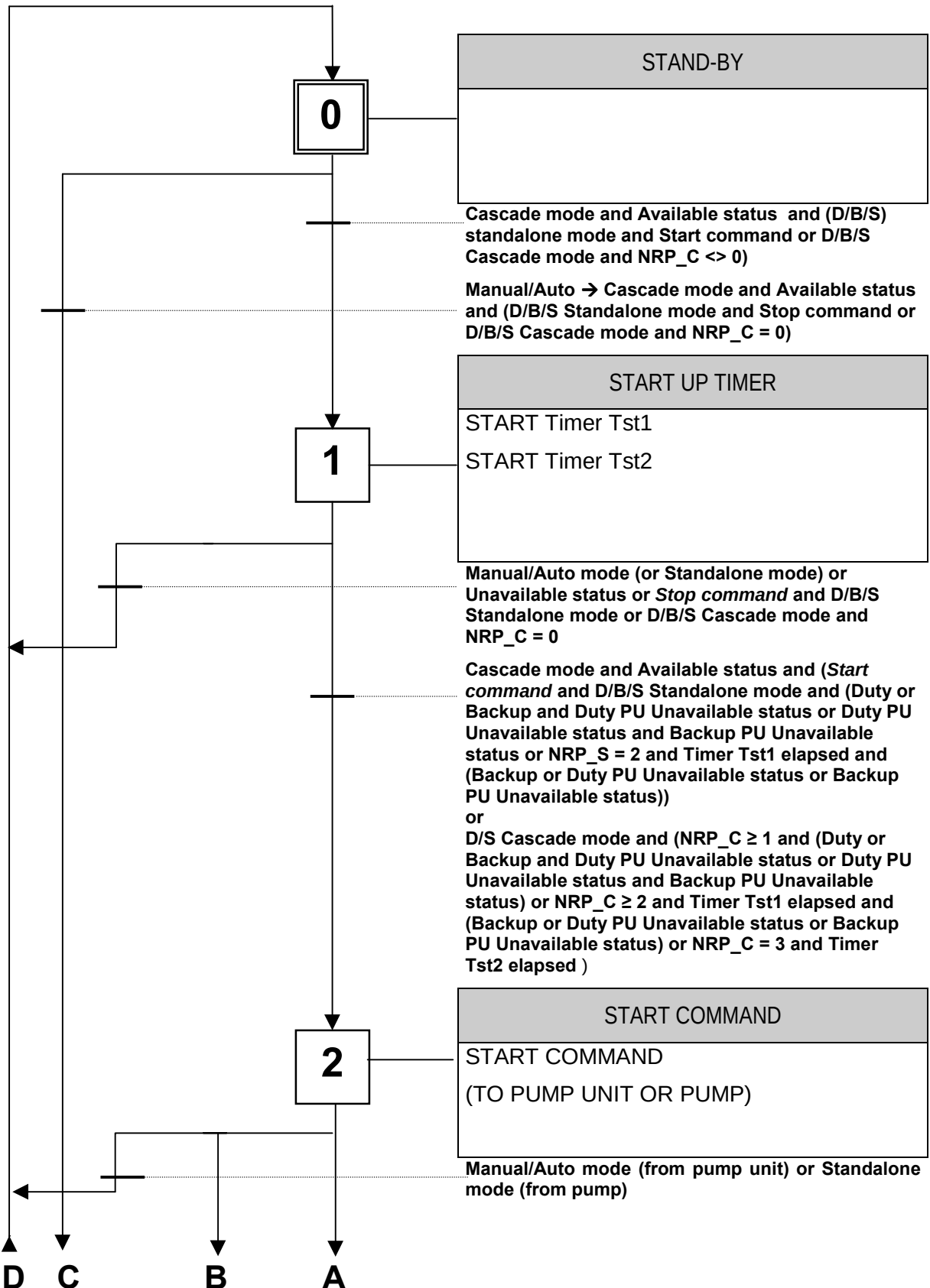
8. Detailed charts

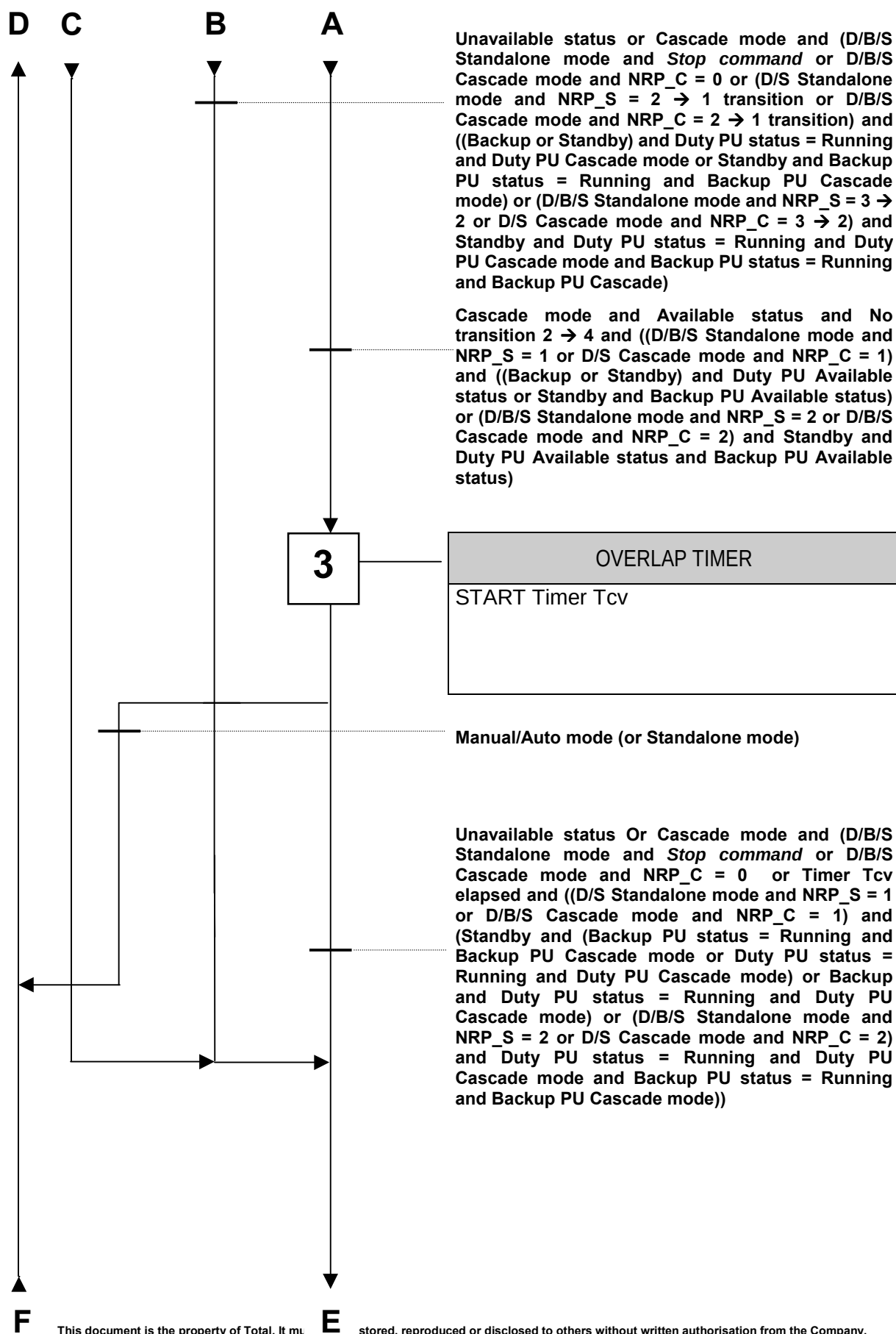
8.1 2 pump units : Duty / Stand-by Standard (D/S)

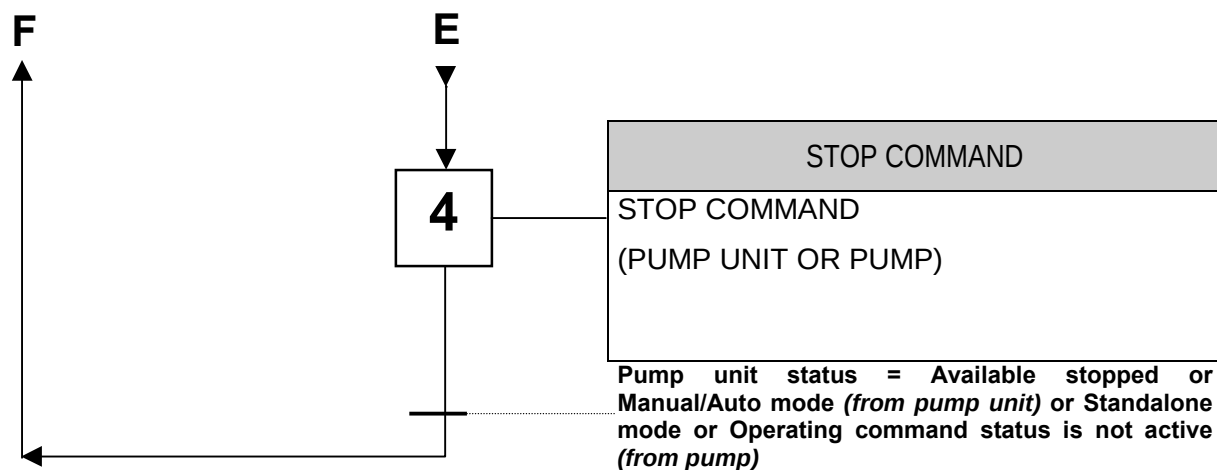




8.2 3 pump units : Duty / Back-up / Stand-by Standard (D/B/S)







8.3 4 pump units: Duty / Back-up 1/ Back-up 2 / Stand-by Standard (D/B1/B2/S)

8.3.1.1 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

SPAvSt : Standby PU Available status

DPSt : Duty PU status

B1PSt : Backup1 PU status

B2PSt : Backup2 PU status

SPSt : Standby PU status



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

