

GENERAL SPECIFICATION

INSTRUMENTATION

GS EP INS 150

**Design method for system configuration -
Standard functions**

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General Specification		GS EP INS 150
Design method for system configuration - Standard functions		
Rev.: 07	Effective date: 11/2012	Page: 2 of 12

Contents

1. Scope	3
2. Reference documents.....	3
3. Glossary.....	4
4. Definitions.....	4
4.1 Standard Function.....	4
4.2 Modes and Controls.....	6
5. Main Commands from HMI and Controls	7
5.1 Valves Commands.....	7
5.2 Motor Interfaces.....	7
5.3 Packages control	7
6. Access levels.....	8
7. Alarm and event management	8
7.1 Alarm and event levels.....	8
7.2 Alarm acknowledgement management	8
7.3 Events and values.....	9
8. General principles	9
8.1 Discrepancy	9
8.2 Fault status	10
8.3 Redundant analogue inputs (RAI Standard Function)	10
8.4 Inhibit and Input enable/disable.....	10
9. List of Standard Functions.....	11

General Specification		GS EP INS 150
Design method for system configuration - Standard functions		
Rev.: 07	Effective date: 11/2012	Page: 3 of 12

1. Scope

The purpose of this document is to define the Design Methodology for Control and Safety System Configuration Standard Functions. The principle of this methodology is the development of Standard Functions which are re-usable within a hierarchical structure.

These Standard Functions are key requirements for the development of the Functional Analysis as defined in [GS EP INS 131](#).

These Standard Functions shall define the operating and control requirements of equipment in both normal and degraded conditions, along with its operator interface definition.

A set of Standard Functions Specifications, listed in § 9, has been prepared and detailed within the [GS EP INS 196](#), [GS EP INS 197](#) and [GS EP INS 198](#), based on the general principles defined in this document. It is believed that these Standard Functions cover the majority of cases. However, each project shall review its specific requirements and prepare supplementary Standard Functions as necessary. Company subsidiaries may use their own library of Standard Functions when available.

This specification requires that the methodology of using Standard Function when configuring instrument systems is maintained in all cases. These shall always be fully tested in accordance with Appendix 4 of the [GS EP INS 134](#), early in the software lifecycle to prove their operation meets the required functionality. This will therefore assist in reducing the overall configuration development time, while at the same time improving overall quality.

All Standard Functions shall be fully documented.

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	

General Specification		GS EP INS 150
Design method for system configuration - Standard functions		
Rev.: 07	Effective date: 11/2012	Page: 4 of 12

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 131	Standards Functions and Functional Analysis Development Requirements
GS EP INS 134	Design and supply of integrated control and safety system
GS EP INS 196	Input and Output Standard Functions
GS EP INS 197	Process Standard Functions
GS EP INS 198	Safety and Fire & Gas Standard Functions

3. Glossary

DCS	Distributed Control System
ESD	Emergency Shut-Down
FGS	Fire and Gas System
HMI	Human Machine Interface
ICSS	Integrated Control and Safety System
MCC	Motor Control Centre
PCS	Process Control System
PDS	Process Data Server
PSS	Process Safety System
UCP	Unit Control Panel (package)

4. Definitions

4.1 Standard Function

A Standard Function describes all logic and calculation functions that characterise either process equipment (transmitter or actuator), or control algorithm management (pressure/temperature compensated flow, totalized flow, duty/backup/standby, etc.).

These functions may be carried out by the Process Control System (PCS), the safety system (ESD system, PSS and FGS), or the package control panel (UCP).

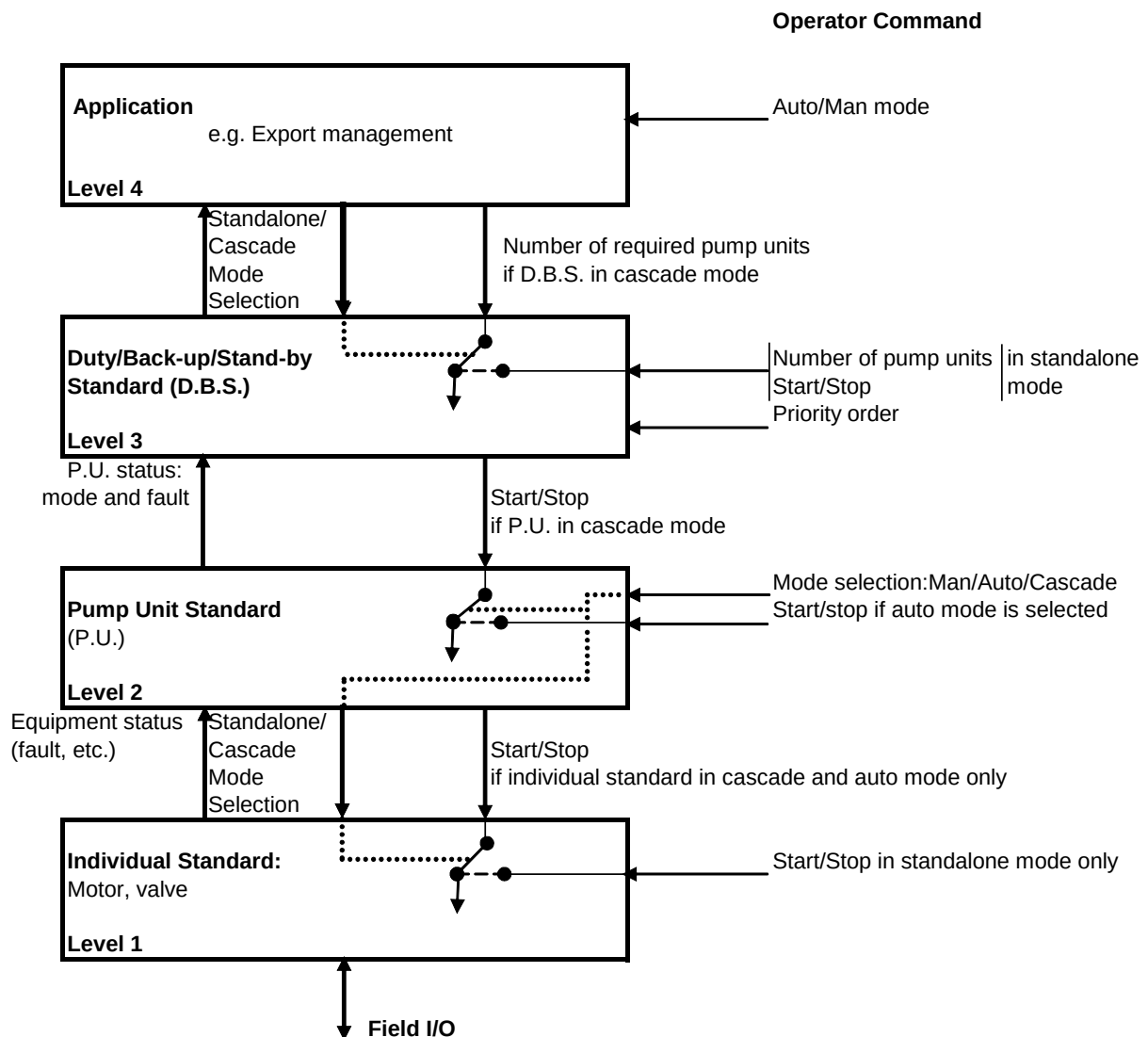
It also describes the associated Human Machine Interface (HMI) representation. Access to operator commands or specific faceplates (pop-up) are detailed in the different Standard Functions, but might be changed in function of Systems features.

All dynamic elements / objects shall be associated with a dedicated faceplate showing detailed information.

The following diagrams show how individual Standard Functions can be linked in a hierarchic way to create more complex functions.

Data may be exchanged in both ways between consecutive levels.

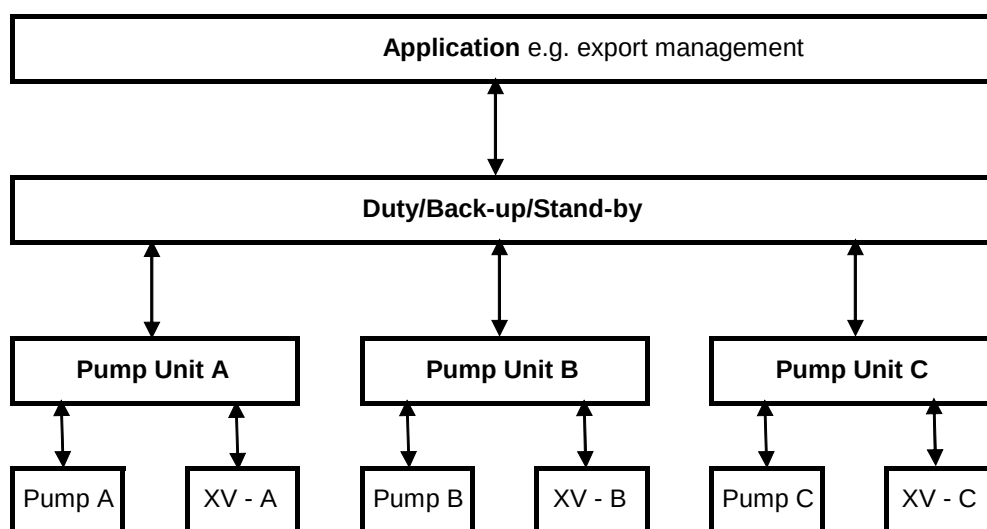
Example of Standard arrangement



To simplify the representation, this arrangement shows one Pump Unit and one individual Standard Function only.

In principle, as many individual Standard Functions as primary elements (e.g. pump (motor), upstream and downstream valves) may be connected to each Pump Unit Standard Function.

Likewise, as many Pump Unit Standard Functions as pump runs may be connected to Duty/Back-up/Stand-by Standard Function.



4.2 Modes and Controls

Two different modes may be implemented within each Standard Function:

- Auto/Man
- Standalone/Cascade.

When it exists, Auto/Man mode is selected by the operator, whereas Standalone/Cascade mode of a Standard Function at level N may be either forced by the Standard Function at level N+1, or selected by the operator.

Standalone/Cascade mode determines whether the corresponding Standard Function runs on its own or is interlocked with a higher level Standard Function.

In order to avoid process upsets during transitions (auto/man, standalone/cascade, etc.), DCS status and commands will be systematically tracked and aligned to those currently present, except if specified differently within the functional analysis.

Consider the example shown above with three pump runs (A, B and C):

- When the operator switches the Pump Unit A to manual mode, the different individual Standard Function will run in standalone mode, which authorises the operator's command (start/stop of the pump, open/close of the valve, etc.). Likewise the operator can not remotely operate any equipment (mainly valves and motors) when the cascade mode is active.
- At the same time, if both Pump Units B and C are set to cascade mode, they will be operated by commands issued from the Duty/Back-up/Stand-by Standard Function. The corresponding valves and motors will be operated without any operator intervention.

General Specification		GS EP INS 150
Design method for system configuration - Standard functions		
Rev.: 07	Effective date: 11/2012	Page: 7 of 12

5. Main Commands from HMI and Controls

Operator commands such as AUTO/MAN, START/STOP, OPEN/CLOSE, SELECTION, SETPOINT, OUTPUT VALUE, etc., are available at the HMI.

However, they may be overridden by process control or safety control. Each Standard Function description defines this possibility.

5.1 Valves Commands

The valve control panels shall comply with **GS EP INS 137** functional requirements.

In addition, the project Standard Functions will have to comply with project specifications requirements.

5.2 Motor Interfaces

The motors Standard Functions shall enable the controls and monitoring as below:

	Start/Stop command	Safety trip command	Status feedback	Unavailable
Low voltage	Yes	Yes	Yes	Yes
High voltage	Yes	Yes	Yes	Yes

Details relative to signals types are given within individual Standard Functions.

Usually electrical interface is achieved through hardwired links. But if cost effective, smart high and low switchboards may be selected. In this alternative, all data and commands will be exchanged via digital links, except safety trip commands which shall always be hardwired.

Tracking between Power Distribution Control System, handling load shedding function, and DCS may be required to avoid discrepancies.

5.3 Packages control

Unless specified differently within the project specifications, a LOCAL/REMOTE selection is available from the DCS HMI for each package.

Packages operated in local mode are still monitored from the DCS.

If the DCS and the package are connected via a digital link, this command will be automatically switched to LOCAL mode in case of link failure.

This link shall be monitored by a watch-dog system in both DCS and package control panel.

When switching from LOCAL to REMOTE mode, the DCS data will be re-aligned on the package states.

General Specification		GS EP INS 150
Design method for system configuration - Standard functions		
Rev.: 07	Effective date: 11/2012	Page: 8 of 12

6. Access levels

Five access levels from MMI are identified:

- **Visitor:** no accessible command
- **Operator:** normal process control
- **Maintenance:** first level of intervention
- **Method:** process parameters modifications
- **Engineer:** all system modifications including system configuration modifications by using the Engineering software tool.

If not requested by the application, the method level may not be implemented.

Levels of access to the different functions are defined individually in each Standard Function.

7. Alarm and event management

7.1 Alarm and event levels

Alarms described hereafter are those associated with the process. Standard Function system alarms and status such as redundancy failure, I/O module failure, system, etc., have their own system management.

Alarms and events are arranged according to four levels. These priority levels are defined according to the source of the alarm and its degree of urgency:

- **Level 0:** indicates that this event shall be only logged on the DCS with no alarm
- **Level 1:** indicates that this event is alarm linked to the process control and consequently issued by the Process Control System (PCS) or packages control panels
- **Level 2:** indicates that this event is alarm linked to the process safety and consequently issued by the Process Safety System (PSS) or packages control panels
- **Level 3:** indicates that this event is alarm linked to the Emergency Safety functions and consequently issued by the Safety Shutdown System (ESD SYSTEM) or the Fire and Gas Systems (main FGS or package FGS in case of turbo-generators for instance).

The level is specified individually for each alarm within each Standard Function.

All alarm information shall be time stamped and recorded.

They shall be available to the operator either in chronological order of occurrence, priority level or according to other criteria defined through by the HMI.

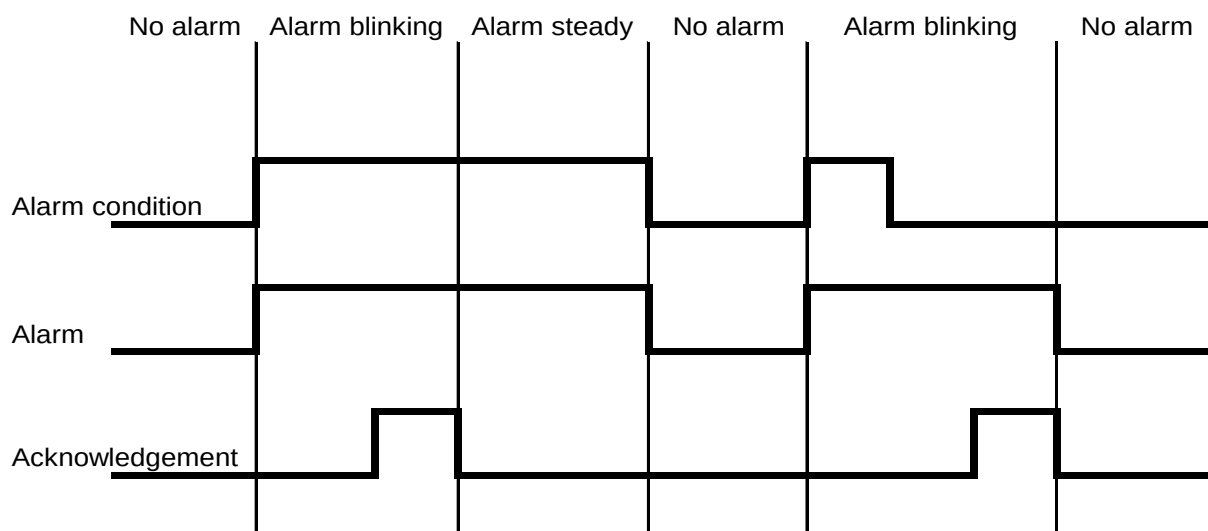
These alarm lists shall be printed upon the operator request. No automatic alarm printing is required.

7.2 Alarm acknowledgement management

Each alarm remains active, until it is acknowledged and the alarm condition has disappeared.

It applies to both display and automatic control. Each alarm operates as shown in the diagram below.

General Specification		GS EP INS 150
Design method for system configuration - Standard functions		
Rev.: 07	Effective date: 11/2012	Page: 9 of 12



Acknowledgement on a process view leads to the individual acknowledgement of all active alarms on the same process view.

Moreover the alarm acknowledgement leads to the acknowledgement of the same alarm on all views and top header where the alarm is present.

Generally no acknowledgement of alarm is possible from alarm list, except when in maintenance access.

Any automatic alarm priority level change or masking shall be as defined within the specific project's functional analysis: e.g. a PALL alarm at pump outlet shall be active only if the pump is running. In this case, the start-up inhibition will be activated by the pump restart (refer to [GS EP INS 134](#) - Appendix 2).

7.3 Events and values

Events and values to be recorded are defined individually within each Standard Function.

8. General principles

8.1 Discrepancy

Motor: The detection of a discrepancy between the command and status leads to lock automatically the "Start/Stop" command on "Stop".

Valve: In general, the detection of a discrepancy between the command and status of the valve will not affect the command state which remains unchanged.

General Specification		GS EP INS 150
Design method for system configuration - Standard functions		
Rev.: 07	Effective date: 11/2012	Page: 10 of 12

8.2 Fault status

8.2.1 Definition

Fault status of a signal corresponds to:

- A fault loop: transmitter or loop itself
- A faulty I/O module.

Consequences of fault status are specified individually within each Standard Function.

8.3 Redundant analogue inputs (RAI Standard Function)

This Standard Function applies where process and safety transmitters measure the same process parameter (e.g. pressure, temperature, level with process tappings at the same elevation) and have the same scale.

It is designed:

- To detect a discrepancy between the process and the safety measurements and issue alarm, whatever the type of PCS, PSS and ESD controllers
- To increase the control and safety functions availability avoiding any spurious trip due to faulty transmitter or faulty loop. For that reason, this function has to be considered as a downgraded mode which cannot be used permanently. The PCS measurement will be used in PSS or vice versa:
 - Either automatically upon fault detection of one of the two transmitters
 - Or manually upon operator command.

Specific HMI representation and report are described within the corresponding Standard Function.

This manual or automatic switching function shall be implemented only if PSS and PCS are based on **the same type of controllers** with communication between both systems based on a system built-in feature providing direct, high speed, redundant and reliable communication.

This Standard Function will be considered with AI and AIS Standards Functions:

- The switching function shall be implemented in both PCS and PSS
- The discrepancy detection will be implemented in the PCS.

8.4 Inhibit and Input enable/disable

Refer to the [GS EP INS 134](#) - Appendix 2 - for detailed description.

9. List of Standard Functions

This list has not to be considered as exhaustive; refer to the scope of this document (§ 1).

List of standard functions				Sub-functions			
	Name	Option	Description	PCS	PSS	ESD	FGS
GS EP INS 196	DI		Digital input without alarm	X			
		_AL	Digital input with alarm	X	X	X	X
GS EP INS 196	DI-LM		Line monitored digital input		X	X	X
GS EP INS 196	AI		Process analogue input	X			
GS EP INS 196	AIS		Safety analogue input		X	X	X
GS EP INS 196	RAI		Redundant analogue inputs	X	X		
GS EP INS 196	DO	_D	Digital output logic (De energise to trip)	X	X	X	X
		_E	Digital output logic (Energise to trip)	X	X	X	X
GS EP INS 196	HIC		Analogue output command	X			
GS EP INS 197	PID		PID controller	X			
		_MR	Cascaded PID controllers (master)	X			
		_SR	Cascaded PID controllers (slave)	X			
		_SPR	Split range PID controller	X			
		_RD	PID controller with redundant valves	X			
		_ON/OFF	PID controller with flip/flop analogue output	X			
		_1DC	PID Controller with a digital output	X			
GS EP INS 197	GCF		Pressure/temperature compensated flow (linear)	X			
		_SQ	Pressure/temperature compensated flow (square root extraction)	X			
GS EP INS 197	TOT		Total flow (daily)	X			
		_AV	Average flow (daily)	X			
GS EP INS 197	MOT		Low voltage motor and High voltage motor with fuse contactor ($P \leq 1500$ kW)	X			
		_BK	High voltage motor with circuit breaker ($P > 1500$ kW)	X			
		_ST	Status monitoring only	X			
GS EP INS 197	PU	_CENT	Centrifugal pump unit	X			
		_CENT_1SDV	Centrifugal pump unit with SDV	X			
		_CENT_1XV	Centrifugal pump unit with discharge valve (XV)	X			

**Design method for system configuration -
Standard functions**

Rev.: 07

Effective date: 11/2012

Page: 12 of 12

List of standard functions				Sub-functions			
	Name	Option	Description	PCS	PSS	ESD	FGS
		_CENT_2XV	Centrifugal pump unit with suction and discharge valves (XV)	X			
		_RECIP	Reciprocating pump unit	X			
GS EP INS 197	D/B /S		Duty/backup/standby	X			
GS EP INS 197	XV		XV (ON-OFF process valve) with 2 limit switches	X			
		_2B	XV with 2 digital outputs and 2 limit switches	X			
GS EP INS 197	HV		Manual valve with 2 limit switches	X			
GS EP INS 198	SDV		Safety control SDV with 2 limit switches		X		
GS EP INS 198	ESDV		ESDV(emergency shutdown valve) with 2 limit switches			X	
GS EP INS 198	BDV		BDV (blow down valve) with 2 limit switches			X	
GS EP INS 198	SBAR		Safety bar		X	X	X
GS EP INS 198	GD		Point gas detection				X
GS EP INS 198	GDB		Infra-red beam gas detector				X
GS EP INS 198	RD		Flame detector				X
GS EP INS 198	RDH/RDIS		Heat/Smoke detector				X
GS EP INS 198	DELUGE		Deluge system (without foam)				X
		_F	with foam				X
		_Water curtain	Water curtain system				X
GS EP INS 198	fire Ext.		Fire extinguishing system logic				X
GS EP INS 198	2ooN		Two out of N voting logic		X	X	X
GS EP INS 198	Fire damper		Gas tight & Fire damper				X