

GENERAL SPECIFICATION

INSTRUMENTATION

GS EP INS 198

Safety and Fire & Gas Standard Functions

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1. Scope

The purpose of this document is to define a set of Standard Functions for most common inputs and outputs.

It includes the following functions with some options:

- SDV
- ESDV
- BDV
- Safety Bar
- Point gas detector
- Beam gas detector
- Flame detector
- Heat/smoke detector
- Deluge
- Fire extinguishing
- Voting logic
- Fire damper.

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	

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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 137	On/off valve control panels and actuators functional and construction requirements
GS EP INS 150	Design method for system configuration - Standard functions
GS EP INS 196	Input and Output Standard Functions
GS EP SAF 312	Fire and Gas detection systems

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Chapter 1 Safety Shut-Down Valve Standard function - SDV -

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1. Scope

The purpose of this document is to define the Standard Function for a Shut-Down Valve, operated by the PSS.

When safety and control logic charts require PCS to operate SDV, PCS digital output will be provided to operate a second solenoid valve.

In order to assist in understanding, this document should be read in conjunction with **GS EP INS 150**, Design Method for System Configuration Standard Functions.

This Standard Function is a fundamental building block, generally linked to the Safety Bar Standard Function.

This Standard Function proposes solenoid valve test facility, as per project requirements.

Partial stroking facility, if required by project specifications, does not affect this Standard Function, contrary to the solenoid valve test, when achieved by means of additional devices mounted inside the control panels.

Another solution, based on smart devices with enhanced diagnostic capabilities, is not described here since depending on the selected devices; however test status and result will be transmitted to PCS for monitoring and recording purposes.

2. General description of functions

2.1 SDV operating description

As per project specifications and **GS EP INS 137**, when safety trip is no longer active, the Control Room operator may initiate either an Open command or an Open Authorisation command when a local action is still necessary to open the valve.

Likewise Close operator command may also be requested as per project specifications.

2.2 List of main functions

- Handling of field inputs/outputs with status and discrepancy detection
- Interfacing with higher level Standard Function (e.g. Safety Bar)
- Operator's commands
 - Open authorisation or open command (as per project requirements)
 - Inhibit
 - Close command (as per project requirements)
 - Close command when in solenoid valve test mode (as per project requirements).

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Chapter 1

3. Interfaces description

3.1 General description

INPUTS						OUTPUTS		
Field	HMI	Internal				Internal	HMI	Field
			<u>Safety Bar Standard Function</u>					
			Standard function SDV					
		● Safety trip			Status (open/closed)	●		
					Discrepancy Status	●	●	
	●	Open authorisation command OR Open command			Operating command Status		●	
					Status (open/closed)		●	
					Discrepancy Status		Alm	
	●	Close command (if required)			Operation in progress Status		●	
					Fault status		Alm	
	●	Close command (in test mode) (opt)			Maintenance inhibit status		●	
					Solenoid valve test mode status (opt)		●	
	●	Completed test command (opt)			Solenoid valve Test completed status (opt)		●	
	●	Maintenance inhibit command			Operation counter (opt)		●	
●		Solenoid valve local by-pass (opt)			Solenoid valve operating command (DO)			●
●		Open limit switch (DI)						
●		Closed limit switch (DI)						
					Opt = Option Alm = Alarm			

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3.2 Specific description of field interfaces

Corresponding field interfaces are:

- SY (DO): solenoid valve operating command: **0 = Close**
- SZH (DI): open limit switch: **1 = Open**
- SZL (DI): closed limit switch: **1 = Closed**

Option:

- SPSL (DI): solenoid valve local bypass: **0 = Active**

Special attention has to be paid when the SDV control panel is fitted with two solenoid valves, one operated by the PSS and the other by the PCS. Preference is given to handle discrepancy function within the PCS, which requires the hardwiring of the limit switches to the PCS and to transmit the PSS command status to the PCS (communication time will be taken into consideration).

4. Detailed description of functions

4.1 Operator's Commands and mode

4.1.1 Specific description

4.1.1.1 Open Authorisation or Open Command

Open Authorisation or Open command, as per project specifications, will be available to the operator from process control display when:

- Concerned safety trip is not active (relevant safety bar not tripped)
- and
- Operating command status = "Closed".

4.1.1.2 Close command

Likewise, Close command may be required. It will be available to the operator from process control display when Operating command status = "Open".

4.1.1.3 Maintenance inhibit

Available when in maintenance access level.

When the maintenance inhibit is active:

- Limit switches are no longer considered in 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 when maintenance inhibit command is active.

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4.1.1.4 Solenoid valve test

This test is designed to be used when the valve is in the open position. The local bypass of the solenoid valve will maintain the valve to its open position, no matter the status of the PSS solenoid command.

The safety function will always override the test function and trip the output to the closed position when necessary.

Specific display will indicate the test has been stopped for safety reasons, and the local operator shall switch back the by-pass to its normal operating mode, in order to allow the valve to move to its safety position.

When the local bypass of the solenoid valve (SPSL) is detected then the test mode is activated. The Close command is available to the operator when the test mode is active and the safety trip is not active.

Upon activation of the Close command by the operator, an adjustable timer (a few seconds) is launched; when elapsed, the Open command is restored and the test completed.

The local operator will then switch back the bypass to its normal position.

The Control Room operator will enter the completed test status for logging purpose as successful if the local operator has observed the solenoid valve being de-energised, else it will be logged as a failed test.

4.2 Status definition

4.2.1 Operating command status

Operating command status is set to:

- Open when
the concerned safety bar not tripped
and
open Authorisation or Open command or (Open test command and test mode) are active
- Close upon activation of
the associated safety trip
or
the Close test command and test mode
or
the Close operator command (as per project specifications).

4.2.2 Solenoid valve Operating command (DO)

Same as Operating command status.

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4.2.3 Open/Closed status

4.2.3.1 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.

4.2.3.2 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.

4.2.4 Discrepancy status

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

Discrepancy status is not active when:

- Internal Closed status is active
- or
- Operating command status = "Open" and Closed limit switch is active, as long as Closed limit switch has not moved (only when Open Authorisation command applies)
- or
- Internal Open status is active (only when Open command applies)
- or
- Operation in progress status is active
- or
- Maintenance inhibit status is active.

When in test mode and after an operator Close command, discrepancy will no longer be active.

4.2.5 Operation in progress Status

Active during "operation in progress" timer counts down.

"Operation in progress" timer is activated:

- Upon a status change of the Operating command status from open to close

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or

- Upon a change of the closed limit switch from active to inactive when operating command status = open authorisation, (only when Open Authorisation command applies)

or

- Upon a status change of the Operating command status from close to open, (only when Open command applies).

4.2.6 Fault status

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

4.2.7 Operation counter

Reports the number of changes of the operating command status (from close to open) when not due to solenoid valve test.

The counter reset command 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.

5. Tuning parameters and variables

Parameter	Access level
Test timer	Maintenance
"Operation in progress" timer pre-set value	Maintenance

6. Representation and animation description (HMI)

6.1 Events and values to be recorded

6.1.1 Events

- Maintenance inhibit command
- Test mode
- Completed test result
- Operating command Status
- Discrepancy Status
- Fault status.

6.1.2 Values

- Operation counter.

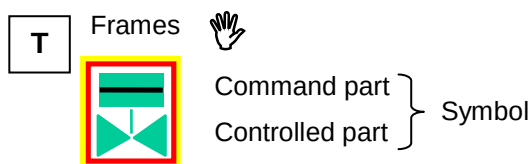
6.2 Alarm handling

Alarm Description	Priority
Discrepancy Status	Level 2
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.

6.3.1 SDV (Shutdown Valve) representation



SDV xxxx ← Hidden label

Symbol **T** is hidden

6.3.1.1 Miscellaneous

SDV xxxx instrument label and Blue Symbol **T** appears on operator request (soft key).

SDV xxxx instrument label is used as target area for maintenance inhibit command.

A “hand” symbol (full yellow) appears near valve when Open Authorisation (or open or Close) commands are available to the operator.

Blue Symbol **T** is used as target area for test commands and test status keyboard entry.

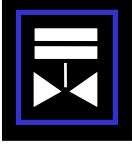
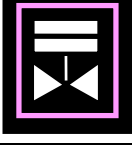
6.3.2 Animation of the symbol (command and controlled parts)

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



Valve in an undetermined position after a time delay

6.3.3 Animation of the frames

Display description	Display	Frames
Normal status		
Safety trip		External frame: White
Maintenance inhibit		External frame: Yellow
Solenoid valve test mode		External frame: Blue
Fault (and maintenance inhibition)		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.

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Chapter 2 Emergency Shut-Down Valve Standard function - ESDV -

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1. Scope

The purpose of this document is to define the Standard Function for Emergency Shut-Down Valve.

ESDV's are automatically closed by emergency safety logic and remotely opened in conjunction with local action. These valves shall never be controlled by the PCS.

This Standard Function is part of the ESD system configuration. However when the safety logic chart requires the PSS to operate an ESDV, then a PSS digital output will be provided to operate a second solenoid valve.

In order to assist in understanding, this document should be read in conjunction with **GS EP INS 150**, Design Method for System Configuration Standard Functions.

This Standard Function is a fundamental building block, linked to the Standard Function of the Safety Bar.

This Standard Function proposes different functional facilities, which may be combined as per project requirements for ESDV functions:

- Electrical local reset
- Solenoid valve test.

Partial stroking facility does not affect this Standard Function, contrary to the solenoid valve test, when achieved by means of additional devices mounted inside the control panels.

Another solution, based on smart devices with enhanced diagnostic capabilities, is not described here since depending on the selected devices; however test status and result will be transmitted to PCS for monitoring and recording purposes.

2. General description of functions

2.1 ESDV operating description

Activation of a local reset is requested so as to allow ESDV to be re-opened, provided safety condition is not tripped.

As per project specifications and **GS EP INS 137**, when safety trip is no longer active the Control Room operator initiates either an Open command or an Open Authorisation command when a local action is still necessary to open the valve.

Likewise a Close operator command may also be requested, as per project specifications.

2.2 List of main functions

- Handling of field inputs/outputs with status and discrepancy detection
- Interfacing with higher level Standard Functions (e.g. Safety Bar)
- Operator commands
 - Open authorisation or open command (as per project requirements)
 - Inhibit

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Chapter 2

- Close command (as per project requirements)
- Close command in test mode (as per project requirements).

3. Interfaces description

3.1 General description

[illegible]

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3.2 Specific description of field interfaces

Corresponding field interfaces are:

- ESY (DO): solenoid valve operating command: **0 = Close**
- ESZH (DI): open limit switch: **1 = Open**
- ESZL (DI): closed limit switch: **1 = Closed**
- ESHS2 (DI): local reset: **1 = Active (pulse)**

Option:

- ESPSL (DI): solenoid valve local bypass: **0 = Active**

Special attention has to be paid when the ESDV control panel is fitted with two solenoid valves, one operated by the ESD system and the other by the PSS. Preference is given to handle discrepancy function within the PSS, which requires the hardwiring of the limit switches to the PSS and to transmit the ESD system command status to the PSS (communication time will be taken into consideration).

4. Detailed description of functions

4.1 Operator's Commands and mode

4.1.1 Specific description

4.1.1.1 Open Authorisation or Open Command

Open Authorisation or Open command, as per project specifications, will be available to the operator on the process control display when:

- Concerned safety trip is not active (relevant safety bar not tripped)
and
- Operating command status = "Closed".

4.1.1.2 Close command

Likewise, a Close command may be required. It will be available to the operator on the process control display when Operating command status = "Open".

4.1.1.3 Maintenance inhibit

Available when in maintenance access level

When the maintenance inhibit is active:

- 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.

The maintenance inhibit status is active when the maintenance inhibit command is active.

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4.1.1.4 Solenoid valve test

This test is designed to be used when the valve is in the open position. The local bypass of the solenoid valve will maintain the valve to its open position, no matter the status of the ESD system solenoid command.

The safety function will always override the test function and trip the output to the closed position when necessary.

Specific display will indicate the test has been stopped for safety reasons, and the local operator shall switch back the by-pass to its normal operating mode, in order to allow the valve to move to its safety position.

When the local bypass of the solenoid valve (ESPSL) is detected then the test mode is activated. The Close command is available to the operator when the test mode is active and the safety trip is not active.

Upon activation of the Close command by the operator, an adjustable timer (a few seconds) is launched; when elapsed, the Open command is restored and the test completed.

The local operator will then switch back the bypass to its normal position.

The Control Room operator will enter the completed test status for logging purpose as successful if the local operator has observed the solenoid valve being de-energised, else it will be logged as a failed test.

4.2 Status definition

4.2.1 Local reset status

This status will be set upon detection of the pulse from local reset push-button and reset upon activation of the Close command when not in test mode.

4.2.2 Operating command status

Operating command status is set to:

- Open when
 - the concerned safety bar has not been tripped
 - and
 - local reset is active
 - and
 - open Authorisation or Open command or (Open test command and test mode) are active.
- Close upon activation of
 - the associated safety trip has been tripped
 - or
 - the Close test command and test mode
 - or
 - the Close operator command (as per project specifications).

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4.2.3 Solenoid valve Operating command (DO)

Same as Operating command status.

4.2.4 Open/Closed Status

4.2.4.1 Open status

HMI open status is active if the Open limit switch is active and the 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.

4.2.4.2 Closed status

HMI closed status is active if the Open limit switch is not active and the 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.

4.2.5 Discrepancy status

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

Discrepancy status is not active when:

- Internal Closed status is active
- or
- ((Operating command status = "Open" and Closed limit switch is active, as long as Closed limit switch has not moved (only when Open Authorisation command applies)
- or
- Internal Open status is active (when Opening command applies))
- or
- Operating in progress status is active
- or
- Maintenance inhibit status is active.

When in test mode and after a Close operator command, then the discrepancy will no longer be active.

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4.2.6 Operation in progress Status

Active during "operation in progress" timer counts down.

"Operation in progress" timer is activated:

- Upon a status change of the Operating command status from open to close
or
- (Upon a change of the closed limit switch from active to inactive when operating command status = open (when Open authorisation command applies)
or
- Upon a status change of the *Operating command status* from close to open (when Opening command applies)).

4.2.7 Fault status

It reports a hardware fault relating to an associated I/O card (field inputs/output).

4.2.8 Operation counter

It reports the number of changes of the operating command status (from close to open) when not due to solenoid valve test.

The counter reset command 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.

5. Tuning parameters and variables

Parameter	Access level
Test timer	Maintenance
"Operation in progress" timer pre-set value	Maintenance

6. Representation and animation description (HMI)

6.1 Events and values to be recorded

6.1.1 Events

- Maintenance inhibit command
- Local reset
- Test mode
- Completed test result
- Operating command Status

- Discrepancy Status
- Fault status.

6.1.2 Values

- Operation counter.

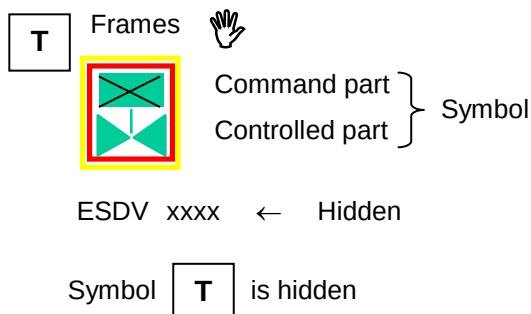
6.2 Alarm handling

Alarm Description	Priority
Discrepancy Status	Level 1
Fault Status	Level 3

6.3 Control display

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

6.3.1 ESDV (Emergency Shut Down Valve) representation



6.3.2 Miscellaneous

- ESDV xxxx instrument label and Blue Symbol [T] appears on operator request (soft key)
- ESDV xxxx instrument label is used as target area for the maintenance inhibit command
- A “hand” symbol (full yellow) appears near the valve when Open authorisation or Open or Close commands are available to the operator
- Blue Symbol [T] is used as a target area for the test command and test status entry.

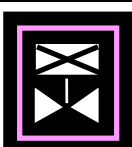
6.3.3 Animation of the symbol (command and controlled parts)

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



Valve in an undetermined position after a time delay

6.3.4 Animation of the frames

Display description	Display	Frames
Normal status		NA
Safety trip		External frame: White
Maintenance inhibit		External frame: Yellow
Solenoid valve Test mode		External frame: Blue
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.

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1. Scope

The purpose of this document is to define the Standard Function for a Blow Down Valve (BDV).

In order to assist in understanding, this document should be read in conjunction with **GS EP INS 150**, Design Method for System Configuration Standard Functions.

This Standard Function is a fundamental building block, linked to the Safety Bar Standard Function, part of the ESD system configuration.

This Standard Function proposes different functional facilities, which may be combined as per project requirements for BDV functions:

- Electrical local reset
- Solenoid valve test

achieved through additional devices mounted inside the control panel.

Another solution, based on smart devices with enhanced diagnostic capabilities, is not described here since depending on the selected devices; however test status and result will be transmitted to PCS for monitoring and recording.

2. General description of functions

2.1 BDV operating description

As per the project safety concept, emergency depressurisation will be provided upon automatic or manual initiation interlocked with "permissive to blowdown" signal, which means in both cases the BDV open command will be activated from internal ESD system variable (safety trip). Individual open command is not available to the operator.

Reset function will also be provided and initiated either automatically upon reset of the corresponding safety bar, either manually from the control room or from the BDV control panel.

Likewise, emergency depressurisation interrupt may be implemented as per project safety concept. This interrupt may be achieved either automatically through the reset of the associated safety bar or manually by means of a push-button located in Control room.

2.2 List of main functions

- Handling of field inputs/outputs with status and discrepancy detection
- Interfacing with higher level Standard Function (e.g. Safety Bar)
- Operator's commands
 - Inhibit
 - Solenoid valve test (as per project requirements).

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Chapter 3

2.3 Interfaces description

2.3.1 General description

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2.3.2 Specific description of field interfaces

Corresponding field interfaces are:

- BY (DO): solenoid valve operating command: **1 = Close**
- BZH (DI): open limit switch: **1 = Open**
- BZL (DI): closed limit switch: **1 = Closed**

Options:

- BPSL (DI): solenoid valve local bypass: **0 = Active**
- BHS2 (DI): reset (from local panel or Control room): **1 = Active (pulse)**
- BHS3 (DI): interrupt push-button in Control Room: **1 = Active (pulse)**

This interrupt push-button will be line monitored and its status issued from the DI_LM Standard Function.

When project specifications require facility to remove the depressurisation interrupt, after its activation, switch will be used instead of push-button to prevent confusion.

3. Detailed description of functions

3.1 Operator's Commands and mode

3.1.1 Specific description

3.1.1.1 Maintenance inhibit

Available when in maintenance access level

When the maintenance inhibit is active:

- 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 when maintenance inhibit command is active.

3.1.1.2 Solenoid valve test

This test is designed to be used when the valve is in the closed position. The local bypass of the solenoid valve will maintain the valve to its close position, no matter the status of the ESD system solenoid command.

The safety function will always override the test function and trip the output to the open position when necessary.

Specific display will indicate the test has been stopped for safety reasons, and the local operator shall switch back the by-pass to its normal operating mode, in order to allow the valve to move to its safety position.

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When the local bypass of the solenoid valve (BPSL) is detected then the test mode is activated. The Open command is available to the operator when the test mode is active and the safety trip is not active.

Upon activation of the Open command by the operator, an adjustable timer (a few seconds) is launched; when elapsed, the Closed command is restored and the test completed.

The local operator will then switch back the bypass to its normal position.

The Control Room operator will enter the completed test status for logging purpose as successful if the local operator has observed the solenoid valve being de-energised, else it will be logged as a failed test.

3.2 Status definition

3.2.1 Reset status

This status will be set upon detection of the pulse from reset push-button and reset upon activation of the Open command when not in Test mode.

3.2.2 Interrupt status

This status will be set upon pulse detection of the line monitored push-button, through DI_LM Standard Function, and reset upon de-activation of the safety trip.

3.2.3 Operating command status

Operating command status is set to:

- Close when
interrupt status is active
or
de-activation of the safety trip and reset status (if applicable) are active
or
close test command and test mode are active.
- Open upon activation of the safety trip or the open test command when in test mode.

3.2.4 Solenoid valve Operating command (DO)

Same as Operating command status.

3.2.5 Open/Closed Status

3.2.5.1 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)

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or

- (Operating command status = "Open") and maintenance inhibit status is active.

3.2.5.2 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.

3.2.6 Discrepancy status

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

Discrepancy status is not active when:

- Internal Closed/Open status are active

or

- Operating in progress status is active

or

- Maintenance inhibit status is active.

When in test mode and after an operator Open command, discrepancy will no longer be active.

3.2.7 Operation in progress status

Active during "operation in progress" timer counts down.

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

3.2.8 Fault status

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

3.2.9 Operation counter

Reports the number of changes of the operating command status changes (from close to open) when not due to solenoid valve test.

The counter reset command 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.

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4. Tuning parameters and variables

Parameters	Access level
Test timer	Maintenance
"Operation in progress" timer pre-set value	Maintenance

5. Representation and animation description (HMI)

5.1 Events and values to be recorded

5.1.1 Events

- Maintenance inhibit command
- Test mode
- Completed test result
- Operating command Status
- Interrupt push-button switch
- Reset status
- Discrepancy Status
- Fault status.

5.1.2 Values

- Operation counter.

5.2 Alarm handling

Alarm Description	Priority
Discrepancy Status	Level 1
Fault Status	Level 3

5.3 Control display

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

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5.3.1 BDV (Blow Down Valve) representation



BDV xxxx ← Hidden label

Symbol  is hidden

5.3.2 Miscellaneous

BDVxxxx instrument label and Blue Symbol  appear on operator request (soft key).

BDVxxxx instrument label is used as target area for maintenance inhibit command.

A “hand” symbol (full yellow) appears near valve when Open or Close commands are available to the operator (commands as per project specifications).

Blue Symbol  is used as target area for Test command and test status entry.

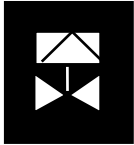
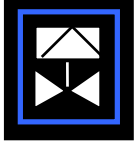
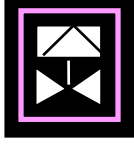
5.3.3 Animation of the symbol (command and controlled parts)

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



Valve in an undetermined position after a time delay

5.3.4 Animation of the frames

Display description	Display	Frames
Normal state		
Safety trip		External frame: White
Maintenance inhibit		External frame: Yellow
Solenoid valve Test mode		External frame: Blue
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.

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Chapter 4 Safety bar Standard function

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1. Scope

The purpose of this document is to define the Standard Function for a safety bar logic.

In order to assist in understanding, this document should be read in conjunction with **GS EP INS 150**, Design Methods for System Configuration Standard Functions.

Some inputs of this Standard Function are the result of treatments processed by higher level Standards Functions e.g. digital inputs, analogue safety inputs or FGS voting logic (DI_AL, DI-LM, AIS, 2ooN, etc.).

This Standard Function is split into three parts:

- The Safety bar inputs
- The Safety bar
- The Safety bar outputs.

2. General Description of Functions

2.1 List of main functions

For the bar inputs:

- Maintenance inhibit handling
- Start-up inhibit handling (optional)
- Trip Initiator latch handling
- First up alarm handling.

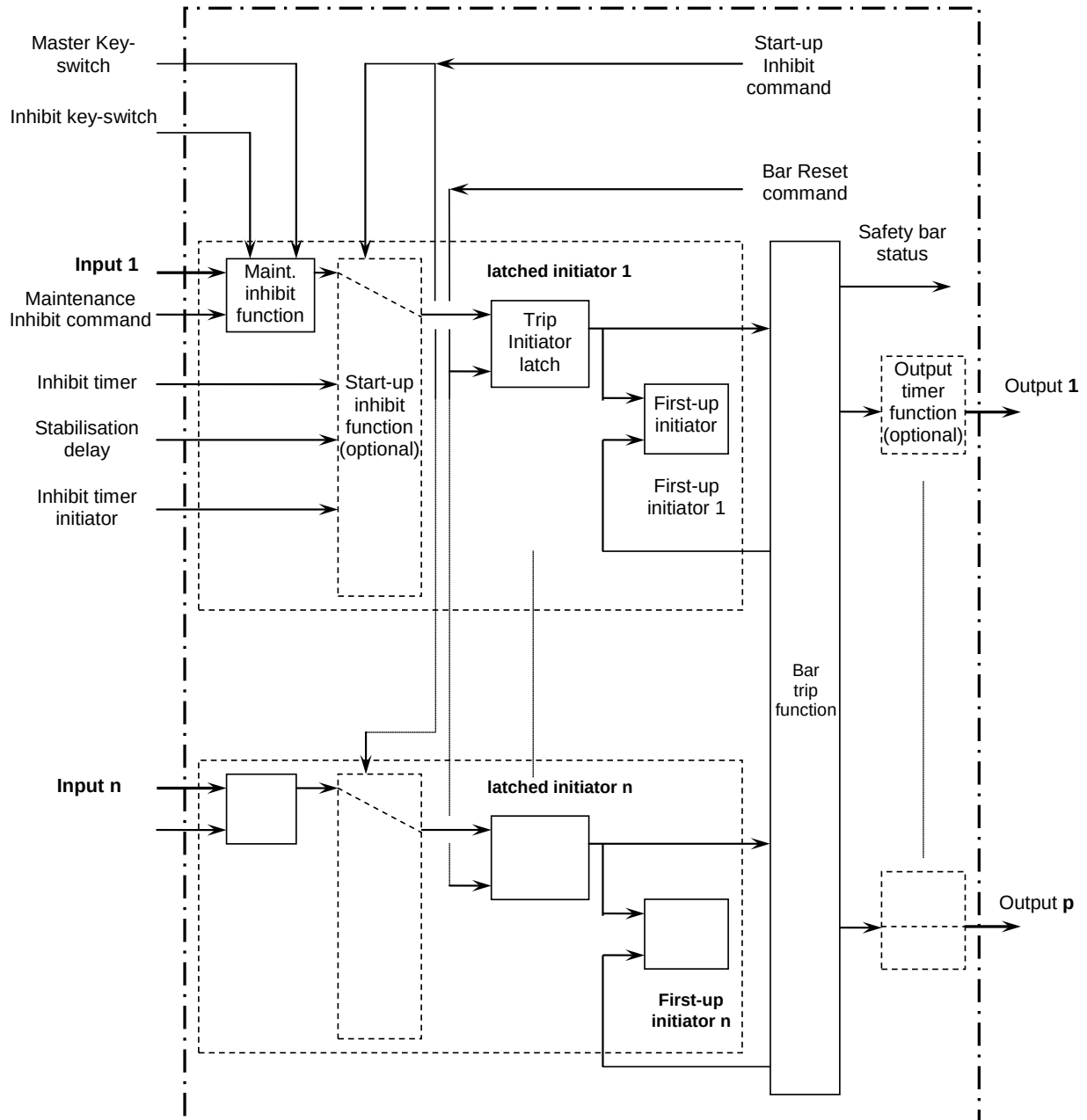
For the bar itself:

- Bar trigger handling.

For the bar outputs:

- Output timer handling (optional).

2.2 Function scheme



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Chapter 4

3. Description of Interfaces

INPUTS			OUTPUTS		
Field	HMI	Internal	Internal	HMI	Field
	Opt	Start-up inhibit command	Bar reset & start-up inhibit commands	Safety bar status	●
	●	Bar reset command		Ready to reset status	●
				Start-up inhibit status	Opt
		● Loop fault	Bar input 1 (specific trip initiator)	Latched trip initiator 1	●
		● Safety threshold - trip initiator		First-up initiator 1	Alm
	●	Maintenance inhibit command		Individual start-up inhibit status	Opt
	Opt	Inhibit timer		Inhibit timer countdown value	Opt
	Opt	Stabilisation delay		Maintenance. Inhibit status	●
	Opt	Inhibit timer initiator			
	●	Master key-switch			
	●	Inhibit key-switch			
		● Higher Safety bar trip	Bar input n (higher Safety bar trip)	First-up initiator n	Alm
			Bar outputs 1 to p	Individual safety trip 1	●
				Individual safety trip p	●
			Safety bar Standard Function	Alm: alarm Opt: option	

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4. Detailed Description of Functions

4.1 Definition of status

4.1.1 Bar input

Each bar input is a trip initiator. Three input types are used in the Safety bar logic:

- Related to a safety threshold applied to analogue measurement or simple calculation (i.e. differential pressure calculation from two pressure values) or to the corresponding loop fault (as per project requirement)
- ESD / SD push-button
- Related to a higher Safety bar.

Each bar input can take the two following status: **TRIP** or **NORMAL**.

4.1.2 Latched initiator

After the start-up inhibit function (optional), each specific trip initiator is individually latched:

- **LATCHED**: when the specific initiator comes up in TRIP condition (and is not Maintenance or process inhibited)
- **UNLATCHED**: after a bar reset command, if the specific initiator is NORMAL (or Maintenance or process inhibited).

4.1.3 First-up Initiator

A specific treatment is required to trap the first-up trip initiator of each Safety bar. This treatment shall be performed individually, for each bar input, except for upstream safety bar.

The first-up initiator is alarmed, but the corresponding acknowledgement is automatically performed to avoid any operator action on the safety mimics.

4.1.4 Safety bar status

A Safety bar can take the following status:

- **TRIPPED**: when, at least, one specific initiator is LATCHED or one higher Safety bar trip initiator is in TRIP
- **NOT TRIPPED**: when all initiators are UNLATCHED and all higher Safety bar trip initiators are NORMAL.

4.1.5 Ready to reset status

This status is active when the bar is TRIPPED and can be reset.

The bar can be reset when all specific trip initiators have disappeared (after acknowledgement) or have been inhibited.

4.2 Maintenance Functions

This section defines maintenance inhibit function related to Safety Bars trip initiators.

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In case of brown field development and potentially new development within the same asset, the existing maintenance inhibit procedure will be maintained, unless otherwise specified in the project documents (e.g. operating philosophy, instrumentation and control philosophy).

4.2.1 Maintenance inhibit definition

Activation of maintenance inhibit command will prevent the input signal to be processed by the Safety Bar logic.

When several thresholds are used in the Safety Logic Diagrams, each threshold will be inhibited individually.

The status of the safety bar input, even if inhibited, shall always be displayed.

The maintenance inhibit function shall not be allowed:

- On operator's commands from the Operator Working Station
- On direct software links from higher level safety bars cannot be inhibited as well.

It shall be allowed:

- On DI when used for transmitting the trip condition from higher level safety bars
- On confirmed detection of a voting logic 2°°N.

Maintenance inhibit can be set on a safety bar input even if in alarm and not acknowledged, thus permitting the reset of the safety bar.

Maintenance inhibit will also be implemented on safety bars inputs resulting from logical operations (for instance "And" gate, selector).

4.2.2 ESD / PSS maintenance inhibit

A first maintenance inhibit MASTER hard wired key-switch shall enable the maintenance inhibit function and provide security control against accidental inhibit operation. No maintenance inhibit can be initiated until this MASTER key-switch is set in the ENABLE position.

All active maintenance inhibits will be reset when this key-switch is switched to the DISABLE position.

Adequate authority level shall operate this MASTER key switch.

A second maintenance inhibit hard wired key-switch shall allow the transfer of the individual maintenance inhibit command to the ESD system and PSS during a limited time interval (by default 30 minutes). This inhibit key switch will be set in the maintenance inhibit while the above MASTER key-switch is in the ENABLE position. Generally, this inhibit key switch is operated by the control room operator in line with the relevant work permit requirements.

All individual maintenance inhibit commands will be set /reset using the Control systems Operator Working Stations. A dedicated maintenance inhibit station might also be considered as alternative, as per Project Instrumentation and control philosophy.

Control systems Operator Working Stations shall be set in Maintenance Mode; dedicated maintenance inhibit station shall be access restricted.

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The individual maintenance inhibit command will be latched in the safety system logic. The individual maintenance inhibit will stay set until one of the following conditions is met:

- The maintenance inhibit is reset from the Control systems Operator Working Stations (set in Maintenance mode) or the dedicated maintenance inhibit station (with restricted access)
- The maintenance inhibit MASTER key-switch is switched to the DISABLE position.

4.2.3 FGS maintenance inhibit

FGS maintenance inhibits principles will be as above and the commands will be sent to the FGS logic using the Engineering Working Station.

4.2.4 Hardware Implementation

The inhibit MASTER key-switch and the second maintenance inhibit key-switch shall be common to maintenance inhibit and input enable/disable functions.

Those key-switches will be hardwired to one ESD controller and then dispatched to all over safety controllers (ESD, PSS and FGS) through the safety network. Hardwired links between safety systems might be considered as alternative where the safety network is not available.

Both key-switches shall be line monitored and therefore processed by DI-LM Standard Function.

The inhibit MASTER key-switch will be of “stay put” type with key reset and protected by lift flap, unlike the inhibit key-switch of a spring return type.

MASTER key-switch: 0 = Enable position

1 = Disable position

Inhibit key-switch:  = On rising edge detection timer will be launched

ESD/PSS/FGS shall capture the input enable/disable command only during the timer countdown.

4.2.5 Maintenance inhibit logging

The status of the above key-switches (i.e. MASTER key-switch and maintenance key-switch) shall be logged by the FGS / PSS / ESD system as event.

Input enable/disable status shall be classified as events, as well.

Their number and their duration shall be available through the Operator Working Station and recorded.

Report and dedicated display shall be generated periodically and upon operator request showing all current active input enable/disable.

4.3 Bar reset command

All Safety bars need one dedicated reset command. This shall be available to the operator from the HMI consoles if the “Ready to reset status” is active. This will allow the unlatching of all latched initiators, and consequently the reset of the Safety bar.

The confirmation that the Safety bar is available for reset is shown by the “Ready to reset status” animation.

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When a higher Safety bar initiator returns to NORMAL, the associated Safety bar automatically returns to the NOT TRIPPED condition, without the need for any operator intervention (assuming there are no other latched trip initiators).

Safety related logical operations (for instance “And” gate, selector) shall not be provided with reset facility.

4.4 Start-up inhibit function (optional)

4.4.1 Start-up inhibit command

The aim of this command is to allow the temporary inhibit of some specific bar inputs which are in the TRIP condition in order to be able to perform the reset of the associated Safety bar (e.g.: low pressure safety threshold initiators, etc.).

There is only a maximum of one start-up inhibit command per bar.

The inhibit is normally performed automatically on bar inputs in the TRIP condition, at the time where the start-up inhibit command is activated.

The activated start-up inhibit of a bar input will be deactivated if the corresponding loop fault occurs or when the corresponding Safety bar trips again after being in Normal Status.

The start-up inhibit of a bar input is not activated if the corresponding alarm for that input has not been acknowledged.

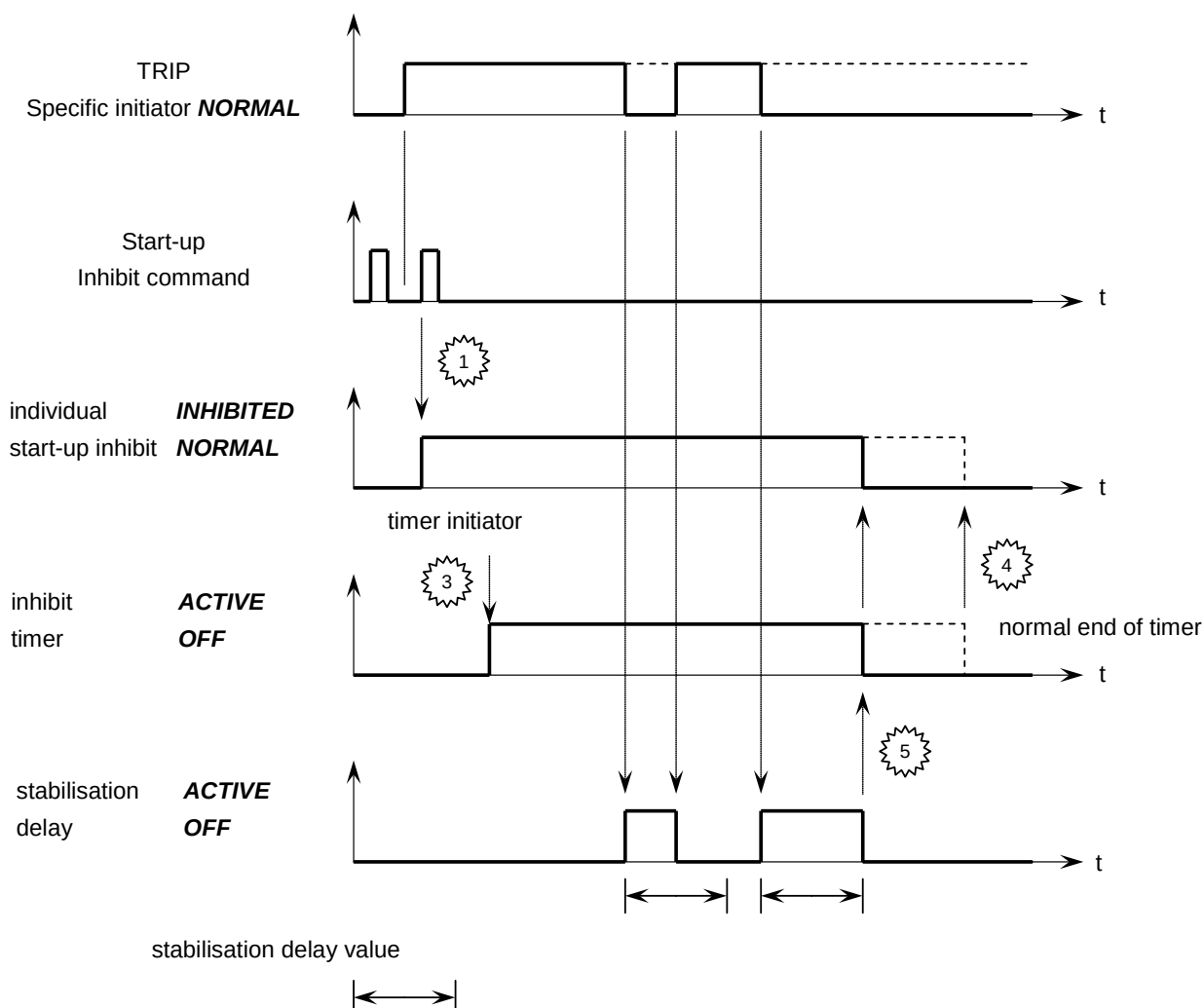
For some bar inputs, such as a PSL associated with a pump stop, after the alarm is masked, the individual start-up inhibit shall be set automatically by an external event (e.g. pump stopped by a Duty/Back-Up/Stand-By Standard Function...) to avoid any unnecessary trip of the associated safety bar.

4.4.2 Start-up inhibit utilisation

1	When the start-up inhibit command is activated, all specific initiators in <i>TRIP</i> (and related to the start-up inhibition function) are <i>INHIBITED</i> .
2	Operator can then use the Safety bar reset command.
3	Inhibition timers are initiated individually by the Safety bar reset or by specific actions (e.g. valve open, pump started, process threshold, etc.).

Two cases are then possible:

	The specific initiator is still in <i>TRIP</i> at the end of its inhibition timer. The initiator is no longer <i>INHIBITED</i>, the initiator is then <i>LATCHED</i> again and the Safety bar is re-triggered and is <i>TRIPPED</i> again.
	The specific initiator returns to <i>NORMAL</i> during the timer countdown. The inhibition timer is reset only if the specific initiator remains <i>NORMAL</i> (threshold status) during a stabilisation period, which avoids spurious Safety bar <i>TRIPS</i> during transient process conditions. After the reset of the inhibition timer, the specific initiator is no longer <i>INHIBITED</i> (please refer to following diagrams).



4.5 Bar output

4.5.1 Output timer handling (optional)

Each bar output corresponds to an individual safety trip command which can be used by internal safety logic or sent directly to the equipment.

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When the output timer function is not used, the individual safety trip command directly follows the associated Safety bar status (TRIPPED → TRIP and NOT TRIPPED → NORMAL).

However, when the timer is used, the individual safety trip command is only performed after a specific individual time delay.

5. Tuning parameters and variables

Parameters	Access level
Start-up inhibit timer pre-set value	Method
Stabilisation delay pre-set value	Method
Bar output time delay pre-set value	Method
Start-up inhibit timer (typically 30 minutes)	Engineer

6. Representation and Animation Description (HMI)

6.1 Events to be recorded

- Maintenance inhibit command
- Start-up inhibit command
- Bar reset command
- First-up initiator status
- Safety bar status.
- Master key-switch Enable / Disable status
- Maintenance inhibit key-switch.

Master key-switch and maintenance inhibit key-switch are common to maintenance inhibit and input enable/disable functions, whatever the concerned safety system (ESD, FGS or PSS).

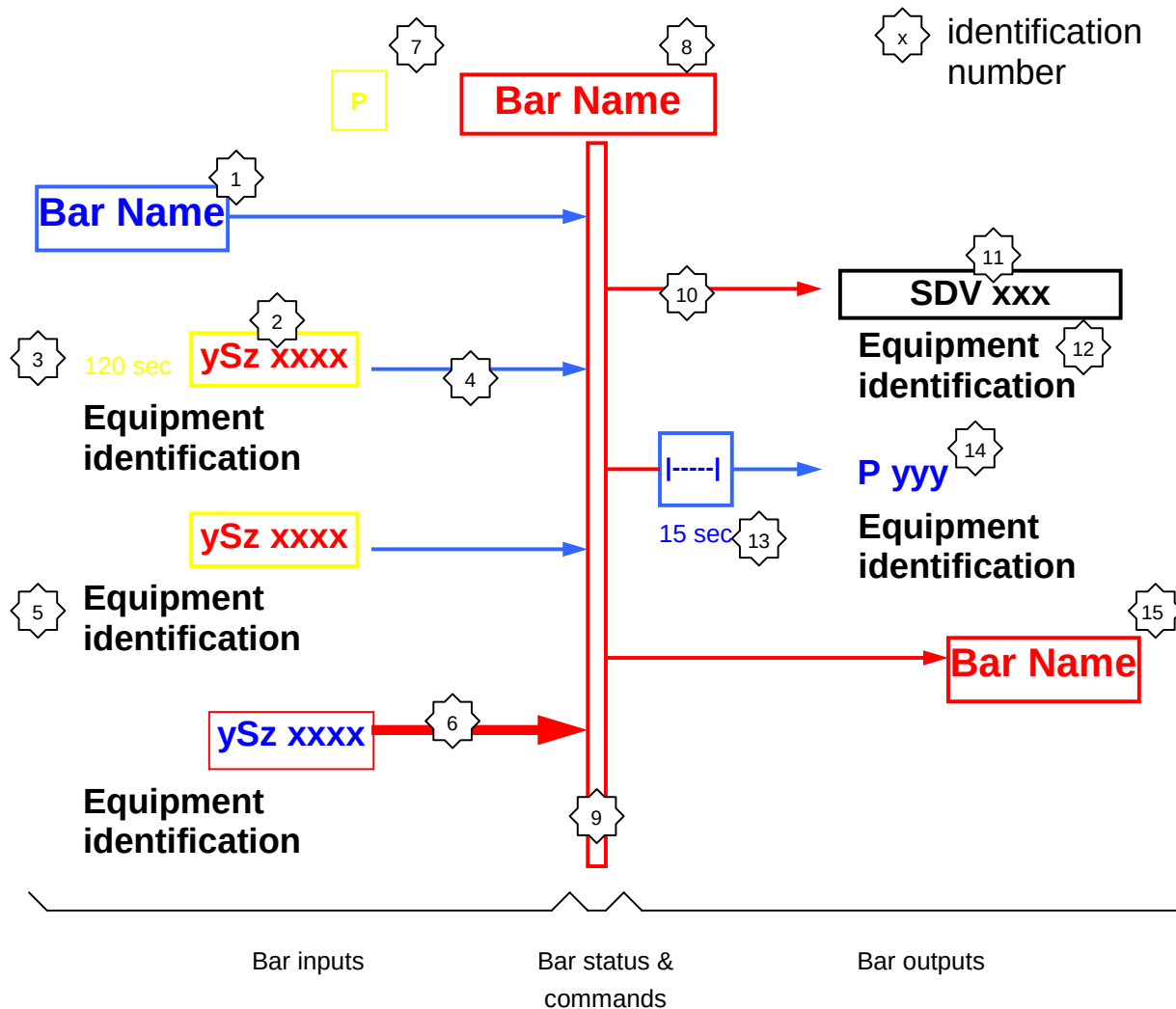
6.2 Alarm level handling

Data	Alarm
First-up initiator (automatic acknowledgement)	Level 3

6.3 General organisation of Safety bar graphic symbols

The safety logic diagrams shown in the next sections are based on a vertical representation, but horizontal representation can also be used to be in line with the Affiliate current practice.

Safety bar representation shall be selected at the Basic Engineering stage.



6.4 Specific animations description

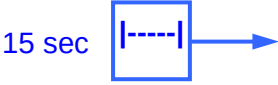
6.4.1 Bar inputs animations

No.	Display description	Display	Colour
1	Higher Safety bar initiator = TRIP (higher Safety bar status = <i>TRIPPED</i>) Higher Safety bar initiator = NORMAL (higher Safety bar status = <i>NOT TRIPPED</i>)	 	Red Blue
2	Specific initiator: The animation associated to each bar input (ySz xxxx) is fully detailed within the AIS standard (section "safety threshold display"). This animation is used as target area for calling a process display.		
3	Individual start-up inhibit status = INHIBITED (The inhibit timer countdown shall be displayed, otherwise the timer pre-set value is displayed on operator request. Timer value display is used as target area to access the pre-set value tuning window.	120 sec 	Yellow Hidden
4	Latched trip initiator = LATCHED Latched trip initiator = UNLATCHED (used as target area for the maintenance inhibit command)	 	Red Blue
5	Text = DISPLAYED (only displayed on operator request) Text = HIDDEN	Equipment identification e.g. name of vessel	White Hidden
6	First-up initiator = FIRST Else		Red Hidden

6.4.2 Safety Bar status & command animations

No.	Display description	Display	Colour
7	Start-up inhibit command status (used as a target area for the start-up inhibit command)		Yellow
8	Safety bar status = TRIPPED (used as target area for the bar reset command) Safety bar status = READY TO RESET Safety bar status = NOT TRIPPED	  	Red Bar name is blue Blue
9	Safety bar status = TRIPPED Safety bar status = NOT TRIPPED	 	Red Blue

6.4.3 Bar outputs animations

No.	Displayed data	Animation	Colour
10	Safety bar status = TRIPPED Safety bar status = NOT TRIPPED	 	Red Blue
11	Individual safety trip command Test mode status Inhibit status In fault status	For frame animations, refer to individual Standard Functions (e.g. SDV, MOT)	
12	Text = DISPLAYED (only displayed on operator request) Text = HIDDEN	Equipment identification e.g. name of vessel	White Hidden
13	Time delay for output = ACHIEVED Time delay for output = NOT USED or ACTING The countdown timer must be displayed, otherwise the timer pre-set value is permanently displayed. (The timer display is used as a target area to access the pre-set value tuning window)	 	Red Blue
14	Valve, Motor, etc., status	For tag animation, refer to individual Standard Functions (e.g. SDV, MOT)	
15	Lower level Safety bar status = TRIPPED Lower level Safety bar status = NOT TRIPPED	 	Red Blue

6.4.4 Animations upon communication or system faults

Bar inputs (initiators) and outputs (except links between Safety bars) are displayed in white colour (concerned animations: 2, 14).

Safety bar status, input arrows and complete output arrows are displayed in blue colour (concerned animations: 1, 4, 8, 9, 10, 13, 15).

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1. Scope

The purpose of this document is to define the Standard Function for a gas detector (GD).

This detector can be optical (GDIR) or catalytic (GDC) type.

In order to assist in understanding, the document should be read in conjunction with **GS EP INS 150**, Design Methods for System Configuration Standard Functions.

This standard is generally used in relationship with the 2ooN logic Standard Function.

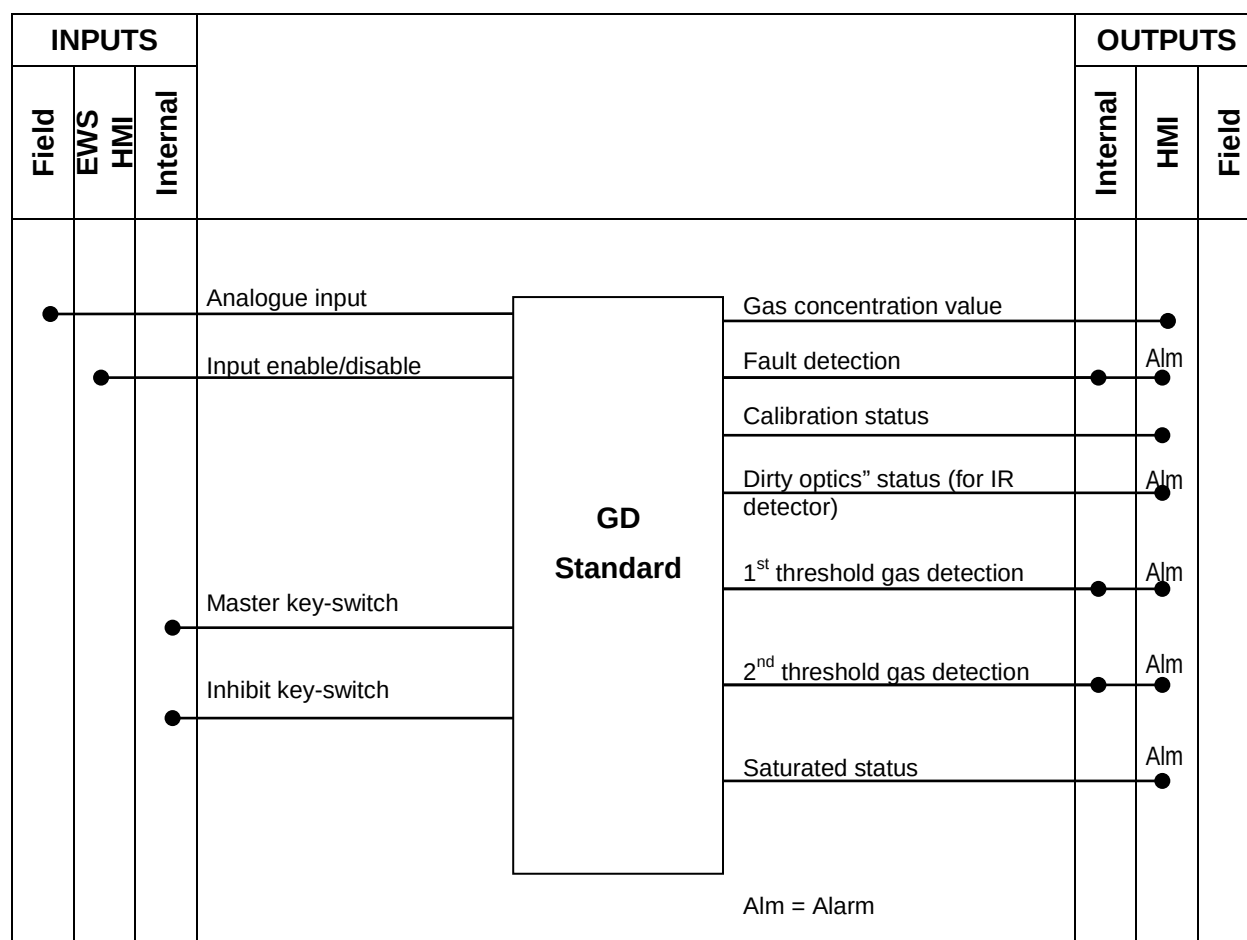
2. General description of functions

2.1 List of main functions

- 4-20 mA signal acquisition
- Conversion in engineering unit (% LFL - lower flammability limit)
- Fault detection (Open & Short circuit)
- 1st threshold gas detection
- 2nd threshold gas detection
- Status handling: calibration, "dirty optics" (for IR detector only), saturated
- Input enable/disable.

3. Interface description

3.1 General description



3.2 Field interface description

Input signal features can be defined as below (thresholds to be adjusted to Vendor datasheet, especially when Hart facility is provided):

- Signal = 0 mA detector in fault
- 1,5 mA detector in calibration mode
- 2 mA "dirty optics" status (only for IR detector)
- 4 mA 0% LFL
- 20 mA 100% LFL
- Signal > 20 mA detector in overrange (saturated).

4. Detailed description of functions

4.1 Status conditions

Below values will be checked with the Vendor.

Internal data	Calculation rules	Status
1 st threshold gas detection	Signal > 1 st high threshold (for DCS alarming and/or FGS logic)	<i>ACTIVE</i>
2 nd threshold gas detection	Signal > 2 nd high threshold (for DCS alarming and/or FGS logic)	<i>ACTIVE</i>
Fault detection	Signal is below 1.9 mA Or input enable/disable command = ACTIVE (for DCS alarming and/or FGS logic)	<i>ACTIVE</i>
Calibration status	Signal is between 1 and 1.7 mA (for DCS animation only)	<i>ACTIVE</i>
Confirmed "dirty optics" status	Signal is between 1.9 and 2.1 mA (for IR detector) during more than 3 minutes (for DCS animation only)	<i>ACTIVE</i>
Saturated status	Signal is > overrange threshold (20 mA) (for DCS alarming only)	<i>ACTIVE</i>

4.2 Maintenance Functions

This section defines input enable/disable principles, this command being used only when detectors are processed by voting logics.

In case of brown field development and potentially new development within the same asset, the existing maintenance inhibit procedure will be maintained, unless otherwise specified in the project documents (e.g. operating philosophy, instrumentation and control philosophy).

4.2.1 Definitions

4.2.1.1 Input enable/disable

When included in voting logic, the enable/disable command will prevent the input signal to be processed by the voting logic (necessary for calibration purpose for instance).

The primary voting logic arrangement shall automatically be reconfigured in accordance with the downgraded voting logic arrangement defined in the Voting Logic Standard Function (Refer to the Chapter 11).

This allows simultaneous calibration of input signals related to the same voting logic without initiation of the voting logic output signal (refer to the Voting Logic Standard Function).

When the input enable/disable is active, the fault status will be forced.

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4.2.2 Input enable/disable logic

A first maintenance inhibit MASTER hard wired key-switch shall enable the input enable/disable function and provide security control against accidental input enable/disable operation. No input enable/disable can be initiated until this MASTER key-switch is set in the ENABLE position.

All active input enable/disable will be reset when this key-switch is switched to the DISABLE position.

Adequate authority level shall operate this MASTER key switch.

A second maintenance inhibit hard wired key-switch shall allow the transfer of the individual input enable/disable command to the FGS during a limited time interval (by default 30 minutes). This inhibit key switch will be set in the maintenance inhibit while the above MASTER key-switch is in the ENABLE position. Generally, this inhibit key switch is operated by the control room operator in line with the relevant work permit requirements.

All individual input enable / disable commands will be set /reset using the Operator Working Stations (OWS).

Use of maintenance working station (MWS) might also be considered as alternative, as per Project Instrumentation and control philosophy.

Access to input enable / disable commands shall be access restricted (e.g. maintenance mode).

The individual input enable / disable will be latched in the safety system logic.

It will stay set until one of the following conditions is met:

- The input enable / disable is reset from either OWS, or MWS
- The maintenance inhibit MASTER key-switch is switched to the DISABLE position.

4.2.3 Hardware Implementation

The inhibit MASTER key-switch and the second maintenance inhibit key-switch shall be common to maintenance inhibit and input enable/disable functions.

Those key-switches will be hardwired to one ESD controller and then dispatched to all over safety controllers (ESD, PSS and FGS) through the safety network. Hardwired links between safety systems might be considered as alternative where the safety network is not available.

Both key-switches shall be line monitored and therefore processed by DI-LM Standard Function.

The inhibit MASTER key-switch will be of "stay put" type with key reset and protected by lift flap, unlike the inhibit key-switch of a spring return type.

MASTER key-switch: 0 = Enable position
1 = Disable position

Inhibit key-switch:  = On rising edge detection timer will be launched

ESD/PSS/FGS shall capture the input enable/disable command only during the timer countdown.

4.2.4 Input enable/disable logging

The status of the above key-switches (i.e. MASTER key-switch and maintenance key-switch) shall be logged by the FGS / PSS / ESD system as event.

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Input enable/disable status shall be classified as events, as well.

Their number and their duration shall be available through the Operator Working Station and recorded.

Report and dedicated display shall be generated periodically and upon operator request showing all current active input enable/disable.

5. Tuning parameters and variables

Parameters	Access level
Min scale pre-set value	Engineer
Max scale pre-set value	Engineer
1 st high threshold pre-set value	Engineer
2 nd high threshold pre-set value	Engineer
Confirmed dirty optic status timer	Engineer
Inhibit Timer (typically 30 minutes)	Engineer

6. Representation and animation description (HMI)

6.1 Events and values to be recorded

6.1.1 Events

- 1st threshold gas detection
- 2nd threshold gas detection
- Fault detection
- Confirmed dirty optic status
- Saturated status
- "Dirty optics" status (for IR detector)
- Calibration status.
- Input enable/disable status
- Master key-switch Enable / Disable status
- Maintenance inhibit key-switch.

Master key-switch and maintenance inhibit key-switch are common to maintenance inhibit and input enable/disable functions, whatever the concerned safety system (ESD, FGS or PSS).

6.1.2 Analogue values

- Gas concentration value (% LFL).

6.2 Alarm handling

Alarm Description	Priority
1 st threshold gas detection	Level 3
2 nd threshold gas detection	Level 3
Fault detection	Level 3
Saturated status	Level 3
Confirmed dirty optic status	Level 3

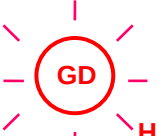
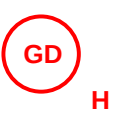
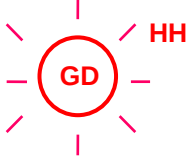
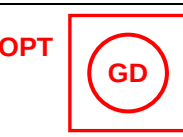
6.3 Control display

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

Site layout animation with detector symbols

	GD xxxx = detector tag name (black/hidden) H = gas 1 st threshold (red + flashing) HH = gas 2 nd threshold (red + flashing) SAT = saturated status (red + flashing) OPT = Confirmed “dirty optics” status (red) CA = calibration status (yellow)
---	---

Upon communication fault and fault, frame animation will be as defined within AI standard.

Internal data	Display	Symbol	Frame
All alarms = INACTIVE		Green	NA
Gas 1 st threshold = ACTIVE and unacknowledged		Flashing red	NA
Gas 1 st threshold = ACTIVE and acknowledged		Red steady	NA
Gas 2 nd threshold = ACTIVE and unacknowledged		Flashing red	NA
Gas 2 nd threshold = ACTIVE and acknowledged		Red steady	NA
Saturated status = ACTIVE and unacknowledged		Red steady (FULL = flashing red)	NA
Saturated status = ACTIVE and acknowledged		Red steady (FULL = red steady)	NA
Saturation alarm = INACTIVE		(FULL = hidden)	NA
Acknowledged confirmed dirty optics = ACTIVE (with fault detection)		(OPT = red steady)	As per AIS Standard Function
Dirty optics = INACTIVE		(OPT = hidden)	
Calibration = ACTIVE (with fault detection)		(CA = yellow steady)	As per AIS Standard Function
Calibration = INACTIVE		(CA = hidden)	
Inhibit of the result of the associated voting logic		Green Red or Yellow	Yellow

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1. Scope

The purpose of this document is to define the Standard Function for an Open Path Gas Detector Standard (GDB).

This type of detector is based on infra-red beam technology, measuring the absorption of IR radiation in a specific volume of gas.

In order to assist in understanding, this document should be read in conjunction with **GS EP INS 150**, Design Methods for System Configuration Standard Functions.

This standard may be used in relationship with the 200N standard.

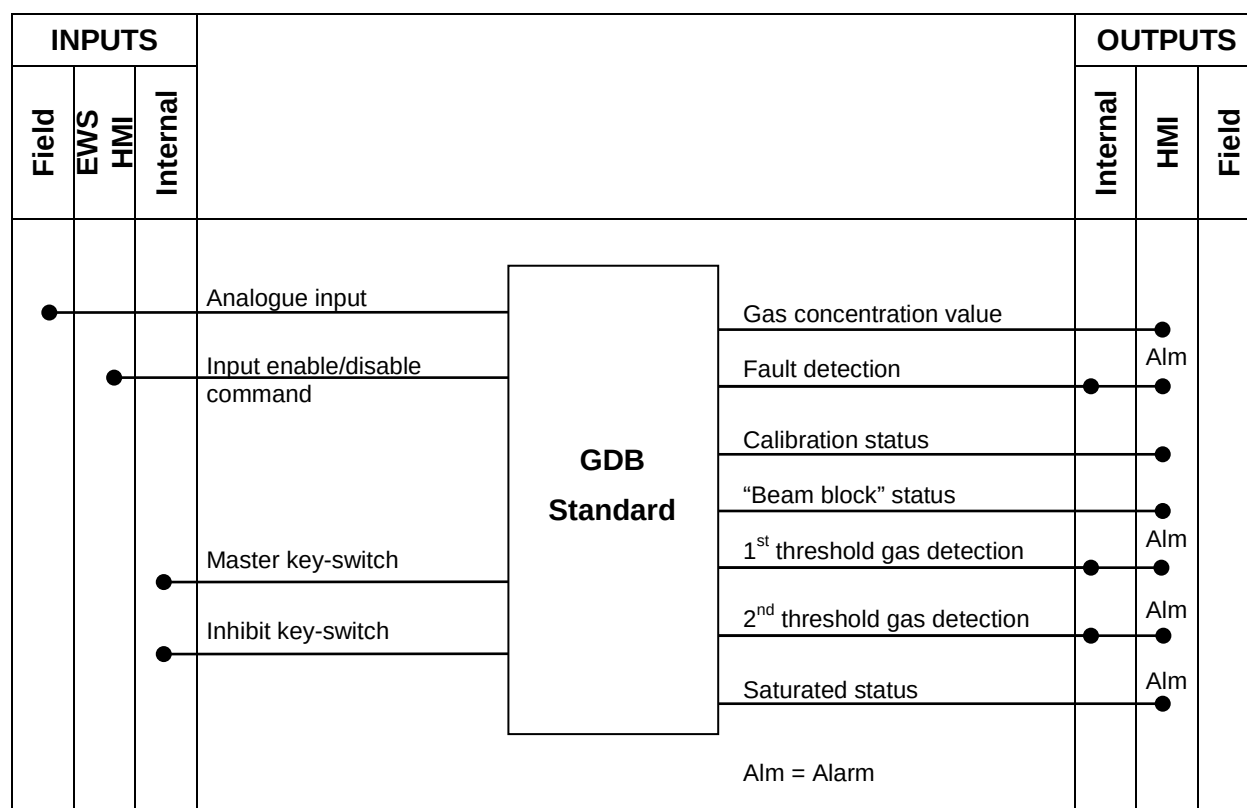
2. General description of functions

2.1 List of main functions

- 4-20 mA signal acquisition
- Conversion in engineering unit (LEL. m)
- Signal fault (Open & Short circuit)
- 1st high threshold gas detection
- 2nd high threshold gas detection
- Status handling: calibration, "blocked beam", saturated
- Input enable/disable.

3. Interface description

3.1 General description



3.2 Field interface description

Analog signal characteristics: (thresholds to be adjusted to Vendor datasheet, especially when Hart facility is provided)

- Signal = 0 mA detector in fault
- 1.5 mA detector in calibration mode
- 2 mA "Blocked beam" status (set points are locally adjustable)
- 4 mA 0 LEL. m
- 20 mA 5 LEL. m (note 1)
- Signal > 20 mA detector in over range.

Note 1: Such value, given for information, has to be confirmed by the Vendor; in function of the purpose, scale can also be selected in ppm.m.

For information, the "blocked beam" signal is only *ACTIVE* during a specific locally adjustable timer (up to 60 minutes). Beyond this timer, the detector switches to fault status (0 mA).

The "blocked beam" status includes the "dirty optic" status

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4. Detailed description of functions

4.1 Status conditions

Below values to be checked with the Vendor.

Internal data	Calculation rules	Status
1 st threshold gas detection	Signal > 1 st threshold (for DCS alarming and/or FGS logic)	ACTIVE
2 nd threshold gas detection	Signal > 2 nd threshold (for DCS alarming and/or FGS logic)	ACTIVE
Fault detection	Signal is below 2.3 mA or maintenance input trip command = ACTIVE (for DCS alarming and/or FGS logic)	ACTIVE
Calibration status	Signal is between 1 and 1.7 mA (for DCS animation only)	ACTIVE
"Blocked beam" status	Signal is between 1.75 and 2.3 mA (for DCS animation only)	ACTIVE

4.2 Maintenance Functions

This section defines input enable/disable principles, this command being used only when detectors are processed by voting logics.

In case of brown field development and potentially new development within the same asset, the existing maintenance inhibit procedure will be maintained, unless otherwise specified in the project documents (e.g. operating philosophy, instrumentation and control philosophy).

4.2.1 Definitions

4.2.1.1 Input enable/disable

When included in voting logic, the enable/disable command will prevent the input signal to be processed by the voting logic (necessary for calibration purpose for instance).

The primary voting logic arrangement shall automatically be reconfigured in accordance with the downgraded voting logic arrangement defined in the Voting Logic Standard Function.

This allows simultaneous calibration of input signals related to the same voting logic without initiation of the voting logic output signal (refer to the Voting Logic Standard Function).

When the input enable/disable is active, the fault status will be forced.

4.2.2 Input enable/disable logic

A first maintenance inhibit MASTER hard wired key-switch shall enable the input enable/disable function and provide security control against accidental input enable/disable operation. No input enable/disable can be initiated until this MASTER key-switch is set in the ENABLE position.

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All active input enable/disable will be reset when this key-switch is switched to the DISABLE position.

Adequate authority level shall operate this MASTER key switch.

A second maintenance inhibit hard wired key-switch shall allow the transfer of the individual input enable/disable command to the FGS during a limited time interval (by default 30 minutes). This inhibit key switch will be set in the maintenance inhibit while the above MASTER key-switch is in the ENABLE position. Generally, this inhibit key switch is operated by the control room operator in line with the relevant work permit requirements.

All individual input enable / disable commands will be set /reset using the Operator Working Stations (OWS).

Use of maintenance working station (MWS) might also be considered as alternative, as per Project Instrumentation and control philosophy.

Access to input enable / disable commands shall be access restricted (e.g. maintenance mode).

The individual input enable / disable command will be latched in the safety system logic.

It will stay set until one of the following conditions is met:

- The input enable / disable is reset from either OWS, or MWS
- The maintenance inhibit MASTER key-switch is switched to the DISABLE position.

4.2.3 Hardware Implementation

The inhibit MASTER key-switch and the second maintenance inhibit key-switch shall be common to maintenance inhibit and input enable/disable functions.

Those key-switches will be hardwired to one ESD controller and then dispatched to all over safety controllers (ESD, PSS and FGS) through the safety network. Hardwired links between safety systems might be considered as alternative where the safety network is not available.

Both key-switches shall be line monitored and therefore processed by DI-LM Standard Function.

The inhibit MASTER key-switch will be of "stay put" type with key reset and protected by lift flap, unlike the inhibit key-switch of a spring return type.

MASTER key-switch: 0 = Enable position

1 = Disable position

Inhibit key-switch:  = On rising edge detection timer will be launched

Input enable/disable command will be authorized to be captured by the ESD/PSS/FGS during the timer countdown only.

4.2.4 Input enable/disable logging

The status of the above key-switches (i.e. MASTER key-switch and maintenance key-switch) shall be logged by the FGS / PSS / ESD system as event.

Input enable/disable status shall be classified as events, as well.

Their number and their duration shall be available through the Operator Working Station and recorded.

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Report and dedicated display shall be generated periodically and upon operator request showing all current active input enable/disable.

5. Tuning parameters and variables

Parameters	Access level
Min scale pre-set value	Engineer
Max scale pre-set value	Engineer
1 st high threshold pre-set value	Engineer
2 nd high threshold pre-set value	Engineer
Inhibit Timer (typically 30 minutes)	Engineer

6. Representation and animation description (HMI)

6.1 Events and values to be recorded

6.1.1 Events

- 1st threshold gas detection
- 2nd threshold gas detection
- Fault detection
- Saturated status
- “Blocked beam” status
- Calibration status.
- Input enable/disable status
- Master key-switch Enable / Disable status
- Maintenance inhibit key-switch.

Master key-switch and maintenance inhibit key-switch are common to maintenance inhibit and input enable/disable functions, whatever the concerned safety system (ESD, FGS or PSS).

6.1.2 Analogue values

- Gas concentration value (LEL. m).

6.2 Alarm handling

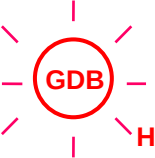
Alarm Description	Priority
1 st threshold gas detection	Level 3
2 nd threshold gas detection	Level 3
Fault detection	Level 3
Saturated status	Level 3
Blocked beam status	Level 3

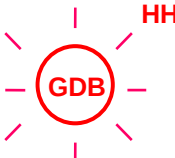
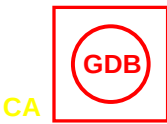
6.3 Control display

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

Site layout animation with detector symbols

	GDB xxxx = detector tag name (black/hidden) H = gas 1 st thresh. (red + flashing) HH = gas 2 nd thresh. (red + flashing) SAT = saturated status alarm (red + flashing) OPT = blocked beam status (red) CA = calibration status (yellow)
---	--

Internal data	Display	Symbol	Frame
All alarms = INACTIVE		Green	NA
Gas 1 st thresh. = ACTIVE and unacknowledged		Flashing red	NA
Gas 1 st thresh. = ACTIVE and acknowledged		Red steady	NA

Internal data	Display	Symbol	Frame
Gas 2 nd thresh. = ACTIVE and unacknowledged		Flashing red	NA
Gas 2 nd thresh. = ACTIVE and acknowledged		Red steady	NA
Saturated status alarm = ACTIVE and unacknowledged		Red steady (SAT = flashing red)	NA
Saturated status alarm = ACTIVE and acknowledged		Red steady (SAT = red steady)	NA
Saturated status alarm = INACTIVE		(SAT = hidden)	NA
Acknowledged Beam block = ACTIVE (with fault detection)		(OPT = red steady)	As per AIS Standard Function
Beam block = INACTIVE		(OPT = hidden)	
Calibration = ACTIVE (with fault detection)		(CA = yellow steady)	As per AIS Standard Function
Calibration = INACTIVE		(CA = hidden)	
Inhibition of the result of the associated voting logic		Green Red or Yellow	Yellow

Upon communication fault and fault, frame animation will be as defined within AI standard.

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1. Scope

The purpose of this document is to define the Standard Function for a Flame detector (RD).

This type of detector can be:

- Infra-red detector (RDIR)
- Ultra-violet detector (RDUV)
- Ultra-violet/infra-red (RDUI).

In order to assist in understanding, this document should be read in conjunction with **GS EP INS 150**, Design Methods for System Configuration Standard Functions.

This standard is generally used in relationship with the 2ooN standard.

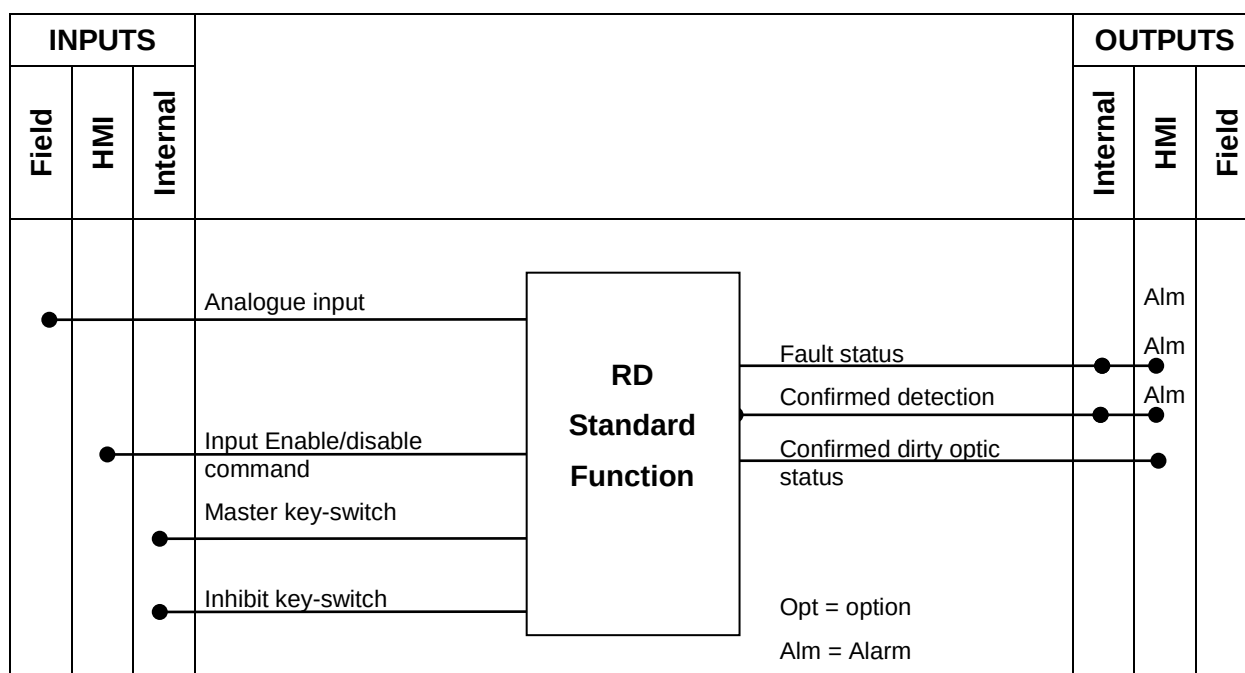
2. General description of functions

2.1 List of main functions

- 4-20 mA signal acquisition
- Detection of fault input (Open & Short circuit)
- Dirty Optics detection
- Detection of flame
- Input enable/disable.

3. Interface description

3.1 General description



3.2 Specific interface description

Analogue signal characteristics: (thresholds to be adjusted to Vendor datasheet, especially when Hart facility is provided)

- < 1.7 mA Open circuit detection
- 1.7 mA < signal < 2.1 mA Dirty Optic
- 04 mA Healthy status
- 20 mA Confirmed detection (after adjustable time delay)
- > 21 mA Short circuit detection.

The confirmed fire detection signal is generated after the fire detection has been active during an adjustable timer (e.g. 10 seconds) configured inside the detector. The dirty optic signal may be caused by different sources:

- Dirty optic
- Faulty detector
- Faulty test lamp.

4. Detailed description of functions

4.1 Status conditions

Below values to be checked with the Vendor.

Status	Conditions
Confirmed detection Status	Active if signal > 18 mA (Confirmed Detection of flame)
Fault Status	Fault if signal is below 1.7 mA or above 21 mA
Confirmed dirty optic Status	Active if dirty optic signal is active during at least 30 minutes

4.2 Maintenance Functions

This section defines input enable/disable principles, this command being used only when detectors are processed by voting logics.

In case of brown field development and potentially new development within the same asset, the existing maintenance inhibit procedure will be maintained, unless otherwise specified in the project documents (e.g. operating philosophy, instrumentation and control philosophy).

4.2.1 Definitions

4.2.1.1 Input enable/disable

When included in voting logic, the enable/disable command will prevent the input signal to be processed by the voting logic (necessary for calibration purpose for instance).

The primary voting logic arrangement shall automatically be reconfigured in accordance with the downgraded voting logic arrangement defined in the Voting Logic Standard Function.

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This allows simultaneous calibration of input signals related to the same voting logic without initiation of the voting logic output signal (refer to the Voting Logic Standard Function).

When the input enable/disable is active, the fault status will be forced.

4.2.2 Input enable/disable logic

A first maintenance inhibit MASTER hard wired key-switch shall enable the input enable/disable function and provide security control against accidental input enable/disable operation. No input enable/disable can be initiated until this MASTER key-switch is set in the ENABLE position.

All active input enable/disable will be reset when this key-switch is switched to the DISABLE position.

Adequate authority level shall operate this MASTER key switch.

A second maintenance inhibit hard wired key-switch shall allow the transfer of the individual input enable/disable command to the FGS during a limited time interval (by default 30 minutes). This inhibit key switch will be set in the maintenance inhibit while the above MASTER key-switch is in the ENABLE position. Generally, this inhibit key switch is operated by the control room operator in line with the relevant work permit requirements.

All individual input enable/disable commands will be set /reset using the Operator Working Stations (OWS).

Use of maintenance working station (MWS) might also be considered as alternative, as per Project Instrumentation and control philosophy.

Access to input enable/disable commands shall be access restricted (e.g. maintenance mode).

The individual input enable/disable command will be latched in the safety system logic.

It will stay set until one of the following conditions is met:

- The input enable/disable command is reset from either OWS, or MWS
- The maintenance inhibit MASTER key-switch is switched to the DISABLE position.

4.2.3 Hardware Implementation

The inhibit MASTER key-switch and the second maintenance inhibit key-switch shall be common to maintenance inhibit and input enable/disable functions.

Those key-switches will be hardwired to one ESD controller and then dispatched to all over safety controllers (ESD, PSS and FGS) through the safety network. Hardwired links between safety systems might be considered as alternative where the safety network is not available.

Both key-switches shall be line monitored and therefore processed by DI-LM Standard Function.

The inhibit MASTER key-switch will be of "stay put" type with key reset and protected by lift flap, unlike the inhibit key-switch of a spring return type.

MASTER key-switch: 0 = Enable position

1 = Disable position

Inhibit key-switch:  = On rising edge detection timer will be launched

ESD/PSS/FGS shall capture the input enable/disable command only during the timer countdown.

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4.2.4 Input enable/disable logging

The status of the above key-switches (i.e. MASTER key-switch and maintenance key-switch) shall be logged by the FGS / PSS / ESD system as event.

Input enable/disable status shall be classified as events, as well.

Their number and their duration shall be available through the Operator Working Station and recorded.

Report and dedicated display shall be generated periodically and upon operator request showing all current active input enable/disable.

5. Tuning parameters and variables

Parameters	Access Level
Confirmed threshold of flame detection (optional)	Engineer
Confirmed dirty optic status timer	Engineer
Inhibit Timer (typically 30 minutes)	Engineer

6. Representation and animation description (HMI)

6.1 Events to be recorded

- Alarm status (flame detection)
- Confirmed flame detection
- Fault status (open or short circuit)
- Confirmed dirty optic status
- Input enable/disable
- Master key-switch Enable / Disable status
- Maintenance inhibit key-switch.

Master key-switch and maintenance inhibit key-switch are common to maintenance inhibit and input enable/disable functions, whatever the concerned safety system (ESD, FGS or PSS).

6.2 Alarm handling

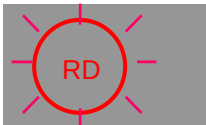
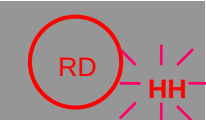
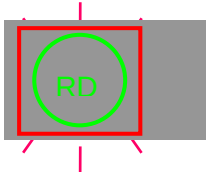
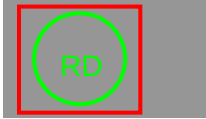
Alarm Description	Priority
Confirmed flame detection	Level 3
Fault Status	Level 3
Confirmed dirty optic	Level 3

6.3 Control display

Display description	Display	Text	Frame
Normal Status		Blue steady	NA
Unacknowledged confirmed detection Status		Red flashing	NA
Acknowledged confirmed detection Status		Red steady	NA
Fault status		Blue steady	Red steady
Communication or system fault		White	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.

6.4 Specific Animation description

Display description	Display	Symbol	Frame
Normal Status		Green	NA
Alarm Status (flame detection) (before acknowledgement)		Red flashing	NA
Alarm Status (flame detection) (after acknowledgement)		Red steady	NA
Confirmed Dirty optic (before acknowledgement)		OPT = Red flashing	NA
Confirmed dirty optic (after acknowledgement)		OPT = Red steady	NA
Confirmed detection (before acknowledgement)		Red steady HH = Red flashing	NA
Confirmed detection (after acknowledgement)		Red steady HH = Red steady	NA
Fault status (before acknowledgement)		Green	Red flashing
Fault status (after acknowledgement)		Green	Red steady
Inhibition of the result of the associated voting logic		Green, Red or Yellow	Yellow

Upon communication fault and fault, frame animation will be as defined within AI standard.

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Chapter 8 Heat & Smoke Detector Standard function - RDH & RDS -

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1. Scope

The purpose of this document is to define the Standard Functions of Heat and Smoke Detectors.

This standard applies to thermostatic heat detector (RDH) and optical smoke detector (RDS).

Four detectors may be mounted on the same loop and are considered as one analogue input.

In order to assist in understanding, this document should be read in conjunction with **GS EP INS 150**, Design Methods for System Configuration Standard Functions.

This standard is generally used in relationship with the 2ooN logic voting standard.

2. General description of functions

2.1 List of main functions

- 4-20 mA signal acquisition
- Detection of input fault (Open circuit)
- Fire detection
- Loop reset command
- Input enable/disable

3. Interfaces description

3.1 General description

INPUTS					OUTPUTS		
Field	EWS	HMI	Internal		Internal	HMI	Field
•			Analogue input	RDH & RDS Standard Function	Detection status	•	Alm
					Fault status	•	Alm
	•		Loop reset command Note 1				
	•		Input enable/disable command		Loop Reset output		•
		•	Master key-switch				
		•	Inhibit key-switch				
					Alm = Alarm		

Note 1: Loop reset command may be set from the Operator Working Station.

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3.2 Specific interface description

Analogue signal characteristics

- < 2 mA Open circuit detection
- 4 mA Signal in normal situation
- > 7 mA Detection status.

Digital output for reset loop.

4. Detailed description of functions

4.1 Status conditions

Status	Conditions
Detection status	Active if signal > 7 mA (for DCS alarming and/or FGS logic)
Fault Status	Fault if signal is below 2 mA (for DCS alarming and/or FGS logic)
Loop Reset output	Active when both detection and loop reset command active

4.2 Commands description

Command	Conditions
Loop Reset	Active when pulse signal (from HMI OWS)
Input enable/disable	Set and reset

4.3 Maintenance Functions

This section defines input enable/disable principles, this command being used only when detectors are processed by voting logics.

In case of brown field development and potentially new development within the same asset, the existing maintenance inhibit procedure will be maintained, unless otherwise specified in the project documents (e.g. operating philosophy, instrumentation and control philosophy).

4.3.1 Definitions

4.3.1.1 Input enable/disable

When included in voting logic, the enable/disable command will prevent the input signal to be processed by the voting logic (necessary for calibration purpose for instance).

The primary voting logic arrangement shall automatically be reconfigured in accordance with the downgraded voting logic arrangement defined in the Voting Logic Standard Function.

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Chapter 8

This allows simultaneous calibration of input signals related to the same voting logic without initiation of the voting logic output signal (refer to the Voting Logic Standard Function).

When the input enable/disable is active, the fault status will be forced.

4.3.2 Input enable/disable logic

A first maintenance inhibit MASTER hard wired key-switch shall enable the input enable/disable function and provide security control against accidental input enable/disable operation. No input enable/disable can be initiated until this MASTER key-switch is set in the ENABLE position.

All active input enable/disable will be reset when this key-switch is switched to the DISABLE position.

Adequate authority level shall operate this MASTER key switch.

A second maintenance inhibit hard wired key-switch shall allow the transfer of the individual input enable/disable command to the FGS during a limited time interval (by default 30 minutes). This inhibit key switch will be set in the maintenance inhibit while the above MASTER key-switch is in the ENABLE position. Generally, this inhibit key switch is operated by the control room operator in line with the relevant work permit requirements.

All individual input enable/disable commands will be set /reset using the Operator Working Stations (OWS).

Use of maintenance working station (MWS) might also be considered as alternative, as per Project Instrumentation and control philosophy.

Access to input enable/disable commands shall be access restricted (e.g. maintenance mode).

The individual input enable / disable command will be latched in the safety system logic.

It will stay set until one of the following conditions is met:

- The input enable/disable is reset from either OWS, or MWS
- The maintenance inhibit MASTER key-switch is switched to the DISABLE position.

4.3.3 Hardware Implementation

The inhibit MASTER key-switch and the second maintenance inhibit key-switch shall be common to maintenance inhibit and input enable/disable functions.

Those key-switches will be hardwired to one ESD controller and then dispatched to all over safety controllers (ESD, PSS and FGS) through the safety network. Hardwired links between safety systems might be considered as alternative where the safety network is not available.

Both key-switches shall be line monitored and therefore processed by DI-LM Standard Function.

The inhibit MASTER key-switch will be of "stay put" type with key reset and protected by lift flap, unlike the inhibit key-switch of a spring return type.

MASTER key-switch: 0 = Enable position

1 = Disable position

Inhibit key-switch:  = On rising edge detection timer will be launched

ESD/PSS/FGS shall capture the input enable/disable command only during the timer countdown.

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4.3.4 Input enable/disable logging

The status of the above key-switches (i.e. MASTER key-switch and maintenance key-switch) shall be logged by the FGS / PSS / ESD system as event.

Input enable/disable status shall be classified as events, as well.

Their number and their duration shall be available through the Operator Working Station and recorded.

Report and dedicated display shall be generated periodically and upon operator request showing all current active input enable/disable.

5. Tuning parameters and variables

Parameter	Access level
Detection threshold	Engineer
Timer Inhibit (typically 30 minutes)	Engineer

6. Representation and animation description (HMI)

6.1 Events to be recorded

- Detection status
- Invalid status
- Input enable/disable
- Loop reset command.
- Master key-switch Enable / Disable status
- Maintenance inhibit key-switch.

Master key-switch and maintenance inhibit key-switch are common to maintenance inhibit and input enable/disable functions, whatever the concerned safety system (ESD, FGS or PSS).

6.2 Alarm management

Alarm Description	Priority
Detection alarm	Level 3
Fault alarm	Level 3

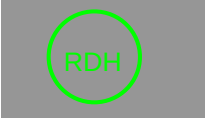
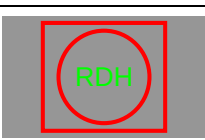
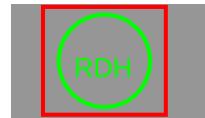
6.3 Control display

RDSxxxx for Smoke detector

RDHxxxx for Heat detector

Display description	Display	Text	Frame
Normal Status		Blue steady	NA
Unacknowledged Alarm Status		Red flashing	NA
Acknowledged Alarm Status		Red steady	NA
Fault status		Red	Red
Communication or system fault		White	Magenta

6.4 Specific Animation description

Display description	Display	Symbol	Frame
Normal Status		Green	NA
Alarm Status (before acknowledgement)		Red flashing	NA
Alarm Status (after acknowledgement)		Red steady	NA
Fault status (before acknowledgement)		Green	Red flashing
Fault status (after acknowledgement)		Green	Red steady
Inhibit of the result of the associated voting logic		Green or red	Yellow steady

Upon communication fault and fault, frame animation will be as defined within AI standard.

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1. Scope

The purpose of this document is to define the Standard Function of a deluge system.

In order to assist in understanding, the document should be read in conjunction with **GS EP INS 150**, Design Methods for System Configuration Standard Functions.

The standard function covers the following deluge systems:

- Water system (DELUGE)
- Water with foam injection (DELUGE_FOAM)
- Water curtains (DELUGE_CURTAIN).

This Standard Function is normally linked to other Standard Functions (e.g. Safety analogue input AIS and Voting logic 2ooN).

2. General description of functions

2.1 List of main functions

- Activation including discrepancy detection
- Field interface including loop fault detection
- Test function.

3. Interfaces description

3.1 General description

INPUTS				OUTPUTS		
Field	HMI	Internal		Internal	HMI	Field
			<u>AIS or Voting logic</u>			
</						

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3.2 Specific description of field interfaces

This Standard Function handles directly its own field inputs and outputs, except for the RPT1 input which will use the AIS Standard Function, since it is also processed by the ESD logic.

- The solenoid valve RY1 (DO provided with output line monitoring facility); logic will be as per:
1 = Open for deluge system with or without foam
0 = Open for water curtain
- The solenoid valve RY3 (DO provided with output line monitoring facility); logic will be as per:
1 = Open for deluge system with foam
- Local indication on the F&G matrix panel:
1 = Release.

Specific inputs are:

- RPT2 (water pressure downstream the deluge valve) used to confirm the release
< 8 mA = NORMAL
- RZH limit switch of the foam valve
1 = Open.

4. Detailed description of functions

4.1 Activation command

4.1.1 Deluge valve

The open command of the deluge valve is activated by the low pressure of the fusible loop.

RPT1 (fusible loop) is used to automatically activate the deluge (with the threshold setting: **< 8 mA = Initiate Deluge**). The AIS Standard Function will handle this condition. However special attention shall be paid to the failure mode of this transmitter and its associated action.

The close command of the deluge valve is only activated by the operator (release reset command from HMI).

4.1.2 Water curtain valve

The open command of the water curtain valve is activated by the voting logic of gas detection of the protected area (as per project fire and gas cause and effect matrix).

The close command of the water curtain valve is only activated by the operator (release reset command from HMI).

4.1.3 Foam valve (option)

The open command of the foam valve is activated when the open command of the deluge valve is activated.

The close command of the foam valve is only activated by the operator (command from HMI).

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4.2 Test command

For each DELUGE system a dedicated screen target located on the geographical representation mimic of the fire detection zones shall give access to the test function. This access shall be in maintenance access level.

A double confirmation (processed at HMI level) is required to verify the operator is fully aware a test is going to be performed.

This test command will activate the open deluge valve command.

4.3 Standard functional behaviour

4.3.1 Operating command status

4.3.1.1 Deluge/Water curtain valve

Deluge command status results from deluge open/close command or test command.

4.3.1.2 Foam valve (option)

Foam command status results from foam open/close command or test command.

4.3.2 Status

4.3.2.1 Deluge release status

Active when RPT2 high pressure > 8 mA.

4.3.2.2 Foam open status (optional)

Active when open limit switch is active.

4.3.2.3 Discrepancy status

4.3.2.3.1 Deluge discrepancy status

Discrepancy between deluge command status and the RPT2 threshold status after a time delay.

4.3.2.3.2 Foam Discrepancy status (optional)

Discrepancy between foam command status and the open limit switch of the foam valve after a time delay.

4.3.2.4 Fault status

Hardware fault concerning DI/DO cards or faulty AI (RPT2) signal.

4.3.3 Activation counter

This function shall be handled at the DCS level.

This reports the number of changes of status of the activation command (from close to open) since the last reset command.

5. Tuning parameters and variables

Parameters	Access level
Pre-set value of discrepancy timer for the deluge valve	Method
Pre-set value of discrepancy timer for the foam valve	Method

6. Representation and animation description (HMI)

6.1 Events and values to be recorded

6.1.1 Events

- Test command
- Test validation
- Open and close foam valve command (optional)
- Deluge command Status
- Deluge discrepancy Status
- Foam command status (optional)
- Foam discrepancy status (optional)
- Fault status.

6.1.2 Values

- Counter of deluge activation (to be recorded by the DCS)
- Counter of foam activation (to be recorded by the DCS).

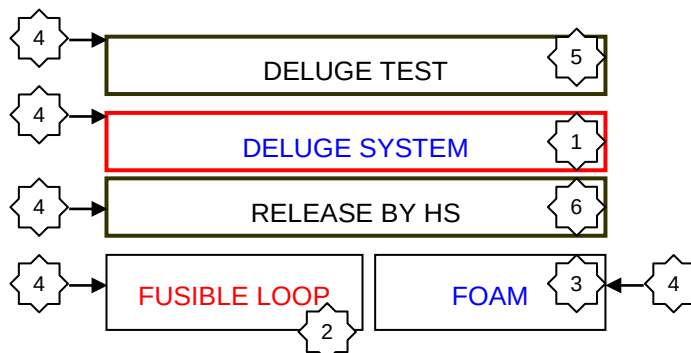
6.2 Alarm handling

Alarm Description	Priority
Release discrepancy alarm	Level 3
Foam discrepancy alarm (optional)	Level 3
Fusible loop low pressure alarm	Level 3
Fault alarm	Level 3

6.3 Control display

As a general rule all alarmed signals are flashing prior to acknowledgement.

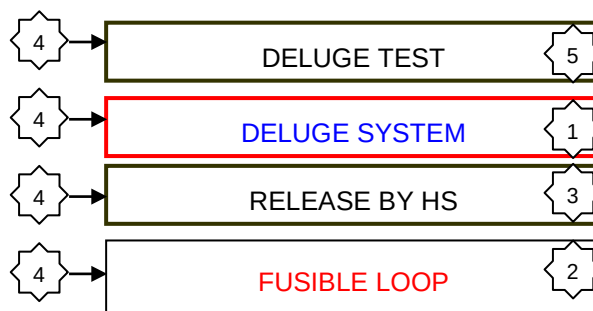
6.3.1 Deluge with foam display



Data animation tables

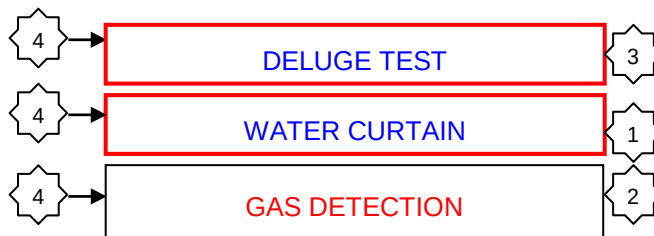
No.	Display description	Display	Colour
1	Deluge activation = NOT ACTIVE Deluge activation command = ACTIVE Release status = ACTIVE Release discrepancy = ACTIVE Used as target area of reset of release command	DELUGE SYSTEM DELUGE SYSTEM DELUGE SYSTEM DELUGE SYSTEM	White Blue Blue steady Red
2	Fusible loop detection = ACTIVE Fusible loop detection = NORMAL (except for water curtain)	FUSIBLE LOOP FUSIBLE LOOP	Red Blue
3	Foam = ACTIVE Foam valve = OPEN Foam valve = CLOSED Foam valve discrepancy = ACTIVE Used as target area of foam close/open command	FOAM FOAM FOAM FOAM	Magenta (flashing) Magenta White Red
4	Fault = ACTIVE Fault = NOT ACTIVE		Red Hidden
5	Test Deluge command = NOT ACTIVE Test Deluge command = ACTIVE Used as target area for the testing command	DELUGE TEST DELUGE TEST	White Yellow (Flashing)
6	PUSH BUTTON = NOT ACTIVE PUSH BUTTON = ACTIVE	RELEASE BY HS RELEASE BY HS	Blue Red

6.3.2 Deluge without foam display



No.	Display description	Display	Colour
1	Deluge activation = NOT ACTIVE Deluge activation = ACTIVE Release status = ACTIVE Release discrepancy = ACTIVE Used as target area of reset release command	DELUGE SYSTEM DELUGE SYSTEM DELUGE SYSTEM DELUGE SYSTEM	White Blue Blue steady Red
2	Fusible detection = ACTIVE Fusible detection = NORMAL (except for water curtain)	FUSIBLE LOOP FUSIBLE LOOP	Red Blue
3	PUSH BUTTON = NOT ACTIVE PUSH BUTTON = ACTIVE	RELEASE BY HS RELEASE BY HS	Blue Red
4	Fault = ACTIVE Fault = NOT ACTIVE	 	Red Hidden
5	Test Deluge command = NOT ACTIVE Test Deluge command = ACTIVE Used as target area of the testing command	DELUGE TEST DELUGE TEST	White Yellow (Flashing)

6.3.3 Water curtain display



Data animation tables

No.	Display description	Display	Colour
1	Deluge command = NOT ACTIVE Deluge command = ACTIVE Release status = ACTIVE Released discrepancy = ACTIVE Used as target area of reset release command	WATER CURTAIN WATER CURTAIN WATER CURTAIN WATER CURTAIN	White Blue Blue steady Red
2	Gas detection = ACTIVE Gas detection = NORMAL	GAS DETECTION GAS DETECTION	Red Blue
4	Fault = ACTIVE Fault = NOT ACTIVE		Red Hidden
3	Test Deluge command = NOT ACTIVE Test Deluge command = ACTIVE Used as target area of the test command	DELUGE TEST DELUGE TEST	White Yellow (Flashing)

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1. Scope

The purpose of this document is to define the Standard Function for Fire Extinguishing Systems (Fire ext.), consisting of inert gas or CO₂ flooding systems.

In order to assist in understanding, this document should be read in conjunction with **GS EP INS 150**, Design Methods for System Configuration Standard Functions.

This standard is generally associated with other Standard Functions such as 2ooN voting logic, safety bar logic, etc.

2. General description of functions

2.1 List of main functions

The logic is composed of the following basic functions:

- Extinguishing command
- Operator alarming
- Solenoid valve command
- Test

3. Interfaces description

INPUTS					OUTPUTS			
Field	HMI	Internal			Internal	HMI	Field	
			Fire Ext. Standard	One loop fault		Alm		
		●		Release reset command	Extinguishing command		●	Alm
		●		Test activation command	Klaxon			●
				●	Extinguishing activation		Alm	●
	●				Local manual activation		●	●
	●				Extinguishing mode			●
	●				Inert gas release status			
					Main solenoid valve			●
					Test status		●	

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4. Detailed description of functions

4.1 Mode and commands management

4.1.1 Test command

Each inert gas extinguishing system logic is provided with a test facility in maintenance access level. This test command activates the extinguishing command no matter the selected mode (either auto or manual).

Dedicated screen areas located on the geographical representation of the fire detection zone mimics will give access to the test command.

A double confirmation (processed at HMI level) is required to verify the operator is fully aware a test is going to be performed. The complete sequence shall be initiated:

- Flashing light and klaxon activation
- Solenoid activation (but no general alarm).

4.1.2 Local manual activation command

Each room is equipped with local manual activation commands. These will activate the extinguishing command no matter the selected mode (either auto or manual).

4.1.3 Release reset command

This reset command, in operator access level, is used to reset the extinguishing command (after the extinguishing activation command has returned to a healthy state). Operating the reset command means the room is back to a safe state.

4.1.4 Extinguishing mode

Auto/manual selector is provided at the main entry to the room. This allows the selection of automatic inert gas release as per the F&G system logic.

4.2 Internal data calculation rules

4.2.1 Extinguishing command

This internal data can take the two following statuses: *INITIATED* - *NORMAL*.

For each inert gas system, the extinguishing command is *INITIATED* when one of the three following conditions is activated:

- Test command
- Local manual command
- Extinguishing activation = *ACTIVE* and extinguishing mode = *AUTO*.

Upon release reset command being operated, the extinguishing command returns to *NORMAL*, if the above three initiating conditions have already returned to *NORMAL*.

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4.2.2 Operator alarming

For each inert gas system, two specific animations are provided to the operators:

- Local animation (inside and outside protected area):
 - Klaxon (inside), when the extinguishing command is *INITIATED*
 - or the inert gas released is *ACTIVE*
 - Flashing lights (inside and outside), when the extinguishing command is *INITIATED*
 - or the INERT GAS released is *ACTIVE*
 - Extinguishing mode (outside), depending on the local selector position
 - Inert gas released (outside)
- Control room animation (HMI consoles):
 - Extinguishing command
 - Extinguishing mode, depending on the local selector position
 - Inert gas released
 - One loop fault, upon line monitored fault or failure of one of the I/O loops handled by the inert gas standard
 - Test activation command.

Upon release reset command, the inert gas released alarm returns to *NORMAL* if the inert gas release status is *NORMAL*.

4.2.3 Solenoid valve initiation

When the extinguishing command is *INITIATED*, the release solenoid valve (line monitored output) is activated after a specific time delay (usually 30 sec) to allow site operators to escape from the protected area.

5. Tuning parameters and variables

Parameter	Access level
Solenoid valve time delay set point	Maintenance

6. Representation and animation description (HMI)

6.1 Events and values to be recorded

- Test command
- Test validation
- Local manual activation command
- Local position
- Inert gas released

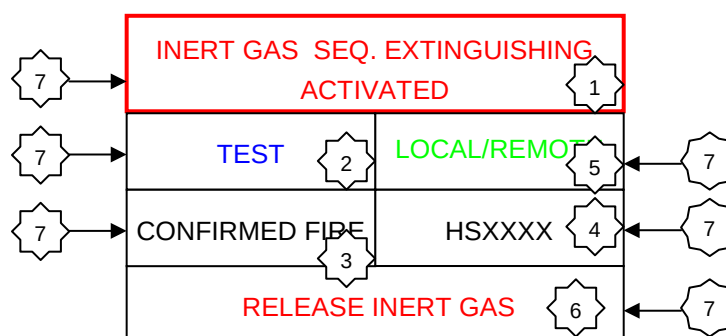
- Extinguishing mode
- Extinguishing command
- Loop fault.

6.2 Alarm management

Data	Alarm
Test command	Level 3
Local manual command	Level 3
Extinguishing command	Level 3
Inert gas released	Level 3
Loop fault alarm	Level 3

6.3 Specific animation description

6.3.1 Animation



6.3.2 Data animation tables (for information)

No.	Display description	Display	Colour
1	Extinguishing command = INITIATED	INERT GAS SEQ. EXTING. ACTIVATED	Red
	Extinguishing command = NORMAL Used as target area to reset release command	INERT GAS SEQ. EXTING. ACTIVATED	Blue
2	Test command = RELEASE (set and reset command)	TEST	Yellow (flashing)
	Else Used as target area for test command	TEST	Blue
3	Confirmed fire = ACTIVE (as per 2ooN voting logic for animation)	CONFIRMED FIRE	Red
	Confirmed fire = NORMAL	CONFIRMED FIRE	Blue
4	Local manual command = RELEASE	HSXXXX	Red
	Local manual command = NORMAL	HSXXXX	Blue
5	Extinguishing mode = MANU	LOCAL	Red
	Extinguishing mode = AUTO	REMOTE	Green
6	INERT GAS released = ACTIVE	RELEASE INERT GAS	Red
	INERT GAS released = NORMAL	RELEASE INERT GAS	Blue
7	Loop Fault = ACTIVE		Red
	Loop Fault = NORMAL		Hidden

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1. Scope

The purpose of this document is to define the Standard Function for Voting logic (2ooN).

In order to assist in understanding, this document should be read in conjunction with **GS EP INS 150**, Design Methods for System Configuration Standard Functions

This standard is generally used in relationship with F&G detectors and AIS standards; it may also be applied to voting logic of DI_AL.

The outputs from the of 2ooN standard are usually processed by the Safety bar standard.

2. General description of functions

2.1 List of main functions

- Confirmed detection
- Fault status.

3. Interface description

INPUTS				OUTPUTS		
Field	HMI	Internal		Internal	HMI	Field

4. Detailed description of functions

The confirmed detection is active when 2°°N detectors/transmitters are in “Alarm”(i.e. exceeding the detection threshold value).

The initial voting logic will be reconfigured automatically in case of faulty detector as per the below tables.

Faulty detectors / transmitters may have different causes:

- Input enable/disable status
- Invalid status (i.e. out of range).

(Refer to AIS - **GS EP INS 196** - and Fire & Gas detectors Standard Functions in this present GS).

The hereafter voting rules are defined per type of function and per type of detector type: safety function, fire and gas detection as per the **GS EP SAF 312**.

4.1 Voting rules for Fire detection

	Voting Configuration	1 Fault	2 Faults	3 Faults
Fusible Plug Loop (pressure sensors)	2oo3	1oo2 + Fault alarm (note 1)	1oo1 + Fault alarm (note 1)	Confirmed detection + Total failure alarm
Smoke Detection	2oo2	1oo1 + Fault alarm (note 1)	Confirmed detection + Total failure alarm	
	2oo3	1oo2 + Fault alarm (Note 1)	1oo1 + Fault alarm (Note 1)	Confirmed detection + Total failure alarm
	2ooN (N>3)	2oo(N-1) + Fault alarm (Note 1)	1oo(N-2) + Fault alarm (Note 1)	Confirmed detection + Fault alarm (Note1)
Other Fire Detection Technologies	2oo2	2oo2 = not permitted		
	2oo3	1oo2 + Fault alarm (Note 1)	1oo1 + Fault alarm (Note 1)	Confirmed detection + Total failure alarm
	2ooN (N>3)	2oo(N-1) + Fault alarm (Note 1)	1oo(N-2) + Fault alarm (Note 1)	Confirmed detection + Total failure alarm

Note 1: No additional alarm will be presented, since already generated in case of faulty detector/ transmitter through the Input Standard Functions (e.g. AIS, RD, RDH).

4.2 Voting rules for Gas detection

	Voting Configuration	1 Fault	2 Faults	3 Faults
Flammable or Toxic Gas Detection	2oo2	2oo2 = not permitted		
	2oo3	1oo2 + Fault alarm (Note 1)	1oo1 + Fault alarm (Note 1)	Confirmed detection + Total failure alarm
	2ooN (N>3)	2oo(N-1) + Fault alarm (Note 1)	1oo(N-2) + Fault alarm (Note 1)	Confirmed detection + Fault alarm (Note 1)
Hydrogen Gas Detection	1oo2	1oo1 + Fault alarm (Note 1)	Confirmed detection + Total failure alarm	

Note 1: No additional alarm will be presented since already generated in case of faulty gas detector through the Input Standard Functions (e.g. GD, GDB).

4.3 Voting rules for ESD / PSS functions ($N \geq 3$)

	Voting Configuration	1 Fault	2 Faults	3 Faults
PSS / ESD Transmitters	2oo3	1oo2 + Fault alarm (Note 1)	Confirmed Detection + Fault alarm (Note 1)	Confirmed Detection + Total failure alarm
	2ooN (N>3)	2oo(N-1) + Fault alarm	1oo(N-2) + Fault alarm	Confirmed Detection + Fault alarm (Note 1)

Note 1: No additional alarm will be presented since already generated in case of faulty transmitter through the Input Standard Functions (i.e. AIS).

For more details of the logic of the voting systems, refer to the Appendix 1.

5. Representation and animation description (HMI)

5.1 Events to be recorded

- Confirmed detection
- Total failure
- Individual input in alarm (only when voting logic used with digital inputs).

5.2 Alarm handling

Alarm Description	Priority
Confirmed detection	Level 3
Total failure alarm	Level 3
Individual input in alarm	Level 3

5.3 Specific animation description

5.3.1 Animation on safety displays

Tag names will be as following:

- Confirmed gas detection → GSH xxxx (first level), GSHH xxxx (second level)
- Confirmed fire detection → RSHH xxxx (smoke), RHHH xxxx (heat)
- Safety threshold detection (AIS) → PSHH xxxx (pressure), etc.

Internal data	Display	Text (safety bar input)	Frame
Confirmed detection = <i>INACTIVE</i>	Tag name	Blue steady	NA
Confirmed detection = <i>ACTIVE</i> Alarm unacknowledged		Red flashing	NA
Confirmed detection = <i>ACTIVE</i> Alarm acknowledged	Tag name	Red steady	NA
Partial failure = <i>ACTIVE</i>		as above	Red steady (internal frame)
Total failure = <i>ACTIVE</i>		as above	(internal frame) Red flashing before acknowledgement Red steady after acknowledgement
Communication fault = <i>ACTIVE</i>		Blue	Magenta (external frame)

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5.3.2 Example of using in F&G safety matrix (for information)

(As per fire extinguishing system Standard Function)

		Inert gas extinguishing system	
Protected room name	GSH xxxx	HMI RELEASE	MAN
	GSHH xxxx	RSSH xxxx	LOCAL RELEASE
	Inert gas RELEASED		

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Chapter 12 Gas tight & Fire Damper Standard function

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1. Scope

The purpose of this document is to define the Standard Function for a Gas tight damper or Fire Damper, operated by the FGS.

In order to assist in understanding, this document should be read in conjunction with **GS EP INS 150**, Design Method for System Configuration Standard Functions.

This Standard Function is a fundamental building block, generally linked to the Safety Bar Standard Function.

2. General description of functions

2.1 Gas tight & Fire damper operating description

The Gas tight & Fire damper is automatically closed by the F&G logic (safety bar) and automatically opened when the safety bar returns to "Not tripped" status after its reset.

Limit switches are hardwired to FGS. Gas tight & Fire dampers positions will be transmitted to the HVAC panel from the PCS through hardwired links or redundant serial link.

The Fire damper can also be locally closed by the associated fusible bulb (or fusible link when electrically actuated). Therefore, in that case, the closed position has to be considered as fire detection.

This fire detection doesn't apply to gas tight dampers.

2.2 List of main functions

- Handling of field inputs/outputs with status and discrepancy detection
- Interfacing with higher level Standard Function (e.g. Safety Bar).

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3.2 Specific description of field interfaces

Corresponding field interfaces are:

- RVY (DO): solenoid valve operating command: **0 = Close**
- RVH (DI): open limit switch: **1 = Open**
- RVL (DI): closed limit switch: **1 = Closed**

Such tags are given for information, but shall be as per project specification.

4. Detailed description of functions

4.1 Operator's Commands and mode

4.1.1 Maintenance inhibit

Available when in maintenance access level.

When the maintenance inhibit is active:

- Limit switches are no longer considered in 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 status will be displayed as defined below.

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

4.2 Status definition

4.2.1 Operating command status

Operating command status is set to:

- Open when the concerned safety bar not tripped
- Close upon activation of the associated safety trip.

4.2.2 Gas tight & Fire damper Operating command (DO)

Same as Operating command status.

4.2.3 Open/Closed status

4.2.3.1 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.

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4.2.3.2 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.

4.2.4 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 not active when:

- Internal Closed/Open status are active
- or
- Operating in progress status is active
- or
- Maintenance inhibit status is active.

4.2.5 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.

4.2.6 Fault status

Reports a hardware fault relating to associated I/O cards (field inputs/output).

5. Tuning parameters and variables

Parameter	Access level
"Operation in progress" timer pre-set value	Engineer

6. Representation and animation description (HMI)

6.1 Events and values to be recorded

6.1.1 Events

- Maintenance inhibit command
- Operating command Status

- Discrepancy Status
- Fault status.

6.2 Alarm handling

Alarm Description	Priority
Discrepancy status	Level 2
Fire alarm	Level 3
Fault Status	Level 3

Fire alarm is generated only when:

- Open command is active
- and
- Open limit switch is not active and closed limit switch is active
- and
- Maintenance inhibit is not active.

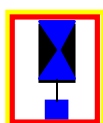
It applies to fire damper only (i.e. doesn't apply to the gas tight damper).

6.3 Control display

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

6.3.1 Gas tight & Fire damper representation

Frames



Controlled part }
Command part } Symbol

Gas tight & Fire Damper xxxx Hidden label

Gas tight & Fire Damper xxxx instrument label appears on operator request (soft key).

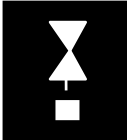
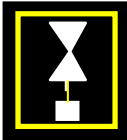
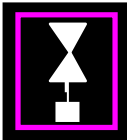
Gas tight & Fire Damper xxxx instrument label is used as target area for maintenance inhibit command.

6.3.2 Animation of the symbol (command and controlled parts)

Display description	Display	Symbol	Tagname on safety bar display
Gas tight & Fire damper closed or Communication or system fault		White White	White
Open command but Gas tight & Fire damper closed		White Fluid colour	White
Gas tight & Fire damper opening in progress		Fluid colour Blinking fluid colour	White
Gas tight & Fire damper open		Fluid colour Fluid colour	Blue
Close command but Gas tight & Fire damper open		Fluid colour White	Blue
Gas tight & Fire damper closing in progress		Blinking fluid colour White	Blue
Gas tight & Fire damper discrepancy when closing before acknowledgement		Red flashing White	Red flashing
Gas tight & Fire damper discrepancy when closing after acknowledgement Or open and closed limit switches active and maintenance inhibit status active		White Red	Red
Gas tight & Fire damper discrepancy when opening before acknowledgement		Red flashing Fluid colour	Red flashing
Gas tight & Fire damper discrepancy when opening after acknowledgement Or open and closed limit switches active and maintenance inhibit status active		Red Fluid colour	Red

 Gas tight & Fire damper in an undetermined position after a time delay

6.3.3 Animation of the frames

Display description	Display	Frames
Normal status		
Safety trip		External frame: White
Maintenance inhibit		External frame: Yellow
Fault (and maintenance inhibition)		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, and yellow.

Appendix 1 Detailed logic for voting systems

Legend:

MooN: M out of N voter

- CHx: represent the value of the input channel. TRUE=no trip condition / FALSE=trip condition
- CHx_OK: represent the fault status of the channel/module. TRUE=good health / FALSE=faulty
- OUT: represent the output of the voter. TRUE=no trip required / FALSE=trip required
- TOT-FAIL: alarm of a Total failure of the voting system. TRUE=no alarm / FALSE=alarm raised
- PART-FAIL: alarm of a Partial failure of the voting system (degraded mode).

TRUE=no alarm / FALSE=alarm raised

Note: PART_FAIL alarm is automatically masked when TOT_FAIL is active.

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Appendix 1
1002 for F&G: H₂ gas detector only

	1	2	3	4	5
Comment	Normal	1. CH-trip condition (1)	2. CH-trip condition (1)	1. Channel Fault (1)	2. Channel Fault (1)
Inputs					
CH1	TRUE	FALSE	FALSE	TRUE	TRUE
CH1_OK	TRUE	TRUE	TRUE	FALSE	FALSE
CH2	TRUE	TRUE	FALSE	TRUE	TRUE
CH2_OK	TRUE	TRUE	TRUE	TRUE	FALSE
Outputs					
OUT	TRUE	FALSE	FALSE	TRUE	FALSE
TOT_FAIL	TRUE	TRUE	TRUE	TRUE	FALSE
PART_FAIL	TRUE	TRUE	TRUE	FALSE	FALSE
	6	7	8	9	10
Comment	1. CH trip + 1. CH Fault (1)	1. CH trip + 1. CH Fault (1)	1. CH trip + 2. CH Fault (1)	2. CH trip + 1. CH Fault (1)	2. CH trip + 2. CH Fault (1)
Inputs					
CH1	FALSE	FALSE	FALSE	FALSE	FALSE
CH1_OK	TRUE	FALSE	FALSE	TRUE	FALSE
CH2	TRUE	TRUE	TRUE	FALSE	FALSE
CH2_OK	FALSE	TRUE	FALSE	FALSE	FALSE
Outputs					
OUT	FALSE	TRUE	FALSE	FALSE	FALSE
TOT_FAIL	TRUE	TRUE	FALSE	TRUE	FALSE
PART_FAIL	FALSE	FALSE	FALSE	FALSE	FALSE

(1) Only the combination of the input values is relevant for the function, but not which input is in faulty status.

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Appendix 1
2002 for F&G (smoke detector)

	1	2	3	4	5
Comment	Normal	1. CH-trip condition (1)	2. CH-trip condition (1)	1. Channel Fault (1)	2. Channel Fault (1)
Inputs					
CH1	TRUE	FALSE	FALSE	TRUE	TRUE
CH1_OK	TRUE	TRUE	TRUE	FALSE	FALSE
CH2	TRUE	TRUE	FALSE	TRUE	TRUE
CH2_OK	TRUE	TRUE	TRUE	TRUE	FALSE
Outputs					
OUT	TRUE	TRUE	FALSE	TRUE	FALSE
TOT_FAIL	TRUE	TRUE	TRUE	TRUE	FALSE
PART_FAIL	TRUE	TRUE	TRUE	FALSE	FALSE
	6	7	8	9	10
Comment	1. CH trip + 1. CH Fault (1)	1. CH trip + 1. CH Fault (1)	1. CH trip + 2. CH Fault (1)	2. CH trip + 1. CH Fault (1)	2. CH trip + 2. CH Fault (1)
Inputs					
CH1	FALSE	FALSE	FALSE	FALSE	FALSE
CH1_OK	TRUE	FALSE	FALSE	TRUE	FALSE
CH2	TRUE	TRUE	TRUE	FALSE	FALSE
CH2_OK	FALSE	TRUE	FALSE	FALSE	FALSE
Outputs					
OUT	FALSE	TRUE	FALSE	FALSE	FALSE
TOT_FAIL	TRUE	TRUE	FALSE	TRUE	FALSE
PART_FAIL	FALSE	FALSE	FALSE	FALSE	FALSE

(1) Only the combination of the input values is relevant for the function, but not which input is in faulty status.

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Appendix 1
2003 for F&G: fusible plug + smoke + other fire detection + flammable and toxic gas

	1	2	3	4	5	6	7
Comment	Normal	1. CH-trip condition (1)	2. CH-trip condition (1)	3. CH-trip condition (1)	1. Channel Fault (1)	2. Channel Fault (1)	3. Channel Fault
Inputs							
CH1	TRUE	FALSE	FALSE	FALSE	TRUE	TRUE	TRUE
CH1_OK	TRUE	TRUE	TRUE	TRUE	FALSE	FALSE	FALSE
CH2	TRUE	TRUE	FALSE	FALSE	TRUE	TRUE	TRUE
CH2_OK	TRUE	TRUE	TRUE	TRUE	TRUE	FALSE	FALSE
CH3	TRUE	TRUE	TRUE	FALSE	TRUE	TRUE	TRUE
CH3_OK	TRUE	TRUE	TRUE	TRUE	TRUE	TRUE	FALSE
Outputs							
OUT	TRUE	TRUE	FALSE	FALSE	TRUE	TRUE	FALSE
TOT_FAIL	TRUE	TRUE	TRUE	TRUE	TRUE	TRUE	FALSE
PART_FAIL	TRUE	TRUE	TRUE	TRUE	FALSE	FALSE	FALSE
	8	9	10	11	12	13	14
Comment	1. CH trip + 1. CH Fault (1)	1. CH trip + 1. CH Fault (1)	1. CH trip + 2. CH Fault (1)	1. CH trip + 2. CH Fault (1)	1. CH trip + 3. CH Fault (1)	2. CH trip + 1. CH Fault (1)	2. CH trip + 1. CH Fault (1)
Inputs							
CH1	FALSE	FALSE	FALSE	FALSE	FALSE	FALSE	FALSE
CH1_OK	TRUE	FALSE	TRUE	FALSE	FALSE	TRUE	FALSE
CH2	TRUE	TRUE	TRUE	TRUE	TRUE	TRUE	FALSE
CH2_OK	FALSE	TRUE	FALSE	FALSE	FALSE	FALSE	TRUE
CH3	TRUE	TRUE	TRUE	TRUE	TRUE	FALSE	TRUE
CH3_OK	TRUE	TRUE	FALSE	TRUE	FALSE	TRUE	TRUE
Outputs							
OUT	FALSE	TRUE	FALSE	TRUE	FALSE	FALSE	FALSE
TOT_FAIL	TRUE	TRUE	TRUE	TRUE	FALSE	TRUE	TRUE
PART_FAIL	FALSE	FALSE	FALSE	FALSE	FALSE	FALSE	FALSE
	15	16	17	18	19		
Comment	2. CH trip + 2. CH Fault (1)	2. CH trip + 2. CH Fault (1)	2. CH trip + 3. CH Fault (1)	3. CH trip + 2. CH Fault (1)	3. CH trip + 3. CH Fault (1)		
Inputs							
CH1	FALSE	FALSE	FALSE	FALSE	FALSE		
CH1_OK	FALSE	FALSE	FALSE	FALSE	FALSE		
CH2	TRUE	FALSE	FALSE	FALSE	FALSE		
CH2_OK	FALSE	FALSE	FALSE	FALSE	FALSE		
CH3	FALSE	TRUE	TRUE	FALSE	FALSE		
CH3_OK	TRUE	TRUE	FALSE	TRUE	FALSE		
Outputs							
OUT	FALSE	TRUE	FALSE	FALSE	FALSE		
TOT_FAIL	TRUE	TRUE	FALSE	TRUE	FALSE		
PART_FAIL	FALSE	FALSE	FALSE	FALSE	FALSE		

(1) Only the combination of the input values is relevant for the function, but not which input is in faulty status.

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Appendix 1
2003 for ESD / PSS (ESD/PSS transmitters)

	1	2	3	4	5	6	7
Comment	Normal	1. CH-trip condition (1)	2. CH-trip condition (1)	3. CH-trip condition (1)	1. Channel Fault (1)	2. Channel Fault (1)	3. Channel Fault
Inputs							
CH1	TRUE	FALSE	FALSE	FALSE	TRUE	TRUE	TRUE
CH1_OK	TRUE	TRUE	TRUE	TRUE	FALSE	FALSE	FALSE
CH2	TRUE	TRUE	FALSE	FALSE	TRUE	TRUE	TRUE
CH2_OK	TRUE	TRUE	TRUE	TRUE	TRUE	FALSE	FALSE
CH3	TRUE	TRUE	TRUE	FALSE	TRUE	TRUE	TRUE
CH3_OK	TRUE	TRUE	TRUE	TRUE	TRUE	TRUE	FALSE
Outputs							
OUT	TRUE	TRUE	FALSE	FALSE	TRUE	FALSE	FALSE
TOT_FAIL	TRUE	TRUE	TRUE	TRUE	TRUE	TRUE	FALSE
PART_FAIL	TRUE	TRUE	TRUE	TRUE	FALSE	FALSE	FALSE
	8	9	10	11	12	13	14
Comment	1. CH trip + 1. CH Fault (1)	1. CH trip + 1. CH Fault (1)	1. CH trip + 2. CH Fault (1)	1. CH trip + 2. CH Fault (1)	1. CH trip + 3. CH Fault (1)	2. CH trip + 1. CH Fault (1)	2. CH trip + 1. CH Fault (1)
Inputs							
CH1	FALSE	FALSE	FALSE	FALSE	FALSE	FALSE	FALSE
CH1_OK	TRUE	FALSE	TRUE	FALSE	FALSE	TRUE	FALSE
CH2	TRUE	TRUE	TRUE	TRUE	TRUE	TRUE	FALSE
CH2_OK	FALSE	TRUE	FALSE	FALSE	FALSE	FALSE	TRUE
CH3	TRUE	TRUE	TRUE	TRUE	TRUE	FALSE	TRUE
CH3_OK	TRUE	TRUE	FALSE	TRUE	FALSE	TRUE	TRUE
Outputs							
OUT	FALSE	TRUE	FALSE	FALSE	FALSE	FALSE	FALSE
TOT_FAIL	TRUE	TRUE	TRUE	TRUE	FALSE	TRUE	TRUE
PART_FAIL	FALSE	FALSE	FALSE	FALSE	FALSE	FALSE	FALSE
	15	16	17	18	19		
Comment	2. CH trip + 2. CH Fault (1)	2. CH trip + 2. CH Fault (1)	2. CH trip + 3. CH Fault (1)	3. CH trip + 2. CH Fault (1)	3. CH trip + 3. CH Fault (1)		
Inputs							
CH1	FALSE	FALSE	FALSE	FALSE	FALSE		
CH1_OK	FALSE	FALSE	FALSE	FALSE	FALSE		
CH2	TRUE	FALSE	FALSE	FALSE	FALSE		
CH2_OK	FALSE	FALSE	FALSE	FALSE	FALSE		
CH3	FALSE	TRUE	TRUE	FALSE	FALSE		
CH3_OK	TRUE	TRUE	FALSE	TRUE	FALSE		
Outputs							
OUT	FALSE	FALSE	FALSE	FALSE	FALSE		
TOT_FAIL	TRUE	TRUE	FALSE	TRUE	FALSE		
PART_FAIL	FALSE	FALSE	FALSE	FALSE	FALSE		

(1) Only the combination of the input values is relevant for the function, but not which input is in faulty status.

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Appendix 1
2ooN (N>3) for ESD+PSS (transmitters) and F&G (smoke+other fire detection+flammable and toxic gas)

	1	2	3	4	5	6	7
Comment	Normal	1. CH-trip condition (1)	2. CH-trip condition (1)	3. CH-trip condition (1)	all CH trip condition	1. Channel Fault (1)	2. Channel Fault (1)
Inputs							
CH1	TRUE	FALSE	FALSE	FALSE	FALSE	TRUE	TRUE
CH1_OK	TRUE	TRUE	TRUE	TRUE	TRUE	FALSE	FALSE
CH2	TRUE	TRUE	FALSE	FALSE	FALSE	TRUE	TRUE
CH2_OK	TRUE	TRUE	TRUE	TRUE	TRUE	TRUE	FALSE
CHx	TRUE	TRUE	TRUE	FALSE	FALSE	TRUE	TRUE
CHx_OK	TRUE	TRUE	TRUE	TRUE	TRUE	TRUE	TRUE
Outputs							
OUT	TRUE	TRUE	FALSE	FALSE	FALSE	TRUE	TRUE
TOT_FAIL	TRUE	TRUE	TRUE	TRUE	FALSE	TRUE	TRUE
PART_FAIL	TRUE	FALSE	FALSE	FALSE	FALSE	FALSE	FALSE
	8	9	10	11	12	13	14
Comment	3. Channel Fault (1)	(N-1). CH Fault (1)	N. (all) CH Fault	1. CH trip + 1. CH Fault (1)	1. CH trip + 2. CH Fault (1)	1. CH trip+ 2. CH Fault (1)	2. CH trip + 1. CH Fault (1)
Inputs							
CH1	TRUE	TRUE	TRUE	FALSE	FALSE	FALSE	FALSE
CH1_OK	FALSE	FALSE	FALSE	TRUE	TRUE	FALSE	TRUE
CH2	TRUE	TRUE	TRUE	TRUE	TRUE	TRUE	TRUE
CH2_OK	FALSE	FALSE	FALSE	FALSE	FALSE	FALSE	FALSE
CHx	TRUE	TRUE	TRUE	TRUE	TRUE	TRUE	FALSE
CHx_OK	FALSE	FALSE (1)	FALSE	TRUE	FALSE	TRUE	TRUE
Outputs							
OUT	FALSE	FALSE	FALSE	TRUE	FALSE	TRUE	FALSE
TOT_FAIL	TRUE	TRUE	FALSE	TRUE	TRUE	TRUE	TRUE
PART_FAIL	FALSE	FALSE	FALSE	FALSE	FALSE	FALSE	FALSE
	15	16	17	18	19	20	
Comment	2. CH trip + 1. CH Fault (1)	2. CH trip + 2. CH Fault (1)	2. CH trip + 2. CH Fault (1)	2. CH trip + 3. CH Fault (1)	3. CH trip + 2. CH Fault (1)	all CH trip + all CH Fault (1)	
Inputs							
CH1	FALSE	FALSE	FALSE	FALSE	FALSE	FALSE	
CH1_OK	FALSE	FALSE	FALSE	FALSE	FALSE	FALSE	
CH2	FALSE	TRUE	FALSE	FALSE	FALSE	FALSE	
CH2_OK	TRUE	FALSE	FALSE	FALSE	FALSE	FALSE	
CHx	TRUE	FALSE	TRUE	TRUE	FALSE	FALSE	
CHx_OK	TRUE	TRUE	TRUE	FALSE	TRUE	FALSE	
Outputs							
OUT	TRUE	FALSE	TRUE	FALSE	FALSE	FALSE	
TOT_FAIL	TRUE	TRUE	TRUE	FALSE	TRUE	FALSE	
PART_FAIL	FALSE	FALSE	FALSE	FALSE	FALSE	FALSE	

(1) Only the combination of the input values is relevant for the function, but not which input is in faulty status.