



Exploration & Production

## GENERAL SPECIFICATION

### INSTRUMENTATION

#### GS EP INS 131

|                                                                                |
|--------------------------------------------------------------------------------|
| <b>Standard Functions and Functional Analysis<br/>Development Requirements</b> |
|--------------------------------------------------------------------------------|

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## 1. Scope

This specification defines the minimum requirements for the development of Standard Functions and Functional Analysis (sometimes called control narratives) for ICSS and packaged units intended for use on TOTAL Exploration & Production facilities. It shall be applied by all projects developing new installations or extending the existing facilities.

Standard Functions are developed to define the Hardware interface and Software requirements for individual instrument and equipment.

These Standard Functions are key requirements for the development of the Functional Analysis which would then define how these functions are applied to specific process/utility and safety sub systems.

This specification shall be used in conjunction with **GS EP INS 110**, **GS EP INS 134**, **GS EP INS 150**, **GS EP INS 196**, **GS EP INS 197** and **GS EP INS 198**.

## 2. Reference documents

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

### Standards

| Reference      | Title |
|----------------|-------|
| Not applicable |       |

### Professional Documents

| Reference      | Title |
|----------------|-------|
| Not applicable |       |

### Regulations

| Reference      | Title |
|----------------|-------|
| Not applicable |       |

### Codes

| Reference      | Title |
|----------------|-------|
| Not applicable |       |



### Other documents

| Reference      | Title |
|----------------|-------|
| Not applicable |       |

### Total General Specifications

| Reference     | Title                                                       |
|---------------|-------------------------------------------------------------|
| GS EP INS 110 | Instrumentation for package units                           |
| GS EP INS 134 | Design and supply of integrated control and safety system   |
| GS EP INS 150 | Design method for system configuration - Standard functions |
| GS EP INS 196 | Input and Output Standard Functions                         |
| GS EP INS 197 | Process Standard Functions                                  |
| GS EP INS 198 | Safety and Fire & Gas Standard Functions                    |

## 3. Definitions

### 3.1 Parties

|                                          |                                                                            |
|------------------------------------------|----------------------------------------------------------------------------|
| <b>Functional Analysis Subcontractor</b> | Subcontractor that develops the Functional Analysis for the complete plant |
| <b>ICSS Supplier</b>                     | Entity that provides the Integrated Control and Safety Systems             |
| <b>Package Supplier</b>                  | Entity that provides the P3 type package                                   |

### 3.2 Abbreviations

|              |                                                 |
|--------------|-------------------------------------------------|
| <b>DMCMS</b> | Data Management and Condition Monitoring System |
| <b>ECS</b>   | Electrical Control System                       |
| <b>EDP</b>   | Emergency Depressurization                      |
| <b>ESD</b>   | Emergency Shut-Down                             |
| <b>FA</b>    | Functional Analysis                             |
| <b>FAT</b>   | Factory Acceptance Test                         |
| <b>FDS</b>   | Functional Design Specification                 |
| <b>FGS</b>   | Fire and Gas System                             |
| <b>HMI</b>   | Human Machine Interface                         |
| <b>ICSS</b>  | Integrated Control and Safety System            |
| <b>I/O</b>   | Inputs/Outputs                                  |
| <b>OFMS</b>  | Overall Flow Metering System                    |



|            |                               |
|------------|-------------------------------|
| <b>OTS</b> | Operator Training Simulator   |
| <b>PCS</b> | Process Control System        |
| <b>PLC</b> | Programmable Logic Controller |
| <b>PSS</b> | Process Safety System         |
| <b>UCP</b> | Unit Control Panel            |

## 4. Introduction

### 4.1 Standard Functions

Standard Functions documents are required to describe the hardware interface and software of an individual instrument or item of equipment. They shall describe the functions required of all process monitoring, control and safety protection.

These Standard Functions then become the building block for the loop wiring hardware design as well as the base configuration of the instrument or item of equipment.

The Standard Functions, both hardware and software, shall be verified and fully tested as per Appendix 4 - Testing Requirements of the **GS EP INS 134** prior to their implementation within the system

### 4.2 Plant Functional Analysis

Functional Analysis documents are required to describe with all relevant data and information the detailed functionalities of process units, utilities, equipment, packages and their interfaces with the ICSS.

It shall logically describe and present such functions and their relationships in an hierarchical structures that expresses the operational needs and enables the ICSS and Package Suppliers to configure the systems adequately without any ambiguity.

The Plant Functional Analysis shall explain how individual Standard Functions are to be used within specific process or utility units of the plant.

The Plant Functional Analysis shall primarily be used for ICSS configuration, OTS design, and shall also be a support for the Factory Acceptance Tests, field production operation manuals documents and maintenance activities.

### 4.3 Package Functional Analysis

The Package Functional Analysis documents are required to describe with all relevant data and information the detailed functionalities of a specific P3 package.

The Package Functional Analysis shall primarily be used for configuring the package UCP. It shall also be used for developing the associated Plant Functional Analysis



## 5. Methodology

### 5.1 Responsible parties

#### 5.1.1 Contractor

Contractor shall have the ultimate responsibility for the Functional Analysis even though actual development of the analysis shall be done by the Functional Analysis Subcontractor, unless specifically defined otherwise by the project contract strategy.

Contractor shall compile all the required documents and drawings as listed in section 7.1 of this specification, these shall be arranged into a readily usable package for the use of the Functional Analysis Subcontractor.

#### 5.1.2 ICSS Supplier

The ICSS Supplier shall develop the Standard Functions to be used within the ICSS system.

These shall be developed in close liaison with the Contractor and Company Field Operations representative.

#### 5.1.3 Functional Analysis Subcontractor

A single experienced Subcontractor shall be engaged by the Contractor to develop all the Functional Analysis for the complete plant.

Such Subcontractor shall be approved by Company.

The Functional Analysis Subcontractor shall work in close liaison with Contractor, Company Field Operations representative, ICSS Supplier and Package Suppliers.

#### 5.1.4 P3-Package Equipment Supplier

Package Supplier shall be responsible for carrying out the detailed Package Functional Analysis for his supplied package equipment. The analysis provided by the Package Supplier shall be part of the input documents required for the Plant Interface Functional Analysis by the Functional Analysis Subcontractor.

### 5.2 Execution plan

#### 5.2.1 Standard Functions

Standard Functions are the base building blocks of the ICSS configuration. They shall be developed by the ICSS Supplier taking into account the specific instruments and equipment to be used on the project.

These standard functions will generally be developed early in the project lifecycle.

They shall be verified by testing, those tests shall be done in accordance with the requirements of **GS EP INS 134** for Standard Function Tests.

Once validated, they shall be considered as “frozen”. Any modification post Standard Function Tests shall require specific approval from Company and the modified Standard Function re-tested.

All Standard Functions shall be developed from approved engineering documents.



### 5.2.2 Plant Functional Analysis

Considering that the Functional Analysis is intended primarily to enable the configuration of the application software by the ICSS Supplier, the finalized revision of the Functional Analysis shall therefore be available prior to commence the application software implementation.

The Functional Analysis shall be developed from engineering documents approved for construction and. after the completion of the HAZOP/ SIL assessment studies.

Functional Analysis is a continuous process until hand over to operations. Functional Analysis Subcontractor shall participate in all parts of this process, specifically including testing and commissioning.

Specific up-dates as-FAT/IFAT and as-commissioned shall be provided by Functional Analysis Subcontractor.

### 5.2.3 Package Functional Analysis

For P3 packages, the Package Supplier shall supply the Package Functional Analysis for approval prior to UCP configuration. Contractor shall ensure that the Package Functional Analysis is approved prior to use by the Functional Analysis Subcontractor.

The Package Functional Analysis shall, in addition, form part of the Package Suppliers final documentation.

## 6. Standard Functions

### 6.1 Software

Software Standard Functions are developed control / logic blocks meant to be repeated without any modifications throughout the systems application with different combinations of control and safety systems I/Os.

All Standard Functions used for the described functions shall be listed with all relations between each other.

Sets of Standard Functions have been prepared and detailed within the [GS EP INS 196](#), [GS EP INS 197](#) and [GS EP INS 198](#). It is believed that these Standard Functions cover the majority of applications. However, each project shall review its specific requirements and prepare supplementary Standard Functions as necessary.

The content of the analysis of Standard Functions shall include the following:

- General Description of Functions:
  - Context
  - List of main functions.
- Description of Interfaces:
  - General description
  - Field interface description.



- Detailed Description of Functions:
  - States, Modes, Commands
  - Calculation rules
  - Typical functional behaviour
  - Degraded modes of operation.
- Tuning Parameters And Variables
- Representation And Animation Description (HMI):
  - Events and values to be recorded
  - Alarm management
  - Faceplate and Control display description.

## 6.2 Hardware

Hardware Standard Functions are developed wiring typical which shall be the basis for the ICSS hardware build. It shall be developed for each type of instrument/loop or item of equipment used. It shall demonstrate that the field device is fully compatible with the ICSS system in all modes of operation

The hardware Standard Function shall fully complement and be verified with, the software Standard Function

The content of the design will include:

- Narrative description
- List of material (card, type, relay type, IS barrier type etc.)
- Typical wiring diagram
- Degraded mode operation description (redundancy etc.).

## 7. Plant Functional Analysis

### 7.1 Input Documents

The Functional Analysis shall be based on the reference documents in paragraph 2 of this specification and applicable project documents such as:

- Process Flow Diagrams
- Piping and Instrumentation Diagrams
- Process notes and descriptions
- Operating philosophy
- Process Control philosophy
- Instruments database and I/O list
- Safety concept
- ESD Diagrams

- Fire and Gas Causes and Effects diagrams
- ESD / F&G interface – electrical isolation block diagram
- Project operator interface specification
- ICSS architecture block diagram
- HMI graphic displays hierarchy and principles
- Alarm management specification
- Equipment layout drawings
- Fire and gas detectors and safety equipment layouts
- Standard Functions
- Package Functional Analysis.

Functional analysis shall be developed from approved engineering documents.

## 7.2 Dossier Structure and Organisation

The Functional Analysis shall be developed in three broad categories:

- **Process Functional Analysis** - for functions attached to the PCS and PSS
- **Safety Functional Analysis** - for functions attached to ESD or FGS or HIPS
- **Interface Functional Analysis** - pertaining to the interfaces between the ICSS and the Packages. This also includes interfaces between the ICSS and other systems such as DMCMS, OFMS.

Further sub-divisions or addition to the above categories may be considered according to the dictates of each project particular requirements.

These dossiers shall be organized such that there shall be a section per each functional process or utility system covering both process control and process safety functions. ESD and Fire & Gas functions shall also be included even if not attached to a specific process function.

These functions and their relationships shall be comprehensively described and evaluated. The level of definition of all relevant data shall be detailed enough to allow ICSS Supplier and OTS Supplier to configure easily without further re-interpretation but also clear enough to be used by anyone even if he/she is not an Instrument System specialist.

A narrative of the functionalities of concerned process/utility section shall be provided, it shall include a general description of the process/utility unit, its main function, all the operation modes and interlocks, switch over and trip conditions, together with all associated systems interfaces.

Sketches and diagrams such as logic loops, sequence charts, etc shall be included to clarify the descriptions.

All I/Os shall be covered in the Functional Analysis including those for Utilities.

For a P3 type package, a dedicated Interface Functional Analysis shall be established based on the Package Functional Analysis and shall describe all interfaces between ICSS and package UCP.

All documents developed during the Functional Analysis shall be organized in a coherent manner.

### 7.2.1 Process/Utility Functional Analysis

This part of the analysis shall provide enough information and details on process control and process safety functions and the associated instrumentation to allow the PCS and PSS configuration.

This shall include as a minimum for each process section:

- General process system description:
  - Process system narratives
  - General process system sketch
  - Main equipment list (tag name, function, service, unit, P&ID)
  - Major operating modes & process functions
  - Initial process conditions.
- Process control system description:
  - Process functional description (detailed sketch, loop descriptions. logic sequencing etc)
  - Alarm grouping / masking (i.e. The specific implementation of alarm management specification requirements)
  - Specific alarms / operator guide messages
  - Tuning parameters.
- Process safety system description:
  - Safety logic diagram legend
  - Safety logic diagram
  - Start-up /maintenance inhibits
  - Tuning parameters.
- Interactions:

**All interactions with the PCS/PSS shall be described, both internal and external to the process system. These will include:**

- Interaction between PCS and PSS within the section
- Interactions with other process functions (external to the section)
- Interactions with other sub-systems and packages (ESD, FGS, ECS etc.)
- Interactions with other facilities (other platforms, etc.).

Interactions already described in the Standard Functions do not have to be described again in this section.

- HMI:
  - HMI displays layout, dynamics, hierarchy and navigation.



- I/O list:

The I/O list table shall have comprehensive fields including at least the following:

- Tag
- Description
- Signal type
- Associated Standard Function
- Systems
- Package (if required)
- Range
- Engineering Units
- Thresholds value.

### 7.2.2 Safety Functional Analysis (ESD, Fire & Gas)

This refers to the Functional Analysis for ESD and Fire & Gas functions including those that are not attached to any specific process unit. It shall describe the safety functions as well as their interactions with the associated instrumentation and other systems.

All ESD functions stated in the ESD logic diagrams and FGS functions stated in the Fire & Gas Cause/Effect Charts shall be included. Likewise the links with others systems and facilities.

The content of such analysis shall include the following:

- Safety systems description
- Safety bar and Instrument identification:
  - ESD Safety bar codification
  - FGS bar, voting and instrument identification
  - Safety Bar Colors
  - List of Standard Functions.
- I/O list table with comprehensive fields (see § 7.2.1)
- ESD levels descriptions with Safety Logic Diagrams:
  - ESD 0 Level
  - ESD 1 level (including, EDP, Electrical Isolation)
  - ESD 2 level
  - Start-up inhibits and tuning parameters.
- HMI:
  - HMI displays layout, dynamics, hierarchy and navigation.

- FGS description with safety logic diagrams:
  - Gas Detection (1st and 2nd Threshold detections, confirm detections, voting tables)
  - Fire detection and Fire fighting
  - Visual and Audible Alarms
  - Manual Alarm Call points
  - The list of exchanged signals with other systems and packages.

- HMI:
  - HMI displays layout, dynamics, hierarchy and navigation.

- Interactions

All interactions, both internal and external to the ESD and the FGS functions shall be described in this section. These will include:

- Interactions between ESD and PCS/PSS
- Interactions between FGS and PCS/PSS (including monitoring from PCS)
- Interactions between FGS and ESD
- Interactions between ESD and HIPS
- Interaction between package fire detection systems / LQ addressable fire detection system and main FGS.
- Communication link failure
- Tuning parameters.

### 7.2.3 Interface Functional Analysis

Interface between package UCP and the ICSS is described in this analysis. The control system architecture and more particularly the type of exchanged data (hardwired or serial) will be represented in relevant diagram, figures and tables. In addition, this section shall provide a brief explanation of the control and the safety operations.

The content of this analysis shall include the following:

- General Description of Package Unit:
  - Package Unit description
  - Package Unit general sketch.
- Package – ICSS interface sketch:
  - Characteristics of Interfaces between UCP and ICSS.
- Local and Remote Operating Modes:
  - Local / Remote transition
  - Local operation from Package Unit HMI
  - Remote operation from ICSS HMI.



- Commands and Parameters accessible from ICSS HMI:
  - Commands
  - Parameters.
- Alarms and Shutdown:
  - Philosophy
  - Description.
- Communication Link Failure Strategy
- Time Synchronization type and description
- Hardwired Signals tables
- Serial Links data exchange table, specifically ensuring only data for operations and control is transmitted.

## 8. Package Functional Analysis

The Package Supplier shall provide a comprehensive Functional Analysis and description of the package. This shall express in detail all the controls, sequential phases, alarms, events and any additional information implemented in the package PLC.

The main purpose of this analysis is to allow the ICSS configuration to be in accordance with the package control scheme, and to enable an efficient communication between the ICSS and the package PLC.

The Package Functional Analysis shall include full details of the package unit control philosophy and shall include the following topics:

- Integrated process control (detailing the way in which the package unit is influenced by, or influences, the connected process system)
- Explanation of the detailed control and safeguarding logic diagrams
- Explanation of all PID constants and control loops calculations
- Adequate documentation for PLC programming (logic diagram for combinatorial logic, grafcet flowchart for sequencing logic)
- Detailed I/O list and instrument index
- Hardwired signals exchanged between UCP and Electrical & Instrumentation interposing relay cabinets (motor control signals)
- Communication links between UCP and ICSS.



## Bibliography

AFNOR NF X 50-151 – Value Analysis and Functional Analysis.

EXERA S3756 X 99 – Practical guide to specifying automatic control for production systems

GS EP INS 107 – Design and installation of instrumentation links

GS EP INS 110 – Instrumentation for package units

GS EP INS 134 – Design and supply of integrated control and safety system

GS EP INS 135 – Cyber Security requirements for design and supply of ICSS and Package Systems

GS EP SAF 261 – Emergency Shutdown and Emergency De-pressurisation (ESD & EDP)

GS EP SAF 312 – Fire and Gas Detection Systems

GS EP SAF 321 – Fire Pump Stations and Fire Water Mains

GS EP SAF 331 – Carbon Dioxide Fixed Fire Extinguishing Systems

GS EP SAF 332 – Water mist and Gaseous Fixed Fire Extinguishing Systems

GS EP SAF 334 – Foam Fire Extinguishing Systems

GS EP SAF 371 – Emergency Control Facilities

## Appendix 1 Engineering Flow Chart

