

GENERAL SPECIFICATION

PROCESS

GS EP ECP 105

Process and Flow Assurance deliverables to be prepared by Contractor during engineering phases

06	12/2017	Requirements clarifications
05	11/2013	Introduction of Flow Assurance specific deliverables
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1. Scope

This general specification is intended to define the minimum requirements applicable to Process and Flow Assurance documents and deliverables which are to be produced (engineering company and/or licensor and/or vendor) for basic and detailed engineering phases.

This general specification is intended for use for facilities such as oil and gas production plants, gas plants, LNG plants, LNG import terminals. It also applies to multiphase production systems and export/injection systems of field developments expected to have high exposure to flow and production chemistry issues.

This general specification defines the documentation to be produced for Company's projects (new installations and major modifications or extensions of existing installations). The breakdown of activities between main contractor, package contractors, sub-contractors, licensors etc and by Company (if applicable), is case-specific and should be specified in a Project Particular Specification.

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 addendums, is the latest revision published at the effective date of this document.

Reference	Title
API STD 520 Part I	Sizing, Selection, and Installation of Pressure-relieving Devices
ISO 4126-10	Safety devices for protection against excessive pressure - Part 10: Sizing of safety valves for gas/liquid two-phase flow

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Unless otherwise stipulated, the applicable version of these documents, including relevant appendices and addendums, is the latest revision published.

Reference	Title
GS EP DEV 001	Asset Objects Tagging
GS EP DEV 002	Reference Data Library
GS EP ECP 103	Process design criteria
GS EP ECP 107	Energy Efficiency calculations
GS EP ICS 001	2D CAD Layouts
GS EP ICS 002	2D CAD Process Schematics
GS EP MEC 275	Multi-Phase Rotodynamic Pumps

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Reference	Title
GS EP PVV 107	Piping Stress Analysis
GS EP PVV 111	Piping design specification
GS EP SAF 260	Design of High Integrity Protection Systems (HIPS)
GS EP SAF 261	Emergency Shut-Down and Emergency Depressurisation (ESD & EDP)
GS EP SAF 262	Pressure protection relief and hydrocarbon disposal systems

3. General

3.1 Terminology and definitions

There are four types of **statements** in this specification: “shall”, “should”, “may” and “can”. They are to be understood as follows:

Shall Is to be understood as mandatory. **Deviating from a “shall” statement requires derogation approved by Company.**

Should Is to be understood as strongly recommended to comply with the requirements of the specification. Alternatives shall provide the same level of protection or performance and this shall be documented.

May Is to be understood as permission.

Can Is to be understood as a physical possibility.

The following terms as defined below have been used throughout this specification.

Process: Discipline(s) in charge to study the oil and gas production plants, gas plants, LNG plants, terminals, etc., and all associated off sites and utility fluids.

Flow Assurance: A cross-functional, multidisciplinary approach aimed at ensuring that, both in design and operation, the reservoir fluids are transferred rapidly to the point of sale and fluid injection issues are integrated.

Flow assurance criticality: classification made by Company of a field with respect to its exposure to flow assurance concerns. It can be either high or low.

Contractor: The person or entity who is party to a contract with the COMPANY for supply of engineering service.

Fortified section: section of flowline with a higher pressure rating. Typical applications are downstream HIPS isolation valves (transient pressure during valve closure), or close to the surface installation to minimise the consequences in case of overpressure.

Gas-dominant fluid: $GOR > 3\,000\text{ Sm}^3/\text{m}^3$

Oil-dominant fluid: $GOR < 3\,000\text{ Sm}^3/\text{m}^3$

Tag: a unique alphanumerical code that reflects the function of an object within an asset. Refer to **GS EP DEV 001**.

3.2 Abbreviations

AIV	Acoustic Induced Vibrations
BDV	Blow Down Valve
BHP	Bottom Hole Pressure
BHT	Bottom Hole Temperature
BoD	Basis of Design
BSC	Basic Engineering project phase
BTEX	Benzene, Toluene, Ethylbenzene and Xylene
Btu	British thermal unit
BWG	Birmingham Wire Gage
CFD	Computational Fluid Dynamics
Cp	Heat capacity at constant pressure
CPT	Conceptual project phase
CGR	Condensate Gas Ratio
Cv	Heat capacity at constant volume
DTE	Detailed Engineering project phase
ESD	Emergency Shut-Down
ESDV	Emergency Shut-Down Valve
FA	Flow Assurance
FIV	Flow Induced Vibrations
F(P)SO	Floating (Production) Storage and Offloading facility
GLR	Gas/Liquid Ratio
GOR	Gas Oil Ratio
GVF	Gas V Fraction
h	Hour
HIPS	High Integrity Protection System

HMB	Heat and Mass Balance
LDHI	Low Dosage Hydrate Inhibitor
LMTD	Log Mean Temperature Differential
LNG	Liquefied Natural Gas
LPG	Liquefied Petroleum Gas
MPP	Multiphase Pump
NPSH_A	Available Net Positive Suction Head
PFD	Process Flow Diagram
PI	Productivity Index
P&ID	Piping and Instrumentation Diagram
PPR	Pre-Project phase
P_{res}	Reservoir Pressure
PSD	Process Safety Diagram
PSV	Pressure Safety Valve
PVT	Pressure Volume Temperature
SDV	Shut-Down Valve
SPS	Subsea Production System
THP	Tubing Head Pressure
THT	Tubing Head Temperature
TL	Tangent Line
T_{res}	Reservoir Temperature
TSV	Thermal Safety Valve
UFD	Utility Flow Diagram
UFR	Umbilicals Flow lines & risers
WC	Water Cut
WLR	Water liquid Ratio

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4. Process and Flow Assurance deliverables

Subject to Company approval and provided that all required technical items are actually issued, Contractor may propose an alternative breakdown of deliverables.

{Rule 1:

Contractor shall prepare, as a minimum and depending on the project phase, the documents listed in Table 1.}

Refer to section 5 for the description of the minimum content of the documents to be prepared and refer to **GS EP DEV 002** for reference data library requirements.

{Rule 2:

Contractor shall prepare, for projects defined by Company as high criticality developments with respect to Flow Assurance, as a minimum and depending on the project phase, the documents listed in Table 2.}

Refer to section 6 for the description of the minimum content of the documents to be prepared.

Table 1 Process deliverables per project phase

		BSC	DTE
Drawings	Process block flow diagram	U	U
	Process Flow Diagrams (PFD's)	U	U
	Utility Flow diagrams (UFD's)	U	U
	Piping and Instrumentation Diagrams (P&ID's)	U	U
	Emergency Shut-Down (ESD) diagram	U	U
	Process and Safety Diagrams (PSD's)	F	U
	Material Selection Diagrams (MSD's)	F	U
Documents	Process basis of design and design principles	U	U
	Fluid Data Book	U	U
	List of process software	U	U
	Simulation description	U	U
	Simulation outputs (including simulation files)	U	U
	Heat and material balances	U	U
	Utility balances	U	U
	Equipment Process data sheets	F	U
	Package process specification	U	U
	Instrument Process data sheets	F	U
	Fluids list	F	U
	Line list	F	U
	Process, utilities and off sites systems description	U	U
	Process operating philosophy	U	U
	Process control philosophy	F	U
Calculation notes	Vessels sizing	F	U
	Columns sizing	F	U
	Pumps	F	U
	Compressors	F	U
	Heat exchangers	F	U
	Lines sizing (Process, Utilities and Off sites piping)	F	U
	Lines (pipelines, flowlines, risers, etc.)	U	U
	Hydrate inhibition in process piping and equipment	F	U
	Tank heating	F	U
	Storage tank blanketing, venting	F	U
	F(P)SO wash tank CFD modelling and sloshing study	F	U
	Depressurisation	F	U
	Relief devices	F	U
	Flare(s)/cold vent(s) loads summary	U	U
	Flare(s)/cold vent(s) network(s) sizing	F	U
	Flare(s)/cold vent(s) radiations	U	U
	High integrity protective system (HIPS)	U	U
	Flow measuring/analysis system sizing	F	U
	Online Analysers	F	U
	Energy efficiency indicators	U	U
Notes	F First issue for Greenfield project, U for Brownfield project		
	U Update, from previous phases		

Table 2 Flow assurance deliverables per project phase (high criticality developments)

		BSC	DTE
Documents	Flow Assurance document register	U	U
	Flow Assurance basis of design and design principles (Contractor deliverables contributing to).	U	note
	Summary of FA data for engineering studies:		
	For topsides or process engineering studies.	U	U
	For pipeline engineering studies.	U	note
	For subsea equipment engineering studies.	U	U
	For product export engineering studies.	U	U
Calculation notes	Flow Assurance manual for operators	U	note
	Design conditions calculation note	U	note
	Steady-state conditions: thermo-hydraulic calculations	U	note
	Dynamic conditions calculation notes	U	note
Notes	Transient conditions calculation notes	U	note
	U : Update, from previous phases Note : Flow Assurance studies should conducted during DTE: - by UFR contractor to provide inputs for its design (e.g. for lateral buckling, pipe walking, ...) - by SPS contractor in case of subsea process equipment, for which dynamic simulations are required		

5. Deliverables description

5.1 Process block flow diagram

Process block flow diagram is a general diagram showing the number of processing trains and the successive process units for a quick understanding. Each unit is represented in a box or symbol with its tag and functionality. The main fluids to and from each box are shown.

5.2 Process Flow Diagrams (PFD)

Refer to [GS EP ICS 001](#) and [GS EP ICS 002](#).

Process Flow Diagrams represent the succession of the operations in the fluid processing to reach the required product specifications set in the objectives of the plant processing.

A legend sheet is provided giving the symbolisation of the main equipment and details on other symbols used.

The succession of operations is pictorially represented by equipment symbols and lines in order to achieve a good understanding of the process.

When equipment is duplicated or if it is spared, only one equipment is shown on the PFD.

The controls are indicated by a simplified symbolic representation of control loops.

The equipment tag is given close to the symbolic representation.

In the upper part of the sheet, the equipment tag is repeated to indicate the function of each equipment.

A number inside a diamond, included on the main lines, refers to the stream number of the heat and material balance table of the unit.

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5.3 Utility Flow Diagrams (UFD)

Similar to PFDs, the UFDs represent the utilities.

5.4 Piping and Instrumentation Diagrams (P&ID)

Reference is made to **GS EP ICS 001** and **GS EP ICS 002**.

P&IDs are detailed drawings used to develop construction drawings and subsequently for operation of the processing plant including off sites, utilities, packages and subsea systems.

5.4.1 P&ID minimum content

The minimum content is summarised in Table 3.

The location of main equipment symbols and line connections represent the relative location of each process component in the plant.

Repeated arrangements can be simplified (e.g. sampling point). In that case, the details of the typical is given in the legend sheet (see section 5.4.2).

In the lower part of the sheet, a description table gives for each equipment, the tag number, the function or service and the main characteristic values. Figure 1 gives typical representation for some equipment.

Table 3 Minimum content of P&IDs

	P&ID
Equipment	All
Equipment characteristics	
Tag	Yes
Elevation	Yes
Description table	Yes
Main lines	All
Secondary lines (e.g. recycles, mini flow, start up lines, crossover, etc.)	All
Lines characteristics	
Line tag	Yes
Nominal diameter	-
Fluid service identification	-
Piping class (if known) or rating, material and corrosion allowance	-
Insulation type	Yes
Insulation thickness/limit	Yes
Heat tracing	Yes
Minimum distance, low points / high points	Yes
Piping class change	
Slope	Yes
Valves	
Type	Yes
Manual isolation valves	
- For operation	Yes
- For maintenance	Yes
Actuated valves with identification	Yes
Actuated valves fail safe position	Yes
Manual valves Normal / locked indication	Yes
Particular line fitting	Yes