



Exploration & Production

GENERAL SPECIFICATION

PROCESS

GS EP ECP 105

Process documents to be prepared during engineering phase

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1. Scope

This general specification is intended to define the minimum requirements applicable to Process related documents which are to be produced by engineering and/or licensor and/or vendor at either basic or detailed engineering phase.

This general specification is intended for use for facilities such as oil and gas production plants, gas plants, LNG plants, LNG import terminals.

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 ECI 002	Drawings and symbols -Principles of presentation at project definition phase
GS EP ECP 103	Process sizing criteria
GS EP SAF 261	Emergency Shut-Down and Emergency De-Pressurisation (ESD & EDP)

3. General

3.1 Documents prepared

As a minimum, the following documents shall be prepared:

- Process design procedure
- Process block flow diagram
- Process heat and material balances
- Process Flow Diagrams (PFD's)
- Utilities balances
- Utilities Flow diagrams (UFD's)
- Piping and Instrumentation Diagrams (P&ID's)
- Process data sheets
- Process instrument data sheets
- Fluids list
- Lines list
- Emergency Shut-Down (ESD) diagram
- Emergency Shut-Down (ESD) matrix
- Process and Safety Diagrams (PSD's)
- Process, utilities and offsites description
- Process operating philosophy
- Calculation notes:
- Vessels sizing
- Columns sizing
- Pumps
- Compressors
- Heat exchangers



- Lines sizing
- Monophasic lines
- Multiphasic lines
- Hydrate inhibition
- Tank heating
- Storage tank blanketing, venting
- Depressurisation
- Relief devices
- Flare(s)/cold vent(s) loads summary
- Flare(s)/cold vent(s) network(s) sizing
- Flare(s)/cold vent(s) radiations
- High integrity protective system (HIPS)
- Flow measuring system sizing
- Energy efficiency indicators

3.2 Terminology and definition

The following term as defined below has been used through out this specification.

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

3.3 Drawing symbolisation

GS EP ECI 002 shall be followed.

The vendor and sub-supplier drawings shall also follow the drawing symbolisation defined for the concerned Project.

The modifications performed on a drawing between two revisions shall be clearly indicated with clouds. For other all documents (lists, data sheets, calculation notes, etc.), the modifications performed between two issues shall be easily visible.

3.4 Abbreviations

BDV	Blowdown Valve
BWG	Birmingham Wire Gage
DCS	Distributed Control System
ESD	Emergency Shut-Down
ESDV	Emergency Shut-Down Valve
HIPS	High Integrity Protective System
LMTD	Log Mean Temperature Differential



LNG	Liquefied Natural Gas
LPG	Liquefied Petroleum Gas
NPSH	Net Positive Suction Head
PFD	Process Flow Diagram
P&ID	Piping and Instrumentation Diagram
PLC	Programmable Logic Controller
PSD	Process Safety Diagram
PSDV	Process Shut-Down Valve
PSV	Pressure Safety Valve
SDV	Shut-Down Valve
TL	Tangent Line
TSV	Thermal Safety Valve
UFD	Utility Flow Diagram

4. Process design procedure

This document shall include at least:

- The purpose of the project
- Brief description
- Codes, standards and specifications
- Softwares packages to be used and a brief description for those not listed in **GS EP ECP 103**
- System of unit
- Process design basis
- Utilities design basis
- Products specifications
- Environmental conditions
- Process sizing criteria
- Plant units list and itemisation
- Equipment abbreviation and tagging philosophy
- Sparing philosophy
- Isolation philosophy
- Standard process hook-ups.



5. Process block flow diagram

A general diagram showing the number of treatment trains and the successive process treatment facilities for a quick understanding. Each unit is represented in a box with its reference item and functionality. The main fluids to and from each box are shown.

6. Process heat and material balances

Process heat and material balance for each process case identified in the design basis shall be issued with the compositions, thermodynamic and physical properties for all streams.

The thermodynamic model, equation of state, correlation's for calculation of liquid and vapour enthalpy, density, entropy, etc. used for the preparation of the heat and material balances shall be clearly indicated.

A stream shall be defined when it is used for sizing calculation and every time that one condition (pressure, temperature, flow rate, etc.) changes.

The computer outputs with all streams well identified shall be provided.

A complete scheme showing the location of the streams is required, it could be either an output sketch from the thermodynamic software simulation if it is easily readable or on the process flow diagrams.

The pressure drops, rotating equipment efficiencies, heat losses and heat inleak, etc. when relevant shall be clearly indicated.

7. Process Flow Diagrams (PFD's)

It presents the succession of the operations in the fluid(s) processing to reach the required products specifications set in the objectives of the plant processing.

The succession of operations are pictorially represented by equipment symbols and lines for a good understanding.

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

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

The equipment reference is given close to the symbolic representation.

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

A process flow diagram for each process case shall be issued and at least the pressure, temperature, flow rate, power and heat duty values are indicated in appropriated "square" shape.

A number inside a diamond, included in main lines, refers to the stream number of the heat and material balance table of the unit, sometimes integrated in the bottom part of the PFD sheet.

8. Utilities balances

Utility balances for each utility with the list of the consumers shall be issued for all operating modes and/or process cases (e.g. loading mode, non loading mode for LNG plant; normal, essential and emergency for electrical balance; etc.).

The margin factor shall be clearly stated.



When thermodynamic simulations are required, the same documents as in section 6 are required (e.g. fuel gas).

9. Utility Flow Diagrams (UFD's)

It presents the succession of the operations and distribution of each utility installed on the plant.

The succession of operations are pictorially represented by equipment symbols and lines for a good understanding.

When equipment is duplicated or if it is spared, only one equipment item is shown on UFD.

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

The equipment reference is given close to the symbolic representation.

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

A utility flow diagram for each utility operating mode and/or process case shall be issued and at least the pressure, temperature, flow rate, power and heat duty values are indicated in appropriated "square" shape.

A number inside a diamond, included in main lines, refers to the stream number of the utility balance table of the plant, sometimes integrated in the bottom part of the UFD sheet.

10. Piping and Instrumentation Diagrams (P&ID's)

These are the detailed drawings used to develop construction drawings and subsequently for operation of the processing plant including the associated off sites and utility fluids.

P&ID's symbol are required for a good understanding, they shall content at least:

- The symbolisation of the main equipment for PFD's and P&ID's
- The symbolisation of the piping, valves and fittings
- The symbolisation of the instrument lines
- The symbolisation and the definition of instrumentation
- The symbolisation of miscellaneous (e.g. limit of package, manhole, slope, special material, etc.)
- The list of the systems
- The list of the fluids symbols
- The list of abbreviations (for fluid, instrument, etc.)
- The insulation symbol and the list and designation of insulation type
- Identification of the equipment and line numbering
- Details of each typical sample connections with their representation symbol on P&ID's
- Details of each meter and analyser with their representation symbol on P&ID's
- Details of each typical actuated valves with their representation symbol on P&ID's
- All details with their representation on P&ID's to allow to make P&ID's more readable



- Etc.

P&ID's shall contain at least:

- All equipment including spares with their references
- All lines (main and secondary) with their numbering (including nominal diameter, fluid service identification, piping material class, insulation type and thickness and line number)
- All piping valves with their types, all actuated valves shall be itemised and their fail safe position indicated, manual valves normally closed and locked position to be indicated
- Piping class change
- Particular line fittings (strainers, flame arrestor, reducer, cap, flanges, spacer, spectacle blind, etc.)
- All PSV's, TSV's and rupture disks with their items, sizes and set pressure
- Complete instrumentation representation (instrumentation for control, alarms, shutdown and indication) with the control loops details, numbering and location (local, local control panel, control room, PLC, DCS, etc.)
- Flow meters, analysers and sampling points
- Initiated ESD action with the ESD level
- Insulation with type thickness and limit
- Tracing
- Slope
- Minimum distances with the required values
- Equipment elevation when this influences equipment design (e.g. pump sizing)
- All process requirements in order to be taken into account by other disciplines (mainly piping and plot plan)
- Tie ins location and number in case of revamping
- Notes for explanation and good understanding
- Etc.

In all cases, the location of main equipment symbols and line connections have to take in account the location of each equipment in the plant.

Due to the degree of detail, it is possible to have only one main equipment item represented on one sheet.

For each equipment item, a reference (item number) is given close to the symbolic representation.

In lower part of the sheet, a table gives for each itemised equipment the item number, the function or service and the main characteristic values as indicated as typical for some equipment in the table as follows:



Drum/Separator ⁽¹⁾		Column ⁽²⁾	
Item number		Item number	
Service		Service	
Pressure Bar g.	Design	Pressure Bar g.	Design Top/Bottom
	Working		Working Top/Bottom
Temperature °C	Design Max./Min.	Temperature °C	Design Max./Min. Top/Bottom
	Working		Working Top/Bottom
Internal diameter mm		Internal diameter mm	
Height or length (TL/TL) mm		Height (TL/TL) mm	
Material		Material	
Corrosion allowance mm		Corrosion allowance mm	
Lining/cladding type		Lining/cladding type	
Insulation type/thickness mm		Insulation type/thickness mm	

Compressor		Pump	
Item number		Item number	
Service		Service	
Type		Type	
Pressure Bar g.	Design	Pressure Bar g.	Design
	Working Suct./Disch.		Working Suct./Disch.
Temperature °C	Design Max./Min.	Temperature °C	Design Max./Min.
	Working Suct./Disch		Working Suct./Disch
Working suction flow rate Nm ³ /hr		Working flow rate m ³ /hr	
Design suction flow rate Nm ³ /hr		Design flow rate m ³ /hr	
		Differential pressure Bar	
		Material	
Shaft power kW		Shaft power kW	
Material		Material	



Exchanger (shell and tube)				Air Cooler	
		Shell	Tubes		
Item number				Item number	
Service				Service	
Type				Service	
Pressure Bar g.	Design			Pressure Bar g.	Design
	Working				Working
Temperature °C	Design Max./Min.			Temperature °C	Design Max./Min.
	Working				Working
Internal diameter mm				Duty MMkcal/hr	
Length mm				Area m ²	
Number of passes				Material	
Duty MMkcal/hr				Corrosion allowance mm	
Area m ²				Motor power kW	
Material					
Corrosion allowance mm					
Insulation type / Thickness mm					

11. Process data sheets

Process data sheets are issued by the Process for all itemised equipment and packages. They contain all process information required for sizing and sometime sketches with sizes for some equipment such as vessels, columns, columns internals.

They are different from the mechanical data sheets which define additional information for construction and which are issued by specialists and/or suppliers. For some of them, forms are available on API documents (e.g. compressor, gas turbine, etc.).

The process data sheet, sometimes could be included in the mechanical data sheet.

When there are different process cases, the process sizing case shall be clearly stated and where necessary all cases shall be stated in order that the equipment shall be correctly sized to cover all the cases including start up conditions (e.g. compressors, hot oil pumps, etc.).

The calculation note shall be attached to the process data sheet.

For packages, the battery limit operating and design conditions for process and utilities shall be clearly stated.

12. Process instrument data sheets

Process instrument data sheets are issued by process for all itemised valves, PSV's, TSV's, rupture disks, instruments, sampling systems, etc. They contain all process information required for sizing and selection of the appropriate instrument.

They are different from the instrument data sheets which define additional information for construction and which are issued by specialists and/or suppliers.

For relieving devices (PSV's, rupture disk, etc.), the sizing case (fire, blocked out, gas blow-by, etc.) shall be mentioned.

When there are different process cases, the process sizing case shall be clearly stated and sometimes all cases shall be stated in order that the equipment shall be correctly sized to cover all the cases (e.g. control valves).

For control valves, PSV's, rupture disks, etc., the calculation notes to determine the flow rate, pressure drop, etc., shall be attached with the process instrument data sheets.

For flow meters and analysers, recommended principles shall be given and the calculation notes to determine pressure drop, operating envelopes in case of multiphase meters, measuring performances, etc., shall be provided.

13. Fluids list

A fluids list is issued by process for all process, offsites and utilities fluids.

This list contain for each fluids:

- The fluid symbol
- The required piping class(es)
- The operating range and design conditions (pressure and temperatures) for each piping class with contaminant contents CO₂, H₂S, H₂O, etc.

This fluid list could be included in the front of the piping class document issued by piping specialists.

14. Lines list

The lines list is issued for all process, offsites and utilities lines and shall contain at least for each line:

- Line number including diameter(s), fluid symbol, piping class, line identification
- Insulation if required with type and thickness
- Tracing if required with the type
- P&ID number(s)
- Line from (equipment or line)
- Line to (equipment or line)
- Operating conditions (pressure and temperature),
- Design conditions (pressure and max. and min. temperatures)
- Vapour flow rate in kg/hr
- Vapour density at operating conditions in kg/m³
- Liquid flow rate in kg/hr or m³/hr
- Liquid density at operating conditions in kg/m³
- Apparent density for two phase flow pm in kg/m³



- Test pressure
- Test fluid.

The above physical information are important for line stress analysis and velocity can be added if required. These information are also very important in case of debottlenecking for the new stress analysis and determination of new support, effort on equipment nozzles, etc.

15. Emergency Shut-Down (ESD) diagram

Emergency Process and Shut-Down diagram including all emergency and process Shut-Down levels shall be issued for onshore and offshore plants including process, offsites and utilities.

For typical see general specification [GS EP SAF 261](#).

This ESD diagram shall also incorporate the safety actions.

16. Emergency Shut-Down (ESD) matrix

Emergency and Process Shut-Down matrix is a translation of the Emergency and Process Shut-Down diagram. The form shall follow the S.A.F.E. Chart (Safety Analysis Function Evaluation Chart) from [AP RP 14C](#). The reset actions shall also be incorporated on this matrix.

This matrix is used by instrument specialists to develop and to perform the software of the Emergency and Process Shut-Down system.

The interfaces with the safety Shut-Down system shall be also mentioned.

This matrix shall be issued for onshore and offshore plants including process, offsites and utilities.

17. Process and Safety Diagrams (PSD's)

It is a Process/Utility flow diagram showing all equipment and the main lines. The controls are not indicated but at least the following shall be shown with their item number:

- Valves actuated by an emergency and/or a process Shut-Down action (ESV, SDV, PSDV, etc.)
- Safety relieving devices (PSV, BDV, Rupture disc, etc.)
- All switches/alarms initiating an emergency and/or a process Shut-Down action.

18. Process, utilities and offsites description

A description of the process, utilities and offsites shall be issued.

This document shall also include the packages and the licenser units.

It shall contain the description of the different functions, equipment, operating conditions and control for all systems in normal operation with the reference to the relevant documents such as PFD's, UFD's, P&ID's, ESD diagram, etc.



19. Process operating philosophy

A process operating philosophy shall be issued for the process, utilities and offsites.

This documents shall also include the packages and licensors units.

It shall contain at least the recommendations and operations description for:

- The first start up
- Restart after a short and a long Shut-Down
- Malfunction of some equipment or part of the plant (e.g. malfunction of reboiler or condenser on a column, Shut-Down of the turbo-expander and operation in Joule Thompson valve mode, etc.)
- Automatic and/or manual Shut-Down
- Scheduled Shut-Down
- Turn down operation.

20. Calculation notes

For the calculation notes, the general specification **GS EP ECP 103** shall be followed.

20.1 Vessels sizing

A calculation note shall be issued with the process data sheet for the sizing of each vessel including at least:

- The basis of design including also the slug containment based on multiphase calculations
- The calculation for the vapour area
- The liquid surge and retention times
- The vessel sizes
- The levels position.

This is also required for flare/cold vent drum, drains drums.

20.2 Columns sizing

A calculation note shall be issued with the column process data sheet for the sizing of each column including as a minimum:

- The basis of design
- The number of theoretical trays or height of packing
- The number and type of real trays or number and height of packing sections and type of packing
- The liquid surge times
- The column sizes
- The levels position



- The characteristics of fluids (flow rate, composition, etc.) for typical points including trays, reboiler, reflux loop, etc.

20.3 Pumps

A calculation note with a sketch showing the pumped fluid circuit shall be issued with the pump process data sheet including at least:

- The suction pressure with the pressure drop between the upstream capacity and the pump
- The NPSH calculation
- The discharge pressure with pressure drop through each piece of equipment, control valve, lines, fittings, etc.
- The estimated efficiency, the hydraulic power and the power of the driver
- The design pressure.

20.4 Compressors

The following calculation notes shall be issued with the process compressor data sheet.

20.4.1 Settle out pressure

A calculation note with a sketch showing the volume and the operating conditions of all sections shall be issued.

20.4.2 Conditions in recycle mode and start-up

A calculation note given the process conditions (pressure, temperature, flow rate, molecular weight, etc.) in recycle mode and start-up taking into account the specified equipment shall be issued.

20.4.3 Downstream anti-surge valve temperature

A calculation note of the downstream anti-surge valve with potential hydrates problems formation shall be issued.

20.5 Heat exchangers thermal calculations

The heat exchangers thermal calculations with at least the following information shall be provided with process data sheet:

- Type and arrangement
- Sizes
- Area per shell or per units
- Fouling factors
- Average film coefficient per fluid, overall heat transfer coefficients clean and dirty
- LMTD correction factor, LMTD corrected
- Number of tubes, tube external diameter, BWG, length, pitch

- Pressure drop
- Skin temperature mainly in particular cases such as possible hydrate problems, deposit due to too high seawater temperature
- Ratio of area selected to area required
- Number of bays, fans number, fans power, air flow rate, air exhaust air temperature and type for air coolers.

The turn-down shall be considered.

For thermosyphon heat exchanger, the elevation and position shall be provided on a sketch (e.g. reboiler position with the column bottom, position of drums for plate fin heat exchangers, etc.).

20.6 Lines sizing

All lines (process, offsites and utilities) sizing except for the flare(s)/cold vent(s) lines downstream the relief devices calculations shall be issued on a summarised table form given at least:

- Line number if available
- Selected size in inches
- Schedule if available or internal diameter in mm or thickness in mm
- Line from (equipment or line and PID no.)
- Line to (equipment or line and PID no.)
- Operating conditions
- Vapour flow rate in kg/hr
- Vapour density at operating conditions in kg/m³
- Liquid flow rate in kg/h or m³/hr
- Liquid density at operating conditions in kg/m³
- Apparent density for two phase flow ρ_m in kg/m³
- Viscosity
- Pressure drop in bar/km
- Velocity in m/s
- ρV^2 or $\rho_m V_m^2$ in kg/m/s²

20.7 Monophasic lines calculation

These calculations are required for pipelines/sealines and long critical piping such as rundown lines, loading lines and at least the following shall be provided:

- Basis for the profile and pipeline or piping characteristics (buried with depth or not, thickness, roughness, coating types, thermal conductivity, thermal capacity and thickness, etc.), external convection coefficient, environmental conditions

- Pressure drop and pressure profile
- Temperature profile if required (e.g. cold products, waxy crude, risk of hydrate formation)
- Over pressure protection study and calculations due to hydrostatic potential problems in case of transient conditions (e.g. Shut-Down) for gases or liquids
- Surge protection and calculations against water hammer effect
- Temperature loss for cold products (e.g. LNG, refrigerated LPG) and their cold maintaining
- Temperature loss in normal operation including the turn down and also in case of Shut-Down for hydrates prevention and products such as waxy crude or with heavy viscosity requiring a special protection (insulation, tracing).

20.8 Multiphasic lines calculations

These calculations using software agreed by company are required for pipelines/sealines and long critical piping such as flow lines production headers and at least the following shall be provided for steady state conditions:

- Basis for the profile and pipeline or piping characteristics (buried with depth or not, thickness, roughness, coating types, thermal conductivity, thermal capacity and thickness, etc.), external convection coefficient, environmental conditions.

and for different flow rates within the pipeline/sealine operating range:

- Pressure drop and pressure profile
- Velocity profiles of the gas and liquid phases
- Temperature profile
- Flow regime along the pipeline/sealine
- Local hold-up profile and overall line liquid hold-up
- % of erosional velocity
- Estimation on the slug capacity detailed calculations.

If transient calculations are required, that will be discussed case by case with company.

20.9 Hydrate inhibition calculations

When an hydrate inhibition is required, a calculation note shall be provided including at least the following:

- Hydrate formation conditions with the method used
- Type of inhibitor
- Calculation method used
- Concentration of the injected inhibitor
- Quantity of water to be inhibited
- Quantity of inhibitor in vapour phase



- Quantity of inhibitor in hydrocarbon liquid phase
- Quantity of injected inhibitor
- Concentration of inhibitor at the outlet of the inhibited system
- Inhibitor losses.

20.10 Tank heating

For tanks requiring an heating device, the duty and sizing calculations shall be provided including at least the following:

- For duty calculation all the basis:
- Tank size
- Environmental conditions
- Heat transfer coefficient
- For sizing, see section 20.5.

20.11 Storage tank blanketing, venting

For a storage tank requiring blanketing and venting, calculation note shall be provided including at least the following:

- The blanketing and venting flow rates for:
- Tank filling
- Tank emptying
- Tank in holding mode.

For cryogenic storage tanks (LNG tanks, refrigerated tanks such as for LPG), calculation note shall be also provided including the boil off.

20.12 Depressurisation calculations

A description of the software or the method shall be issued for company approval prior to starting the calculations.

A depressurisation calculation note shall be issued for all depressurisation devices and includes at least the following:

- The zone to be depressurised by the concerned device
- The initial hydrocarbon inventory
- The required depressurisation time and the final pressure
- The calculations in case of fire and without fire given at least the following:
- Initial level, pressure and temperature for each case
- Ambient conditions
- Heat input in case of fire
- The flow rate versus time



- Depressurised part pressure versus time
- Depressurised equipment gas, liquid, metal temperature versus time
- Temperature downstream the depressurisation device versus time
- Back pressure
- Restriction orifice size for each case.
- After selection of the blowdown restriction orifice size, the calculations shall be reworked for the non sizing case and the above required calculations shall be provided
- The selected design temperature and material.

The depressurisation calculations shall not be stopped at the final required pressure but shall be done to near the atmospheric pressure to be sure that the lowest temperature is obtained.

20.13 Relief devices calculations

A calculation note shall be issued for each relief device including for this relief device all the concerned relieving cases such as:

- Blocked outlet
- Fire
- Gas blow-by
- Blow-by, inadvertent upstream valve opening from highest pressure source
- Loss of power
- Loss of air or gas instrument
- Loss of cooling
- Loss of heating
- Loss of reflux
- Heat exchanger tube failure
- Check valve malfunction(e.g. check valve leakage at the discharge of a compressor in case of Shut-Down if the downstream SDV is not closed, etc.)
- Transient pressure surges
- etc.

20.14 Flare(s)/cold vent(s) loads summary

For each flare(s)/cold vent(s) a load summary shall be issued for each relieving cases (see section 20.13) plus the loads for all other cases such as in normal operation and in depressurisation. At least the following shall be included:

- All relief devices (relief valves, blowdown valves, pressure control valves, etc.)
- All relieving cases

- For all relieving cases the following shall be given upstream and downstream of each relief device:
- Fluid state
- Fluid flow rate in kg/hr and for two phase flow % wt. vapour
- Fluid molecular weight, for two phase flow molecular weight of vapour and liquid
- Cp/Cv for vapour
- Density for vapour
- Density for liquids
- Temperature
- Pressure.

20.15 Flare(s)/cold vent(s) network sizing

The flare/cold vent lines sizing calculations shall be provided and will give at least for the inlet and outlet of each lines and at each connecting points and for the selected sizes:

- The back pressure
- The velocity in m/s and in Mach
- The ρV^2 in kg/m/s²
- Fluid state
- Fluid flow rate in kg/hr and for two phase flow %wt. Vapour
- Fluid molecular weight, for two phase flow molecular weight of vapour and liquid
- Cp/Cv for vapour
- Density for vapour
- Density for liquid
- Temperature
- Pressure.

These calculations shall be issued for each relieving cases and not only for the design case. The general specification **GS EP ECP 103** shall be followed.

If the $\rho V^2 > 100\,000$ kg/m/s², the vibration and support calculations shall be issued.

20.16 Flare(s)/cold vent(s) radiations calculations

Preliminary radiation levels calculations performed by the party in charge of Process design or by suppliers and the final calculations performed by suppliers shall be issued to company for different scenario with at least the following:

- Method used
- Flare(s) or cold vent(s) arrangement
- Flare(s) or cold vent(s) tip type and size

- Flow rate, composition, molecular weight and temperature through each flare or cold vent
- Emissivity factor for each flare or cold vent
- Wind velocity, calculations shall be performed for wind velocity 0 m/s and the maximum wind stated on process design basis
- Air temperature
- Relative humidity
- Solar radiation
- Flare tip elevation
- Isopleths in horizontal and/or vertical plan for at least the following radiation levels including the solar radiation: 500, 1000, 1500, 2000, 3000, 5000 Btu/hr.ft²
- Radiation levels at required particular points mainly offshore such as crane cabin, monkey board, crown block, etc.

20.17 Hips system calculations

Multiple disciplines input is required for an HIPS.

For the process, at least the calculation note for the build-up time is required.

20.18 Flow measuring system sizing

All flowmeter sizing shall be issued in a summarised table giving at least:

- Line number
- Size
- Fluid state
- Flow regime
- Fluid flow rates (gas, water, oil in case of multiphase meter) at actual and standard conditions expressed in volume and mass
- Water cut ranges in case of wet oil measurement
- Operating conditions (pressure and temperature)
- Viscosity
- Liquids and gas density
- Specific installation requirements
- Influence factors
- Method used
- Pressure drop
- Fluid velocity
- Calculation method



- Uncertainty.

Detailed calculation notes shall be provided for each flowmeter.

Similar information shall be given for on line analyser (including components to determine with their ranges, compositions of streams, etc.) and sampling systems.

20.19 Energy efficiency indicators

An energy efficiency calculation note shall be developed for new developments and existing facilities modification projects. It shall be updated at each stage of the project (Basic Engineering – Detailed Engineering) with the latest information available.

It shall include, but is not limited to, the following:

- a description of the system perimeter and boundaries and the production profiles selected for the calculation (it is required to cover the production life by selecting several “key” years),
- Energy efficiency calculation requires process data based on the yearly average.
 - In case process simulations are ran for peak production flow, the availability has to be accounted for.
- a list of all assumptions used for this calculation,
- an energy balance table and associated diagram,
- the following key energy efficiency indicators:
 - Energy Intensity = ratio between the sum of consumed energy plus imported energy divided by the plant oil and gas production (MJ/boe)
 - Auto-Consumption = ratio between the consumed energy and the sum of the consumed energy and the exported energy (MJ/MJ)
 - Efficiency = ratio of valued energy at system outlet divided by the energy input into the system (MJ/MJ)
 - KPI 1 = ratio between the consumed energy and lost energy (flare + vent) needed to produce the exported final products divided by the exported products energy (MJ/MJ)
 - DGEP Indicator, named Specific Energy Efficiency = ratio between all consumptions and losses, to all valorisations (direct sales and future valorisation via re-injection). (MJ/boe).
 - any other relevant project-specific energy efficiency indicator



Bibliography

Reference	Title
API RP 14C	Recommended Practice for Analysis, Design, Installation, and Testing of Basic Surface Safety Systems for Offshore Production Platforms