

## GENERAL SPECIFICATION

### PIPING VALVES VESSELS

#### GS EP PVV 551

|                   |
|-------------------|
| <b>Flare Tips</b> |
|-------------------|

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|------|---------|------------------------------------|
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|      |         |                                    |
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| General Specification |                         | GS EP PVV 551 |
|-----------------------|-------------------------|---------------|
| Flare Tips            |                         |               |
| Rev.: 02              | Effective date: 10/2017 | Page: 2 of 57 |

## Contents

|                                                         |           |
|---------------------------------------------------------|-----------|
| <b>1. Scope .....</b>                                   | <b>4</b>  |
| <b>2. Reference documents.....</b>                      | <b>5</b>  |
| <b>3. Abbreviations and technical definitions .....</b> | <b>6</b>  |
| <b>4. Scope of Supply .....</b>                         | <b>7</b>  |
| <b>5. Flare Process Design.....</b>                     | <b>10</b> |
| 5.1 Data to be provided by the Contractor.....          | 10        |
| 5.2 Combustion.....                                     | 12        |
| 5.3 Hydraulics .....                                    | 12        |
| 5.4 Radiation.....                                      | 13        |
| 5.5 Smokeless operation.....                            | 14        |
| <b>6. Mechanical design .....</b>                       | <b>15</b> |
| 6.1 Pressure bearing parts.....                         | 15        |
| 6.2 Supporting system .....                             | 15        |
| <b>7. Materials of construction.....</b>                | <b>16</b> |
| 7.1 Flare tips.....                                     | 16        |
| 7.2 Flare risers and utility piping.....                | 16        |
| 7.3 Supporting systems .....                            | 17        |
| 7.4 Summary table.....                                  | 18        |
| <b>8. General Design Requirements .....</b>             | <b>19</b> |
| 8.1 Pipe LP Flare tip .....                             | 19        |
| 8.2 High Pressure flare tip.....                        | 22        |
| 8.3 Open ground flare burner (OGF).....                 | 24        |
| 8.4 Enclosed ground flare burner (EGF) .....            | 27        |
| 8.5 Burn pit and liquid burners .....                   | 29        |
| 8.6 Purge reduction device .....                        | 29        |
| 8.7 Pilots.....                                         | 30        |
| 8.8 Ignition systems .....                              | 31        |
| 8.9 Flare riser and utility piping .....                | 33        |

| General Specification |                         | GS EP PVV 551 |
|-----------------------|-------------------------|---------------|
| Flare Tips            |                         |               |
| Rev.: 02              | Effective date: 10/2017 | Page: 3 of 57 |

|                          |                                                                |           |
|--------------------------|----------------------------------------------------------------|-----------|
| 8.10                     | Flare supporting systems .....                                 | 33        |
| 8.11                     | No Flaring Operation.....                                      | 36        |
| 8.12                     | Aircraft warning lights.....                                   | 37        |
| 8.13                     | Structural steel, stairs, ladders, walkways and platforms..... | 38        |
| <b>9.</b>                | <b>Instrumentation, control and safety logics .....</b>        | <b>38</b> |
| 9.1                      | General requirements .....                                     | 38        |
| 9.2                      | Pilot flame detection system.....                              | 38        |
| 9.3                      | Smokeless systems control.....                                 | 39        |
| 9.4                      | Flare operation monitoring .....                               | 40        |
| <b>10.</b>               | <b>Fabrication and welding .....</b>                           | <b>41</b> |
| <b>11.</b>               | <b>Inspection and testing .....</b>                            | <b>41</b> |
| 11.1                     | General requirements .....                                     | 41        |
| 11.2                     | Non Destructive Testing.....                                   | 42        |
| 11.3                     | Hydrostatic pressure test .....                                | 43        |
| 11.4                     | Performance test.....                                          | 43        |
| 11.5                     | Tightness test .....                                           | 44        |
| <b>12.</b>               | <b>Shipment and erection.....</b>                              | <b>44</b> |
| 12.1                     | General.....                                                   | 44        |
| 12.2                     | Shop assembly and delivery conditions .....                    | 44        |
| 12.3                     | Erection and lifting .....                                     | 45        |
| <b>13.</b>               | <b>Safety and environment.....</b>                             | <b>46</b> |
| 13.1                     | General requirements .....                                     | 46        |
| 13.2                     | Radiation level .....                                          | 46        |
| 13.3                     | Emissions to the atmosphere .....                              | 46        |
| 13.4                     | Noise .....                                                    | 47        |
| <b>14.</b>               | <b>Guarantees .....</b>                                        | <b>47</b> |
| <b>Bibliography.....</b> |                                                                | <b>48</b> |
| Appendix 1               | Flare data sheet .....                                         | 49        |
| Appendix 2               | Documents to be included with the proposal .....               | 56        |
| Appendix 3               | Final Documentation .....                                      | 57        |

| General Specification |                         | GS EP PVV 551 |
|-----------------------|-------------------------|---------------|
| Flare Tips            |                         |               |
| Rev.: 02              | Effective date: 10/2017 | Page: 4 of 57 |

## 1. Scope

This General Specification covers the process design, mechanical design, fabrication, inspection/testing, shipment and erection of flares to be installed in off shore (fixed and floating units), onshore oil & gas fields, LNG plants and unconventional fields.

It covers all types of flares and flare tips.

This specification does not cover the following equipment:

- Vents
- Flare gas recovery units
- Thermal oxidizers and tail gas incinerators.

Flares delivered under this specification shall be of a proven design and the Vendor shall provide references of existing equipment that have been running trouble free for at least five years.

The flare tips/burners and auxiliary items attached to the flare tips/burners such as pilots, ignition electrodes, flame detection device shall allow continuous trouble free operation between two plant major overhauls (five years minimum).

It's not meant to limit the Vendor ability to make progress in terms of innovative design change, cost reduction or to prevent him from looking for solutions that might noticeably reduce the weight of the equipment. The Vendor may submit any deviation to this specification that he considers justified. Any deviation can only be implemented after the Company's written approval.

This specification does not necessarily cover in full details the requirements of the specialities (process, structural, electrical, instrumentation, material selection/corrosion, pressure vessels and piping, welding) involved in the design and fabrication of this equipment and therefore it shall be used in conjunction with these specialties specifications.

Flare systems shall be designed in order to minimize the impact on the environment and contribute to Company objectives on flaring activities in Oil & Gas facilities which are:

- The reduction of the flared gas volumes during emergency and continuous operation
- The improvement of the quality of the flaring activities (smokeless combustion, high destruction efficiency).

| General Specification |                         | GS EP PVV 551 |
|-----------------------|-------------------------|---------------|
| Flare Tips            |                         |               |
| Rev.: 02              | Effective date: 10/2017 | Page: 5 of 57 |

## 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 521              | Pressure-relieving and Depressurizing systems                                                                                                                         |
| API STD 537              | Flare Details for Petroleum, Petrochemical, and Natural Gas Industries                                                                                                |
| ASME B31.3               | Process Piping                                                                                                                                                        |
| ASME BPVC Section IX     | ASME Boiler & Pressure Vessel Code - Section 9: Welding and Brazing Qualifications                                                                                    |
| ASME BPVC Section V      | ASME Boiler & Pressure Vessel Code - Section 5: Nondestructive Examination                                                                                            |
| EN 10204                 | Metallic products - Types of inspection documents                                                                                                                     |
| ICAO Annex 14 Volume I   | Annex 14 to the Convention on International Civil Aviation - Aerodromes - Volume I: Aerodrome design and operations - Chapter 6.6: Visual Aids for Denoting Obstacles |
| NACE MR 0175 / ISO 15156 | Petroleum and natural gas industries - Materials for use in H <sub>2</sub> S-containing environments in oil and gas production                                        |
| NACE MR 0103             | Petroleum, petrochemical and natural gas industries - Metallic materials resistant to sulfide stress cracking in corrosive petroleum refining environments            |

### Total General Specifications

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

| Reference     | Title                                                                                   |
|---------------|-----------------------------------------------------------------------------------------|
| GS EP COR 005 | Material selection for oil and gas production systems                                   |
| GS EP COR 170 | Materials for upstream sour service application. Specification for selection and design |
| GS EP ECP 103 | Process design criteria                                                                 |
| GS EP EXP 107 | Commissioning Execution                                                                 |
| GS EP INS 110 | Instrumentation for package units                                                       |

| General Specification |                         | GS EP PVV 551 |
|-----------------------|-------------------------|---------------|
| Flare Tips            |                         |               |
| Rev.: 02              | Effective date: 10/2017 | Page: 6 of 57 |

| Reference     | Title                                                                                                      |
|---------------|------------------------------------------------------------------------------------------------------------|
| GS EP PVV 112 | Piping material classes                                                                                    |
| GS EP PVV 171 | Steel piping fabrication                                                                                   |
| GS EP PVV 211 | Design and fabrication of pressure vessels according to ASME VIII                                          |
| GS EP PVV 611 | Welding of pressure containing piping and equipment                                                        |
| GS EP PVV 612 | Piping and equipment subject to severe sour service. Metallurgical and welding requirements                |
| GS EP PVV 622 | Piping and equipment subject to mild and intermediate sour service. Metallurgical and welding requirements |
| GS EP SAF 262 | Pressure protection relief and hydrocarbon disposal systems                                                |
| GS EP STR 001 | Weight monitoring and weighing offshore and onshore units                                                  |
| GS EP STR 103 | Design and fabrication of skids and equipment supporting structures                                        |
| GS EP STR 201 | Material for offshore steel structures                                                                     |
| GS EP STR 401 | Loadout, seafastening, transportation and installation of offshore structures                              |

The following priority rules shall apply:

- Laws and Regulations of the Country of installation must be applied wherever more stringent than the other contractual documents
- Project contractual documents
- The specification
- Codes and Standards listed in the contractual documents and in the specification.

Any divergence between any of the Contractual Reference Documents, or between this specification and any other Contractual Reference Document, shall be reported to the Company for decision. In such a case, and unless otherwise agreed or decided by the Company, it is understood that the more stringent requirement shall apply.

### 3. Abbreviations and technical definitions

For the purpose of this document, the following terms and definitions apply:

|             |                                            |
|-------------|--------------------------------------------|
| <b>ASME</b> | American Society of Mechanical Engineers   |
| <b>ASTM</b> | American Society for Testing and Materials |
| <b>CRA</b>  | Corrosion Resistant Alloys                 |
| <b>CS</b>   | Carbon Steel                               |
| <b>DPI</b>  | Dye Penetrant Inspection                   |
| <b>EGF</b>  | Enclosed Ground Flare (refer to § 8.4)     |

| General Specification |                         | GS EP PVV 551 |
|-----------------------|-------------------------|---------------|
| Flare Tips            |                         |               |
| Rev.: 02              | Effective date: 10/2017 | Page: 7 of 57 |

|                 |                                           |
|-----------------|-------------------------------------------|
| <b>FAT</b>      | Factory Acceptance Test                   |
| <b>FFG</b>      | Flame Front Generator (refer to § 8.8)    |
| <b>FG</b>       | Fuel Gas                                  |
| <b>FGRU</b>     | Flare Gas Recovery Unit (refer to § 8.11) |
| <b>GAD</b>      | General Arrangement Drawing               |
| <b>GTAW</b>     | Gas Tungsten Arc Welding                  |
| <b>HAZ</b>      | Heat Affected Zone                        |
| <b>HEI</b>      | High Energy Ignition (refer to § 8.8)     |
| <b>HP</b>       | High Pressure                             |
| <b>HV</b>       | High Voltage                              |
| <b>LLP</b>      | Very Low Pressure                         |
| <b>LP</b>       | Low Pressure                              |
| <b>MDS</b>      | Material Data Sheet                       |
| <b>MP</b>       | Medium Pressure                           |
| <b>NDE</b>      | Non Destructive Examination               |
| <b>OGF</b>      | Open Ground Flare (refer to § 8.3)        |
| <b>PDS</b>      | Process Data Sheet                        |
| <b>P&amp;ID</b> | Piping and Instrument Diagram             |
| <b>PLC</b>      | Programmable Logic Controller             |
| <b>PMI</b>      | Positive Material Identification          |
| <b>PWHT</b>     | Post Weld Heat Treatment                  |
| <b>RT</b>       | Radiographic Testing                      |
| <b>SS</b>       | Stainless Steel                           |
| <b>VT</b>       | Visual Testing                            |
| <b>WPS</b>      | Welding Procedure Specification           |
| <b>WPQR</b>     | Welding Procedure Qualification Record    |
| <b>WQTR</b>     | Welder Qualification Test Record          |

## 4. Scope of Supply

The Vendor's scope of supply shall include all the studies and calculations necessary for the design of the flare components in order to reach the performances indicated on the data sheet in Appendix 1.

At proposal stage the flare Vendor shall supply the documentation requested in Appendix 2.

| General Specification |                         | GS EP PVV 551 |
|-----------------------|-------------------------|---------------|
| Flare Tips            |                         |               |
| Rev.: 02              | Effective date: 10/2017 | Page: 8 of 57 |

With the delivery of the flare the Vendor shall supply the final documentation listed in Appendix 3.

The flare package shall consist in the following parts and equipment. This list is not restrictive and may be expanded or shortened depending on the specific project requirements:

#### Main mechanical Parts

- Flare Tip featuring:
  - Upper section complete with flame stabilisers and windshield
  - Lower section including body and flange
  - Pilot gas burners
  - Pilot Ignition system for each pilot
  - Pilot Flame detection system for each pilot
  - Smokeless assistance system, if applicable
  - Velocity seal included in tip as applicable.
- Flare riser
- Flare seal drum with manhole, process/utilities nozzles and instrument connections fitted with inlet flange, if applicable
- Supporting system (guyed support, self support, fixed derrick, or demountable derrick as applicable) including all necessary caged ladders and platforms from grade to flare top areas
- Any other items required for proper operation.

#### Piping and Instrumentation

- The ignition and control panel:
  - Automatic High Energy Ignition / reignition system (HEI) with all necessary instrumentation and controls, including:
    - . HEI top junction box mounted close to the top platform and below flare tips outlet
    - . HEI extension cables from top junction box to bottom junction box and to ignition panel
    - . HEI bottom junction box mounted at flare stack base.
  - Manual Flame Front Generation (FFG) system comprising of but not limited to the following:
    - . Fuel gas and instrument air lines with inlet flange connections
    - . Gas and air pressure reducing valves fitted with filters and bypass
    - . Pressure gauges for gas and air
    - . Pilot gas and ignition lines with outlet flange connections and their associated piping from FFG panel to flare tip pilots

| General Specification |                         | GS EP PVV 551 |
|-----------------------|-------------------------|---------------|
| Flare Tips            |                         |               |
| Rev.: 02              | Effective date: 10/2017 | Page: 9 of 57 |

- . Ignitor transformer with weather-proof and explosion proof housing
- . Spark ignitor
- . Ignition sight port
- . Push button
- . Pilot selector valves (if there are multiple pilot gas lines and/or pilot ignition lines from the ignition panel to the flare pilots)
- . Small KO drum if fuel gas may contain some condensates.
- Panel framework to house the above with structural support, canopy, fully piped, wired, complete with instrumentation (including transformers, lamps, alarms and pushbuttons as indicated in flare data sheets), final painting and rain/radiation shield.
- Other types of flare ignition methods such as pellets ignition systems comprising of but not limited to the following:
  - . Pellets which are the source of ignition
  - . Ballistic ignition cabinet installed at grade level
  - . Guide pipe which guides the ignition pellets from the ignition cabinet to the fragment collector
  - . Fragment collector located at the top platform, near the flare tip.
- A pilot flame-out detection system including:
  - Pilot flame detection: two (2) type K single element thermocouple per pilot
  - Thermocouples top Junction box mounted at least 12 m below flare tips outlet
  - Thermocouples instrument cables from top junction boxes to bottom junction boxes at flare stack base and to the ignition panel
  - Thermocouples bottom junction box, mounted at flare stack base
  - Alternate or redundant flame detection system as applicable.
- All other piping supports brackets and guides, valves and instruments required for proper operation.

#### Electrical

- Retractable type aircraft warning light system, including:
  - Retractable aircraft warning lights
  - Junction boxes for AWL, mounted at flare stack base
  - Power cables between junction boxes and AWL
  - AWL local panel, installed close to ignition system
  - Electrical junction boxes, cables, cables glands, cables entries, terminal blocks.
- Grounding wiring on skids
- Earthing connections.

| General Specification |                         | GS EP PVV 551  |
|-----------------------|-------------------------|----------------|
| Flare Tips            |                         |                |
| Rev.: 02              | Effective date: 10/2017 | Page: 10 of 57 |

### Miscellaneous

- All material required for site erection which could not be installed due to shop prefabrication extent such as:
  - Bolts, nuts and gaskets for erection and tie-in connection
  - Plastic hard covers for each piping connection to Contractor's connecting flanges.
- Spare parts for erection, commissioning and start up
- Spare parts required for two (2) year normal operation/maintenance
- Export packing and weather protection for shipping
- Stowage blocks, lifting lugs, lifting beams, cradles stiffeners and other special supplies for the handling, transport and erection of the equipment, if applicable
- Saddles for temporary storage of stacked riser trunks
- Any temporary items (structure, platform...) required for the replacement of flare tip
- Surface preparation and primary coating as required, on equipment and piping to be further heat insulated (not applicable to flare tips)
- Contractor and Vendor nameplates.

## 5. Flare Process Design

### 5.1 Data to be provided by the Contractor

The Contractor shall provide the flare Vendor with all the necessary data that will allow him to properly design the flare. The Contractor shall bring to flare Vendor's attention any site constraint that may impact on the design, fabrication, start-up and operating procedures.

The Contractor shall fill its part of the flare data sheet later on to be completed by the flare Vendor.

The data includes but is not limited to:

- Data for several operating cases including:
  - Emergency flaring: maximum relieving cases during short term operation (generally less than 15 min)
  - Maximum continuous flaring: important relieving cases during longer time (typically more than 15 min up to several days)
  - Continuous relieving case with minimum operation cases (including purge gas flow rate).
- For above defined cases the following data shall be provided:
  - The effluent designation along with its detailed chemical composition (%mole) and molecular weight (g/mol)
  - Mass flow rate (kg/h), inlet temperature (°C) and inlet pressure (barg) upstream of the provided equipment, as well as allowable pressure drop (barg)

| General Specification |                         | GS EP PVV 551  |
|-----------------------|-------------------------|----------------|
| Flare Tips            |                         |                |
| Rev.: 02              | Effective date: 10/2017 | Page: 11 of 57 |

- Severity of sour service (if applicable)
- Environmental parameters to be considered for radiation calculation including wind speed, wind direction, ambient temperature, solar radiation, relative humidity and maximum allowable radiation levels (in continuous operation and emergency operation) at specific receptor locations
- The smokeless operation requirements defined by a flow rate (kg/h), a Ringelmann index and an expected smokeless assistance technology (steam, air, sonic flow) if needed
- The allowable noise level in continuous operation and emergency operation in several specific locations
- Required Destruction & Removal Efficiency (%) or Combustion Efficiency (%).
- The Utilities conditions including:
  - The fuel gas type with detailed composition, temperature and pressure (for pilots, FFG ignition system and purge gas)
  - The other available utilities conditions:
    - . Instrument air
    - . Electric power
    - . Nitrogen as back-up for purge gas, if applicable
    - . Propane bottles as back-up for pilots, if applicable
    - . Smokeless assistance medium (steam, air, fuel gas), if applicable.
  - The minimum, normal, maximum and mechanical design values of pressure and temperature shall be given for all above utilities.
- The applicable mechanical design codes for:
  - Structural design (including loads)
  - Pressure parts (including conditions) like water seal drum (if applicable) and piping.
- The expected technology for:
  - Type of flare: elevated flare, open or enclosed ground flare, liquid burner, burn pit, or else
  - Supporting system: self-supported, guyed-supported, derrick supported (fixed or demountable)
  - Expected flare tip/burner type: LP Pipe, assisted LP flare tip, single exit HP flare tip, multi arm HP flare tip, multi arm variable slot HP flare tip, or else
  - Ignition system: Flame Front Generation panel, High Energy Ignition, High Voltage Ignition or pellets ignition system
  - Pilot flame detection system: Thermocouple based, flame ionisation, optical, acoustic
  - Gas seal: dynamic, molecular, staging.

| General Specification |                         | GS EP PVV 551  |
|-----------------------|-------------------------|----------------|
| Flare Tips            |                         |                |
| Rev.: 02              | Effective date: 10/2017 | Page: 12 of 57 |

- The mechanical data including design temperature / pressure (if applicable), required material grade (including Nace requirement if any), corrosion allowance for:
  - Riser and liquid seal (if applicable)
  - All utility piping.
- The requirement for diurnal beaconage (AWL or paint) and nocturnal beaconage (AWL)
- The anticipated method for:
  - Initial erection method
  - Maintenance of the flare tip
  - Flare tip replacement method.

## 5.2 Combustion

The flare shall ensure proper combustion of the flared effluent and ensure a destruction efficiency (%DE) greater than 99% and a combustion efficiency (%CE) greater than 98%.

The waste gas shall have a LHV greater than 7.45 MJ/Nm<sup>3</sup> (200 BTU/Scf) for unassisted flares and 11.2 MJ/Nm<sup>3</sup> (300 BTU/Scf) for assisted flares to sustain combustion on their own without any auxiliary fuel additions.

Toxic gas flares like acid flares (they can burn H<sub>2</sub>S and NH<sub>3</sub>) shall be designed with a high destruction efficiency. In order to reach acceptable levels of destruction efficiency, assistance with additional support gas injected upstream of the flare or directly at the tip level may be proposed.

The flare tip design shall ensure that the destruction efficiency is not affected by the smokeless technology. Vendor shall indicate in operating manual how to avoid over aeration (or over steaming) of the flame that is detrimental to destruction efficiency.

## 5.3 Hydraulics

### 5.3.1 Exit velocity

On pipe flares the exit velocity shall be limited to 0.5 Mach for peak, short term, infrequent flow with 0.2 Mach maintained for the more normal and frequent conditions. Pipe flares shall be designed within these exit velocity limits in order to ensure that flame remains stable and flare does not extinguish.

In case of important flows and if a pipe flare reaches a hydraulic diameter greater than 60 in (resulting from the 0.5 Mach criteria), then an allowable exit velocity up to 0.8 Mach can be accepted under Company's written approval.

Above 0.8 Mach only sonic (or High Pressure) flare tips shall be used.

Sonic (or HP) flare tips will preferably have several tips rather than one only (single exit HP flare tip).

When flared gas has a low heating value the high velocity flare tips shall not be used. It is particularly the case for flared gas with LHV lower than 200 to 300 BTU/scf (equivalent to

| General Specification |                         | GS EP PVV 551  |
|-----------------------|-------------------------|----------------|
| Flare Tips            |                         |                |
| Rev.: 02              | Effective date: 10/2017 | Page: 13 of 57 |

7.45 MJ/Nm<sup>3</sup> to 11.2 MJ/Nm<sup>3</sup>) that require assist gas to enrich LHV and ensure proper combustion.

Also Acid flare tips for which a good H<sub>2</sub>S destruction is critical should have velocities in the range of 20 to 30 m/s only.

All above guidelines are giving maximum allowable exit velocity and these limits can be restricted by the allowable pressure drop.

### 5.3.2 Pressure drop

There can be several flare networks in a single plant with different operating pressures:

- One HP flare network for the protection of HP equipment
- One LP flare network for the protection of LP equipment
- One LLP flare network for the protection of LLP equipment.

The typical allowable pressure drop of flare package (from flange inlet):

- HP Flare: 2 to 6 bars
- LP Flare: 0.3 to 0.5 bar (300 mbar to 500 mbar)
- LLP Flare: less than 0.05 bar (50 mbar).

Vendor shall provide pressure drop vs flow rate curves for flare tips.

### 5.3.3 Flow rate

The flares shall be designed to properly run under many different flaring conditions. These different conditions can generally correspond to the following categories:

- Emergency flaring: maximum relieving capacity during short term (usually less than 15 minutes) operation corresponding to overall plant depressurizing (due to General Electric Power Failure or Fire inside the units)
- Maximum continuous flaring: important relieving case during longer time (more than 15 minutes up to several days) corresponding to operation with some equipment under shutdown or maintenance
- Continuous relieving case with minimum flow rate corresponding to purging of flare system with purge gas that can be fuel gas, natural gas or nitrogen.

## 5.4 Radiation

Contractor shall define all the necessary conditions to be considered by the vendor to define the flare height (in case of an elevated flare) in accordance with **GS EP SAF 262** and **GS EP ECP 103**.

In order to ensure a clear definition of the parameters Contractor shall specify values of the following factors in the data sheet according to the site location, local meteorological conditions and layout of the plant:

- Wind speed and wind direction
- Ambient temperature

| General Specification |                         | GS EP PVV 551  |
|-----------------------|-------------------------|----------------|
| Flare Tips            |                         |                |
| Rev.: 02              | Effective date: 10/2017 | Page: 14 of 57 |

- Solar radiation
- Relative humidity
- Maximum allowable radiation levels (for emergency and continuous operating conditions) at specific locations.

The Vendor shall indicate the air transmissivity and the flared gas emissivity considered in the flare radiation study. The flare study will feature radiation isopleths.

The emissivity value should not only be considered as a function of the type of the flared gas type only as it is established that it depends on several factors inherent to:

- The flared gas:
  - Molecular weight gas (high MW increases emissivity)
  - Liquid droplets content (150 µm and above) increase emissivity.
- The combustion condition:
  - Dark smoke production or smoky flame modifies emissivity.
- The flare technology:
  - Smokeless steam injection modifies emissivity
  - Sonic flow and exit velocity modifies flame emissivity.

The Vendor shall provide the temperature profile along the flare stack as well as the surface temperatures at specific receptors.

## 5.5 Smokeless operation

### 5.5.1 General

As per **GS EP SAF 262**, it is Company's policy to install smokeless flares, where feasible, for maximum continuous flaring. Contractor shall inform Company at early stage of Project execution in case of impossibility.

Flare smokeless combustion is defined in **GS EP SAF 262** by a Ringelmann index 1 (20% opacity) or an index 0 (0% opacity).

As per **GS EP SAF 262**, Ringelmann index shall not be greater than 1 (20% opacity) during continuous flaring.

Also **GS EP SAF 262** specifies that Ringelmann index shall not be greater than 2 (40% opacity) during emergency flaring.

Vendor shall indicate the operating range of smokeless combustion and the Ringelmann number for each operating case.

| General Specification |                         | GS EP PVV 551  |
|-----------------------|-------------------------|----------------|
| Flare Tips            |                         |                |
| Rev.: 02              | Effective date: 10/2017 | Page: 15 of 57 |

### 5.5.2 Technical solutions

When the lack of combustion air inside the combustion zone is leading to smoke formation, flare vendors should propose different device using energy (coming from another media or coming from flared gas) to create turbulence and entrain air inside the combustion zone that are mainly:

- Steam assisted flare tips (steam is rarely available off shore)
- Air assisted flare tips
- High pressure flare tips (common technology on shore and off shore).

## 6. Mechanical design

### 6.1 Pressure bearing parts

The design pressure and design temperature shall be determined following the [GS EP ECP 103](#).

The design pressure of a flare system shall be based on the maximum back pressure developed during flaring in worst case conditions. A minimum 3.5 barg pressure shall be considered for the flare riser.

In addition to the maximum design temperature, the minimum design temperature shall be specified for all equipment.

The mechanical design pressure is the pressure that shall be entered in the strength of material calculations used to determine the thickness of the various flare pressure bearing parts according to the selected Design Code requirements and formulae.

The mechanical design temperature is the temperature at which the allowable stress values are evaluated according to the selected Design Code.

The hydrotesting pressure shall be derived from the mechanical design pressure using the rules of the selected Design Code.

LLP and LP flare tips are not considered as pressure bearing parts.

Although their thickness is designed to withstand the design pressure the flare tips and risers are not submitted to hydrostatics pressure tests.

The flare tip shall be designed according to the [API STD 537](#), [API STD 521](#) and Company General Specifications specified in the project Particular Specification.

### 6.2 Supporting system

The supporting systems for vertical elevated flares are designed to withstand the design loads defined in § 5.1 Mechanical design - Design loads of [API STD 537](#):

- Wind loads as per the local codes and regulation and wind induced vibrations
- Earthquake as per the local codes and regulation
- Internal pressure (if applicable)
- Jet thrust for HP flare with exit velocity above 0.8 Mach

| General Specification |                         | GS EP PVV 551  |
|-----------------------|-------------------------|----------------|
| Flare Tips            |                         |                |
| Rev.: 02              | Effective date: 10/2017 | Page: 16 of 57 |

- Flashback pressure if specified by Purchaser
- Nozzle loads applied by flare header onto flare inlet flange
- Thermal loads due to operating temperatures and subsequent expansion or retraction
- Other erection, maintenance and special loads.

The supporting system shall be designed according to the structural and mechanical design codes and Company General Specifications specified in the project Particular Specification.

## 7. Materials of construction

Material selection of flare systems shall follow the requirements of **GS EP COR 005**.

Material selection shall be suitable for the applicable process design conditions.

The Minimum Design Temperature shall be indicated on the data sheet by the Contractor.

### 7.1 Flare tips

**Note:** The following recommendations can be usefully considered for material selection:

As a general rule, flare tips shall be made of a heat resistant material, such as 310 S Stainless Steel.

In special case where a high resistance to chloride attack (off shore marine application) and high temperature is required the use of higher Nickel content alloy can be specified: Incolloy 800H, Alloy 330 or Inconel 625.

In special case where a sulphur rich gas needs to be flared, the use of high nickel alloys (Alloy 800H, Alloy 330 or Inconel 625) in high temperature condition is to be avoided as Nickel may be attacked by atomic sulfur and might combine into a nickel sulphide.

Under high sulphur content and high temperatures, materials with Chromium to Nickel content ratio greater than 1 (e.g.: SS 310 S) shall be used.

In case of very high sulphur content vendor may propose alternate material provided that such alternate material has proven more resistant than SS 310 S under specified operating conditions. The use of alternate material shall be subject to Company's authorization.

For other cases or in case of doubt the advice of Company metallurgy/corrosion specialists is required.

All materials shall be referenced using a recognized international normative system. Unless otherwise stated in the project requisition, pressure retaining parts shall be referenced using the SA materials sheets in section II of the ASME Code for pressure vessels or ASTM standards relating thereto.

### 7.2 Flare risers and utility piping

#### 7.2.1 General

The flare risers and utility piping materials shall normally follow the project piping specifications.

The following paragraphs give the usual materials and possible exceptions.

| General Specification |                         | GS EP PVV 551  |
|-----------------------|-------------------------|----------------|
| Flare Tips            |                         |                |
| Rev.: 02              | Effective date: 10/2017 | Page: 17 of 57 |

### 7.2.2 Risers

The material for risers is specified by the purchaser in line with the flare header material. The purchasing documents shall state all useful process for the appropriate selection of the material, also considering the following requirements:

- CS suitable for wet sour service (or wet H<sub>2</sub>S service) when sulfide stress cracking is possible in accordance with [NACE MR 0175 / ISO 15156](#) for oil and gas production facilities and natural gas sweetening plants, or in accordance with [NACE MR 0103](#) for other applications (e.g. oil refineries, LNG plant and chemical plant). Also refer to [GS EP COR 170](#) and [GS EP PVV 612](#) or [GS EP PVV 622](#) for such situations.
- CS suitable for low temperature service in case of very low ambient or process temperature down to -100°C. Low Temperature CS material shall be designed to [GS EP PVV 112](#) for such situations SS 304L or 316L for acid flare and cryogenic service. The purchasing documents shall clarify whether the material shall be specifically qualified for the service conditions.

### 7.2.3 Utility piping

Steam, fuel gas support, instrument air follow site or project piping specifications and are generally made of CS.

Small lines for pilot fuel gas and FFG ignition shall be considered as special cases. FG may contain H<sub>2</sub>S and water produced by combustion may condensate in FFG lines if the FFG lines are not permanently purged. Also utility piping on riser is not accessible during flare operation and internal corrosion in a small line is critical and can lead to plugging of pilot filters or extinction of FFG during ignition.

Hence in order to avoid corrosion, SS piping shall be used for FG and FFG lines.

## 7.3 Supporting systems

Derrick structures may be designed for fabrication from members that are structural shapes, pipe or plate or any combination thereof. On shore derricks are hot dip galvanized to limit corrosion as much as possible and reduce the needs for painting during derrick lifetime.

Guy wires shall be all metallic, galvanized steel wire rope or structural bridge strand. Guy wire hardware shall be galvanized. Galvanizing shall be at least equivalent to the guy wires on which they are used.

The materials for the steel structures, the ducts and the stack shall be selected according to the requirements of specification [GS EP STR 201](#).

**Flare Tips**

Rev.: 02

Effective date: 10/2017

Page: 18 of 57

## 7.4 Summary table

The materials of construction listed in the table below correspond to the expected or minimum material of construction.

| Item                                                                               | Material                                                                                            | Comment                                                                                                                                                               |
|------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Flare tips</b>                                                                  |                                                                                                     |                                                                                                                                                                       |
| Upper parts in contact with flame or exposed to flame impingement                  | Grade 310 S (*) (plate and pipe)<br>CK20 or HK (*) (castings)                                       | This covers upper part of body/arms, steam injection piping, steam injection nozzles, wind shield, flame retainers, pilot head, lifting lugs<br>(*) 800 H may be used |
| Lower part in contact with flared gas and potentially exposed to flame impingement | Grade 310 S (*)                                                                                     | This covers lower part of body/central barrel, pilot piping above fuel/air mixer<br>(*) 800 H may be used                                                             |
| Flanges                                                                            | Grade 316 L or same SS grade as the counter flange                                                  | This covers the inlet flange of tip, pilot FG connection, pilot FFG connection, steam connection                                                                      |
| Internal parts exposed to flame impingement                                        | Grade 310 S (*)                                                                                     | This covers upper part of internal steam/air injection pipe<br>(*) 800 H may be used                                                                                  |
| Internal parts not exposed to flame impingement                                    | Grade 310 S (*) or 347 or 321<br>CK20 or HK (castings)                                              | This covers bottom part of internal steam/air injection pipe and center steam injection<br>(*) 800 H may be used                                                      |
| Piping normally not exposed to flame impingement                                   | Grade 347 or 321                                                                                    | This covers steam manifold and piping located on flare tip                                                                                                            |
| Pilot FG filter, fuel/air mixer                                                    | Grade 316 L                                                                                         |                                                                                                                                                                       |
| Noise attenuation muffler                                                          | Grade 304 or 316 L in marine environment                                                            | Noise attenuation muffler                                                                                                                                             |
| Refractory concrete                                                                | Minimum service temperature of 1650°C, with > 60% alumina and < 1.0% Fe <sub>2</sub> O <sub>3</sub> | Flare tip without refractory concrete is preferred. If used chemically bonded refractory is preferred                                                                 |
| <b>Liquid seal and purge gas seals</b>                                             |                                                                                                     |                                                                                                                                                                       |
| Velocity Seal                                                                      | Grade 316 L or same SS grade as Lower part of tip                                                   |                                                                                                                                                                       |
| Molecular Seal                                                                     | Grade 316 L                                                                                         |                                                                                                                                                                       |
| Liquid Seal                                                                        | Same grade as flare header connected from KO drum                                                   |                                                                                                                                                                       |