



Exploration & Production

GENERAL SPECIFICATION

ROTATING MACHINERY

GS MEC 213

Fuel gas treatment units

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1. Scope

This specification indicates the minimum requirements for design and construction of gas turbines fuel gas treatment units.

The analysis and physical properties of the fuel gas before treatment are given in the project specification.

The purpose of this general specification is to define the characteristics of the fuel gas treatment unit. These characteristics must be considered as technical minima, and any requirements of the project specification must be met. In case of disagreement between the project specification and this general specification, the project specification shall prevail.

Each gas turbine will be equipped with its dedicated fuel gas treatment unit with its own control system hook up directly to each gas turbine PLC control panel. Other configurations may be offered, subject to COMPANY formal approval and compliance with requirements of operation and maintenance of equipment.

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.

Equipment and installations must be in accordance with (in order of precedence):

1. The country local regulations where equipment and/or installations shall be operated
2. The project specification
3. The present general specification
4. The COMPANY General Specifications
5. The International Standards.

In case of discrepancy between documents the more stringent requirements shall apply.

Standards

Reference	Title
ASTM D 1072	Test for total sulphur in fuel gases
ASTM D 1142	Test for water vapour content of gaseous fuel
ASTM D 1704	Test for particulate matter in the atmosphere
ASTM D 1826	Test for calorific value of gases
ASTM D 1945	Analysis of natural gases by chromatography

Professional Documents

Reference	Title
Not applicable	



Regulations

Reference	Title
Not applicable	

Codes

Reference	Title
Not applicable	

Other documents

Reference	Title
SI	International System of Units

Total General Specifications

Reference	Title
GS MEC 301	Rotating machines inspection and shop tests

3. Characteristics of the gas after treatment

3.1 Composition

The composition given in the project specification for the fuel gas upstream of the fuel gas treatment unit shall detail all the components up to C14.

Based on fuel gas composition upstream the fuel gas treatment skid, the gas turbine MANUFACTURER will perform all necessary engineering studies to reduce the contaminants down to the specified gas turbine criteria. The gas turbine MANUFACTURER will guarantee that the recommended design will not reduce the hot gas parts expected life cycle time between overhaul.

When sulphur is present, the amount of H₂S after fuel gas treatment shall not exceed one per cent in any case, taking into account the quality of the filtered air combustion air.

The engineering study results will be presented will be presented to COMPANY for review and comments.

Gas fuel analysis sampling device shall be installed and shall allow sampling without any disturbance of gas turbine operation.

3.2 Pressure

The delivery pressure of the gas treatment unit shall be sufficient to feed the gas turbine at all anticipated fuel flow rates with at least 20% margin.

The nominal pressure requirement is stated in the project specification

- The pressure control valve (s) and associated controller shall be such that the allowable pressure variations in steady conditions do not exceed $\pm 1\%$ of the nominal value requested at the fuel gas treatment unit outlet.
- During transient operating conditions such as starting up, acceleration, and deceleration of the gas turbine, the pressure variations shall not exceed $\pm 5\%$ of the nominal value.

3.3 Heating value

The fuel gas composition downstream of the fuel gas treatment unit, the nominal lower heating and the Wobbe index shall be calculated.

The nominal lower heating value the fuel gas shall be that indicated in the individual project specification or that decided upon by agreement among the VENDOR of the driving machine and the COMPANY.

The fuel gas treatment unit shall have provision to accommodate possible variations of raw gas compositions resulting in a lower value variation of $\pm 10\%$.

3.4 Temperature

The temperature of the fuel gas leaving the treatment unit shall meet all of the following requirements:

- Temperature such that no hydrate forms during the successive expansions in the circuits of the driving machine
- Temperature 30°C (or higher value if required by the gas turbine MANUFACTURER) higher than the dew points of water and hydrocarbons at any operating conditions between start up and maximum load
- Temperature above 0°C
- Temperature below 85°C .

4. Stages of treatment

4.1 Separation and filtration

The first stage of treatment shall consist of a separation device. Filtration assembly shall be installed downstream of the pressure control valve and the separator.

The scrubber shall be designed to remove 100% of 10 microns (or bigger) droplets.

The separators shall be fitted with automatic drains, hand drains and vent valves, and the instrumentation specified paragraph 5.2.

Each filter will be designed for the maximum flow + 20% and no maintenance required before 4,000 (four thousands) hours operation and it shall be possible to replace the filter elements without interfering with operation. If interlock transfer valves are used, they shall be tight shut off type.

The filtration will be coalescer type with the following characteristics:

- 100% efficiency for solids removal for 3 micron size and above

- 100% efficiency for liquid droplets removal for 10 micron size and above
- 99% efficiency for liquid droplets removal for 5 micron to 10 micron size.

4.2 Adjustment of pressure level

The installation of booster compressors shall only be considered if the pressure levels require their use. The API standard for centrifugal or reciprocating compressors would apply in this case. If required, such equipment and installation shall be detailed in separate project specifications.

The pressure shall in all cases be adjusted by expansion. At least two expansion lines shall be supplied, each dimensioned for the maximum flow rate, to allow for maintenance on one of the pressure control valve without interfering with the operation of the gas turbine package.

4.3 Temperature control

Any temperature reduction shall be achieved using exchangers or atmospheric coolers. One atmospheric cooler (single bundle with two electrical motors fans) will be acceptable; if water coolers are used, two exchangers, each capable of the nominal thermal load, shall be installed. Temperature control shall be accomplished by partial by-pass of the coolers.

The fuel gas heaters shall be electric devices or exchangers using a heat-conveying fluid (oil, water, steam or gas). In all cases the temperature control shall be achieved by varying the heating power: either the electric power or the flow of heating fluid.

When electrical heaters are used, continuous control shall be by means of thyristors and designed to minimise perturbation on electrical grid. Heaters shall be designed for increasing the gas temperature by at least 30°C (or higher if required) at maximum gas fuel flow with 20% margin. They shall switch OFF in no flow conditions and automatically switch ON when fuel gas flow is detected.

When the Δt across the fuel gas heater is lower than 10°C, a signal from the fuel gas treatment skid shall be sent to the turbine control panel for alarm and gas turbine normal stop sequence.

The gas turbine will be prevented to start until the temperature across the heater has reached the specified value.

The gas fuel warm up will be part of the automatic gas turbine start sequence.

5. Construction

5.1 General rules

The gas treatment unit shall be built in the form of a single skid assembly which can be handled by single lift. The gas treatment unit shall be designed for continuous operation and for at least:

- 40000 hours for scrubber internals
- 10000 hours between maintenance inspections
- 4000 hours between filter cartridge replacements.

Insulation and heat tracing is required and will be part of scope of supply for the fuel gas treatment unit. Insulation and heat tracing of the line between the fuel gas treatment unit and the gas turbine will be supplied by other.

The number of fluid and electrical connections shall be held to a minimum, typically:

- One gas inlet
- One treated-gas outlet
- One heating-fluid inlet and one outlet (if used)
- One compressed-air inlet
- One liquid drain outlet
- One gas outlet to flare
- One electric power connection (if electricity is used)
- One junction box for measurements
- One junction box for alarm and shutdown signals
- One junction box for thermocouples (if used).

5.2 Instrumentation and safety devices

The locations and types of the measurement and control functions to be provided are listed in Appendix 1.

Actuated valves, built into the treatment unit, with local control and remote control, serve to disconnect and vent the gas treatment unit in case of an emergency shutdown.

5.3 Inspections and tests

Shop inspections shall be carried out in accordance with the quality and inspection plan developed for the project. It shall cover all main components like separator, filters, heater, cooler, control valves, instruments, piping and skid.

As a minimum, on these main components, two inspections, the first one before tests and the second one before shipment, shall be conducted in presence of a COMPANY representative.

The tests of the treatment unit shall include:

- Mechanical tests and performance tests of the gas compressors (if used)
- Operating tests of heaters
- Operating tests of all instruments.

When a string test is required for the shaft line, the fuel gas treatment unit shall be used.

Appendix 1 Typical measurements and control functions

Typical pressure and differential pressure measurement and control functions

Measurement point	Local reading	Control-room reading	Recording	Control-room alarm
Gas inlet pressure	x	x		x
Separator pressure	x			
Pressure downstream of separator	x	x		
No. 1 filter differential pressure	x			x
Pressure at no. 2 filter	x			
No. 2 filter differential pressure	x			x
Unit output pressure	x	x	x	x

Typical level measurement and control functions

Measurement point	Local reading	Control-room reading	Control-room alarm
Inlet separator	x	x (A)	x (C)

(A) If the control loop is not local only

(C) Two levels, alarm and shutdown of machines

Typical temperature measurement and control functions

Measurement point	Local reading	Control-room reading	Recording	Control-room alarm
Gas inlet	x	x		x
Downstream of pressure control valve	x			
Upstream of heater	x	x		
Downstream of heater	x (B)	x (B)		x

(B) A single point if the heater is the last element of the treatment unit

Typical flow measurement and control functions

Measurement point	Local reading	Control-room reading	Control-room alarm
Outlet of unit (downstream of filter)	x	x	x

Appendix 2 Typical PFD of gas fuel treatment unit

