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Hellenic Gas Transmission System Operator

HELLENIC GAS TRANSMISSION SYSTEM OPERATOR

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HIGH PRESSURE (HP) TRANSMISSION SYSTEMS

ELECTRONIC FLOW COMPUTERS (FOR NATURAL GAS M/R STATIONS)

QUALITY ASSURANCE PAGE

CHANGES LOG

REVISIONS LOG

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REFERENCED DOCUMENTS

EU Directive 2004/108/EC EMC
[Electromagnetic Compatibility Directive]

EU Directive 94/9/EC ATEX

[Equipment Explosive Atmospheres Directive]

Job Specification 970/2
[Shop Inspection of Equipment and Materials for NGT Project]

ELOT EN 1776
[Gas supply systems - Natural gas measuring stations - Functional requirements]

ELOT EN 12405
[Gas meters - Conversion devices]

ELOT EN 60529
[Degrees of protection provided by enclosures (IP code)]

EN 60801
[Electromagnetic compatibility for industrial-process measurement and control equipment]

ELOT EN ISO 12213-3 (GERG 88)
[Natural gas - Calculation of compression factor - Part 3: Calculation using physical properties]

EN ISO 13686
[Natural gas - Quality designation]

1.0 SCOPE

1.1 ITEM

Electronic Flow Computer (FC) including one printer.

1.2 APPLICATION

Computation of volume and mass flow of natural gas at normal conditions (0°C and at 1.01325 bar), using inputs from orifice plates, ultrasonic or turbine meters, densitometers or/and gas chromatographs, gas pressure and temperature transmitters (actual conditions). Telemetry transmission of calculated results is also included in the scope.

2.0 GENERAL REQUIREMENTS

2.1 STANDARDS AND GUIDELINES

- **EU Directive 2004/108/EC EMC**
- **EU Directive 94/9/EC ATEX**
- **ELOT EN 1776**
- **ELOT EN 12405**
- **EN 60801**
- **ELOT EN ISO 12213-3 (GERG 88)**

2.2 CONSTRUCTION REQUIREMENTS

The flow computer must be suitable to be mounted on the front side of a control panel in 50cm racks, and be able to operate with a 24 VDC ±10% power supply.

The flow computer must operate using a password facility in order to prevent unauthorized entry or alteration of stored data or constants.

The flow computer shall be designed for use in a safe area in combination with intrinsically safe barriers for instruments that receives data from and which are located in hazardous areas.

It shall include a system of secured data storage and of enough capacity, in which the operation reports shall be registered.

The flow computer shall at least be able to accept the following inputs per metering run:

- Two high frequency pulse inputs from a turbine meter or two 4 - 20mA analog inputs from two differential pressure transmitters associated to an orifice meter. In case of an ultrasonic meter, a single high frequency pulse input might be used to facilitate the data exchange between an ultrasonic meter control unit and the flow computer.

- Two high frequency pulse inputs, one from an actual and one from a standard density transducer respectively, in case where volume conversion to standard conditions is performed using the density correction method.

- An Ethernet interface (Modbus TCP) and a Modbus-RS serial link, to a PLC, or to a gas chromatograph, or a local supervisory invoicing computer and an RTU, to facilitate the transfer of data (superior calorific value, density at normal conditions, CO_2 content etc) necessary for gas volume correction calculations.

- Two analog inputs (4 - 20 mA) from respective temperature and pressure transmitters.

It shall be possible to enter via keyboard:

- Warning and alarm limits on input and computed data.

- Any man-machine dialog necessary for the computer programming and function.

Each flow computer shall provide output to a printer. The printer may be of the reduced paper width type and be suitable for long time operation (35 days) without paper replacement. It shall have the possibility to print parameters on command or at regular intervals preceded by time and date.

The printer may also be an integral part of the flow computer itself.

Each flow computer shall at least provide the following output signals:

- As a minimum, one computer failure alarm.
- One pulse output representing corrected volume (Nm^3).
- One pulse output representing uncorrected volume (m^3).
- A number of voltage free contacts for deviation alarms.
- An Ethernet interface (Modbus TCP) and a Modbus-RS serial link, to a local supervisory invoicing computer or / and an RTU, for local storage and telemetry transmission of calculated results. These interfaces might be physically the same with those specified in the input requirements, simultaneously handling input-output data transfer. The later case implies that data from the gas chromatograph reach the flow computer via a supervisory invoicing computer.
- A minimum of six (6) 4 - 20 mA analogue outputs representing customer configurable variables.

The following information shall be at least available to be depicted on the front display of the flow computer when requested.

- Totalized mass per meter run (kg).
- Totalized actual volume per meter run (m^3).
- Totalized volume at normal conditions per meter run (Nm^3).
- Measured density (kg/m^3) at working conditions (If a densitometer is used).
- Mass flow rate (kg/h).
- Compressibility factor (if applicable).
- Corrected volume flow rate (Nm^3/h).
- Pressure (bar).
- Temperature (°C).
- Calculated gas density, using PTZ equations (if applicable).
- Alarm indications.

The front display shall be of electronic type and have a minimum of 2 lines of 16 characters.

The flow computer shall have facilities for:

- Entry of data in computer memory via an integral keypad.

- If a programming option via a remote PC is available, it should be quoted separately and shall include the required software.

- Retention of program and stored data during power supply failure (24 hours minimum).

- Self-diagnostics to verify the integrity of the computer.

The flow computer shall be insensitive to influences from electric signals normally occurring in the area where they are installed.

All inputs shall be protected against possible transients and noise signals.

The flow computer enclosure protection shall be minimum IP 20 **(ELOT EN 60529),** installed inside a control panel of IP 52.

2.3 FUNCTIONAL REQUIREMENTS

The inputs from the turbine meter shall be used for the computation and monitoring of the turbine meter.

A preset deviation between the two turbine meter inputs shall cause a turbine meter failure condition.

Volume conversion to standard conditions (corrected volume) may be performed using either PTZ or density correction methods.

Density correction method implies the use of a densitometer. In both cases, supplementary instrumentation shall be used, such as, a gas chromatograph (PTZ correction) or a standard density transducer (density correction) in order to supply the correction method with the necessary input data, such as density at normal conditions, superior calorific value, e.t.c.

Alternatively all input data necessary for the computation of flow may be transferred from a remote main control center through an RTU / SCADA system, or directly be entered by means of an integral keypad.

ELOT EN ISO 12213-3 (GERG 88) method shall be used to compute the compressibility factor (if applicable), or outside the limits of this method with the methods described in the **EN ISO 13686**.

If the available instrumentation can allow both a direct measurement of density using a densitometer, as well as a density calculation using PTZ correction equations, then a comparison between the two values shall be made and an alarm shall be activated if the difference exceeds a predetermined value.

An alarm shall also be given in the cases where orifice plates are used as the main measurement devices, and when the difference between the two electronic differential pressure transmitters exceeds a preset value.

In general an alarm condition shall occur in the event of:

- Any excess of the preset range limits of the input and computed variables.

- Error indication from the self-checking facility (flow computer failure).

- Power supply failure.

A flow computer or a turbine meter failure or a density deviation case shall inhibit the increment of any counter output and shall generate, as a minimum, a print-out of the following:

- Alarm condition.
- Actual time and date.
- Actual totalized mass (kg).
- Actual totalized uncorrected volume (m^3).
- Totalized corrected volume (Nm^3).

In addition, the computer shall generate, at fixed time intervals or when requested, a print-out of all variables and alarm conditions.

Remote programming, if available, should be separately quoted as an option. Computational accuracy shall be equal or better than ±0.02%.

2.4 DATA EXCHANGE

The flow computer shall provide the means for exchange of data with a supervisory computer and or a telemetering system. Input/output functionality and facilities are already specified in the construction requirements section of this document.

The main communication with the external devices shall be mainly done via an Ethernet interface, utilizing the MODBUS TCP protocol. A serial link shall be used as an alternative to the Ethernet.

The serial link shall be either RS-232 or RS-485 type, depending on whether the port has been configured for point to point or bus network (multi-drop) communication. The MODBUS (ASCII / RTU) protocol shall be used with the flow computer configured as a "slave" device.

2.5 TESTING

2.5.1 FACTORY TEST

The flow computer shall undergo a factory acceptance test for verifying that all specified requirements have been met. The Manufacturer shall deliver all necessary FAT reports to confirm that the specified requirements have been fulfilled.

2.5.2 SITE TEST

A final commissioning test will be carried out after installation of the computer on site.

2.6 INSPECTION AND CERTIFICATION

Inspection will be performed by an Accredited Inspection Body appointed by the Owner.
Inspection requirements are defined in the following documents:

a. Material requisition.
b. **Job Specification 970/2**
c. Relevant project specifications.
d. Inspection clauses of applicable Standards.

2.7 COMPLIANCE WITH THE EU DIRECTIVES

Instrumentation that complies with the "New Approach" directives shall be provided with:

a. A physical CE marking and other information as required by the relevant directives.
b. A declaration of conformity which lists all the directives with which the product complies.
c. Any other information specified by the directive, e.g. user instruction.