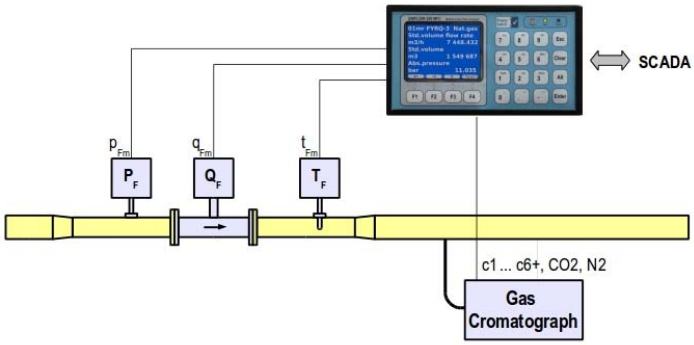
Uniflow-200 in non-standard applications
Case study 2 – energy balance of the gas-piston cogeneration station

What does a flow computer do?

Measurement of the quantity of the fluid flowing in pipelines probably one of the most frequent measurement task in industrial applications.
The primary element of the flow metering system (e.g. turbine meter, ultrasonic meter, etc.) measures volume flow rate at line conditions. The flow rate shall be converted to volume flow rate at certain pressure and temperature (at standard reference conditions) or to mass flow rate. It is equally important to calculate the energy flow rate provided by volumetric or mass flow rate of the fluid.

In flow measurement systems, flow computers perform the necessary calculations. Sometimes some simplified set of calculations is embedded into flow meters or multivariable transmitters. However, in the flow measurement systems for custody transfer applications the flow computer is usually a separate device.

A simple measuring system for natural gas flow measurement is shown on the following figure.



There are many flow computers on the market, capable to perform calculations required in simple measuring system.

In this article I will show a non-standard application which utilize the special features implemented in the Uniflow-200 flow computer manufactured by Process Control Kft, Hungary.

Calculation of the energy balance of the gas-piston cogeneration station

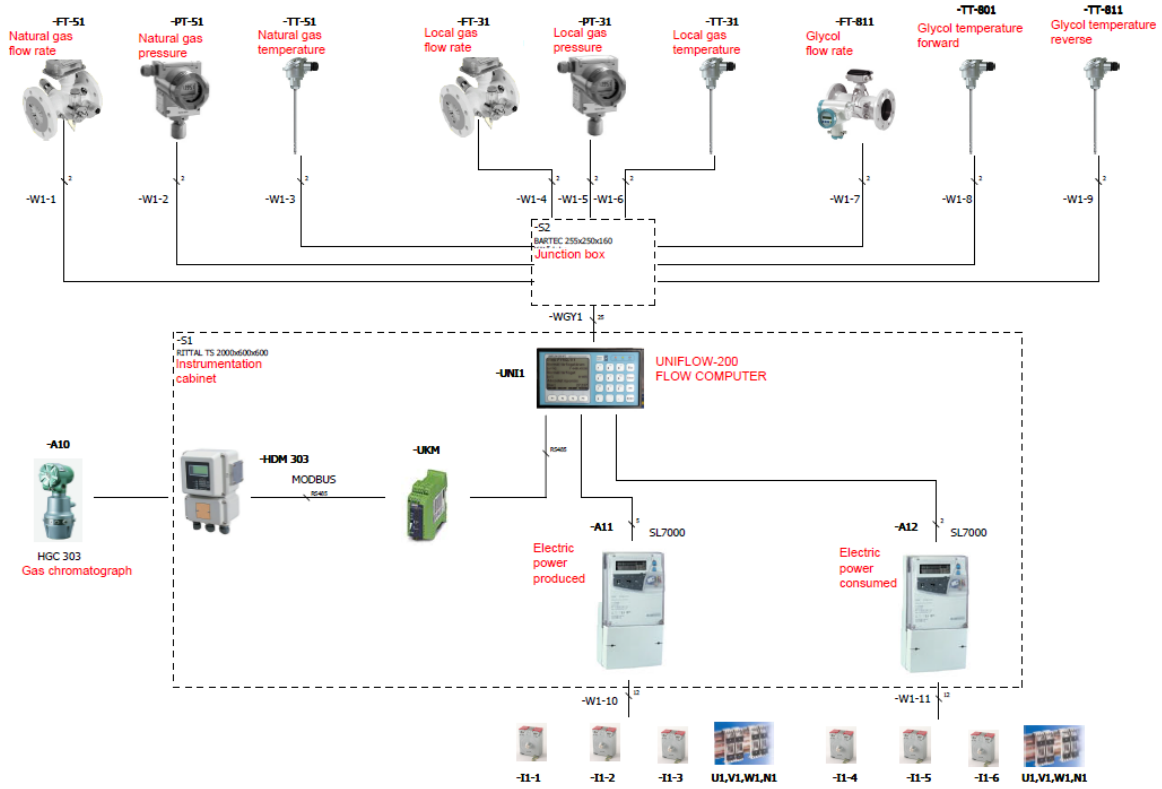
In recent years increasingly finds application CHP (combined heat and power) based on gas engines. They can be an economical solution to provide energy for small factories, residential areas or remote mountain resort.
CHP feature is that they can consume combustible gases from different sources, while producing electricity and heat energy. It is necessary to keep records of the consumed and produced energy.

The application described in this case study implemented in a processing plant of natural gas with high inert content and with CO2 removal. There are three gas engines installed. The complete measurement of the consumed and produced energy and the calculation of the engine efficiency are realized in Uniflow-200 flow computer. One flow computer is installed for each engine.

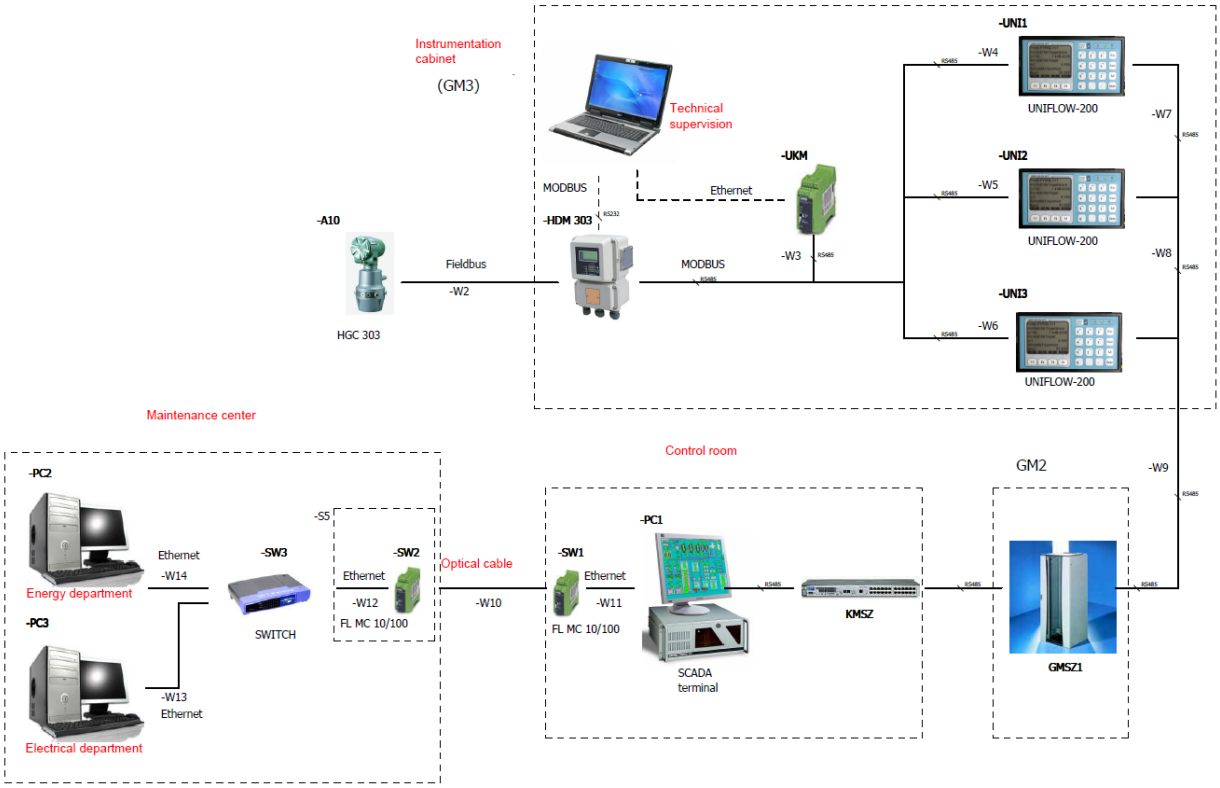
Uniflow-200 performs tasks as follows:

- Measurement of high inert content natural gas consumption. Gas flow is measured by turbine meter; the flow computer performs volume conversion to base conditions with PTZ correction;
- Measurement of the flow of natural gas from the main gas pipeline (alternative fuel). Gas flow is measured by turbine meter; the flow computer performs volume conversion to base conditions with PTZ correction;
- Polling gas chromatograph analyzing composition of the natural gas in two streams (high inert content and pipeline quality), and taking the gas composition into account in compression factor and energy flow rate calculation;
- Measurement of mass flow of glycol (serving as heating agent) with a Coriolis flowmeter. Temperature measurement in the "forward" and "reverse" pipeline and calculation of the thermal energy carried away;
- Measurement of the effective and reactive power generated by the generator
- Measurement of the electrical power used by the motor;
- Calculation of the efficiency of CHP in view of generated (electric and thermal) energy and consumed (gas and electric) energy;

Connection of the transmitters, sensors to the flow computer can be seen on the figure below.



All three flow computers are connected to the data acquisition system, as shown in the following figure. All data from the flow computers are available to all interested departments (Department of operation, energy, etc.) through the corporate data network.



Obviously, it is not difficult to implement energy balance and efficiency calculation in a DCS or any other supervisory system.

The case study demonstrates that for a small, stand-alone CHP station where no supervisory system installation is justifiable all the essential calculations can be done in flow computer.