

Solutions for non-transparent gas measurements and improved data transmission

by **Achim Zajc und Jost Körte**

The requirements imposed on provision of data for billing purposes and especially network capacity optimization have increased enormously in recent years. The following article presents possible ways how these new requirements imposed on data provision can be met with innovative metering concepts and instrumentation.

1. INTRODUCTION

Due to the significant increase of supply points in complex natural gas networks and the necessity of making these data available promptly, sometimes to nearly real time, large quantities of data arise that must be verifiable, so that end consumers' invoices can be generated in short time. Taking into consideration what computing services have been available at each particular point in time of installation of the devices shows that this process, as simple as it may sound at first, turns out to be extraordinarily complex upon closer examination [1]. This was the case in the past and will become even more complex as of 2015 as the redesign of GABi Gas 2.0 (basic model for the compensation lines and accounting rules in the gas sector) has been implemented in Germany [2]. The measuring point's complexity from the device-related perspective is shown in **Figure 1**.

The consequences of the data's changes, provision for planning, billing and accounting are:

- more frequent data retrievals up to hourly data retrieval for RLM customers and
- non-transparent measuring points having to be upgraded or enabled to become transparent.

2. SOLUTION CONCEPTS FOR SYSTEM-INTEGRATED MEASURING POINTS

The following scenarios for different measuring points are conceivable:

- Situation A: PTZ corrector is already present but lacks communication capabilities

- Situation B: non-transparent natural gas volume measurement
- Situation C: New measuring point - compact dual stream meter run
- Situation D: dual stream meter run with integrated redundancy

2.1 Situation A: PTZ corrector is already present but lacks communication possibilities

The AMR^{flexM} GPRS communication module can be retroactively installed in this constellation. The AMR^{flexM} GPRS communication module belongs to the category of parameterizable automatically operated AMR modules that can be attached to various manufacturers' PTZ correctors with intrinsically safe data outputs. The AMR^{flexM} meets the need for frequent data readout from meters and subsequent data transmission to SCADA or other parent systems regardless of the volume corrector's manufacturer. Thus the AMR^{flexM} is the ideal solution for an already installed volume corrector that is lacking the capability to communicate with the SCADA system. The AMR^{flexM} can be easily integrated with little cost into an existing measuring point in a hazardous zone with explosion protection zone 1 or 2.

The AMR^{flexM} module has two main functions: (1) communication with a SCADA or parent system and (2) the recording of data from the connected PTZ corrector via pulses and status information. A GSM module or GPRS modem is integrated into the AMR^{flexM}, which takes care of the communication with the SCADA or other parent systems through mobile networks in the CSD regime (dial-up connection).

Internal lithium batteries ensure the electrical power supply of the device. The energy consumption has been considerably reduced thanks to use of the latest technology electronic components. The device runs for five years in defined operation (data readouts twice daily) without having to replace the batteries. Moreover it's possible to replace the battery in the explosion hazardous zone. The internal back-up battery provides the voltage supply during battery replacement so that the archiving of data and pulse inputs is unaffected.

An installation in explosion hazardous zone 2 is presented by way of example in **Figure 2**. An installation in explosion hazardous zone 1 is also possible due to the AMR^{flexM} communication unit's ATEX approval [3].

Electronic volume correctors (EVC) from different manufacturers and generations can be connected to the device using RS-232 or RS-485 interfaces with intrinsically safe circuits, or via the electric current interface (4-20 mA). MEC^{flex} correctors manufactured by Metreg Technologies can be connected to the device just like correctors from other manufacturers.

The AMR^{flexM} device has six digital inputs and one digital output. These inputs can be configured as binary input (e.g. for scanning a door contact or a safety shut-off valve) or as pulse input (for connection to a gas meter or of corrector outputs).

A maximum of four pulse inputs are possible. The digital output can be configured as either a binary or a pulse output. Data from PTZ correctors and binary or pulse outputs are read out and stored in the archive at parameterizable periodic intervals. The device's operating state is also monitored. Alarm statuses are monitored according to the configuration. The archive content is transmitted to the SCADA or parent data management system using GSM/GPRS communication. Communication can also be performed in a 'transparent regime'. In this regime, the SCADA or data management system can communicate directly with the volume correctors that are connected to the communication module and read out actual or archived values.

2.2 Situation B: non-transparent natural gas volume measurement

The most convenient possible solution for PTZ correction and data transmission can be installed as a replacement solution in the case of non-transparent natural gas volume measurement situations. The reason for this is basically quite simple: attempts should be made to avoid large investment and installation costs for retrofitting an existing measuring unit. In this case a volume corrector with an integrated battery-operated modem is viewed as ideal for operation in the explosion hazardous zone. Battery operation certainly restricts retrieval frequency to once or twice daily; however five years of operation is possible under these conditions. If

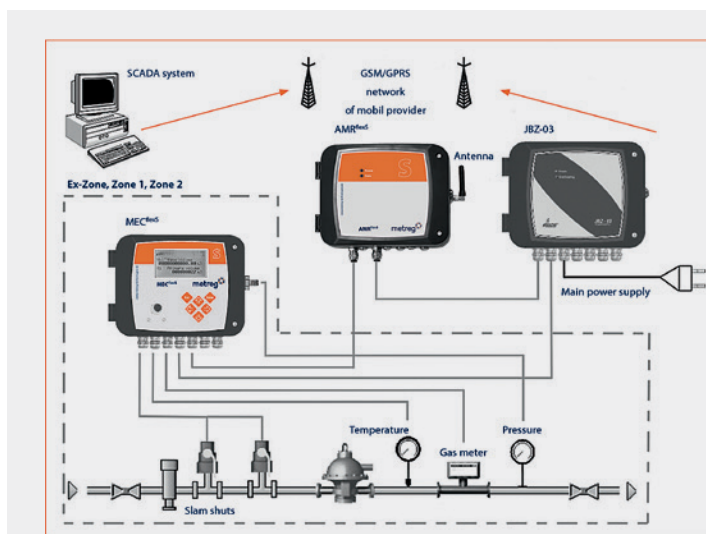


Figure 1. Exemplary, traditional structure of a commercial/ industrial measuring point with gas volume meter, volume corrector and modem, as well as other facilities

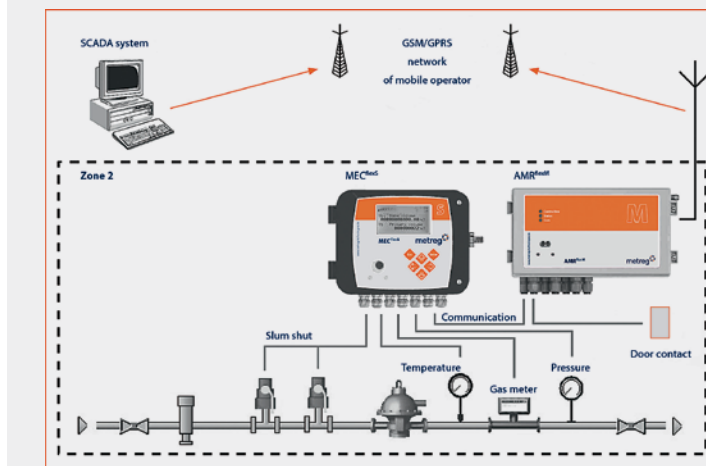


Figure 2. Data transmission via AMR^{flexM} in combination with an EVC, also from other corrector manufacturers

more frequent data transmissions are needed, operation of the volume corrector together with the modem using an external electrical power supply is possible in addition to battery operation with the MEC^{flex} and AMR^{flex} product families.

The MEC^{flexM} PTZ corrector is the ideal solution for non-transparent gas volume measurement (**Figure 3**) shows a typical installation). The MEC^{flexM} (**Figure 4**) is a compact PTZ corrector with integrated GSM/GPRS modem based on the latest technology and exact operating volume determination. It also measures operating pressure and temperature with great accuracy. Moreover the MEC^{flexM} with integrated GSM/GPRS modem is MID approved [4] and can be deployed in both explosion hazardous zones 1 and 2 pursuant to the ATEX certificate [5]. The MEC^{flexM} is an instrument for correcting gas volumes under operating condi-

tions into gas volumes under standard conditions according to selectable standard compressibility equations.

The MEC^{flexM} records the pulses from the gas meter for volume under operating conditions and measures the operating gas temperature and pressure for this purpose. MEC^{flexM} belongs to a new generation of electronic PTZ correctors. It was developed based on the latest microprocessor technology. The device has access to large archiving capacities and offers the possibility of flexibly modifying the data acquisition interval.

The device supports the calculation algorithm for computing compressibility acc. to AGA 8-92DC, AGA NX-19 mod., AGA 8-G1, AGA 8-G2, SGERG-88, or fixed value. The MEC^{flexM} features a digital output pulse generator as a standard function, which responds to the operating volume and standard volume as well as to alarm signals. Data protection is ensured either using the hardware switch or through the use of programmable passwords.

The MEC^{flexM} was designed as a complete solution based on a flexible modular system. The device is battery operated

by default. It also offers the external electrical power supply as an optional possibility. All of the required actual and computed values are displayed on a back-lit graphic LCD display that is operated using a six-button keyboard. Fundamental parametrizations can also be undertaken on site using the keyboard. Communication with a SCADA or parent system can be managed via an RS-232/RS-485 serial interface, the optical interface using an infrared head, or via the integrated GSM/GPRS modem ('pull' or 'push' method).

2.3 Situation C: New measuring point – compact dual stream meter runs

A typical dual stream measuring installation is presented in Image 5. The model MEC^{flexV} PTZ corrector from Metreg Technologies comes into its full use here.

The MEC^{flexV} is like the other members of the MEC^{flex} product family also an instrument for correcting gas volumes under operating conditions into gas volumes under standard conditions according to selectable compressibility equations. For this purpose also this device reads out pulses from the gas meter, and measures the gas temperature and pressure under operating conditions. The MEC^{flexV} can be deployed as a PTZ, PT, TZ or T corrector just like the MEC^{flexS} and MEC^{flexM} devices. The device supports the calculation algorithm for computing compressibility acc. to AGA 8-92DC, AGA NX-19 mod., AGA 8-G1, AGA 8-G2, SGERG-88, or fixed value.

The MEC^{flexV}'s mechanical design was selected so that the corrector can be operated as a single stream volume corrector on the one hand, or optionally as a dual stream volume corrector within MID approval on the other hand [6]. The optional possibility of supplementing with a third non-metrological channel is additionally available. The MEC^{flexV}'s full version can thus monitor and measure a maximum of three metering runs.

The optional integrated GSM/GPRS modem is used to transmit the recorded data to SCADA or parent systems via a mobile radio network ('pull' or 'push' method). The MEC^{flexV} can also be used in explosive hazardous zone 1 or zone 2 with the integrated modem [7]. The MEC^{flexV} is moreover equipped with up to four analogue inputs, eight digital inputs, and four digital outputs.

The MEC^{flexV} corrector as the whole MEC^{flex} product family belongs to a new generation of electronic PTZ correctors. It was developed based on the latest microprocessor technology. The device has access to large archiving capacities and offers the possibility of flexibly modifying the data acquisition interval. The device has a digital output pulse generator as a standard function, which responds to the operating and standard volume as well as to alarm signals. Data protection is ensured either using the hardware switch or through the use of programmable passwords. MEC^{flexV} was designed as a complete solution based on a flexible modular system.

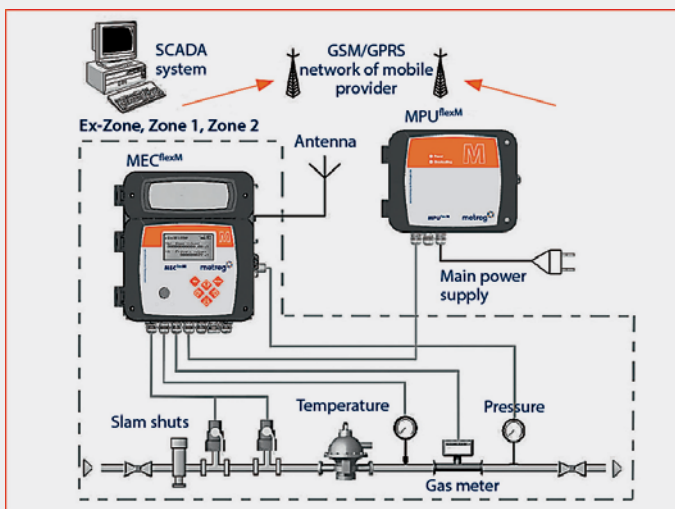


Figure 3. Data transmission using the integrated modem in the model MECflexM volume corrector



Figure 4. Model MECflexM PTZ volume corrector

The MEC^{flexV} is battery operated and also offers the possibility of an external power supply. All of the required actual and computed values are displayed on a back-lit graphic LCD display that is operated using a six-button keyboard. Fundamental parametrizations can also be undertaken using the keyboard. Communication with the SCADA or parent system can be managed via an RS-232/RS-485 serial interface, the optical interface using infrared head, or via the integrated GSM/GPRS modem ('pull' or 'push' method).

2.4 Situation D: dual stream measuring unit with integrated redundancy

As illustrated under 2.3 and **Figure 5**, the MEC^{flexV} is in a position to operate two meter runs under MID conditions. One hundred per cent redundancy can be realized for the volume conversion as well as for data transmission (provided that the MEC^{flexV} is equipped with a modem) by cross-wiring (pressure, temperature, and meter pulses) two model MEC^{flexV} PTZ correctors in a measuring system as illustrated in **2.4**. With this feature the MEC^{flexV} is the first compact PTZ corrector that is in a position to deliver such an economical, easy-to-install full redundant solution. Such functionality is normally only achieved within the 'flow computer class' of volume correctors. With the MEC^{flexV} this solution, however, can be achieved as shown in **illustration 2.4**, completely installed in the explosion hazardous zone 1 or 2 without the need for the creation of an explosion safe zone. This way the cost for a redundant system including AMR features with GSM/GPRS communication is possible.

3.SUMMARY

The flexible, modular design of the MEC^{flex} product family from Metreg Technologies is in a position to easily and efficiently retrofit existing measuring points with modern corrector functions as well as with correspondingly modern data communication. This can be achieved either with an additional AMR^{flex} communication device or with a fully integrated MEC^{flexM} device with integrated communication capabilities.

For the first time in this measuring-unit segment, the MEC^{flex} product line also offers a very cost-effective possibility of 100% redundancy in the PTZ corrector and data transmission, which is normally only possible with flow computers.

Moreover with the MEC^{flexM} and MEC^{flexV}, it has been possible to introduce PTZ correctors that can transmit data during battery operation directly from explosion hazardous protection zone 1 via GPRS/GSM. This scalable, flexible product series stands out in a way that it enables the user to install everything from simple applications to complex complete solutions.

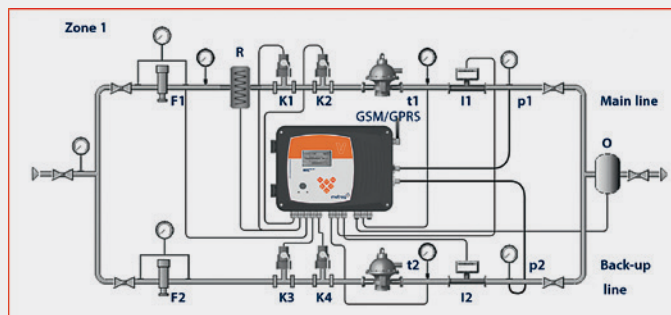


Figure 5. Dual stream metering run with a model MECflexV volume corrector having an integrated modem pursuant to MID approval

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AUTHOR



Dr. Achim Zajc
 Managing Director |
 Metreg Technologies GmbH |
 Fürstenwalde |
 Phone: +49 3361 733 9004 |
 E-mail: achim.zajc@metreg-technologies.de



Dipl.-Ing. Jost Körte
 Managing Director |
 Metreg Technologies GmbH |
 Fürstenwalde |
 Phone: +49 3361 733 9003
 E-mail: jost.koerte@metreg-technologies.de