Key considerations for the installation and operation of electronic flow computers for the gas industry

by Denis Rutherford

Executive summary

Electronic Flow Measurement (EFM) makes chart recorder technology a thing of the past. Now the de facto standard for measuring natural gas, EFMs are solar-powered flow computers designed for use in remote locations where solar is the only power and technician access is less than ideal. This white paper discusses an overview of current flow computer technology and examines key considerations in the configuration, installation, selection of solar-power system components, operation, maintenance, and testing of EFM flow computers.

998-2095-04-13-12AR0

Summary

Executive summary

This white paper discusses an overview of current flow computer technology and criteria for selection.

Introduction

Say goodbye to obsolete chart recorder technology and bulky multi-component flow computers and make way for Electronic Flow Measurement (EFM). The EFM is a solar-powered single to multi-run flow computer - an evolution in gas measurement technology. Designed for use in remote locations where solar is the only power and technician access is less than ideal, the EFM incorporates a dedicated single-run flow computer, solar/battery power supply and communication system in an all-in-one, compact, easy-to-install package.

The EFM requires a Man-Machine Interface (MMI) to configure. The MMI or Configuration Software allows editing of the flow computer configuration parameters with configuration dialogs for process inputs, contract specifications, compressibility calculations, and flow calculations for each meter run. The operator may write configuration data to the flow computer or read it back. Parameter checking is provided on user entries.

The EFM is an electronic natural gas flow computer providing the following industry standard calculations:

- AGA-3 (1992) for gas volume calculation with orifice meters
- AGA-7 for gas volume calculation with turbine meters
- AGA-11 for gas volume calculations with Coriolis meters; V-Cone for gas volume calculation with V-Cone gas flow meters;
- AGA-8 detailed calculation for gas compressibility
- NX-19 for gas compressibility calculation in legacy applications.
- AGA-10 speed of sound calculation for verifying the accuracy of an ultrasonic meter

The MMI configuration software (normally software residing on a laptop) displays the flow computer current readings, historical logs, alarm logs, and event logs for each meter run. The MMI supports multiple configuration and display windows open simultaneously to display data from multiple views.

The MMI can be used to configure and calibrate the EFM to the individual sensors or Multivariable Transmitters (MVT). The gas flow computer automatically polls the MVT transmitter for sensor information used in the gas flow calculations.

The EFM provides wizard-style dialogs to guide you through the configuration, maintenance and calibration procedures.

The MMI configuration software can display current readings, historical data logs, and event logs to spreadsheet files.

The configuration software generates customised reports consisting of configuration data, historical data logs, gas quality logs, event logs, alarm logs, and calibration in format suitable for Volumetric Validation Software such as Flow-Cal.

The flow computer integrates with SCADA systems using Modbus-compatible communications. You can access data, configuration, and calculation factors over a SCADA network as well as locally at the flow computer.

Configuration

The configuration parameters are fairly typical with each of the EFM manufacturers.

- Initialise Command – The Initialise command erases programs in the flow computer and sets the flow computer to default settings.
- Real Time Clock – Sets the Real time Clock in the Flow Computer
- Sensor and Display – Configures the sensor parameters of external transmitters. Sets operating limits, alarms and configures the display.
- Flow Run – Configures the parameters for a selected meter run such as AGA-3 parameters, AGA-8 parameters, pressure and temperature base references.
- Communications - Configures the protocol and data format for the individual communication ports on the EFM
- Power Management Configuration – Setting the power management features to minimise the power consumption of the EFM.
- Pulse Input Configuration – Configuration of the AGA-7 parameters.
- Gas Sampler Output Configuration – Configuration of the pulse output for stroking the external gas sampler.
- Read Configuration – The ability to retrieve the EFM's configuration and save it to a file.
- Write Configuration – Writing the changes to the parameters of the configuration back down into the EFM

Installation

The installation of the EFM is the key to performing practically zero corrective maintenance. Because the device is microprocessor-controlled with micro surface-mount integrated circuitry, the unit needs to be electrically isolated completely from cathodic protection devices. These devices produce a negative voltage that cause degrading effects to the electronics and causes intermittent readings and communication errors. Eventually the unit catastrophically fails. Many EFMs incorporate built-in enhanced lightning protection by utilising MOVs, diode resistor protection and optical isolating devices. This circuitry works by dissipating the energy through a common ground that is connected to a grounding rod. A copper ground rod that is driven 2.4m (~8ft) into the ground is needed to ensure a good solid ground.

Even with the EFM grounded properly a nearby lightning strike could travel up the pipe and damage the EFM.

Isolating the EFM from the pipe can be done at a fairly low cost. Even with isolating gaskets to keep the cathodic protection and nearby lightning strikes electrically isolated from the EFM, you have to look at the entire measurement skid for other ways that unwanted stray current can travel to the EFM. Tubing lines are frequently run along the side of the pipe and routed over the isolating gaskets thereby having a null effect on any isolation attempt. To be completely sure the EFM is isolated a dielectric isolation kit can be inserted between the EFM and five-way manifold valve attached to the transmitter. A PVC coupling could be used to isolate the temperature probe from the pipe.

Solar Power System Selection

The EFM is almost always located in remote areas where power is not available. Due to the low current consumption components of the EFM system, a small battery and solar panel can be deployed at a much lower cost than bringing in power from another source. The battery needs to be sized so that the system can last 14 days without usable sunlight. The solar panel needs to be of sufficient size to recharge the battery within 10 days of the return of usable sunlight. There are two types of batteries that are used with an EFM. Let's discuss the differences and which one is the best choice.

Flooded or Sealed Batteries

Sealed batteries make sense in some applications - but not all. Sealed Absorbed Glass Mat (AGM) batteries are generally about 2 times as expensive as flooded, and the cycle lifetime is usually similar or a little longer. Nearly all sealed batteries are AGM or gelled.

Sealed AGM types are usually the best choice in these situations:

> In areas with poor or no ventilation

> In areas or applications where maintenance is a problem, or is poorly done

> Any place that a flooded battery might spill or break and cause damage

> Where the escape of hydrogen and oxygen gases normally lost in flooded lead-acid batteries must be prevented

> The batteries are in a spot where it is difficult or time-consuming to check water levels

> In situations where the batteries must be side-mounted in order to fit in the installation enclosure

Flooded batteries are probably your best choice if none of the above applies.

Flooded batteries are fine for most applications. They are nearly always less expensive, and there is better availability of types and sizes. They are the best choice where:

> Adequate ventilation for the batteries is present

> Tipping, spillage or breakage is not a concern

> The batteries are in an area where maintenance can be performed without too many problems

> A very large battery bank is required

Solar System Sizing Example

Example 1

An EFM system with a spread-spectrum radio that is receiving and transmitting 12 times a day draws about 1.5A-Hr/day. Let us consider a system located in Conway AR. Referencing the solar isolation map in Figure 1, Arkansas falls within Zone C. Referencing Table 1 and cross referencing, Zone C with a total daily current consumption of 1.5A-Hr, you will find that a 10W solar panel and 36A-Hr battery is needed.

Example 2

Changing the radio to an Ethernet spread-spectrum radio will increase the total hourly current consumption to 7.9A/Hr and the battery size to 100A-Hr, with a 60W solar panel.

Note the increase in the size of the solar panel and battery, the further north you go where there are more cloudy days and cooler weather.

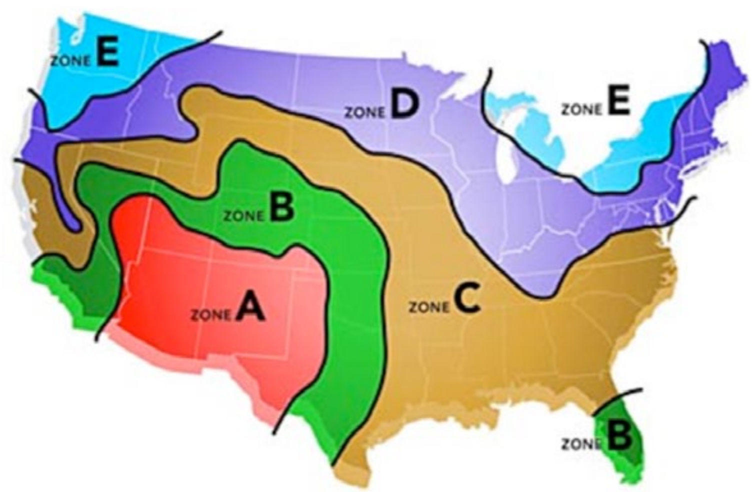

Figure 1:
Solar Isolation Zone Map

Solar Wattage	Battery Size	Zone A	Zone B	Zone C	Zone D	Zone E
10	18 36	2.43	1.99	1.55	1.11	0.66
20	18 36	4.91	4.02	3.12	2.23	1.34
40	18 36 99	9.49	7.76	6.04	4.31	2.59
50	99	11.96	9.79	7.61	5.44	3.26
65	99	15.22	12.45	9.69	6.92	4.15
85	99 198	19.80	16.20	12.60	9.00	5.40
130	99 198	30.94	25.31	19.69	14.06	8.44
170	265	39.60	32.40	25.20	18.00	10.80
260	420	61.88	50.63	39.38	28.13	16.88
390	530	92.81	75.94	59.06	42.19	25.31

Figure 2:
12V Complete Solar-sizing Matrices

Operation

The operation of a flow computer is broken up into three parts:

- Configuration of station and measurement parameters
- Maintenance (calibration of the sensors)
- Viewing of data and creation of reports

Maintenance

Maintenance of the flow computer is the verification and calibration of the transmitters to the EFM. This process starts with verifying that the EFM is accurately reading the sensors or transmitters that are measuring the Static Pressure, Differential Pressure and Temperature. When the EFM is brand new out-of-the-box, the unit requires calibration. A reference that is twice as accurate to the stated accuracy of the transmitter is required.

Testing

Transmitter testing is divided into three routines:

- As Found
- Calibration
- As Left

The As Found routine is the witness verification of the EFM where a user tests the EFM at five different pressure points for both the Differential and Static Pressure sensor. Depending on the manufacturer, the temperature transducer is tested at one or two points. The As Found routine is a test to determine if the EFM is within custody-transfer calibration. The volume that the meter is measuring determines the period of the AS Found routine. Each gas production company has different measurement policies and standards as to how often this check is performed. During the As Found check, if the EFM is found to be outside of calibration then a Calibration routine is performed.

The Calibration routine is where the user will calibrate by setting a trim in the sensor to bring it in line with the reference standard. This trim is different for each EFM manufacturer. Some manufacturers require a zero mid-range and span. Others require a zero and span only.

The As Left routine is performed after a calibration is done. This is just like the As Found routine where a five-point check is performed to insure that the sensors are operating within spec. The As Left check is a way to prove that the meter is accurately measuring across its entire range.

Conclusion

EFMs are the de facto standard for measuring natural gas. These units can consistently perform with a much higher accuracy than chart recorders. The key to longevity and maintaining a trouble-free unit is the installation. Adhering to precautionary measures along with the proper selection of solar-power system components, will give you the best performance in the most adverse conditions.

Schneider Electric

Telemetry & Remote SCADA Solutions
48 Steacie Drive, Kanata, Ontario K2K 2A9 Canada
Direct Worldwide: 1 (613) 591-1943
Fax: 1 (613) 591-1022
Toll Free within North America: 1 (888) 267-2232
www.schneider-electric.com

This document has been printed on recycled paper