Gas Metering Station Design

The best design policy is to keep it simple.

The foundation of measurement lies in metering and regulator stations

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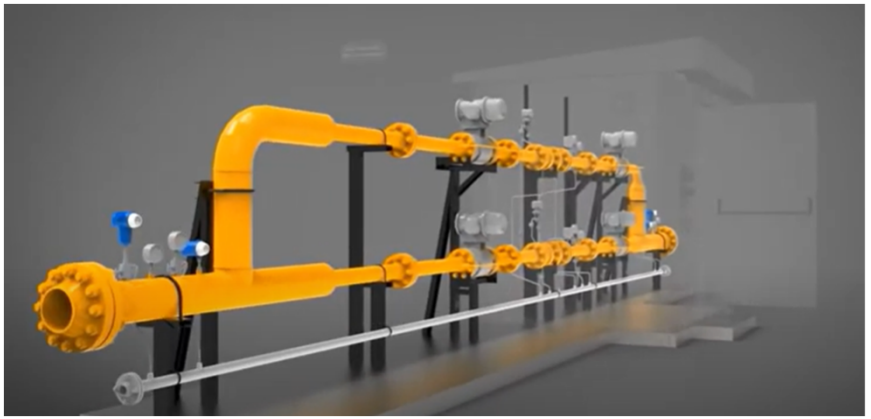
Standards Several codes and standards are applicable to measuring facilities

The following is a list of applicable regulatory agencies and standard writing entities

1) American Gas Association (AGA)
2) American Petroleum Institute (API)
3) American Society of Mechanical Engineers (ASME)
4) American National Standards Institute (ANSI)
5) Gas Processors Association (GPA)
6) U.S. Department of Transportation (DOT) Office of Pipeline Safety (OPS)
7) U.S. Department of the Interior (BLM, BOEMRE, and BSEE)
8) National Fire Protection Association (NFPA)
9) National Electric Code (NEC)
10) U.S. Environmental Protection Agency (EPA)
11) U.S. Occupational Safety and Health Administration (OSHA)
12) Applicable local, state, and federal requirements not governed by the previous agencies

Examples of gas metering skids



Initial data

- To design a measuring facility properly, some initial data are needed for equipment sizing and selection. One of the classic challenges of the designer is trying to interpret the commercial representative's statement of range, i.e., consider a station with a range stated as 0 – 250 million standard cubic feet per day (mmscfd). The first consideration is that this will be a rather large meter station. Secondly, there is no indication of what is being fueled, so the range requirements can be verified. Also, it is appropriate for the design engineer to advise that zero is not a flow rate and determine the actual minimum station flow rate.

- A metering system usually consist of multiple meter runs. Using multiple smaller meters means very low flows can still be measured accurately by sending all flow through one meter run. In addition, a meter run can be isolated for repairs or inspections while flow measurement continues through the other runs. In many cases one of the meter runs is assigned as master meter run. The goal is to use the master meter only for periodical verification of the duty meters, so possible contamination or wear in the duty meters will cause a difference with the master meter that is only used periodically.

Use a reference for customers' requirements and sizing.

Where is it going or coming from
Power plant
Mainline pressure
City gate – "peak hours."
Pipeline interconnect
Receipt from gas storage
Compressor stations
etc……..

<u>Steady-state of flow #1</u>

Table 1. Design Considerations

Design Considerations	Units
Expected flow rates (maximum, normal, and minimum)	MMscfd
Peak hourly flow rate	Mscfh
Projected growth	MMscfd
Pressure (maximum, normal, and minimum)	psig
Maximum Allowable Operating Pressure (MAOP) of both systems	psig
Maximum Operating Pressure (MOP) of both systems	psig
Overpressure protection (type, method, and responsibility)	
Expected flowing temperatures (maximum, normal, and minimum)	ºF
Base pressure	psia
Base temperature	ºF
Atmospheric pressure	psia
Gas relative density	unit less
Gas heating value	Btu/scf
Hydrocarbon dew point temperature	ºF
Water content	lbs. / MMscf
Maximum carbon dioxide, nitrogen, and oxygen (diluents)	mole %
Maximum hydrogen sulfide	grains/100 scf
Gas composition and gas quality determination method	
Maximum delivery pressure (downstream of the meter)	psig
Maximum allowable noise	dBA
EGM software and hardware specifics per operating company	
Control method requirements (e.g., flow control with pressure override)	
Remote monitoring and control requirements (SCADA)	
Frequency of monitoring required (real-time/daily/weekly/monthly)	
Location (onshore/offshore/wetland/residential area, etc.)	
Availability of utilities (electricity, telephone, etc.)	
Local building or other permit requirements	
Liquid removal, measurement, and re-injection requirements	
Condensate removal/storage/handling requirements	
Criticality of service (is shutdown of service for inspection allowable or not)	
Filter separator requirement	
Heating requirement	Btu/hr
Odorization requirement	

Major critical components

- **Metering**:
  - Typical maximum velocity values for different inferential meter types are as follows
  - 1) Orifice meter = 30 feet per second AGA 3
  - 2) Turbine meter = 45 feet per second AGA 7
  - 3) Ultrasonic meter = 70 feet per second AGA 9
- **Sampling** - The goal should be to sample gas from the least-turbulent point in the meter run. Sample probes need to be installed in a straight run of horizontal pipe. The sample probe should extend into the middle third of the pipe diameter
- **Conditioning** - The conditioning of natural gas is the set of techniques used to remove any remaining or subsequently formed liquids, condensates, or solids from gas flows. Using indirect heaters and separators to achieve and maintain necessary gas temperatures prevents operators from incurring damage to metering and regulator station
- **Online gas chromatographs** - must be installed with attention to the same sampling criteria-

The slightest condensation of hydrocarbon liquids inside a calibration gas cylinder will cause measurement bias if the cylinder is used for calibration without preheating. For guaranteed success, the designer must maintain a current working knowledge of equipment and recent research that drives changes in industry standards and meter station design.

Gas metering stations must perform custody transfer, conditioning, metering and regulating

- **Natural gas filter** units are installed at each station to remove entrained liquids and solids from the gas stream. The filters may comprise cyclonic elements to centrifuge particles and liquids to the sides of the enclosing pressure vessel. These particles and liquids will then drop down for collection in a sump, which can be drained periodically
- A **control valve** should be installed downstream of the meter run to control the flow through the meter and the delivery pressure. This valve will primarily operate to limit the station throughput to prevent the incoming gas volume from exceeding the meter capacity or the nominated book but will also be equipped with a pressure override.

The leading equipment includes filters, heaters, pressure reducers, regulators, and flow metering skids. In addition, each station is generally equipped with drains for collection and disposal, an instrument gas system, and storage tanks.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