APPLIED NGL METERING STATION DESIGN

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INTRODUCTION

A liquid measurement station can be as simple as a single meter run allocation measurement or as complex as a multi meter run station with a multi-tasking control system. Regardless of complexity the measurement quality is no better than the quality of the system design. Utilizing a state of the art meter technology will not yield any better results than allowed by the system design.

Liquid measurement stations are found in all areas of the hydrocarbon industry from oil production to custody transfer to refining. A heavy emphasis is placed on the accurate measurement of product in each area of the industry. For this reason the design of a measurement system deserves a high degree of focus.

PURPOSE OF THIS PAPER

The purpose of this paper is to draw attention to the factors that must be considered in the design of a quality measurement system. It is the goal of this paper to provide the following:

1. Basic requirements of a quality measurement system.
2. Outline the typical components of a measurement system.
3. System design check list.

It is impossible to give adequate time to the design of all the different measurement applications. Therefore this paper will concentrate on the features of a typical custody transfer measurement station.

BASIC MEASUREMENT REQUIREMENTS

To provide optimum measurement accuracy, measurements should be taken when (1) the product is in a clean homogenous single phase, (2) the flow rate, temperature, and pressure are constant, and (3) the operating conditions are within the best performance range of the measuring devices.

As you know the above conditions rarely exist together in the real world. Therefore, the design of any system must compensate for variations in the fluid properties and process conditions.

In order to achieve the greatest performance under real world conditions measurement systems must be designed with equipment to perform the following tasks:

1. Filter debris from the product
2. Eliminate any air
3. Condition the flow to eliminate turbulence
4. Prevent leaks during metering and field calibration (proving)
5. Provide accurate flow measurement over the flow range of the station
6. Provide stable process conditions
7. Generate accurate measurement data
8. Produce accurate calibrations of the primary metering device

TYPICAL COMPONENTS

Inlet and Outlet Manifolds:

The manifolds act to direct the flow into and out of the individual meter runs. The design of the manifolds should take into consideration pressure drop and the possible future expansion of the system.

Isolation Valves:

These valves are used to isolate a specific meter run for maintenance of its other components.

Strainer

The purpose of the strainer is to remove harmful debris from the fluid to be metered. A typical strainer should be fitted with a closure or blind flange top for quick and easy removal of the filter basket.

The filter basket mesh is designed to protect the meter and control valve. When the presence of a large amount of debris is anticipated at startup, an additional small mesh basket liner should be considered for additional protection during the initial startup period.

Meter Run Piping:
This is the piping before and after the metering device. The design of this piping may require provisions for the removal of flow turbulence from the fluid. Straightening vanes may be used to increase the effectiveness of the piping in the removal of flow turbulence.

The piping should be designed for easy removal of the meter and should be supported adequately to reduce the possibility of stresses being introduced into the system.

Primary Meter Device:
The primary meter device is the central, most critical element of a liquid measurement station. The selection of this device depends on the flow conditions, the required span of flow, and the fluid properties.

Proving Connections:
These connections provide for the ability to calibrate the meter under operating conditions. This is a requirement of custody transfer measurement. These connections utilize special double block and bleed valves to prevent leakage past the meter device during the calibration. Double block and bleed valves are designed with dual seals and a bleed system to test the integrity of these seals.

Control Valve:
The control valve is designed for small pressure drop adjustments to maintain equal flow rates through multiple meters and to maintain stable flow during the proving of a meter. A control valve may also be required to provide proper back pressure on the meter and proving connections to maintain the fluid in a single phase.

Check Valve:
Check valves are installed to prevent equipment damage and inaccurate measurement due to backflow.

Instrumentation:
In custody transfer systems, the volume measurement and meter proving must be corrected for the effects of pressure and temperature on the piping and system components. Each meter run and the prover outlet piping should be fitted with both pressure and temperature transmitters to transmit accurate signals for these process conditions to a flow computer which will compute volume corrections.

Densitometers:
Densitometers are often used in the custody transfer measurement of hydrocarbons to measure and monitor the fluid density. This measurement is transmitted to a flow computer for purposes of calculation and monitoring.

Samplers:
Sampler systems can be used to sample the product being measured. The rate of sampling can be based on time or on measured flow rate. The collected sample can be used to determine the product density as well as the water content.

Air Eliminator:
Air eliminators are required in applications where air is present. The removal of air is necessary to protect the meter from damage as well as provide accurate measurement.

SYSTEM DESIGN CHECK LIST
Below is a check list to assist in the organization of the many tasks required to complete the design of a high quality liquid measurement station.

1. Determine the site and process requirements.
2. Select the technology type and size of the measurement device.
3. Select the proving method to be used.
4. Review the piping design for compliance with pressure drop restrictions.
5. Develop the system pricing and component availability.
6. Layout system components and piping.
7. Prepare system fabrication drawings.
8. Fabricate and assemble the system.
9. Test function of each component and if possible the overall performance of the system
10. Install the system if not built in place

CONCLUSION

The design of a liquid measurement station requires the consideration of numerous factors and influences. A good understanding of these factors and influences along with an organized approach will increase the probability of producing a quality liquid measurement station.