The Present Traceability hierarchy of Natural Gas Measurement in China and It's Prospect

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Abstract With the development of natural gas industry in China, turbine flow meters, Vortex flow meters and Ultrasonic flow meters have been applied nationwide in recent years. It changes the fact that orifice flow meters used to cover about 95% market of natural gas measurement. Those different flow meters are used to adapt to various process installation conditions.

Meanwhile three traceability chains have been established in southwest and northeast of China for10 years. The test facilities, management, inter-lab comparison and service in-situ has been promoted greatly, even to international level. The Nanjing Calibration Station will be built up within 3 to 5 years. By then the traceability hierarchy will become more perfect in China. It is also related to some legislative problems. The present configuration and prospect of the traceability hierarchy in China is presented in this paper.

Key word natural gas flow rate traceability hierarchy present prospect

Introduction

Natural gas has become the most increasing energy consumption in the 21st century. It accounts for 25% of energy consumption. So the accurate measurement of natural gas not only leads to a fair trade, but also improves the producing techniques and then causes the progresses socially and commercially. Presently, several important projects including West to East Long Distance Pipeline, Shanxi to Beijing Pipeline and Zhong County to Wuhan Pipeline, have been proceeded. And some regional LNG pipelines in Guangdong, Hujian and Shanghai have been planned. With the fast development of natural gas industry in China, a higher requirement has been given to natural gas measurement.

Now orifices are most popular in natural gas measurement. But some new natural gas flow meters ,such as ultrasonic flow meters and turbine meters ,are widely used recently. Especially the ultrasonic flow meters are widely used in high pressure and large flow rate conditions. The natural gas trade measurement in China is mostly volume metering, and it is transiting to both volume metering and energy metering, then to energy metering. Meanwhile it will transform from static metering to dynamic metering. So the natural gas flow measurement has been developed to a multiple form. Consequently it boosts the progress of the natural gas flow traceability hierarchy in China.

tNatural Gas Flow Rate Measurement Traceability Hierarchy in China

Since late 20th century, a feasible natural gas flow rate measurement traceability hierarchy has been established in Southwest and Northeast of China according to the supplement and consumption of natural gas at that time. It is mainly comprised of three trace chains as following. The three trace chain are independent from each.

1.1 the first trace chain

The primary standard in National Crude Oil Large Flow Rate Calibration Station(DQVS) is a bell prover. A portable sonic nozzle group is the reference standard which is used in verification and calibration of flow meters under 20 bar in fields directly. The actual flow rate is up to 4600m^3/h and the expanded uncertainty is 0.25%.

1.2 the second trace chain

There are a gravimetric standard and a sonic nozzle group in CVB, which are primary standard and secondary standard respectively. CVB also plans to build up a portable ultrasonic reference standard and a turbine meter group reference standard. The trace chart is showed in figure 1.

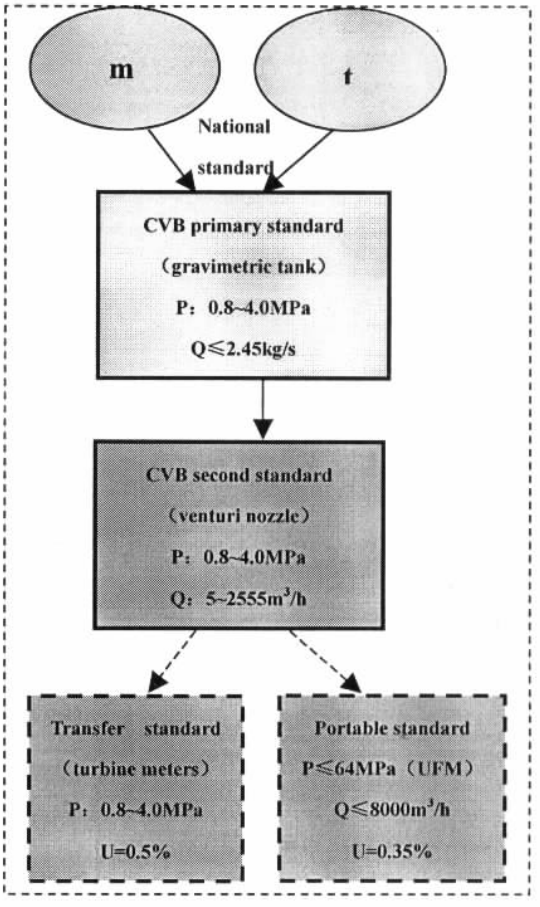

Figure 1 traceability chart

1.3 the third trace chain

Chongqing Verification Branch (CQVB) has a pVTt and a sonic nozzle group as the primary standard and secondary standard. The claimed uncertainty is 0.25% and 0.5% respectively. They are used in verification and calibration of natural gas flow rate under 10 bar.

1.4 Other traceability

Many oil fields and institutes have built up their own reference standards. Most of them are bell provers. They are used for medium or small flow rate under low pressure.

Generally speaking, the present natural gas traceability hierarchy has realized the traceability of flow meters which are used in different areas , different working conditions. It ensures the fair and accurate measurement in fields. In China, the level and capacity of natural gas flow rate standards has become similar to some developed countries. The

managements, the research of natural gas flow and the services for fields have become a feasible system. For instance, CVB has embarked on some informal comparison to NMi, PTB, CEESI and SwRI. It indicates that the test results are very similar. CVB has also carried out a project preparing for high pressure KC and an unique project which is a pipeline flow profile research making use of PIV(velocity measurement by particle imaging) .Meanwhile , DQVS proceeds the on-line verification and calibration of natural gas flow rate in Northwest and Northeast of China.

Prospect

2.1 The natural gas flow calibration facilities in China are located regionally

In present, different flow meters are used in different areas in China because of different development stage of natural gas industry. For example, orifices are most popular natural gas flow meters in Southwest accompanying with some medium and small –sizes turbine meters. But a large number of large-sized ultrasonic and turbine flow meters are used for high pressure and large flow rate measurement along the WEST TO EAST long distance pipeline and Shanxi to Beijing pipeline. They are mostly used in distribution stations and city gate stations in Inner Mongolia , Beijing, Daqing and Guangdong. But the three verification stations (DQVS, CVB, CQVB) adapt to medium or small flow rate measurement under 40bar. So the higher pressure and larger flow rate measurement require a more feasible traceability hierarchy. The Nanjing Calibration Station which is on building can improve the situation after running. At that time , the configuration of the traceability hierarchy will be more perfect.

2.2 The transfer standards become multiple

Though the stationary calibration facilities have realized a natural gas flow calibration on the base of geometric verification, there are still some problems. For example, the calibration conditions differ from the metering conditions mostly. Long distance transportation after calibration would affect the measurement performance of flow meters. Additionally, installation of large diameter flow meters is very difficult. So verification or calibration in a stationary facility will be difficult to realize. Then it is quite necessary to use a portable facility in fields. Because of being accurate, calibration stable and robust, sonic nozzles and ultrasonic flow meters are very suitable to be transfer standards. The portable standards can trace to the stationary standards. The uncertainty of these transfer standards are from 0.4% to 0.25%.For instance, DQVS has a portable sonic nozzle facility. It has worked as a transfer standard for many years and proves to be very efficient. CVB plans to build up a portable ultrasonic transfer standard and is preparing for the documentary works.

In natural gas flow trace chain, a check standard can be used to ensure an accurate measurement as TCC uses ultrasonic flow meters as check standards for it's reference meters. This concept has been accepted in China eventually.

2.3 United and unique national standard for natural gas flow

As known, natural gas flow rate is a synthetic measurand. There is no national standard for natural gas flow in China. The expanded uncertainty of the primary standard in CVB is 0.1% , which is on the same level ad other similar flow standard in the world. So the national standard for natural gas flow will be improved and united eventually according to the metrology laws.

2.4 International lab recognition

In 2000 FLOWMEKO Brazil, China has become a member of WGFF. And CVB has

been nominated by NMI as the lab which will take part in the BIPM KC for high pressure gas. Through inter-lab comparisons, regional KC and BIPM KC, a horizontal comparability will be quantified between NMIs in China and other countries. Then an international lab recognition can be achieved.

conclusion

A lot of researches on traceability and measurement of natural gas flow have been carried out in China. The comparisons between China and NMi, PTB and SwRI show that test results are very similar. In addition, a comparison among four primary flow standards will be proceeded in China this year. All these will improve the traceability hierarchy for natural gas in China greatly.