

Introduction (Overseas)

In order to comply with commercial agreements, government legislation and internal company procedures etc., oil and gas operators are required to generate and report a multitude of totals such as:

- Production Totals (Well, Field)
- Export Totals
- Reservoir Management Totals (Injected Water or Gas)
- Environmental Totals (Flare, Fuel and Water Overboard), etc.

These totals are generated by installed flow meters and their associated systems. The associated systems can include:

- Flow Computers
- Platform Control Systems
- Data Historians
- Hydrocarbon Accounting Systems
- Business Reporting Systems

It is important that data integrity and uncertainty levels are maintained within these systems, as commercial agreements and government legislation require that the totals are fully verified and their uncertainty is within stipulated limits.

KELTON[®] provide a service that can:

- Verify Flow Data Integrity (from meter to reporting)
- Assess the uncertainty in the reported totals (not just the uncertainty in the instantaneous flowrate at the meter).

Combining this service with the KELTON[®] UNCERTAINTYPLUS[®] modules provides a powerful method to demonstrate compliance with commercial agreements and government legislation.

Objective

The objective is to demonstrate that the uncertainty in a customer's reported totals comply with requirements. To achieve this, the following are recommended:

- Development of meter uncertainty model (UNCERTAINTYPLUS[®])
- Data flow analysis
- Development of a data flow uncertainty model
- Review of the meter and data flow uncertainty models
- Identify any meter or data flow modifications required to meet uncertainty limits.

Data Flow Analysis

This is a systematic process of route tracing and identification of data handling/manipulations (i.e. data flow elements) applied within a data flow structure. It can identify elements that may affect data integrity. Figure 1 shows a typical data flow analysis for a flare system reporting an annual total to a government authority for compliance with environmental legislation.

About KELTON[®]

KELTON[®] is an independent and accredited company specialising in flow measurement consultancy, auditing, training and the provision of specialist software. Founded in 1991, the company employs more than 50 people with 30 consultants who have over 500 man years of experience in the management, operation and maintenance of flow measurement systems. KELTON[®] has an outstanding reputation in the industry. Services include:

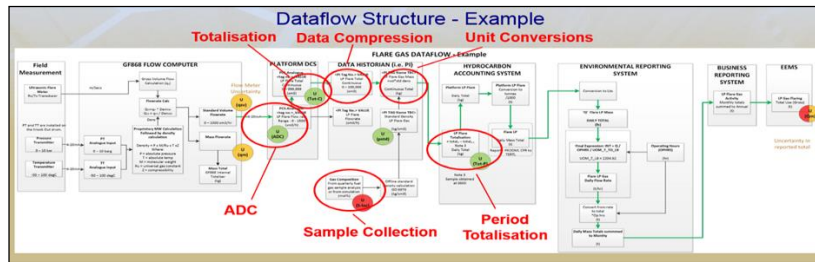
- Audit and Certification
- Uncertainty Calculations & Models
- Measurement Training
- Engineering Studies
- Metering System Documentation & Support
- Software Applications

Currently service is provided worldwide for; major oil & gas operating companies, gas transmission & distribution companies, LNG terminal operators and system integrators. Presently, service is offered from three strategic locations: UK, Qatar and Abu Dhabi.

If additional information is required on KELTON[®] flow consultancy services or software applications visit:

www.kelton.co.uk





Data Flow Uncertainty Model

The data flow uncertainty model determines the uncertainty in the reported totals. To do this it includes contributions from:

- Meter flow rate readings
- Data flow elements.

Meter Flow Rate Readings

The flow rate readings contribution to the reported total uncertainty is derived from the meters flow rate uncertainty characteristic (UNCERTAINTYPLUS®). See figure 2 below. The contribution depends on the flow rates that generate the reported total. If operational flow rates are below the linear region of the meter uncertainty characteristic then an analysis will be required to determine the contribution. Figures 2 & 3 show an example of a flare meter uncertainty characteristic and its annual total flowrate distribution chart. The large quantity of low flows (in the non-linear region) result in a larger reported total uncertainty than might have been expected.

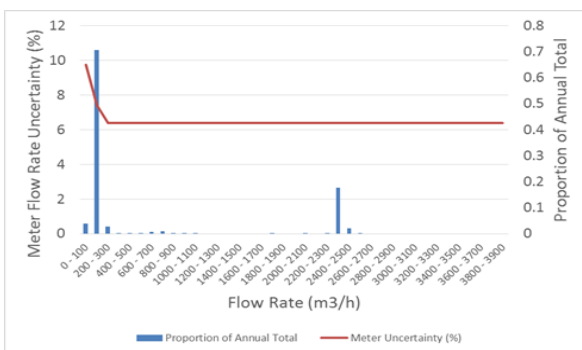


Figure 2: Meter Uncertainty Characteristic and Flow Rate Distribution

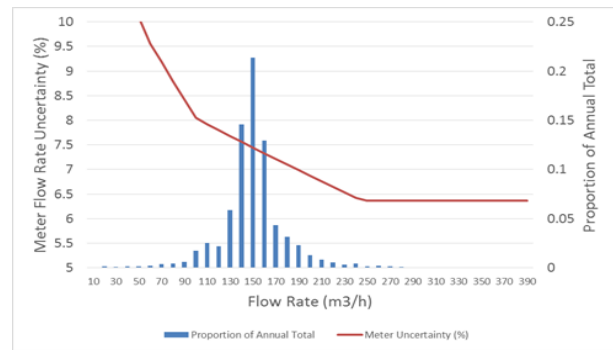


Figure 3: Close up of Figure 2 at low flows

Data Flow

Data flow elements (i.e. data handling and manipulation methods) can potentially result in additional uncertainty in the reported total. Each data flow element is reviewed and if required an estimate of the additional uncertainty is calculated. Examples of data flow elements which result in additional uncertainty include:

- Low specification analogue to digital converters
- Low update frequency totalisation
- High data compression settings
- Volume/mass conversions using high uncertainty density values
- Inappropriate allocation methods (e.g. by difference on low flow stream).