

SOLV Limited - Project Experience 2003 to 2018

Projects listed in the table below include details of our experience with examples of typical engineering and software projects since formation of SOLV Limited in 2003 through to 2018.

SOLV hydrocarbon flow measurement and allocation experience, includes but is not restricted to:

1. Audits using criteria of fiscal, allocation and process metering and allocation systems;
2. Uncertainty Studies using RSS (Numerical and Analytical) and Monte Carlo Simulation;
3. Specifications of fiscal, and allocation metering, and hydrocarbon allocation systems;
4. Design of fiscal, and allocation metering, and hydrocarbon allocation systems;
5. Witnessing calibration, commissioning, FAT, SAT and related activities;
6. Preparation of manuals;
7. Engineering studies;
8. Procedures;
9. Supervision;
10. Consultancy;
11. FLOWSOLV[®] flow calculation traceable standards based software; and,
12. FLOWSOLV[®] CUSTOM flow measurement and allocation software development.

Project	Description
<p>Metering Support, 5 Systems</p> <p>Client Confidential, GCC, 2016 to 2018</p>	<p>Measurement validation for Duty/Standby (2) High GVF Wet Gas MPFM, inspection, calibration checks and validation procedure.</p> <p>Review of Well Test High GVF Wet Gas MPFM.</p> <p>Audit of Gas Export 2 stream USM and Uncertainty, including calibration on gas at high RN (Reynolds Number), as original calibration on Air at low RN, to correct MF.</p> <p>Audit of Condensate Export Duty/Standby/Master 2 stream Coriolis Z configuration and uncertainty with recommended modifications to meet fiscal standards and uncertainty.</p> <p>Design of Wet Gas Venturi metering system and flowcomputer configuration, including calibration of Venturi on water.</p>
<p>Measurement Technical Review</p> <p>Client Confidential, North America, 2014 to 2018</p>	<p>Periodic performance review of all fiscal and allocation measurement for oil plant export to nearby facility for processing and commingling with other fields prior to pipeline export. Original development set a precedent in the region for use of Fiscal measurement with a MPFM (Multi-Phase Flow-Meter).</p> <p>Apart from the Fiscal MPFM measurement of gas, and water for disposal the review includes imports for gas lift, gas injection, fuel gas, water injection. Well Test MPFM's are also reviewed.</p> <p>A number of recommendations have been made to improve various aspect of the measurement including utilisation of a DWT (Dead Weight Tester) which has eliminated unnecessary replacement of the MPFM DP transmitters.</p>

Project	Description
<p>FLWSOLV[®] V5, V5.1, & 5.2</p> <p>FLWSOLV[®] READER[™]</p> <p>FLWSOLV[®] UNITS[™]</p> <p>FLWSOLV[®] CUSTOM[™]</p> <p>SOLV Limited 2011 to 2018</p>	<p>Upgrade of FLOW SOLV[®] V4 to V5 to enhance existing 45 calculations, bug fix and to modularisation of methods for use in custom software applications.</p> <p>V5.1 addition of API MPMS Chpt. 11.1:2004 Amd. 2007/08 Oil thermal and compressibility correction to standard conditions including Imperial tables 5/6, 23/24, metric 15°C tables 53/54 and 20°C Tables 59/60 with Alternate Observed or Alternative User Defined Standard conditions.</p> <p>V5.2 currently in development; addition of light hydrocarbon methods, API MPMS Chpt. 11.2.2/2M Compressibility, 11.2.4 Thermal Expansion, and 11.2.5 Equilibrium Pressure.</p> <p>FLWSOLV[®] is a very flexible standard's based flow computation software product with rigorous traceability, and compliance checks. The software is in continuous development with a series of additional methods added to provide maximum coverage for fiscal, custody transfer and process flow measurement.</p> <p>FLWSOLV[®] READER[™] is a free application that allows colleagues and 3rd parties to view FLOW SOLV[®] FSPV files.</p> <p>FLWSOLV[®] UNITS[™] is a free unit conversion application, included with FLOW SOLV[®].</p> <p>FLWSOLV[®] CUSTOM[™] software development service is offered using existing modules from FLOW SOLV[®] and other software for specialised applications.</p> <p>To find out more visit www.flwsolv.com</p>
<p>AGA10 DLL</p> <p>Caldon, USA, 2016</p>	<p>Supply of AGA10 DLL for integration with an existing software package for use with Caldon's Gas Ultrasonic flow meters.</p> <p>Developed using the FLOW SOLV[®] AGA10 module.</p>
<p>Keystone Pipeline Uncertainty</p> <p>TransCanada, Canada/USA, 2013</p>	<p>Uncertainty Model of the Keystone Pipeline Storage facilities at Hardisty, Alberta, Canada and 6 LACT Units from entry at Hardisty, take-off points in the USA, up to Cushing.</p> <p>Models are run regularly to obtain the uncertainty at actual operating conditions and product for monitoring pipeline operations.</p> <p>Developed as conventional RSS (Root Sum Square) conforming to the internationally accepted GUM (Guide to the Expression of Uncertainty in Measurement) method.</p>
<p>MPFM Allocation Uncertainty</p> <p>Client Confidential, 2012</p>	<p>Defined uncertainty matrix for allocation tariff adjustment for field life for a heavy oil multiphase measurement.</p>

Project	Description
<p>Condensate Gathering System Uncertainty,</p> <p>SEPCo (Shell), Pinedale, Wyoming, USA, 2007, 2008, 2012</p>	<p>Assess the uncertainty of a Coriolis measurement for allocation of gas condensate to lease holders and the BLM for a gas gathering system.</p>
<p>AGA10 MatLab Addin</p> <p>DNV, Norway, 2011</p>	<p>MatLab Addin for DNV research project developed using the FLOWSOLV[®] AGA10 module.</p>
<p>Saih Rawl Custody Transfer Metering Requirements and Uncertainty</p> <p>PDO, Oman, 2009</p>	<p>Statement of Requirements for a Crude Oil Coriolis Metering System with BS&W and Master Meter for RFQ.</p> <p>Uncertainty Analysis for typical system using modified ISO/IEEE/OIML/BSI GUM (International Guide the Uncertainty of Measurement) RSS (Root Sum Square) method, verified by MCS (Monte Carlo Simulation)</p>
<p>MPM FAT</p> <p>ConocoPhillips, Norway, 2009</p>	<p>FAT (Factory Acceptance Test) of 4 multi-phase flow-meters at MPM's factory in Norway prior to storage of meters not immediately required.</p>
<p>Entrada over Magnolia</p> <p>ConocoPhillips/Callon, GoM USA, 2005 to 2008</p>	<p>Specification and uncertainty for MPM multi-phase flowmeters for allocation of oil and gas production of the 3rd party Entrada field and the Magnolia platform production. Analysis using a Monte Carlo Simulation of the MPM meter uncertainty.</p>
<p>Crude Oil Tanker Loading</p> <p>Client Confidential, SEA, 2007</p>	<p>Investigation of discrepancy between export loading tanks and liquid ultrasonic Custody Transfer meter to identify the cause and assess the uncertainty of both measurements.</p>
<p>MPFM Heavy Oil Uncertainty</p> <p>Client Confidential, 2007</p>	<p>Uncertainty analysis of a Dual Gamma Venturi MPFM (Multi Phase Flow Meter) for a heavy oil application with very low Reynolds Number which required a correction to the Venturi Cd (Coefficient of Discharge).</p> <p>Monte Carlo was used to simulate the Dual Gamma phase detector measurement based on a physical model from first principles.</p>

Project	Description
Sarbanes-Oxley Compliance SEPCo (Shell), USA, 2006 to 2007	Custody Transfer uncertainty analysis and validation of measurement for Shell Exploration and Production Companies 90 percentile production for Sarbanes-Oxley compliance in the USA. Included offshore and onshore oil and gas production at five facilities.
Audit and Uncertainty ConocoPhillips, Indonesia, 2006	Audit and uncertainty analysis of fiscal ultrasonic gas custody transfer meters at three onshore facilities in Sumatra and two offshore facilities in the South China sea.
PDO Oman MOL Allocation Study SGS (Shell), Hague, 2006	Investigation of Crude Oil allocation uncertainty using data from an earlier site inspection of 48 measurement entry points to PDO's MOL in Oman in partnership with SGS (Shell Global Solutions). Several allocation methods were examined to determine the most equitable method and make recommendations.
COSTALD Flow Computer Constants Alderley, Iran, 2005	Thermal Compressibility correction constants found using COSTALD (Corresponding States Liquid Density) for 3 refinery products to correct volumes to standard conditions at Asaluyeh Harbour, Iran.
Alpine Well Test Allocation Uncertainty ConocoPhillips, Alaska, USA, 2005	CRU (Colville River Unit) well test allocation uncertainty at CD1 and CD2 drill sites at Alpine using Monte Carlo Simulation.
LNG Meter Type Approval Trials ConocoPhillips & ExxonMobil, Kenai, Alaska, USA, 2005	Trials of Coriolis and multipath Ultrasonic Meters to assess suitability for flow measurement of LNG in Qatar. Meters were compared to storage tanks which were calibrated by ship loading. Developed data acquisition spreadsheets with AGA8 gas density and COSTALD LNG liquid density and statistical analysis of results. Caldor 8 path UFM selected by clients for type approval for use with LNG storage tank loading in Qatar.
MOL (Main Oil Line) Entry Health Check PDO, Oman, 2005	Site inspection to document each of 48 measurement nodes entering the MOL. Work included estimate of uncertainty and bias and assessment of the condition of each meter. Meters comprised full Custody Transfer meters with prover's, PD, Coriolis, Ultrasonic, Orifice and V cone meters.
Course and MOL Meter Calibration PDO, Oman, 2005	Storage tank electronic tape dip measurement course. Calibration of the MAF terminal MOL reception meter using a storage tank measurement.

Project	Description
MAF Oil Export Terminal Uncertainty PDO, Oman 2004	Uncertainty study and model of the MAF (Mina Al Falal) oil export terminal measurement and material balance uncertainty. Included export ship loading meters, refinery feed and returns, export to Shell marketing, tank farm, and MOL import. Included review of all measurement, calibration and maintenance procedures.
Flowcomputer Constants for Refinery Products Alderley, Iran, 2004	Calculation of Thermal and Compressibility constants $C_{t_{lm}}$, and $C_{p_{lm}}$ for 14 refinery products with COSTALD for use in flowcomputers.
Falcons Nest Audit Pioneer Natural Resources, GoM, USA 2004	High level audit of all flow measurements, including subsea Venturi meters.
Mars TLP, Gulf of Mexico SEPCo (Shell), USA 2004	Study to determine the uncertainty of allocation of oil and gas exports to fields, and wells including material balance where well production is found by monthly well testing with Schlumberger Vx MPFM.
Shearwater Condensate Master Meter Replacement Shell Expro, (Sigma3) UK, 2004	Replacement of the Shearwater Crude Oil Export metering system prover loop due to lining failure. Replaced with Krohne Altosonic V Ultrasonic Master Meter. Development of flowcomputer equations with Reynolds Number correction, flowcomputer configuration and uncertainty analysis.
Teesside Power Station PX Limited, UK, 2004	Review of gas turbine cooling air, fuel gas, steam and water flow measurement. Ongoing measurement support.
API UATG RP API, 2003	Uncertainty input to API (American Petroleum Institute) RP (Recommended Practice) for well-rate determination and uncertainty for multiphase flow meters.