Paya Petro Technology

MPFM Solution Provider

Petro-Loop Introduction and Specifications









- Introduction of VG MPFM (PETROYATECH)
- Operation envelope of VG MPFM
- Existing known International Flow Loops
- Petro-loop Specs



3 Touch the Flow

VG MPFM Technique

- Conditioning: inline (No Separation)
- Velocity (Venturi)
- Phase fractions (Gamma ray and Electrical Capacitance)
- Pressure rating: up to 2000 psi
- Temperature ratings: up to 250 F
- Pipe sizes: up to 8-inch
- GVF: up to 98%





- Client provided data are analyzed through VG Advisor software

to find the optimum venturi sizing.

• Process flow data are imported and evaluated in the software.





Worldwide Flow Loop Specifications



[mm1

100

200

304.8

25.4

100

76.2

4

Steel/

Steel/

gas.

250

200

82

40

127

52.

153.2

31.8

76.2

57, 114.3

140.

400



and Petroleum Stainless Steel

London), UK

TUV-NEL, Scotland

Established in East Kilbride, Scotland in 1947 as a UK Government research laboratory

Privatised in 1995, but remains one of the UK's National Measurement Institutes

NEL is a business of the Munich based TÜV SÜD Group

Over 100 staff with 75% professional engineers

Largest grouping of flow experts





NEL Flow Test Facilities (Oil & Gas Sector)





Flow Rate and Pressure Specs in NEL



- Three phase flowing pressure is up to 15 bars
- Up to 6-inche pipes are covered

| Gas | | Oil | | Water | |
|--------------------------|--|------------------------------|------------------------|----------------------------|-----------------|
| Volumetric flowrates | 100 m ³ /hr to 1400 m ³ /hr | Volumetric flowrates | 0.05 l/s to 200 l/s | Volumetric flowrates | 0.05 l/s to 400 |
| Operating Temperature | 20 ± 1°C | Operating Temperature | 10 to 60 °C | Operating | 10 to 40 °C |
| Operating Pressures | 10 to 63 bar | Viscosity Range | 1.5 to 1500 cSt | Temperature Uncertainty | 0.4.1.0.45.9/ |
| Uncertainty | 0.35% | Line Pressure Uncertaintv | Up to 7 bar | Range | 0.1 to 0.15 % |
| | | Range | 0.03 to 0.08 % | | |
| | | | | | |



Nitrogen gas Up to 600 m³/hr (uncertainty < 1.5%)</th> GVF 0 - 100% Water Cut 0 - 100%

Multiphase flow line

Refined Oil

Salt water

| Line pressure | 0 to 15barg |
|------------------|-------------|
| Line temperature | 5 to 55°C |
| Line sizes | 1 to 6-inch |

| Fluid Type | Metering Device | |
|------------|---|--|
| Oil | Faure Herman helical-blade turbine meters (1 ¼ and 3- inch) | |
| Water | Flat-blade turbine meters (11 ¹ ⁄ ₂ and 3-inch) | |
| Gas | turbine meters (1 $\frac{1}{2}$, 1 and 3-inch) | |

Up to 140 m³/hr (uncertainty < 1%)

Up to 140 m^3/hr (uncertainty < 1%)

Flow Metering Devices in NEL



PETROYATECH

0.9 0.85 0.7 0.7 0.65 0.6 0.5 0.5 0.5 0.45 0.4 0.3 0.25

Average flow rate error is 1%.

PETROYATECH

NORCE Multiphase Flow Loop

- The NORCE Multiphase Flow loop is a three-phase closed flow loop owned by NORCE. It is located at NORCE Fantoft in Bergen
- Start-up in 2009
- Flow pressure: up to 8 bars, depending on flow rate
- The test facility consists of a 3" and a 6" flow lines
- Acceptable error: up to **1.5%**

| Fluid Type | Flow Capacity | Metering Device |
|---------------|------------------|--------------------|
| Oil | 100 m3/hr | Turbine |
| Water | 100 m3/hr | Turbine |
| Gas | 1100 m3/hr | Vortex |

N R C E





Petro-loop (PETROYATECH)

- Average flow rate error is 2%
- Level gauges are utilized to capture precise flow rate variations



Petro-Loop Specifications

- Water phase: Magnetic flow meter
- Oil phase: Ultrasonic flow meter
- Gas phase: Thermal mass flow meter
- Beside of these, rotameters installed a each flow section to monitor and validate visually.

| Items | Specs | | |
|-------------------------|---------------------|--|--|
| Maximum oil flow rate | up to 40 m3/h | | |
| Maximum water flow rate | up to 40 m3/h | | |
| Maximum gas flow rates | up to 1000 m3/h | | |
| Operation pressure | Up to 6 bara | | |
| Operation temperature | Ambient condition | | |
| Pipe size | 3-inch (ID = 80 mm) | | |
| WCT | 0-100 % | | |
| GVF | 0-95 % | | |









Certificates



All laboratories are certified ISO 17025. •

| Certificate No: 140165-2 ID No: Calibration Date: 1401/04/26 Cal Location: Exp Cal.Date: 1402/04/26 Customer and Equipment Specification | |
|--|--------------------------------|
| Calibration Date : 1401/04/26 Cal Location : Exp Cal.Date : 1402/04/26 Customer and Equipment Specification | |
| Exp Cal.Date: 1402/04/26 Customer and Equipment Specification | Cal lab |
| Customer and Equipment Specification | |
| | |
| Customer name - Location : پترو فناوری پایا Manufacturer : | Iran Madar |
| Equipment : Flow meter Fluid / Density : | Water / 1000 kg/m ³ |
| Serial No. / Model : IMC1401.0080.10746 / MAG ab3000 K.Fac : | |
| Size : 3 " Resolution : | 0.01 m ³ /h |
| Traceability : The Reference Standards are traceably calibrated to national and international | l metrology institute |
| Reference Equipment : Master Flowmeter S/N: ZAC1445 Cert NO | D : 40072925 |
| Ambient Condition : Temperature : (20 ± 5) 'C Humidity : (≤ 50) | %RH |
| Calibration method : The Calibration Was Performed in Comparison Method According to SPK-W-0 | 05 |

Confidence level is 95% and coverage factor K=2. Uncertainty :

| | <u>Calibratio</u> | n Report | | |
|---|---|--|-------------------------------|---|
| UUC Flow (m ³ /h) | Reference Flow (m ³ /h) | Deviation (m ³ /h) | Erorr % Red | Measurement Uncertainty (±%Rdg) |
| 0.500 | 0.501 | 0.001 | 0.2 | |
| 2.000 | 2.011 | 0.011 | 0.6 | |
| 5.000 | 5.043 | 0.043 | 0.9 | 0.8 |
| 10.000 | 10.117 | 0.117 | 1.2 |] 0.5 |
| 25.000 | ~25.351 | 0.351 | 1.4 |] |
| 40.000 | 40.486 | 0.486 | 1.2 | |
| a said and | 1 | | unsigned of the | - |
| 2. The User must act in 3. This Certificate shall SPK-F70-00 ated by | a order to recalibrate during I not be publishes or repro- Lab. N | g a specified duced other fanager | period of ti than in full. | me. NACI/Lab/ Lab |
| 2. The User must act in 3. This Certificate shal SPK-F70-00 ated by | n order to recalibrate during I not be publishes or repro Lab. N HES | g a specified duced other fanager kandari | period of the | me. <u>NACI/Lab/</u> Lab ننعت بژوهان کون |

| Certificate No : | 140165-1 | | ID No : | | |
|---------------------------|------------------|------------------------------|-------------------------------|--------------------------------|--|
| Calibration Date : | 1401/04/26 | Cal Location : | | Cal lab | |
| Exp Cal.Date : | 1402/04/26 | | | | |
| | Custor | ner and Equipment | Specification | | |
| Customer name - Location | : | پترو فتاوری پایا | Manufacturer : | | |
| Equipment : | | Ultrasonic Flow meter | Fluid / Density : | Water / 1000 kg/m ³ | |
| Serial No. / Model : | | 21860423/ TUF-2000B | K.Fac : | 1 | |
| Size : | | 3 " | Resolution : | 0.01 m³/h | |
| Traceability : The | Reference Standa | rds are traceably calibrated | to national and international | metrology institute | |
| Reference Equipment : | Master | Flowmeter S/N: ZAC | 1445 Cert NO | : 40072925 | |
| Ambient Condition : Tempo | | erature : (20 ± 5) *C | Humidity : (≤ 50) % | %RH | |
| Calibration method : The | Calibration Was | Performed in Comparison M | lethod According to SPK-W-05 | 5 | |

Uncertainty : Confidence level is 95% and coverage factor K=2.

| Calibration Report | | | | | |
|------------------------------|------------------------------------|----------------------------------|----------------|------------------------------------|--|
| UUC Flow (m ³ /h) | Reference Flow (m ³ /h) | Deviation (m ³ /h) | Erorr % Red | Measurement Uncertainty (±%Rdg) | |
| 2.000 | 2.012 | 0.012 | 0.6 | | |
| 5.000 | 5.031 | 0.031 | 0.6 | | |
| 10.000 | 10.053 | 0.053 | 0.5 | | |
| 20.000 | 20.141 | 0.141 | 0.7 | 0.8 | |
| 30.000 | 30.235 | 0.235 | 0.8 | | |
| 40.000 | 40.382 | 0.382 | 1.0 | | |

H.Eskandari

1. This Certificate is not Valid Without Special Stamp.

2. The User must act in order to recalibrate during a specified period of time.

3. This Certificate shall not be publishes or reproduced other than in full.

SPK-F70-00

Calibrated by





NACI/Lab/1138









- 1. Experimental validation of multiphase flow models and testing of multiphase flow meters: a critical review of flow loops worldwide,2007
- 2. NEL Flow Test Facilities, <u>www.tuvsud.com</u>
- 3. DESIGN OF A HIGH-PRESSURE RESEARCH FLOW LOOP FOR THE EXPERIMENTAL INVESTIGATION OF LIQUID LOADING IN GAS WELLS, 2008
- 4. Designing A Multi-Phase Flow Loop, ICCES, 2009



Paya Petro Technology



Designed and Manufactured by PETROYATECH™ Multiphase Flow Metering Department

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