Technical Highlights from TC Flow

TC- Chair Petra Milota

Flow

ENG58 – MultiFlowMet Improving Multiphase Flow Metrology

The Challenge

The Challenge

Oil & gas satisfies well over half of the world's energy needs. On extraction, well fluids - oil, water and measured using multi flowmeters. Uncertain the field are very high compared to those fo phase measurements

Why are field uncertainties so high?

- Intrinsic complexity of the fluids
- Technology is new compared with single phase
- **Differences between metrology labs**
- **No agreed reference methods/standards**

Partners

EURAMET participant

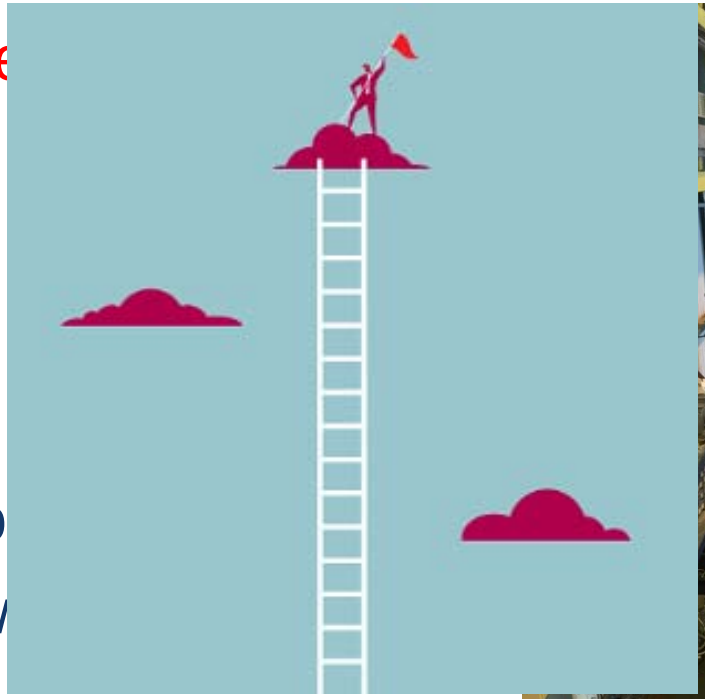
Model & Software developers

Multiphase flow labs

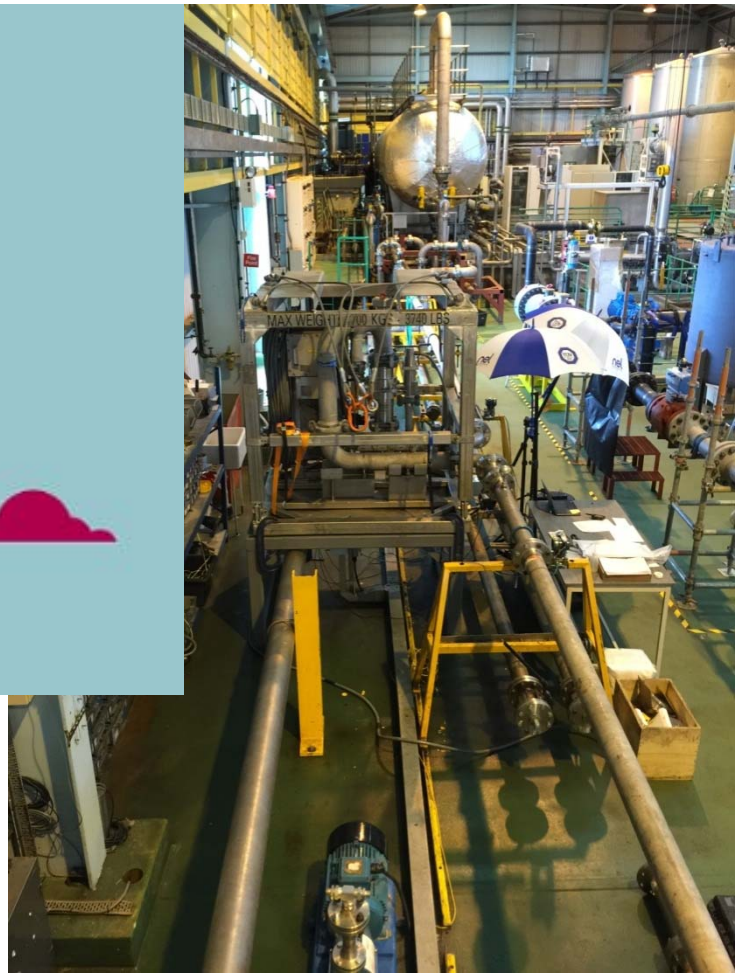
Instrumentation developers

Goal

- To develop an accurate and validated metrological refe

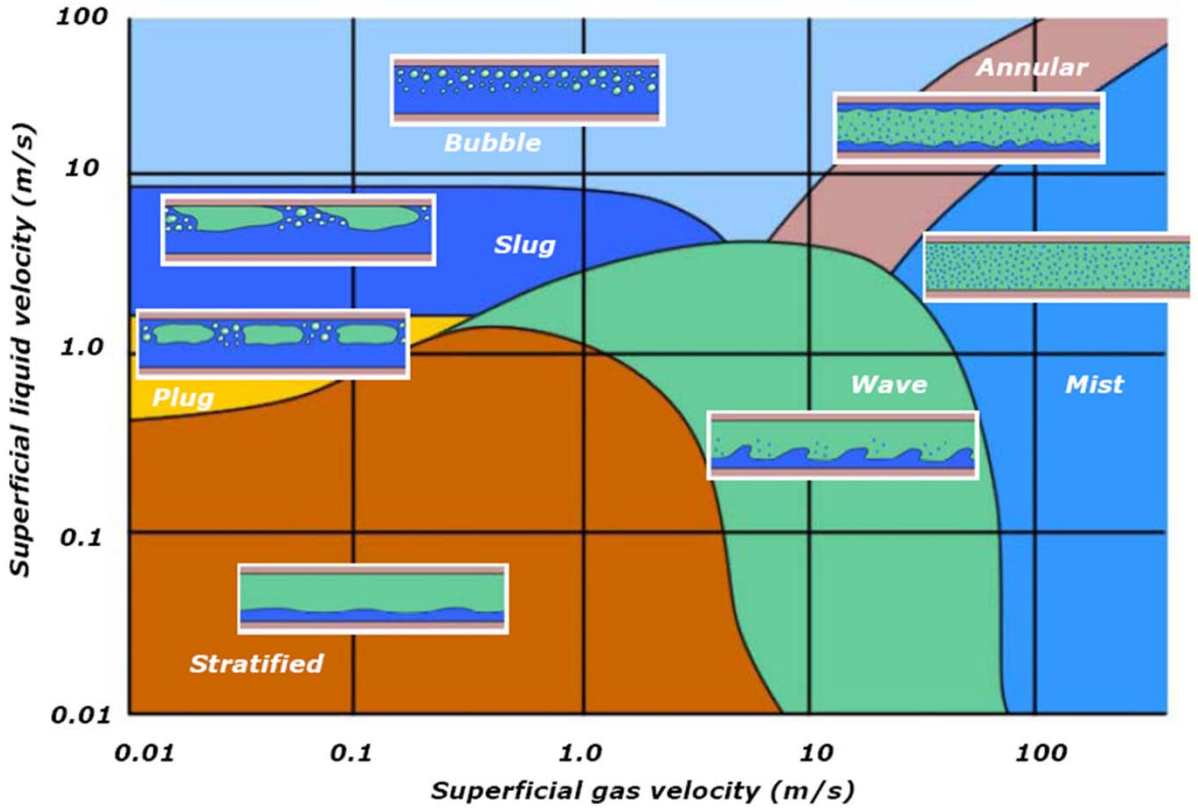


- Intercomparison multiphase labs
- Harmonisation o budgets & reviev evidence

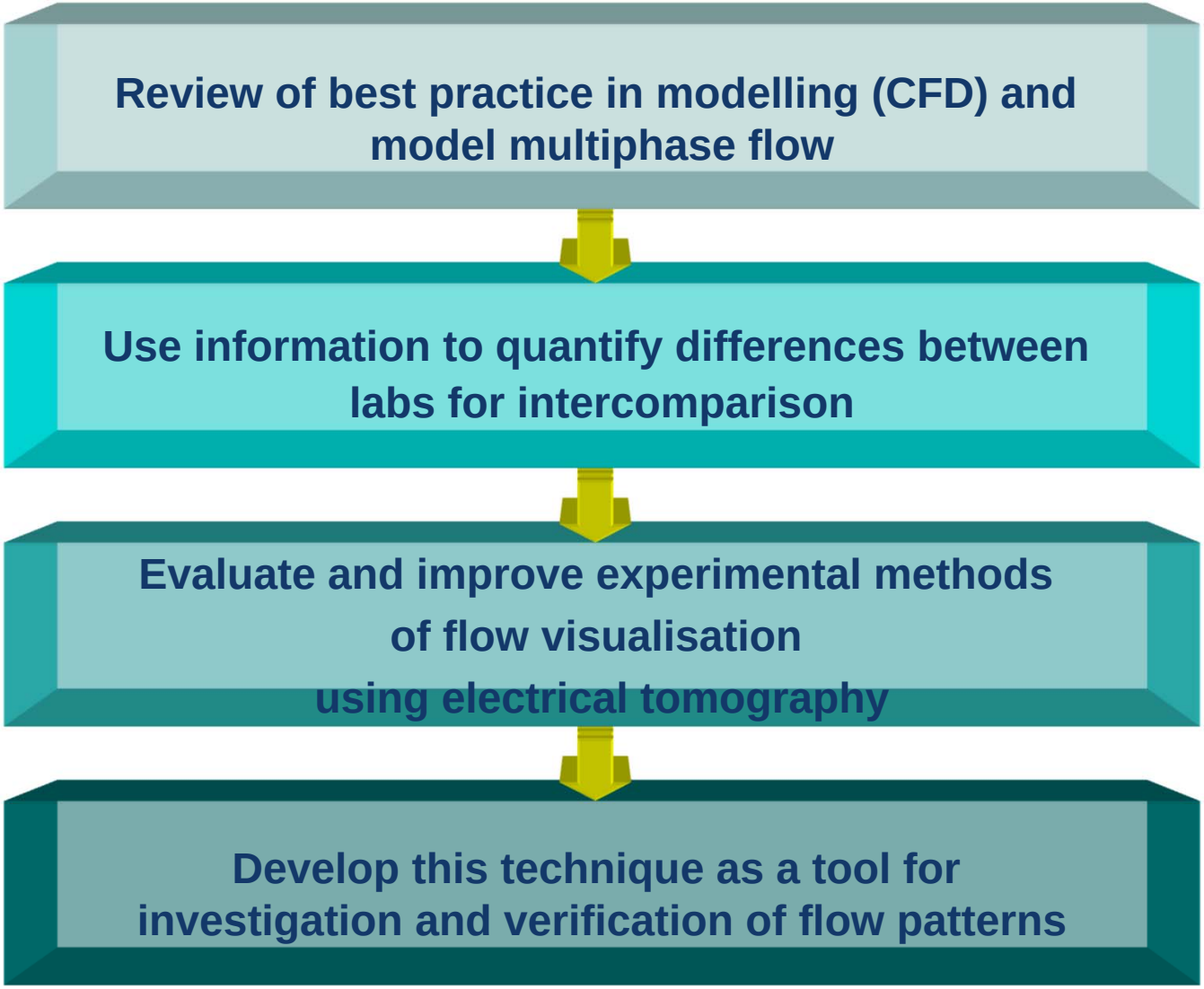


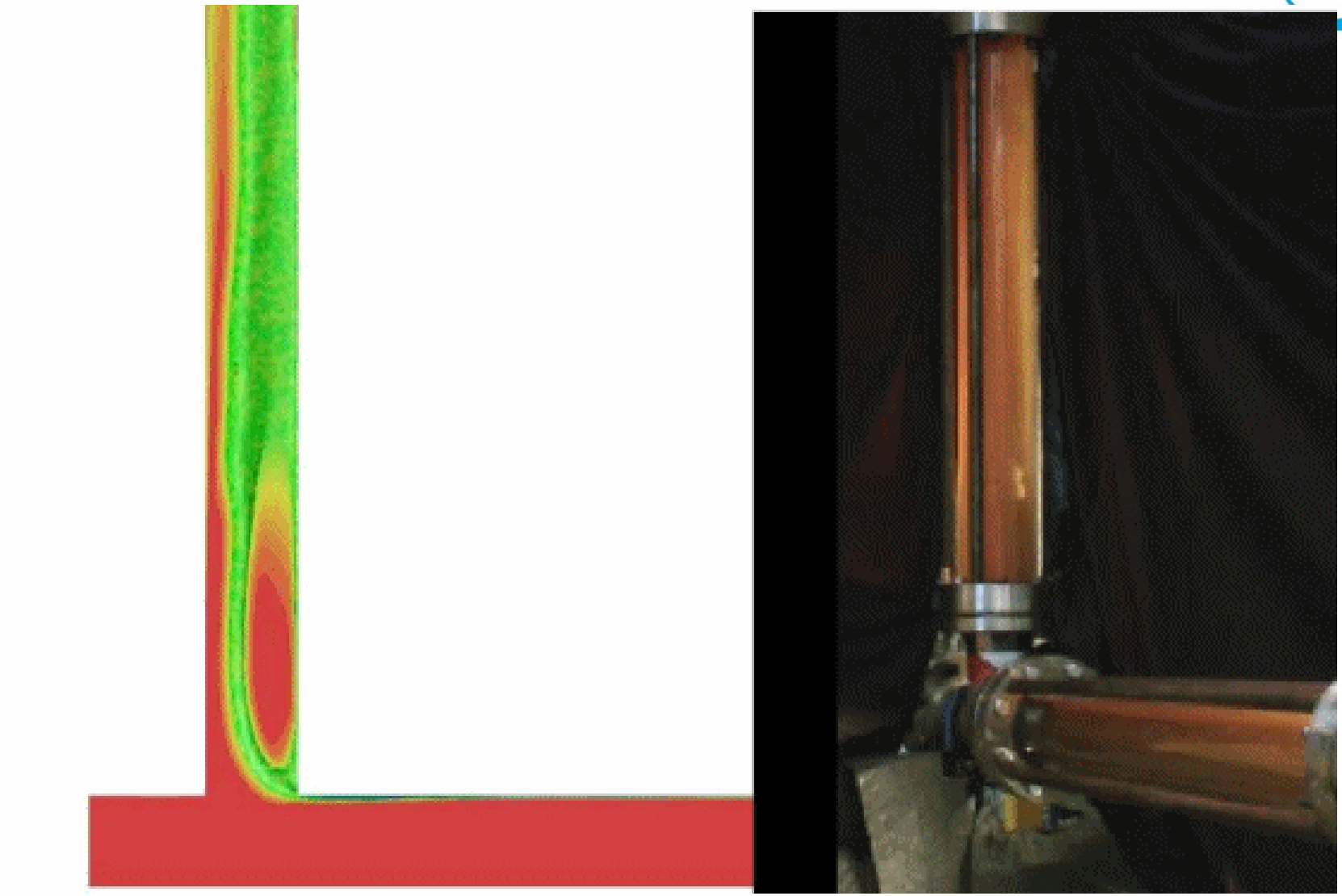
Theoretical and experimental determination of flow patterns

Changes with field variables such as pressure, temperature and component fluid properties and velocities



To Dos


Review of best practice in modelling (CFD) and model multiphase flow
Use information to quantify differences between labs for intercomparison
Evaluate and improve experimental methods of flow visualisation using electrical tomography
Develop this technique as a tool for investigation and verification of flow patterns



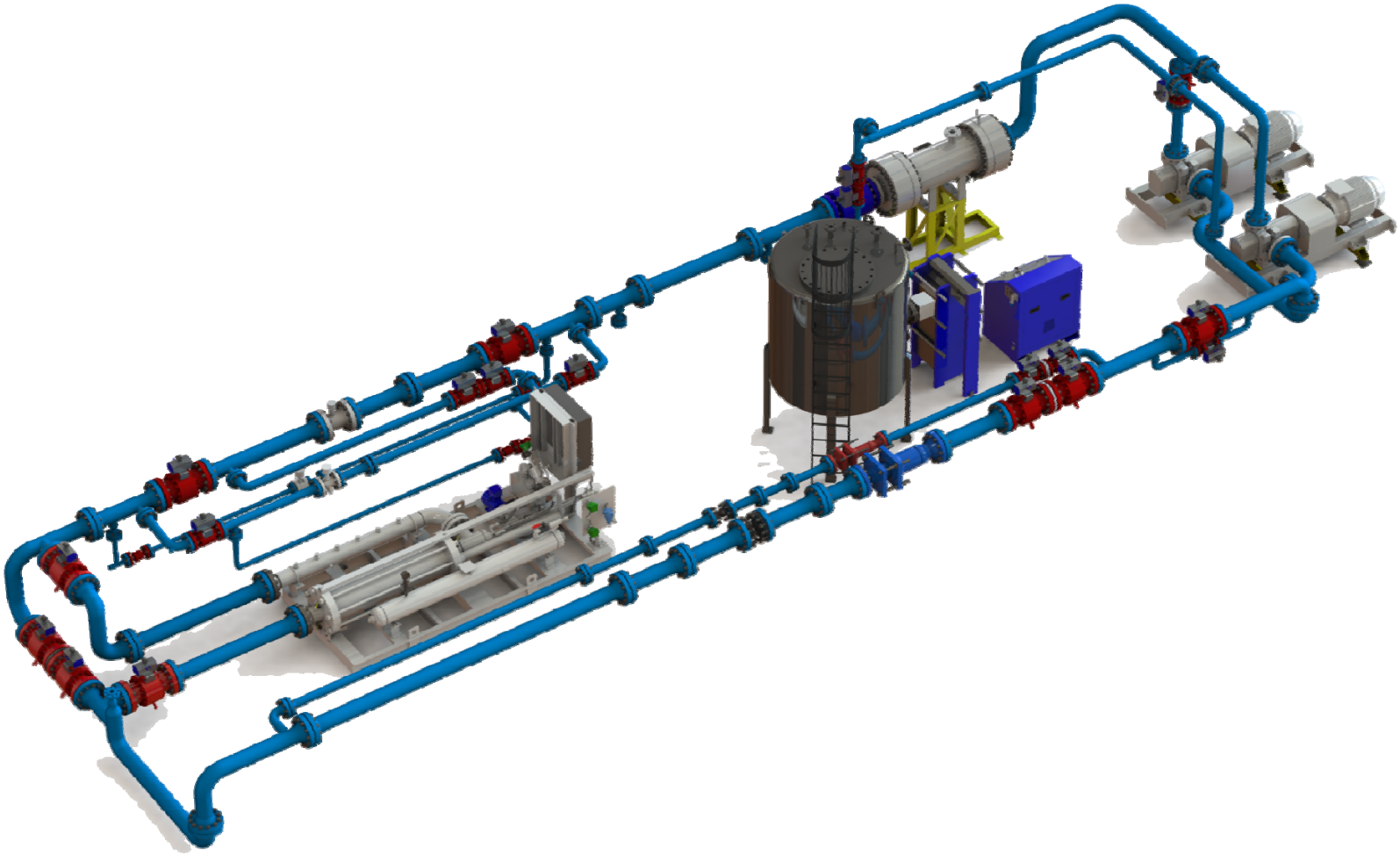
Elevated Pressure & Temperature Liquid Flow Facility

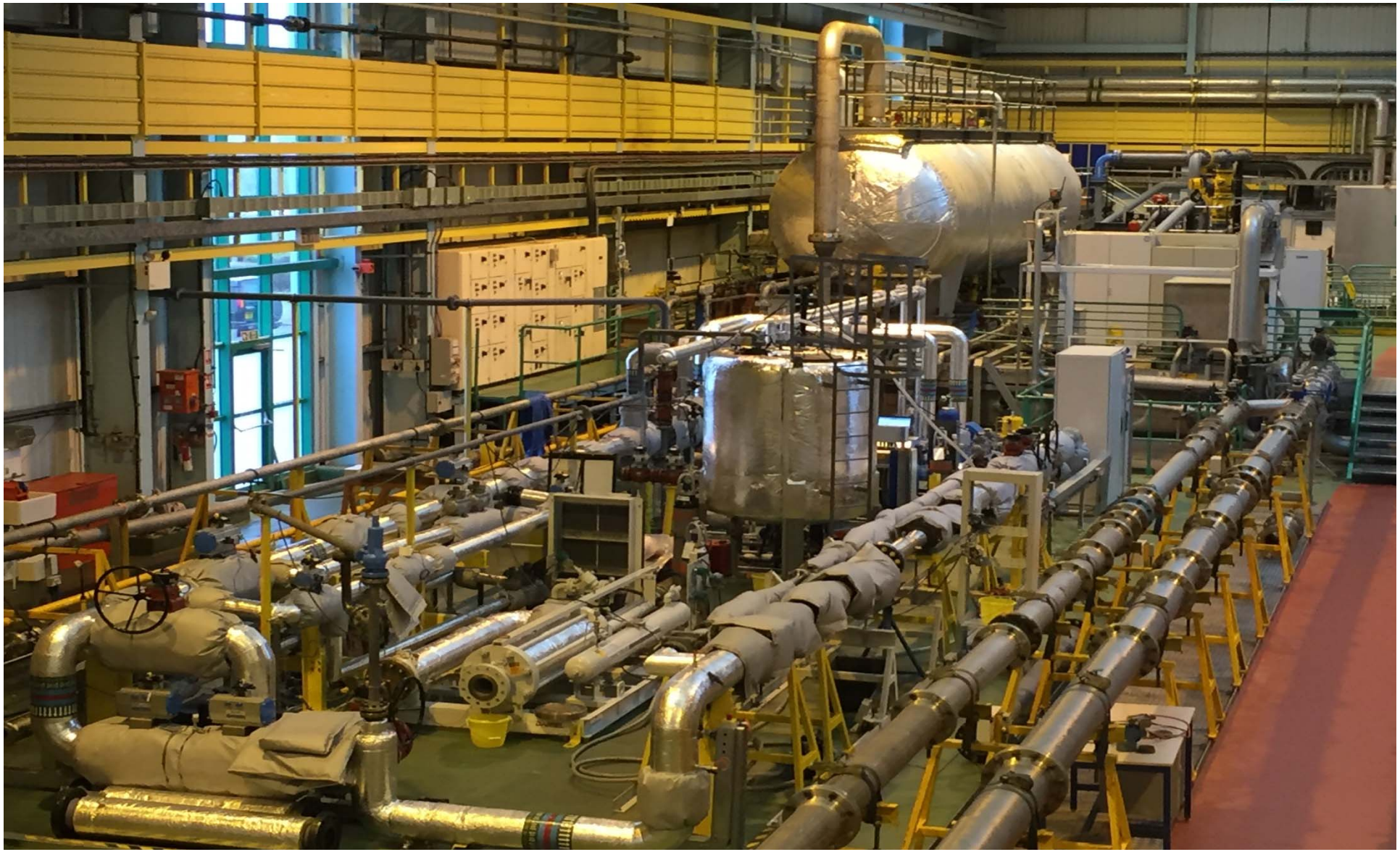
Chris Mills, NEL

Facility Design

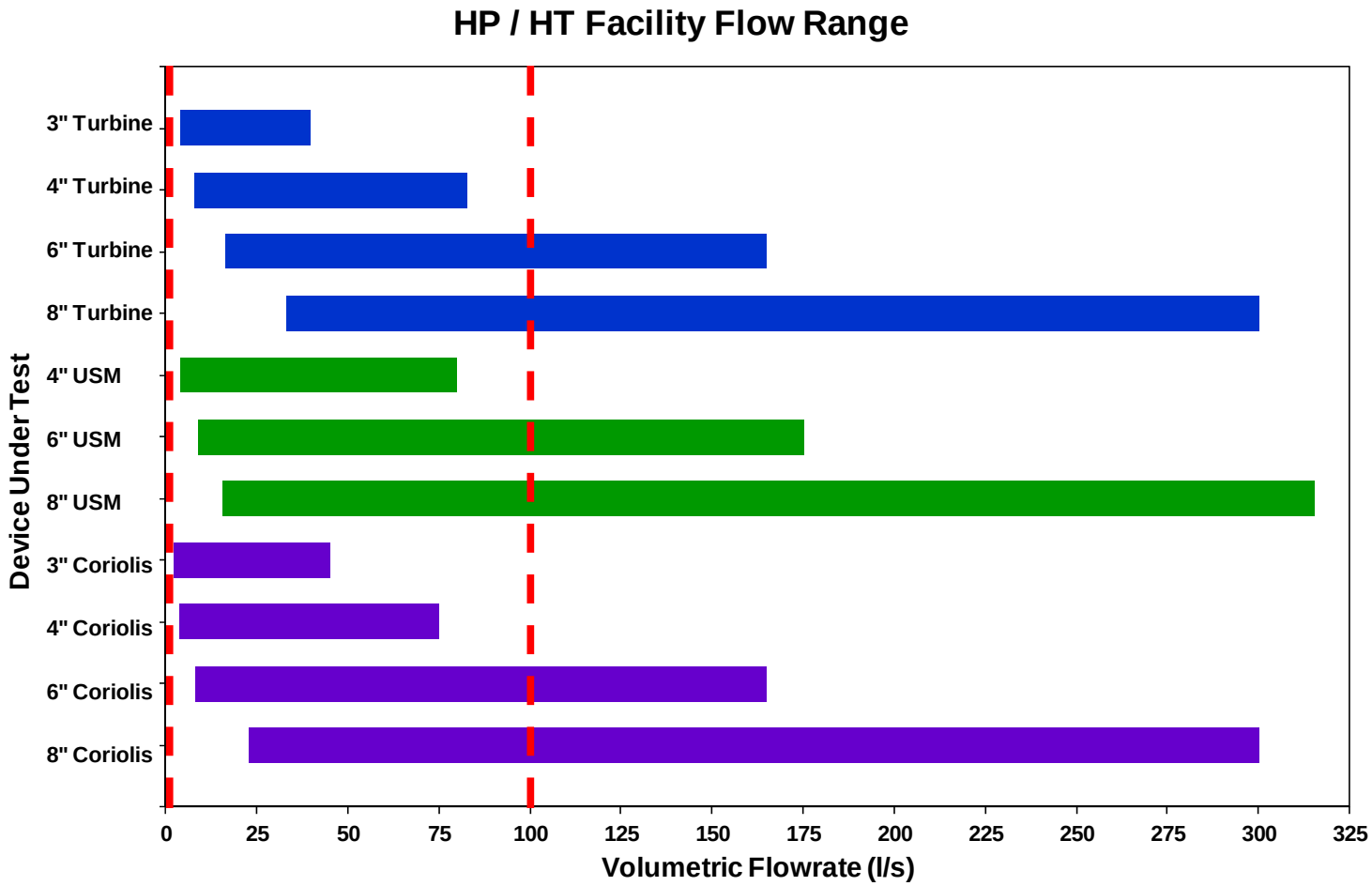
Item	Spec
Maximum Pressure:	100 bar g
Minimum Pressure:	1 bar g
Pressure Control:	+/- 0,5 bar
Maximum Temperature:	80 ° C
Minimum Temperature:	20 ° C
Temperature Control:	+/- 0,5 ° C
Maximum Flow:	100 l/s
Minimum Flow:	0,2 l/s
Maximum Fluid Density:	0,95 kg/l
Minimum Fluid Density:	0,7 kg/l
Maximum Fluid Viscosity:	15 cP [mPa·s]
Minimum Fluid Viscosity:	1 cP
Test Section Pipe Size:	1 – 8 inch OD
Test Section Pipe Length:	10 metres
Measurement Uncertainty:	± 0,08 (k=2)

The Facility





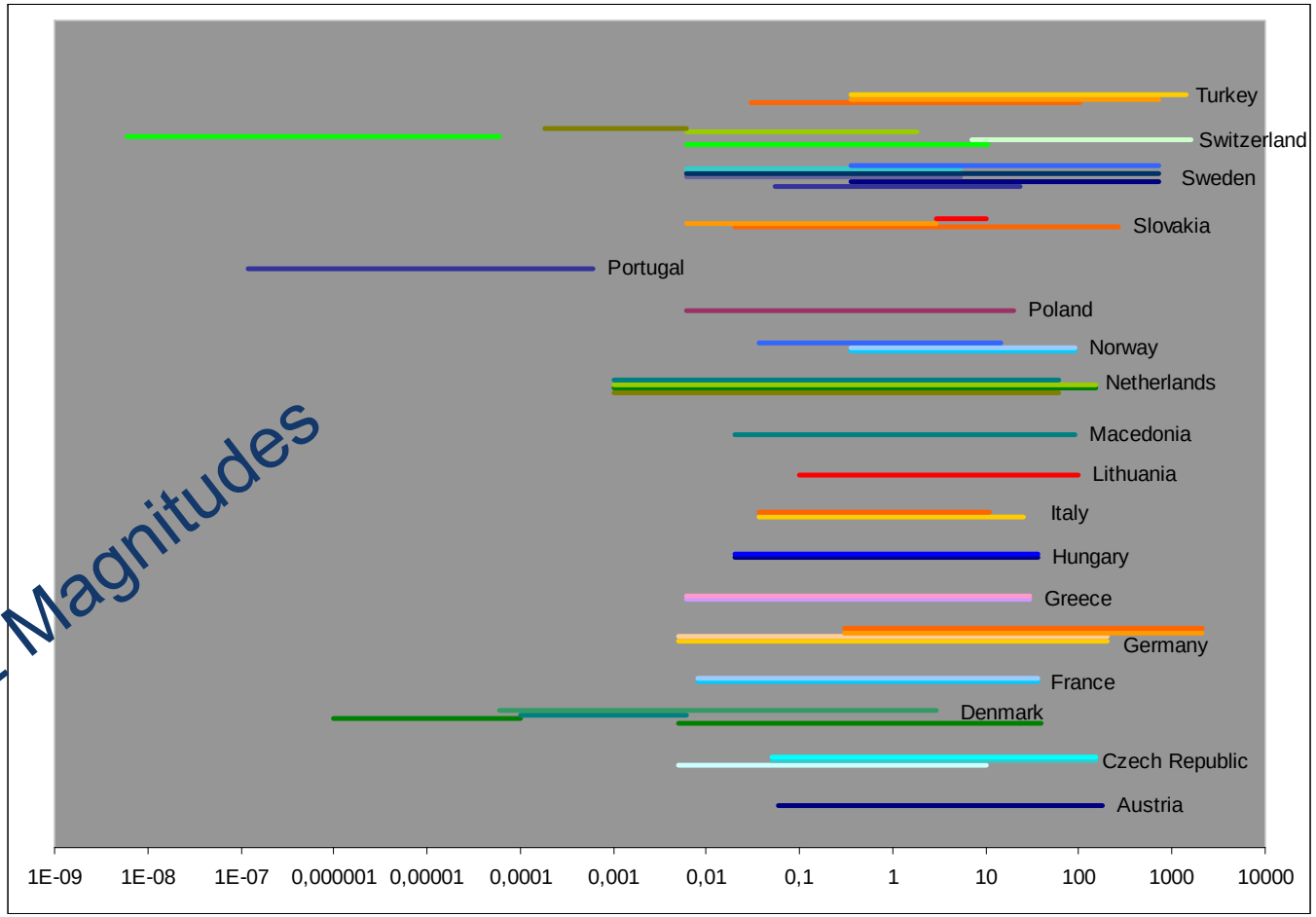
Flow Range


HP / HT Facility Flow Range
Device Under Test
3" Turbine
4" Turbine
6" Turbine
8" Turbine
4" USM
6" USM
8" USM
3" Coriolis
4" Coriolis
6" Coriolis
8" Coriolis
0
25
50
75
100
125
150
175
200
225
250
275
300
325
Volumetric Flowrate (l/s)

Water Flow Range

m^3/h, L/s, kg/s, t/h, kg/h, mL/min, L/h

From 0,000000006 m^3/h ≙ 0,001 mL/min up to 2100 m^3/h



Schweizerische Eidgenossenschaft
Confédération suisse
Confederazione Svizzera
Confederaziun svizra

Federal Institute of Metrology METAS

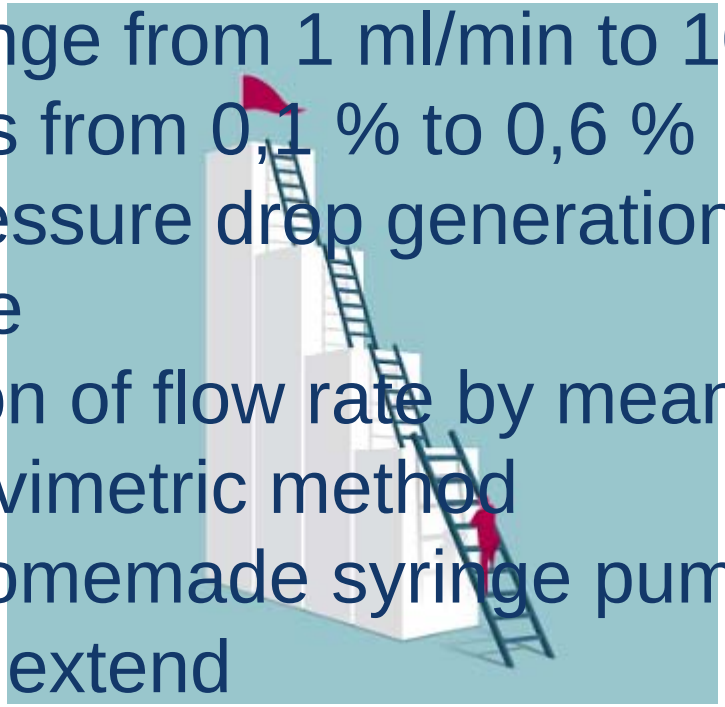
New METAS milli-flow primary standard
(1- 100) mL/min, (0,06 – 6,0) L/h

Marc de Huu

MEDD
Drugmetrology.com

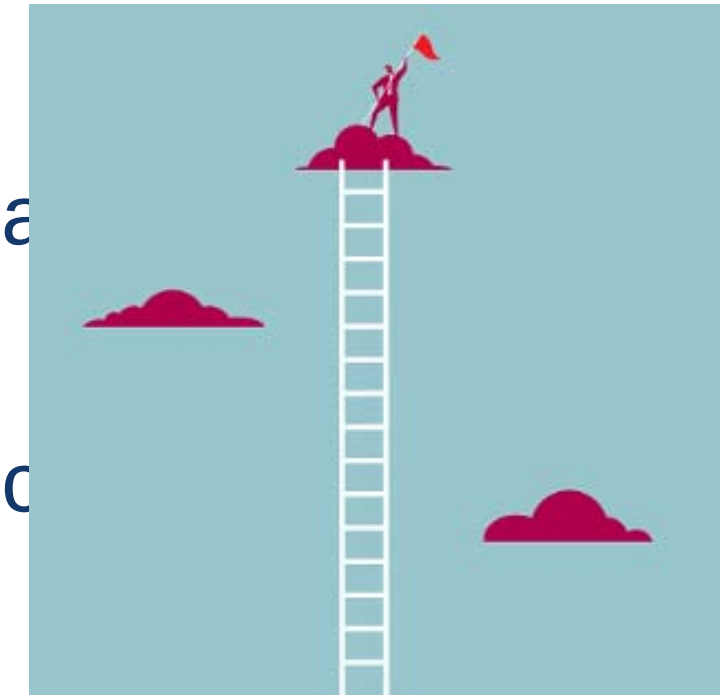
The Challenge

- Build a primary standard
- Flow rate range from 1 ml/min to 100 nl/min
- Uncertainties from 0,1 % to 0,6 %
- Constant pressure drop generation over a capillary tube
- Determination of flow rate by means of the dynamic gravimetric method
- Moreover, homemade syringe pump as flow generator to extend
- flow rate range to 100 ml/min in order to
- calibrate flow sensors with other liquids than water



Goal

- Calibrate syringe against scales
- Dynamic gra
- Calibration c ow rates
- Transfer standard with (almost) any liquid



Results Primary standard for micro-flow at METAS

Water tank with immerged metallic bellow and pressure controller

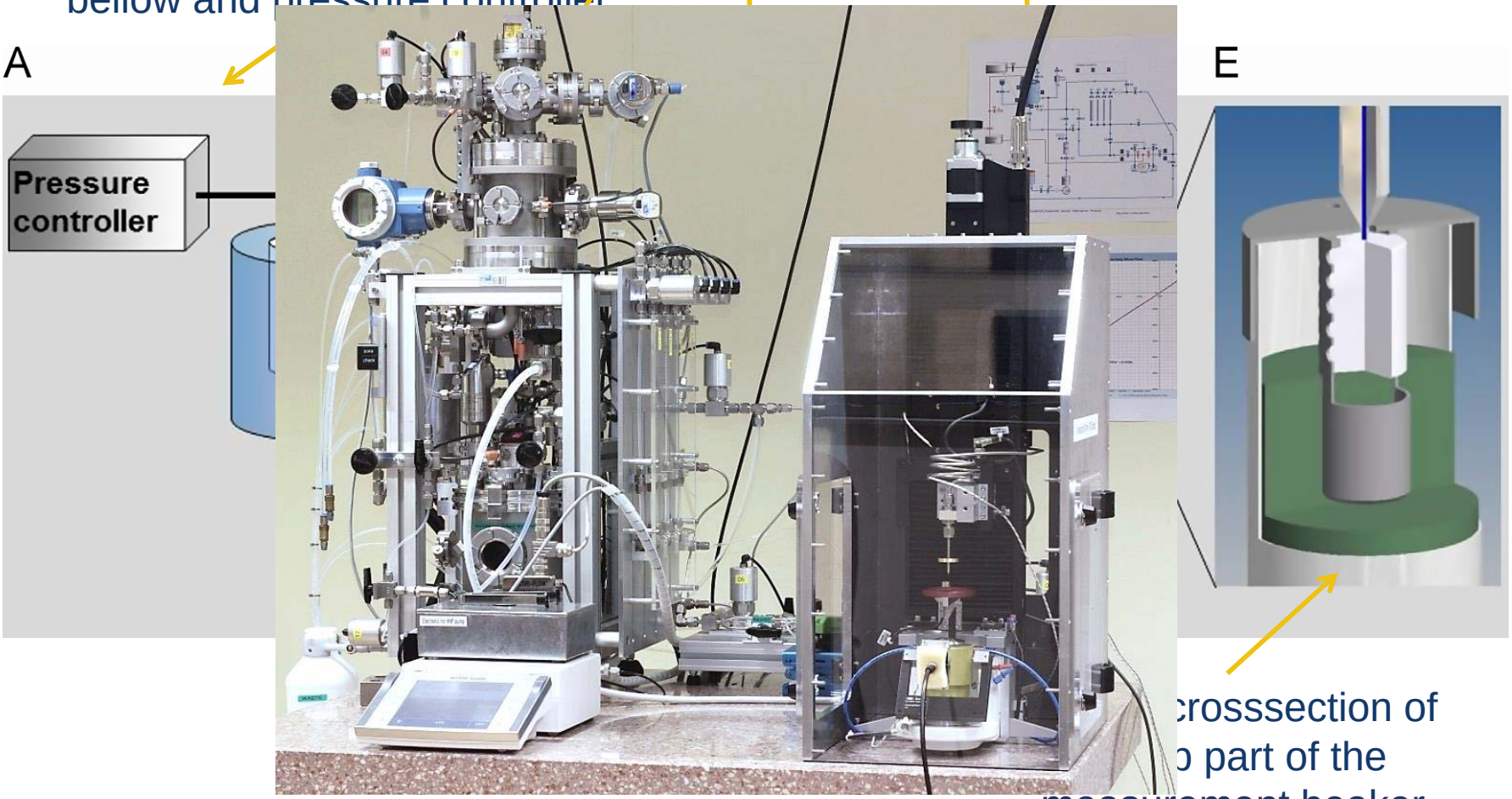
Capillary tube

Device under test (DUT)

Measurement beaker on the balance

A

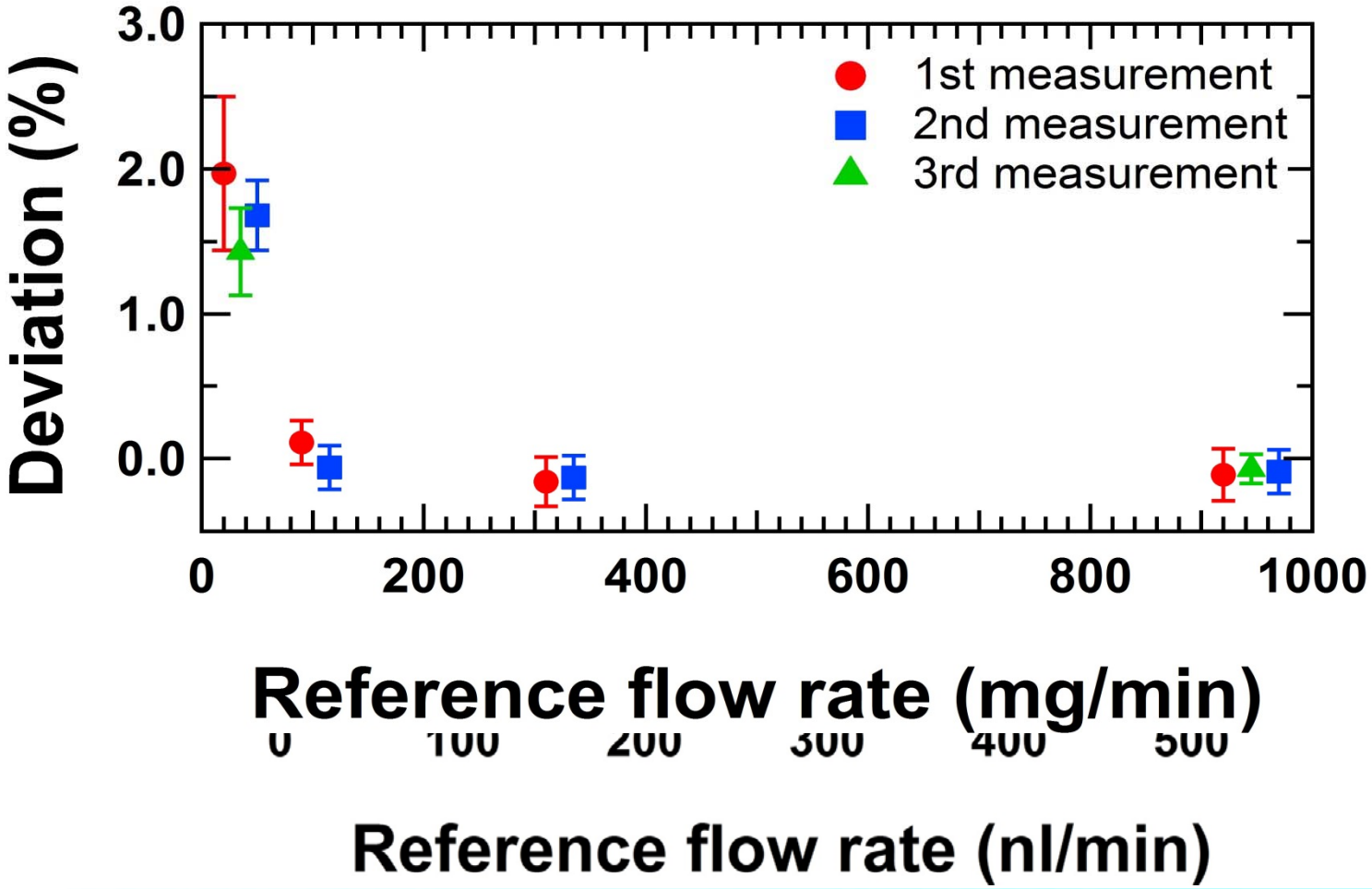
E



crosssection of
o part of the
measurement beaker

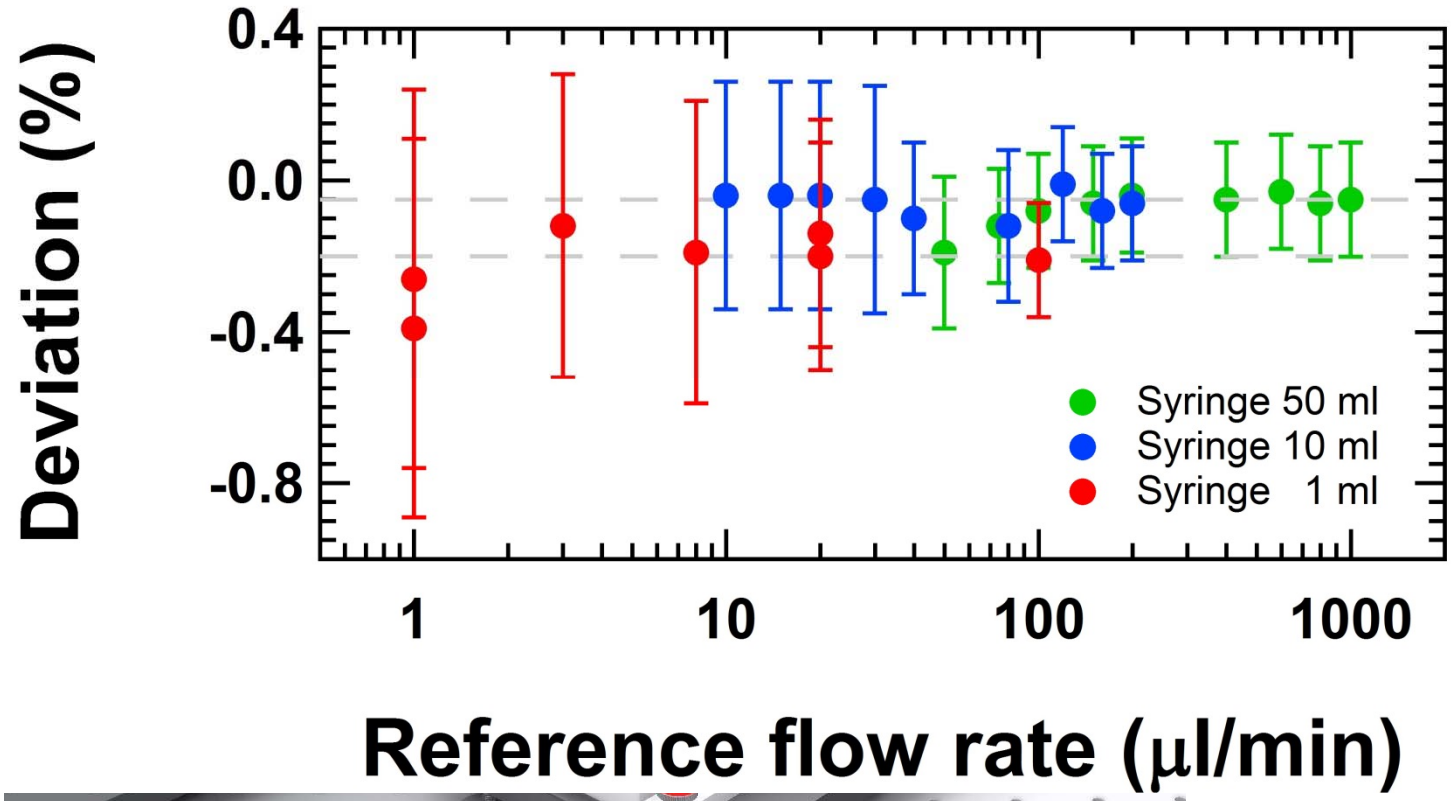
The flow rate range is from 1 ml/min to 100 nl/min

Reproducibility of the calibrations of different types of flow meters



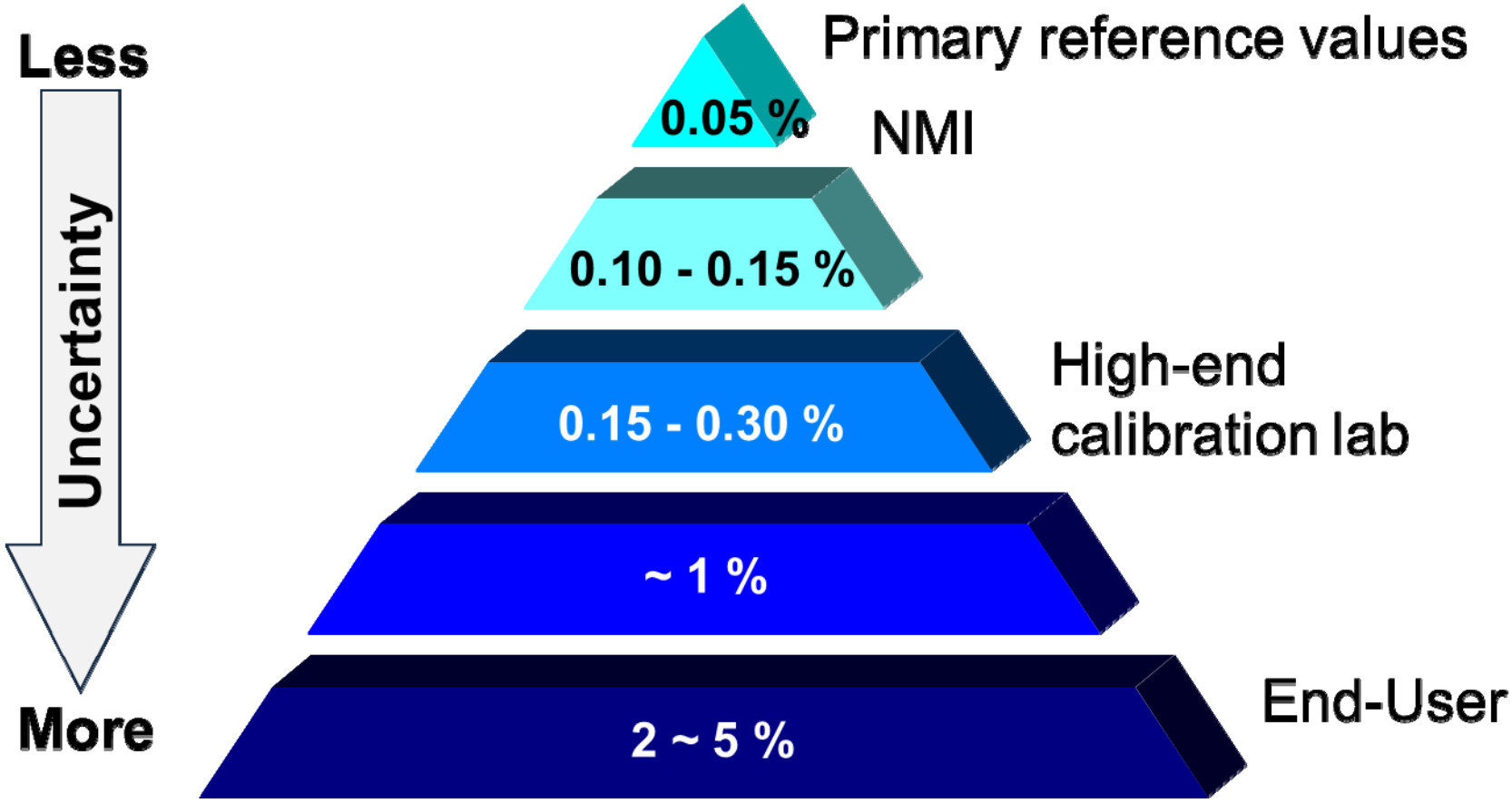
How to calibrate flow sensors with other liquids

Syringe Pump MSE TAS syringes



wo
ge
r flow
/min
l/min.

International traceability



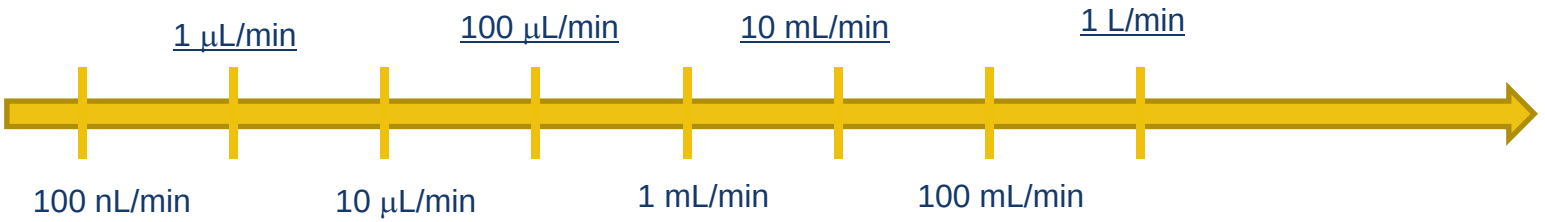
METAS flow range

Micro Flow

Syringe pump

Milli Flow

Older rigs



Conclusion

- New Milli Flow primary standard for liquids
- Dynamic gravimetric method
- Characterisation finished before the summer
- Calibrate flow sensors with other liquids
- (Trans)Portable system
- METAS low flow range:

  100 nL/min – 100 mL/min
- Flow range of food, medical and pharma industry