Dual flaremeter installation Alvheim FPSO

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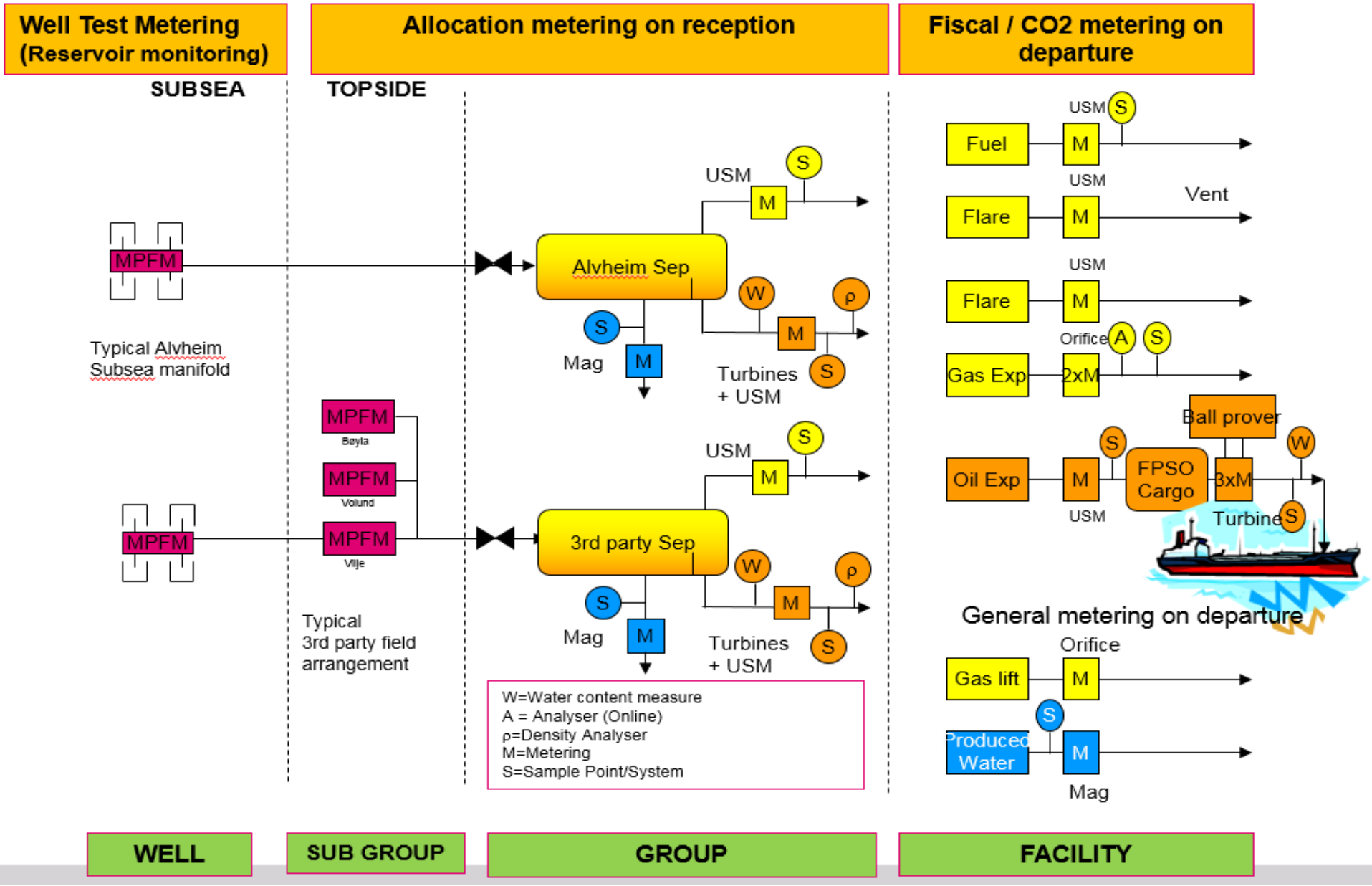
NFOGM Temadag Mars 2019

ALVHEIM METERING AND ALLOCATION OVERVIEW



ALVHEIM PROBLEM:

- Fluenta FGM130 Flare meter, single path ultrasonic flare meter. Often stops working at higher rates
- Liquid condensation or other problematic conditions for the meter/transducers? High velocity?
- No immediate fix for this that we are aware of
- FGM130 no longer supported.
- Difficulties in changing out transducers or other parts

ALVHEIM SOLUTION?

- Alvheim already have the GE Panametrics flare meter on the cold vent line, works ok, but low rates
- Other AkerBP installations have the Panametrics flare meter installed, reporting same issues with higher rate flaring as Alvheims Fluenta FGM130. Resulting in many corrections.
- Upgrade/replace to a new flare meter. Which one? Panametrics? Sick? Fluenta FGM160?
- Various experiences collected from many operators told us that there was no guarantee that a change out to a new meter would solve our problems
- DP Based flare tip calculation of rates?


Greetings
from
FUNNIER
CALIFORNIA

- ABB LGR-950 H2S and O2 analyzer FAT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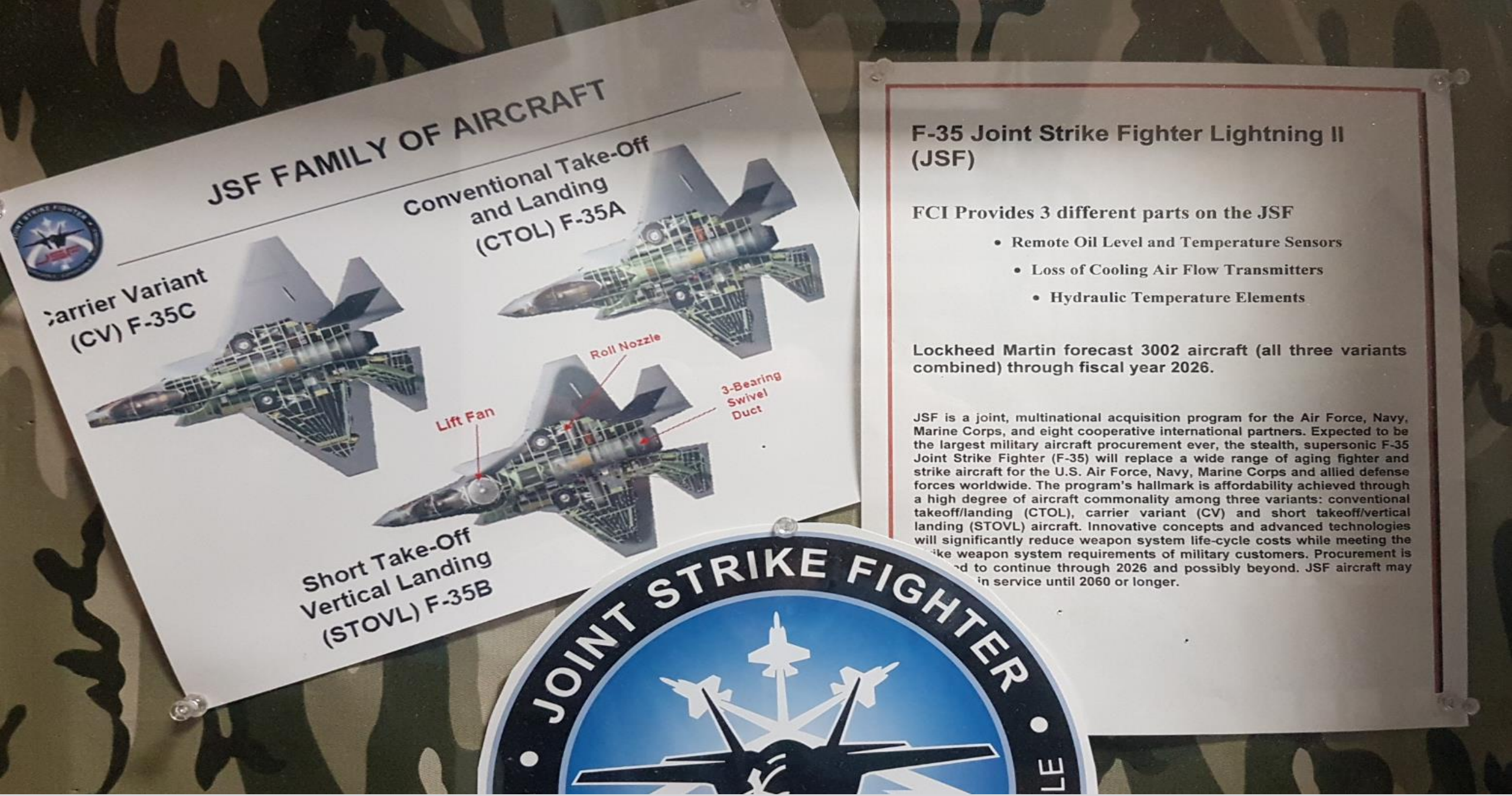
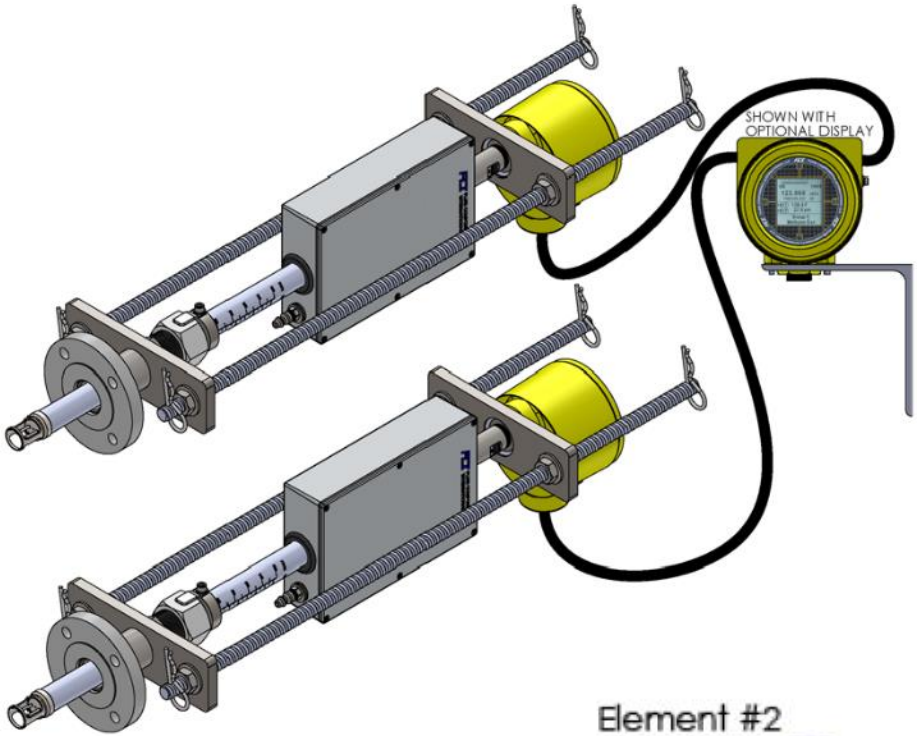
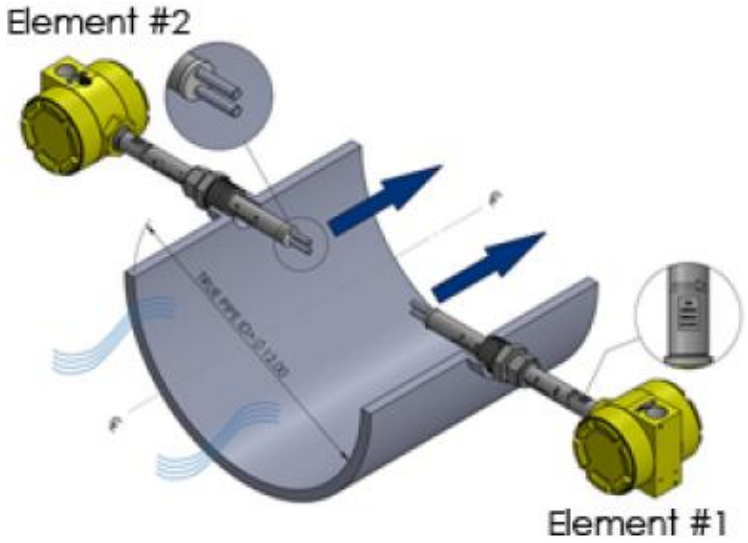

JSF FAMILY OF AIRCRAFT
Conventional Take-Off and Landing (CTOL) F-35A
Carrier Variant (CV) F-35C
Roll Nozzle
Lift Fan
3-Bearing Swivel Duct
Short Take-Off Vertical Landing (STOVL) F-35B
F-35 Joint Strike Fighter Lightning II (JSF)
FCI Provides 3 different parts on the JSF
Remote Oil Level and Temperature Sensors
Loss of Cooling Air Flow Transmitters
Hydraulic Temperature Elements
Lockheed Martin forecast 3002 aircraft (all three variants combined) through fiscal year 2026.
JSF is a joint, multinational acquisition program for the Air Force, Navy, Marine Corps, and eight cooperative international partners. Expected to be the largest military aircraft procurement ever, the stealth, supersonic F-35 Joint Strike Fighter (F-35) will replace a wide range of aging fighter and strike aircraft for the U.S. Air Force, Navy, Marine Corps and allied defense forces worldwide. The program's hallmark is affordability achieved through a high degree of aircraft commonality among three variants: conventional takeoff/landing (CTOL), carrier variant (CV) and short takeoff/vertical landing (STOVL) aircraft. Innovative concepts and advanced technologies will significantly reduce weapon system life-cycle costs while meeting the
ike weapon system requirements of military customers. Procurement is
d to continue through 2026 and possibly beyond. JSF aircraft may
in service until 2060 or longer.
JOINT STRIKE FIGHTER





ST100 Series Features

Four conduit ports provide greatest signal integrity and separation for power input, analog output lines, digital I/O, relays and/or auxiliary input signals; choice of NPT or M20 threads

AC or DC power supply

Weather-proof, ruggedized, Ex rated enclosures
- Choices for local or remote mounting
- NEMA 4X, IP67
- Aluminum or optional all stainless steel

Global agency approvals of entire instrument system for hazardous location installations:
FM, FMc, ATEX, IEC, NEPSI, CPA, Inmetro, GOST *

Multiple calibrations
- Up to five independent, separate calibrations
- Same gas, different flow range to optimize accuracy and extend turndown up to 1000:1
- Exclusive SR2x™ split range / dual calibration

Precision calibration and calibration choices
- Specific gas and application matched calibration in FCI NIST traceable facility

Extensive selection of process connections
- Retractable packing gland assemblies
- Fixed connections
- ANSI or DIN flanges
- Simple, adjustable installation with threaded NPT connector

Stainless steel or Hastelloy-C276 wetted parts

Remote up to 1000' [300 m]

Extensive analog and digital communications output choices
- Triple 4-20 mA with HART
- FOUNDATION™ fieldbus H1
- PROFIBUS PA
- Modbus RS-485
- 0-1 kHz or 0-10 kHz frequency or pulse
- Dual relays
- USB port
- Ethernet

On-board data logger

Four (4) optical touch buttons
- Proximity activation, no need to open enclosure
- Full instrument programmability
- Protected against unwanted activation

Comprehensive informational display
- Digital readout of all measured parameters; flow rate, total flow, temperature and pressure with engineering units
- Analog flow rate bar graph
- Alarm relay status indication
- Instrument fault indication
- User programmable 17 character field *(example: display gas type, tag number or application/location)*
- Display orientation rotates in 90° increments electronically
- Backlighted: auto-on activation via proximity sensor or set for always on

Multi-function: measures mass flow rate and temperature; STP Series adds pressure measurement

Permanent laser-etched depth gauge markings; ensures accurate centering of adjustable-length elements

All welded sensor elements for maximum service life and leak-proofing

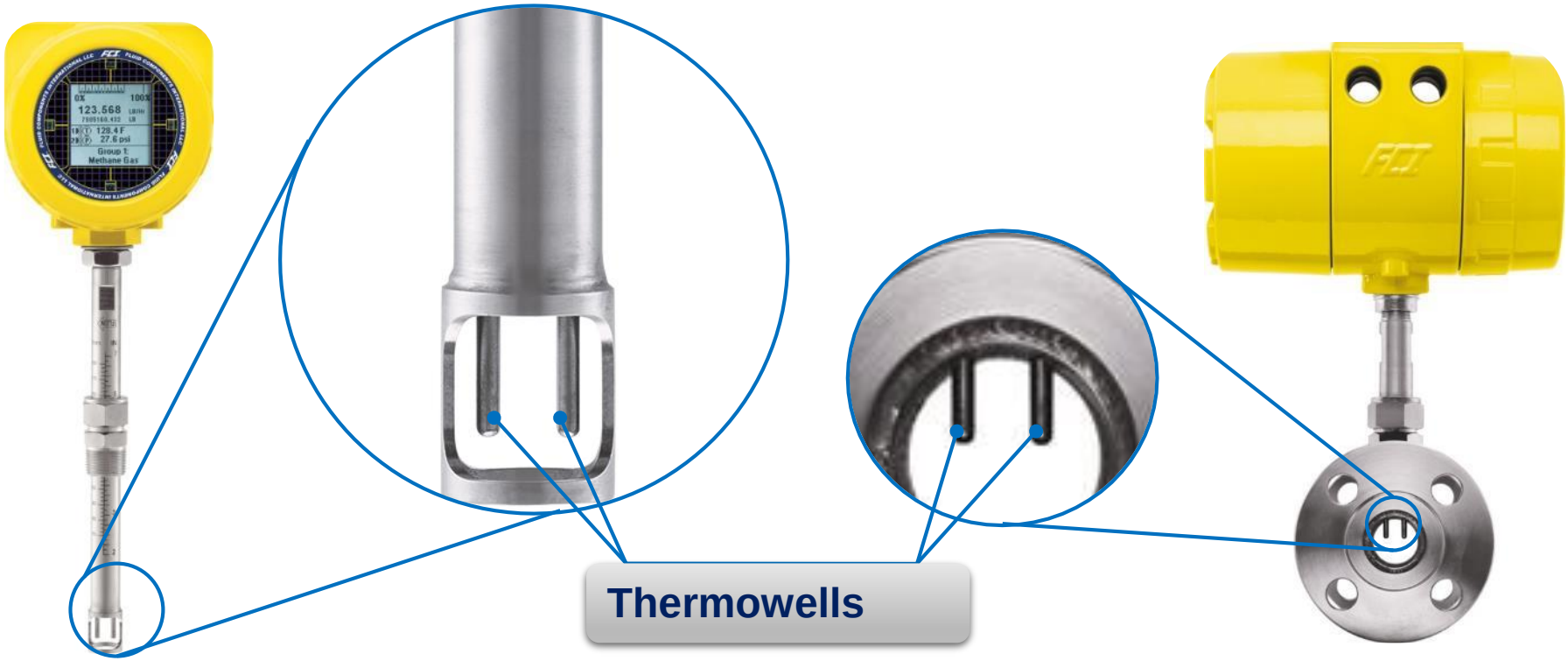
Precision, wide-ranging platinum RTD sensors

Exclusive equal mass sensors provide optimum performance in processes with wide temperature swings

Choice of flow element styles to optimize application performance

Theory Construction of Sensor

Flow element consists of 2 thermo-wells welded to the end of a probe or inside of a spool piece, it can be an insertion meter or mounted directly in a spool piece in case of an in-line flow meter.



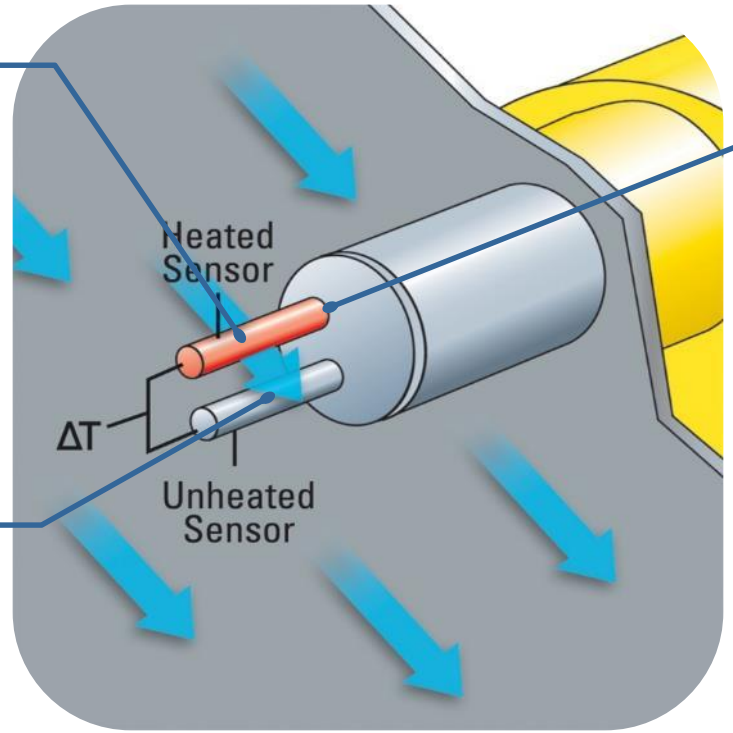
Insertion Type Thermal Mass Flowmeter

In-Line Type Thermal Mass Flowmeter

Theory Construction of Sensor & Delta R/T of RTD's

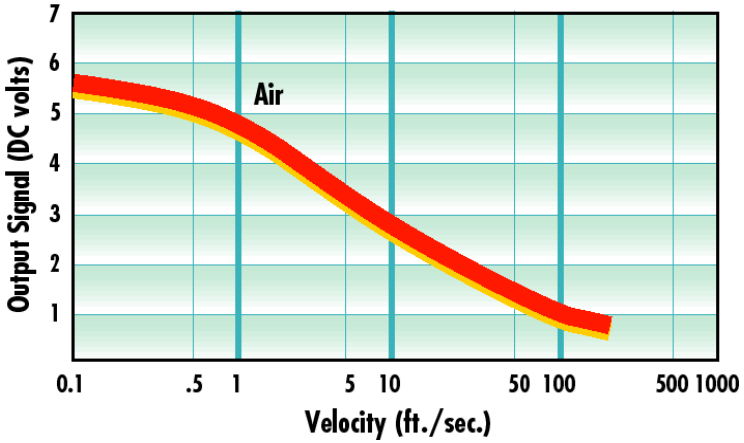
Active RTD:
RTD sensor (Pt1000 Ω) plus heater element in one thermowell

Reference RTD:
RTD sensor (Pt1000 Ω) in one thermowell



Signal Processing:
Electronics supplies constant power to Active RTD sensor and senses the temperature difference between Active RTD and Reference RTD flow sensor

Mass Flowmeter:
The temperature difference between the Active and Reference flow sensors is directly proportional to the mass flow of the gas.



Theory

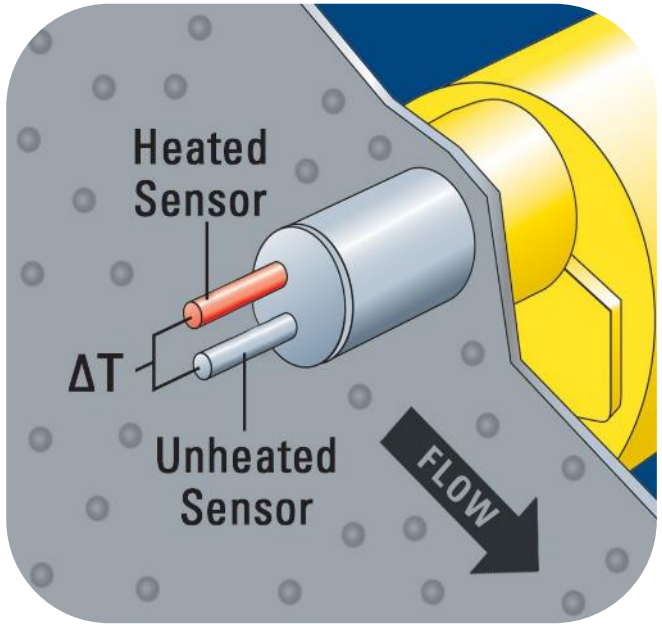
Theory of Operation: Types of Technology

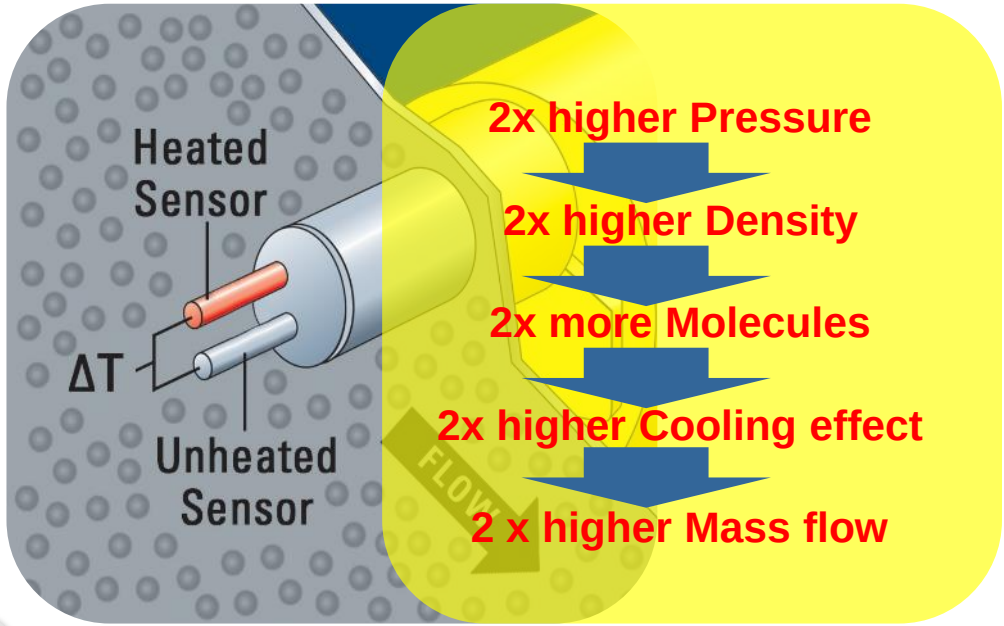
There are 2 types of Thermal Technology:

1) **Constant Temperature (All other thermal manufacturers): Adjusts heater current to keep Delta T always the same and measures the current that it takes to keep it the same Delta T between the sensors.**
   - **Results in unstable flow measurement in wet or dirty gas.**
   - **Requires electronics (signal amplifiers and filters) mounted in local probe enclosure with remote configuration.**

2) **Constant Current (ST100): Uses Constant Power heater current and measures the Delta R which is dependent on the process media and flow velocity. (FCI Patented Technology)**
   - **Results in stable flow measurement in wet and dirty gas.**
   - **No electronics mounted in local probe enclosure with remote configuration.**

Theory Theory of Operation Pressure Change





Case 1

Medium:	Natural Gas
Pipe:	DN100x1.5
Temp:	20ºC
Velocity:	25.7 m/sec (actual)
Pressure:	**100 KPa**
Density:	**0.7 kg/m³** (actual)

Measured ΔT = 21ºC

Measured Mass Flow rate = 500 KG/Hr

Event

Pressure increases from 1 to 2 Bar, all others remains the same

Case 2

Medium:	Natural Gas
Pipe:	DN100x1.5
Temp:	20ºC
Velocity:	25.7 m/sec (actual)
Pressure:	**200 KPa**
Density:	**1.4 kg/m³** (actual)

Measured ΔT = 18.5 ºC

Measured Mass Flow rate = 1000 KG/Hr

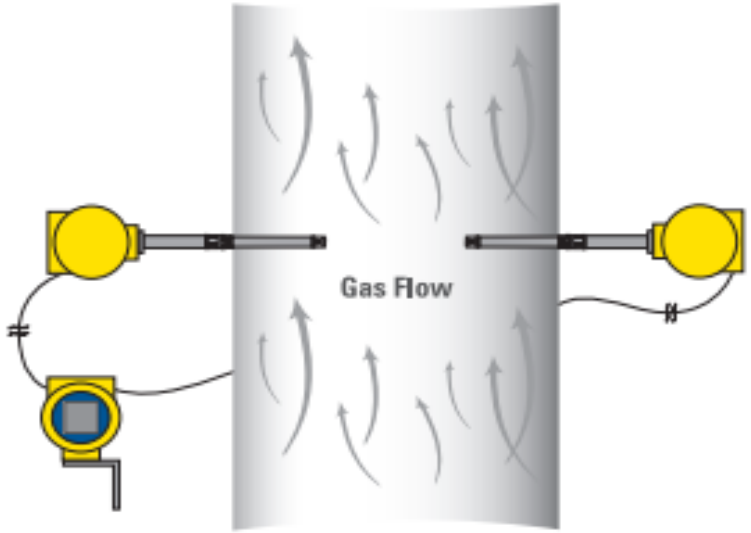
Flare
Flowmeter

Thermal Mass Flowmeter Dual Sensing

- Dual Sensing system with averaging transmitter
- To get uncertainty down to 5% or better

Challenges

- Distorted, swirling and non-repeatable flow profiles due large pipe sizes



Dual sensing ST100 series with one transmitter

IMPROVED INSTALLATION ACCURACY AND REPEATABILITY BY AVERAGING THE FLOW RATES

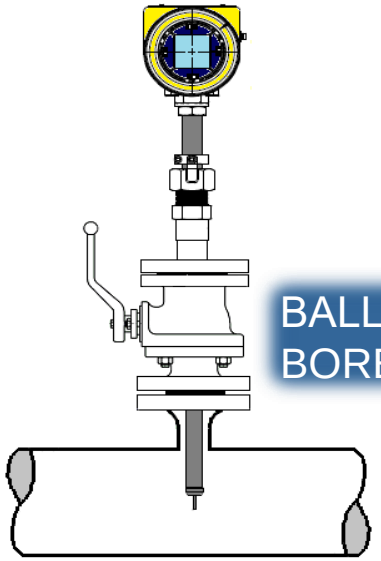
FLARE METERING

ST100 SERIES

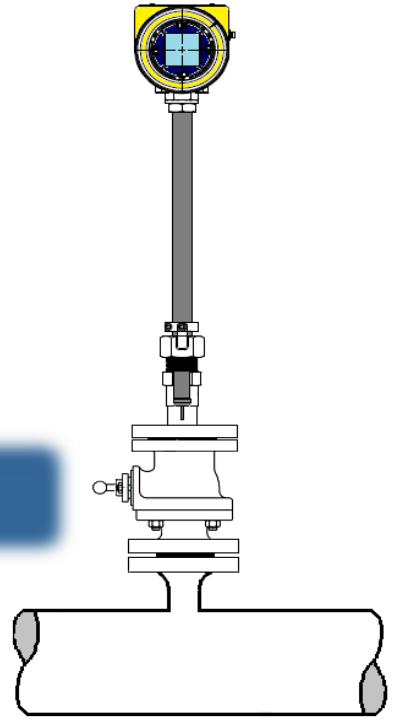
RETRACTABLE HOT TAPE INSTALLATION

ALLOWS RETRACTION UNDER PRESSURE

- NO DOWNTIME TO PLANT OPERATIONS



BALL VALVE MINIMAL SIZE 1.5” FULL BORE



PROBE NORMAL OPERATION WITH BALL VALVE OPEN

PROBE RETRACTED WITH BALL VALVE CLOSED

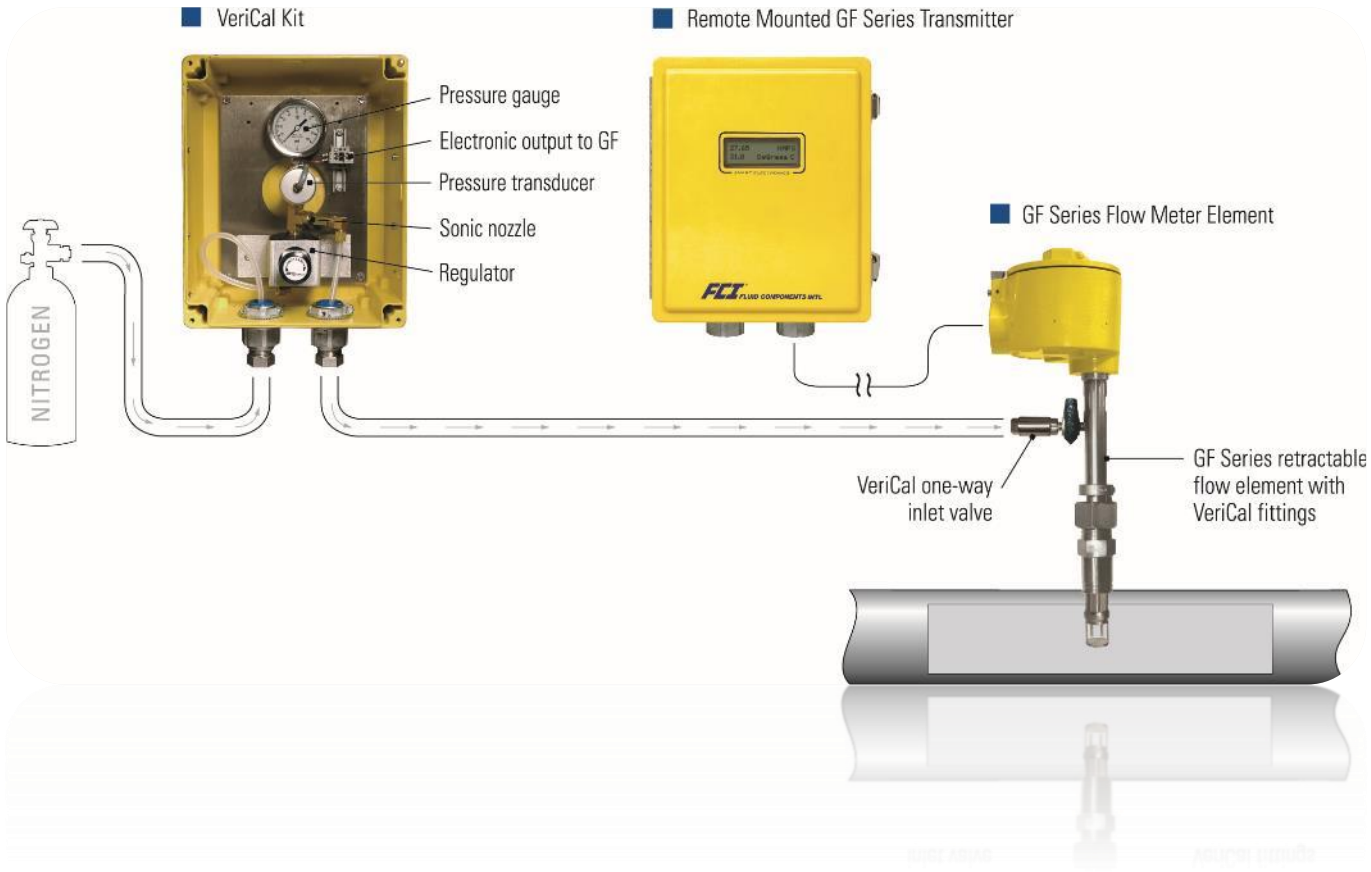
How can we verify the accuracy of the thermal mass flare meter?

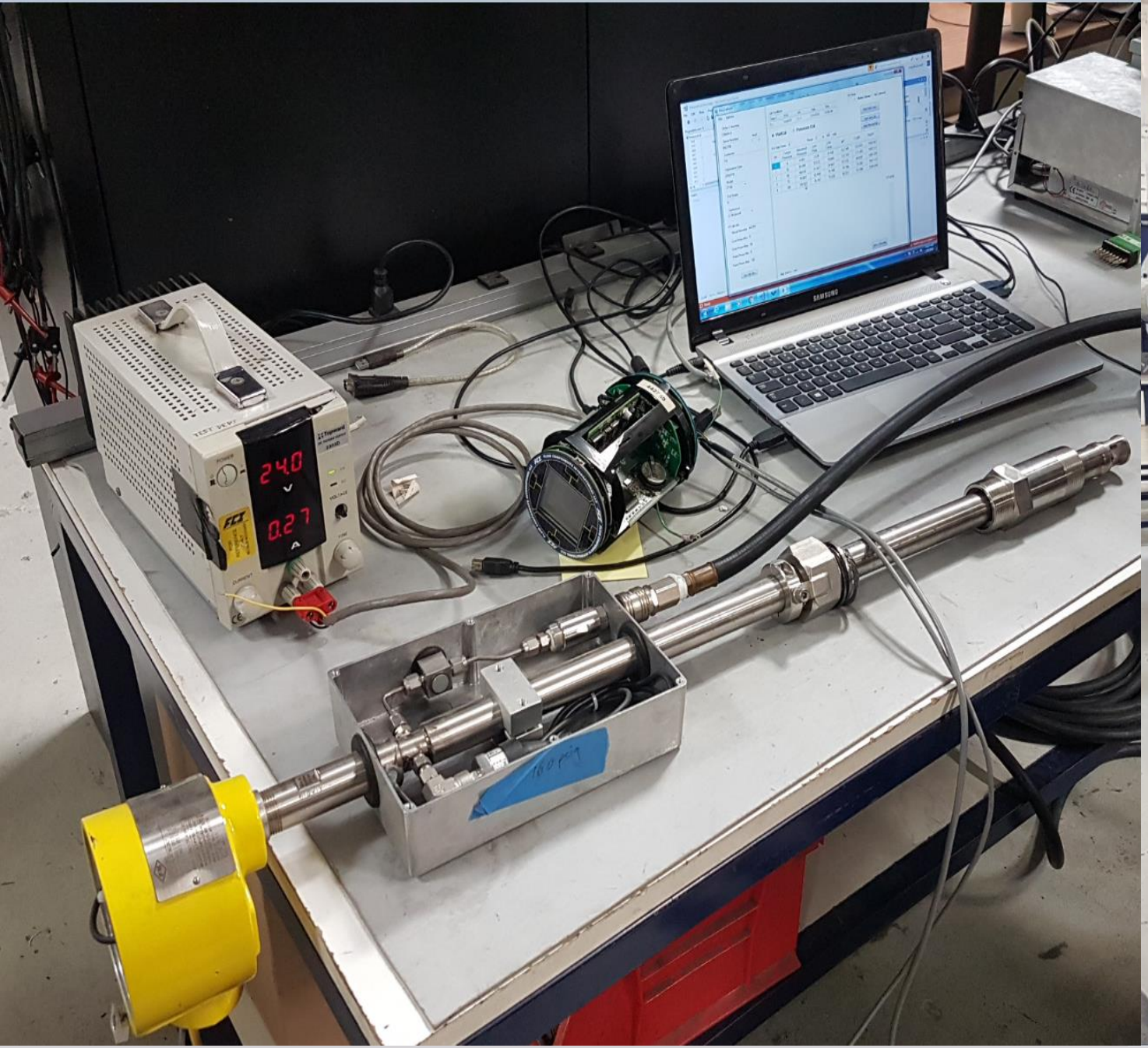
- Flow meter has a VeriCal system included that allows a local verification of the accuracy, due to simulating a specific flow on the thermal sensor
- Measuring results will inform client on instruments performance, i.e verification purpose
- Validation of correct transmitter settings, upon installation
- Troubleshooting excessive dirt built-up on flow element
- Mechanical damage to element

- It is also a “flush” of the element that can be tried if problems occur

- **Does it really say something on accuracy?**
- **Do the USM transducer zero flow test in a box?**

VeriCal On site calibration System




24.0
0.27


EVACUATE
TO
AREA 3
EXIT

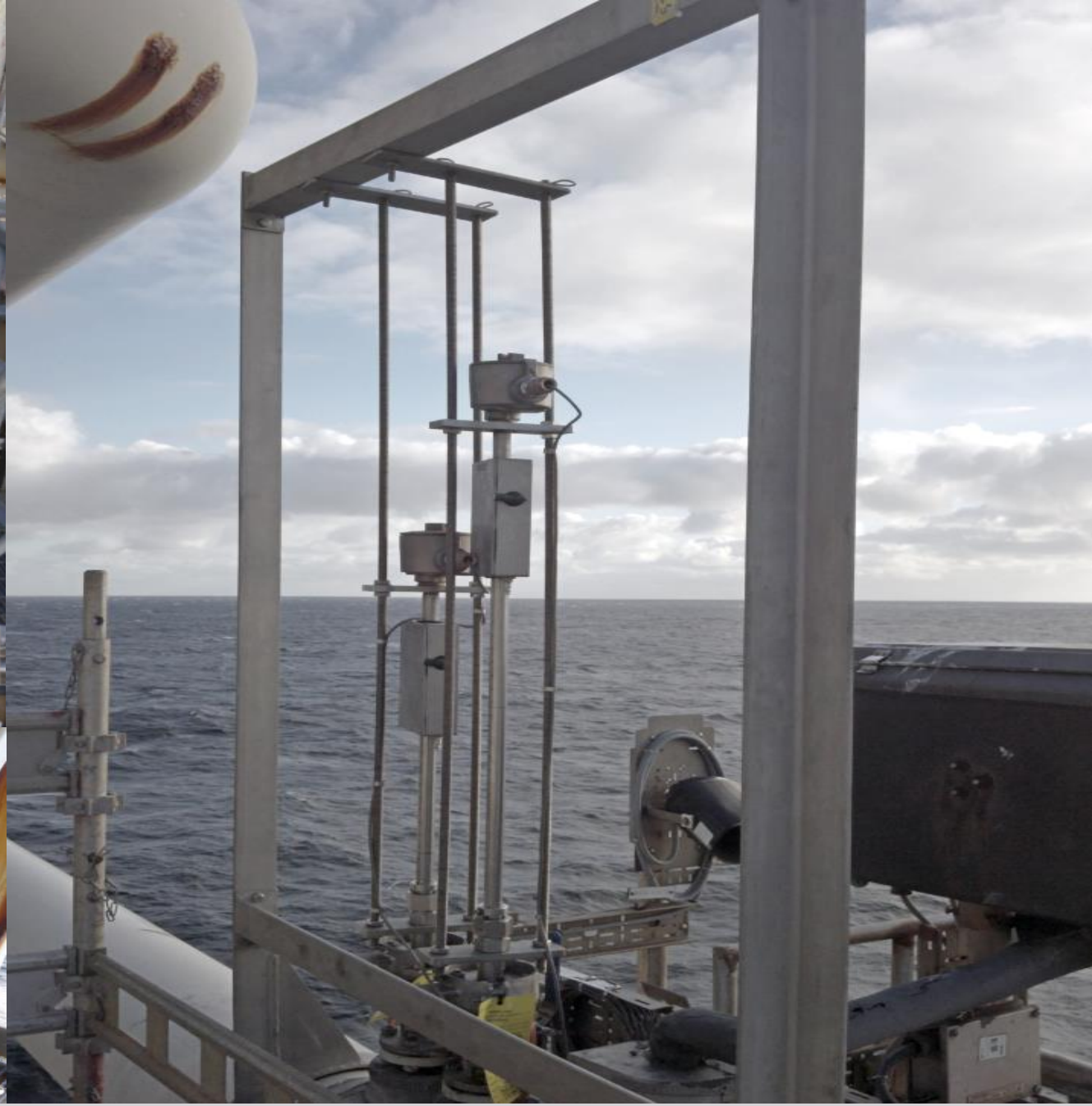
- ST100 has built in temperature measurement
- Sending Temp to FGM130, which then operates as normal
- ST100 conversion to Std volume using FGM130 density

Flare Gas 43II001

evel

Data from Flare Gas Computer		FGM130	ST100
Pressure	bara	2.00	2.04
Temperature	degC	2.07	2.63
Velocity	m/s	45.00	
Mass Flow Rate	kg/h	715.06	
Std. Volume Flow Rate	Sm3/h	572.13	123.00
Mass previous day	kg	1000	49564
Std. Volume previous day	Sm3	800.0	60498.0
Acc. Mass (NRS)	kg	13868	
Acc. Std. Volume (NRS)	Sm3	11094	139268
Density	kg/m3	0.8210	0.8210
Mole weight	kg/kmol	18.23000	
Kinetic Viscosity	-	5.0000000	
Compress. at Std. Cond.	-	0.99990	
Compress. at Oper. Cond.	-	0.97000	
Velocity of sound	m/s	384.60	
Historical Velocity of sound	m/s	383.00	
Upstream delay	-	1.00	
Downstream delay	-	2.00	
Optical delay	-	3.00	
CW factor	-	2.50	
Upstream transit time	-	42.00	
Downstream transit time	-	24.00	
Delta CW	-	0.10	
Pipe diameter	m	0.7620	
Calculated by PM			
Mass today	kg	7168	59167
Std. Volume today	Sm3	5734	72086


43FE4100A
43FE4100B
43FE4100A
43FE4100B




43FT4100

Flare metering overview

- A new flare meter was installed in series with the existing one. Now we have a new FCI ST100 flare meter and the old Fluenta FGM130 meter running. Plan here was to:
  - a) Find solution for metering of higher flare rates where normal USMs usually fail
  - b) Prepare for the day when the FGM meter no longer works (No longer supported)
  - c) Investigate (in the name of science) whether existing USM flare meters work as well as intended
  - d) Always be on the forefront of technology

ALVHEIM

AkerBP

Monthly Report

Alvheim

Page 1 of 1

01/11/2018 00:00

Flare Gas 43II001

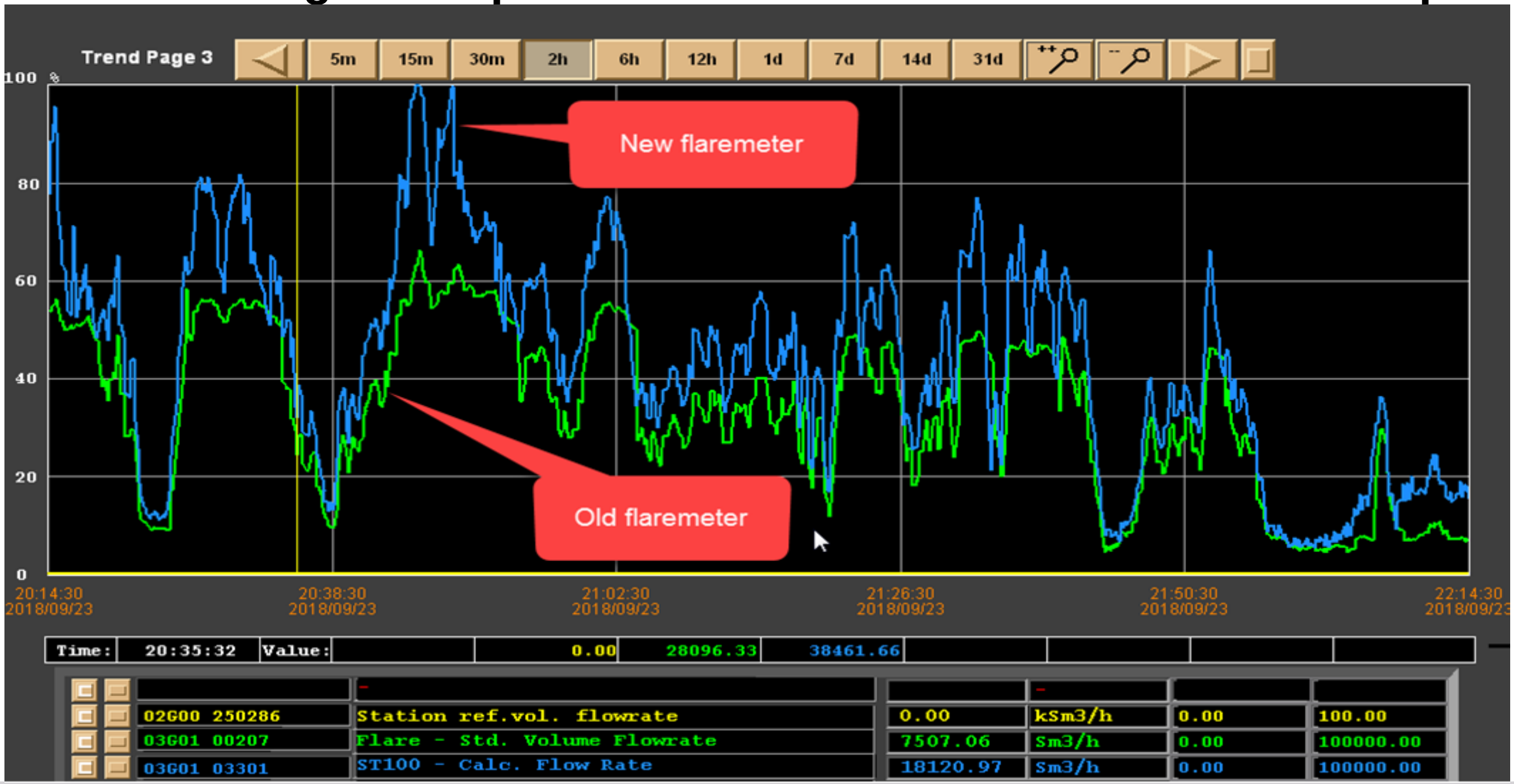
Accumulated Production Previous Month:

		FGM130	ST100
Mass	kg	1 048 558	1 040 389
Std.Volume	Sm3	1 069 579	1 073 506

- First month of operation showed very similar results (0,3%) as existing FGM 130!

Flare metering – Comparison old and new flare meter during trip

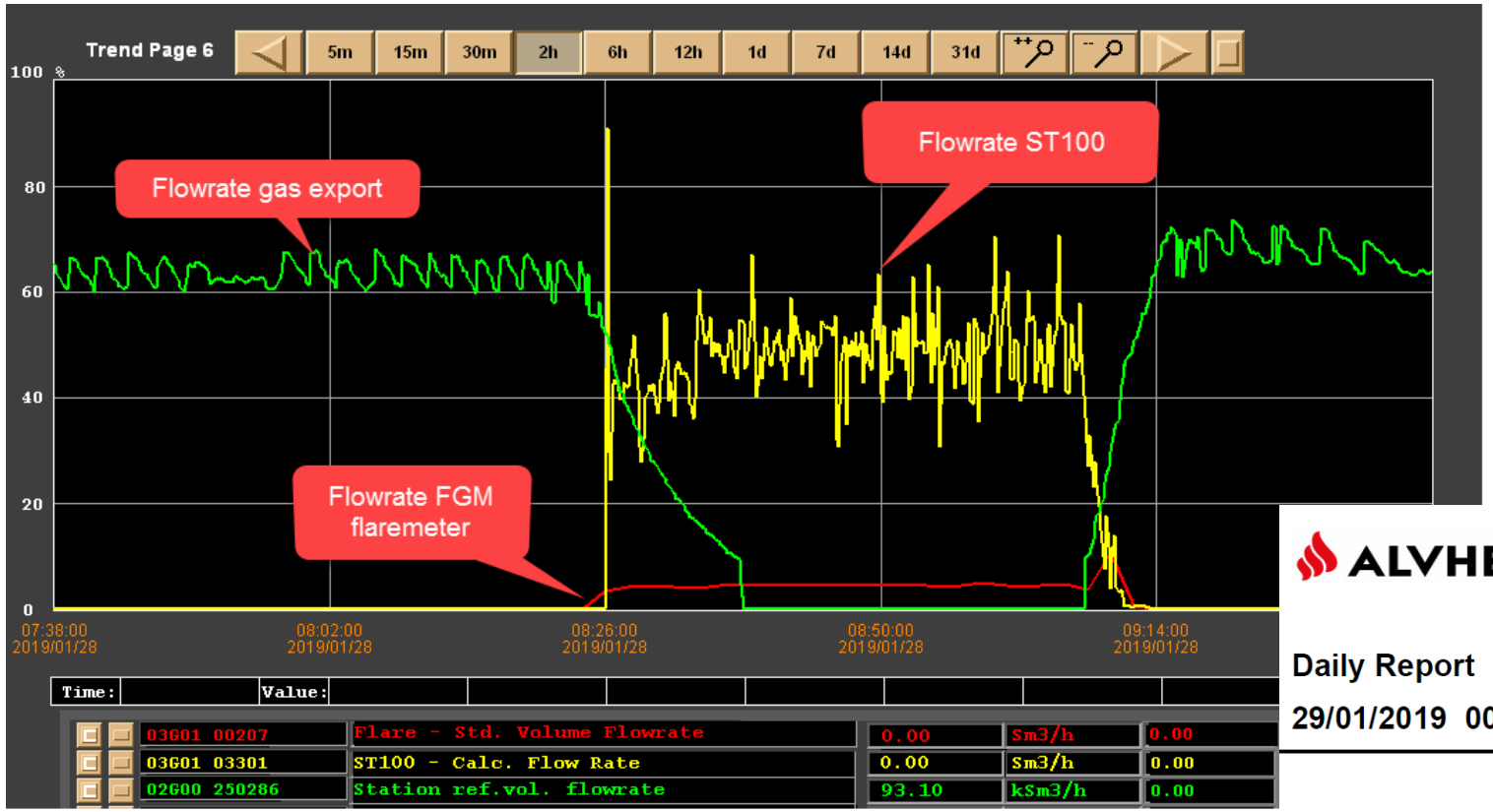
Flare metering – Comparison old and new flare meter normal ops



Flare metering – Comparison old and new flare meter normal ops

- ST 100 Red trend
- FGM 130 yellow trend

Flare metering – Mismeasurement example – Easy correction
Just use daily value from ST100



ALVHEIM

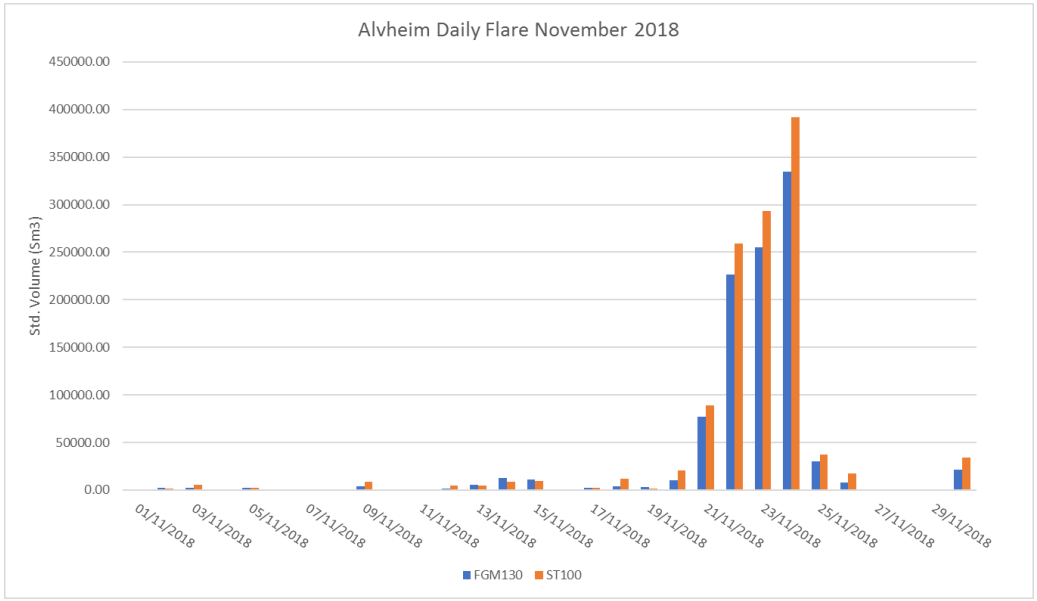
Daily Report **Alvheim**

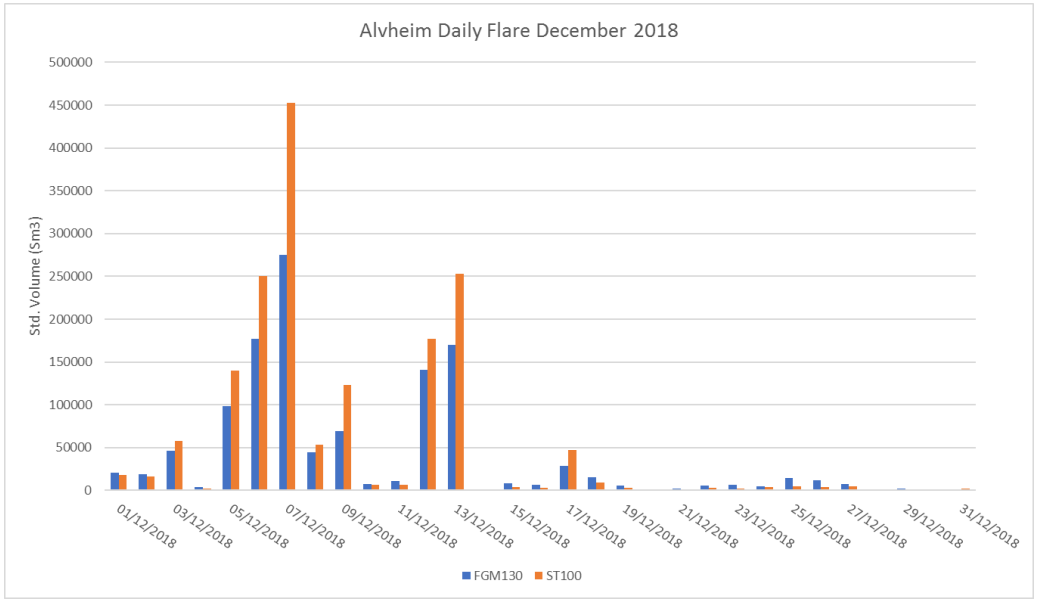
29/01/2019 00:00 **Flare Gas 43II001**

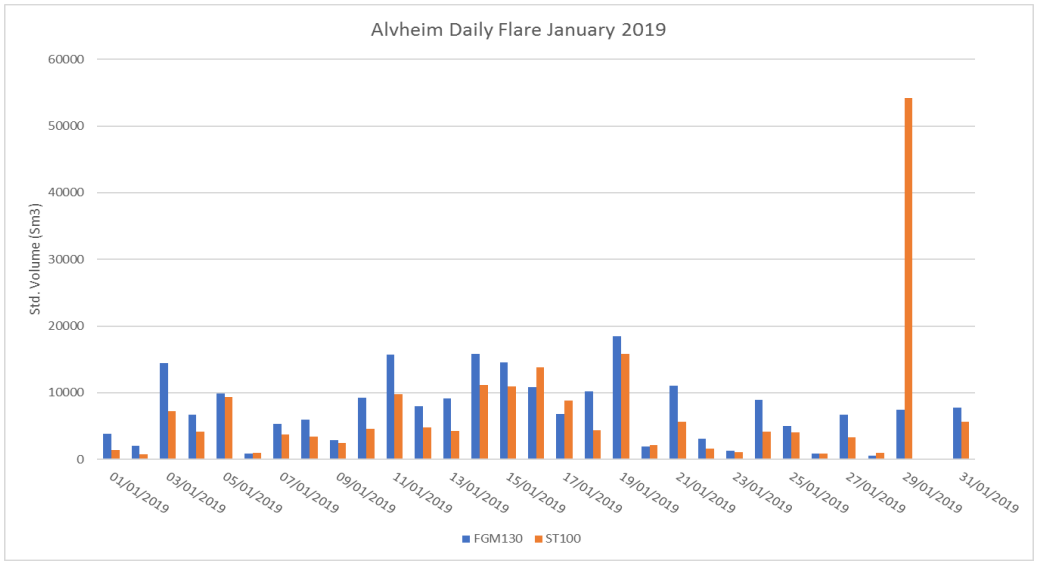
Accumulated Production Previous Day:

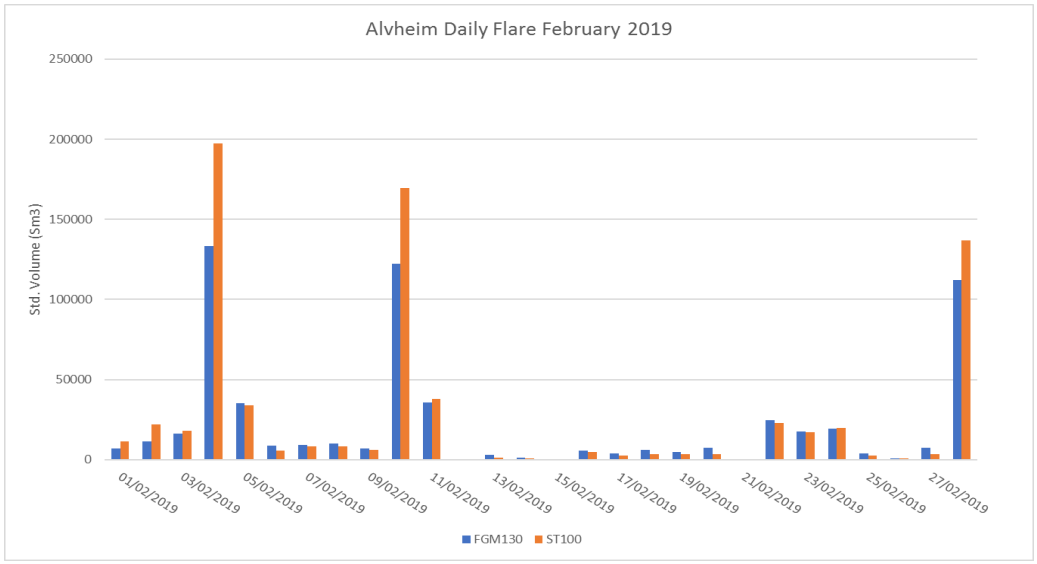
		FGM130	ST100
Mass	kg	7 397	56 790
Std.Volume	Sm3	7 394	54 237

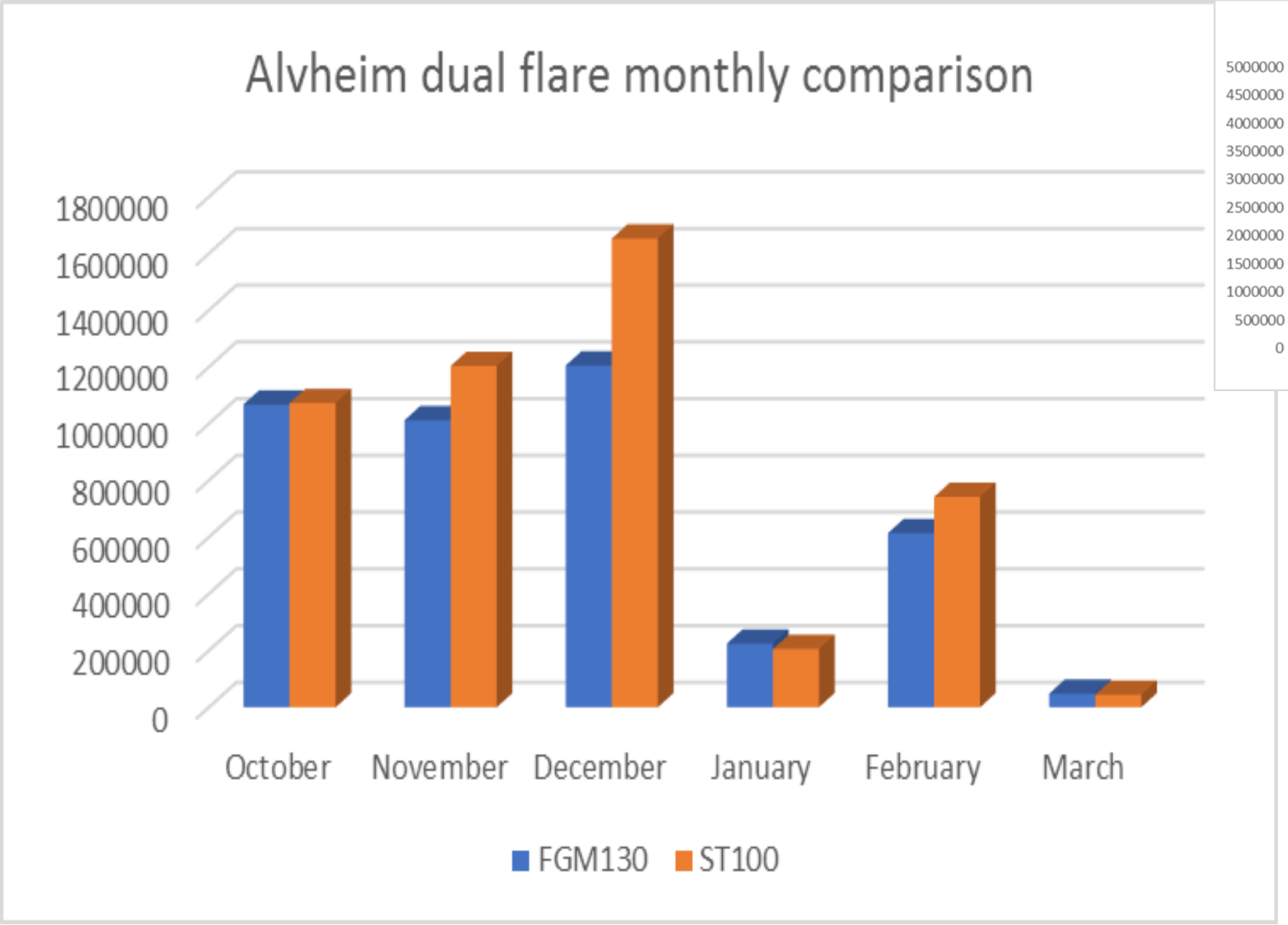
Flare metering Alvheim, both flare meters

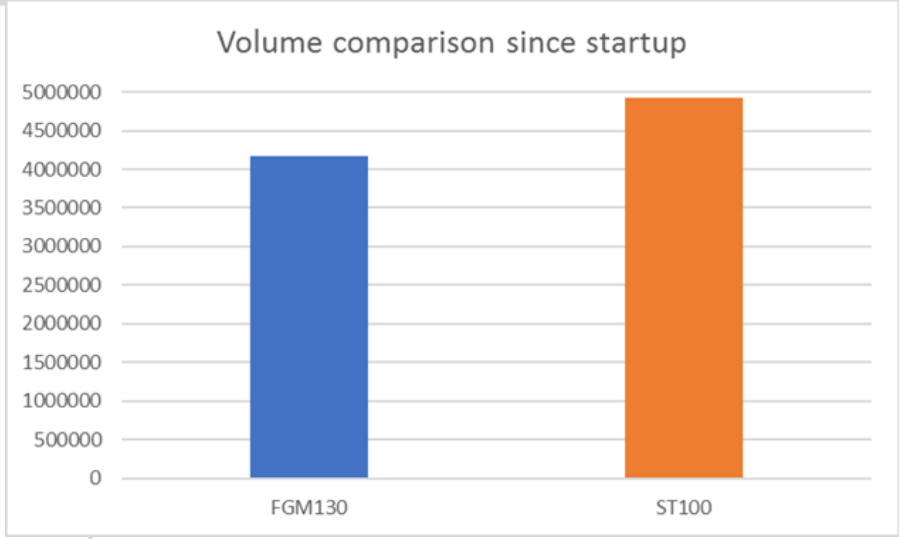












- **15% more volume from ST100**

Conclusion/Recommendation

- For new flaring systems, always prepare piping for insert type flowmeters by adding flanges and valves for easy installation

- Cost effective and simple solution that seems to work very well

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