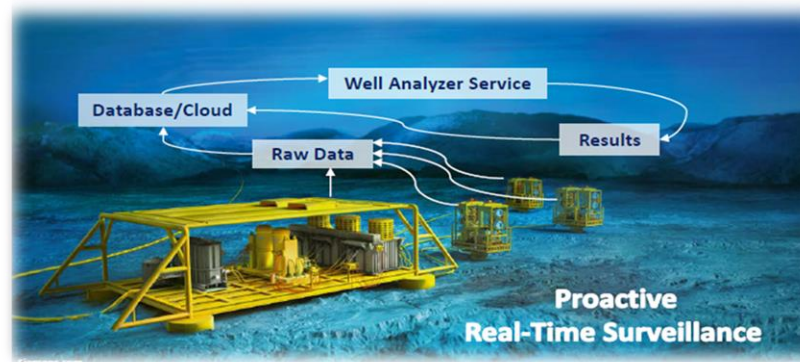


# Well Analyzer

*Pro-Active*

*Automated Real-Time Surveillance (ARTS)*

*Well/Reservoir Evaluation Software Package*



***Failed Subsea Flow Meters***

***Wet Gas Wells***

***North Sea***

***Oilfield Data Services, Inc.***

# ODSI Well Analyzer

Digital Operator Support Real-Time Automated System  
Real-Time Reporting on Well/Field KPI's

## The Well Analyzer RTS Concept:

**Experienced Surveillance Engineers**  
+  
**Automation**

### VFM/PVT

Virtual Metering

Auto Real-Time  
PVT Tuning &  
Calibration

### Flow Assurance

Wax, Hydrates,  
Asphaltenes, Scale,  
Corrosion,  
Emulsion Detection  
& Mitigation

### Production & Reservoir Performance Optimization

Auto Real-Time PTA &  
Reporting

Scale, Asphaltene  
detection in reservoir &  
wellbore

In-place and recoverable  
hydrocarbon volume  
monitoring

In-place and recoverable  
hydrocarbon volume  
monitoring

### Field Development & NPV Optimization

Short- and long-term  
asset and NPV  
Optimization

Drilling Decisions –  
Optimal Well Placement

### Asset Modeling, Monitoring & Diagnostics

Raw sensor data



Data  
Communication



Intermediate Data  
Repository



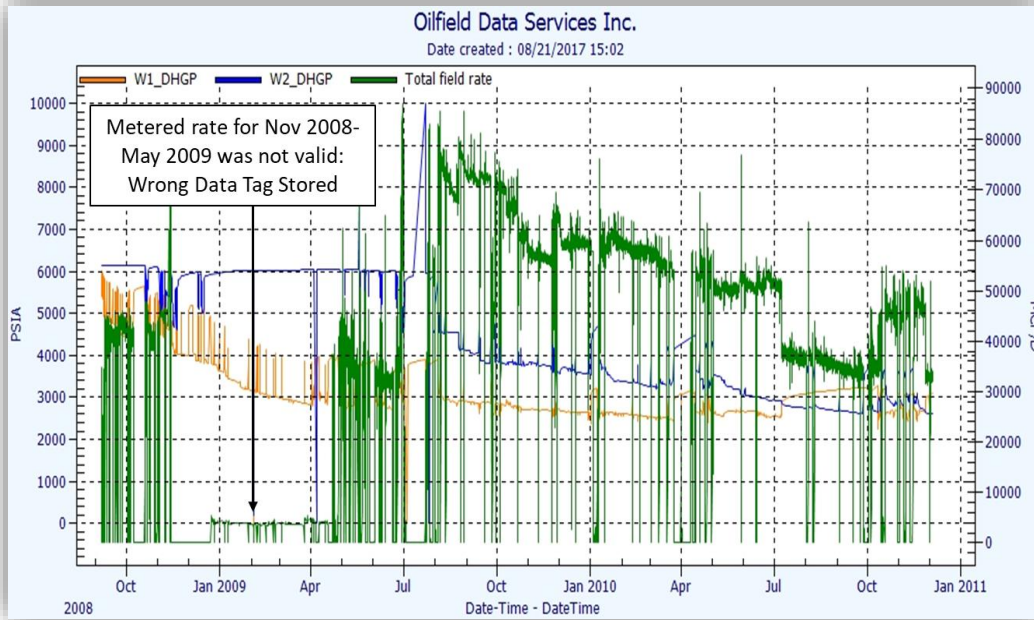
Real-Time Data  
Management

# Well Analyzer Automated Real-Time System (ARTS) Features



- Automated Rate Calculations and PVT Adjustments
- Conversion to BHP/Datum Depth
- Automated Pressure Transient Interpretation of Build-ups (PBUs) and Drawdowns (DDs)
- Time-Lapse Skin, Perm, Mobility-Thickness,  $P^*$  and P.I. or I.I.
- Continuous calculations of observed in-place, hydraulically connected, mobile and recoverable HC Volumes
  - Static & Flowing MBAL, Decline Analysis

# Background - Failed Subsea Flow Meters



- 2 wells equipped with tree and downhole gauges
- Both lost communication with subsea Wet Gas meters
  - Individual rates were not available
- Tied-back to the host facility, where the total field rate was measured

## Objectives

- Demonstrate the ability to calculate individual gas rates
- Calculate BHP at mid-completion
- Perform auto-PTA

- Lost communication with subsea MPFMs
- High subsea MPFM installation cost
- No individual well allocations

### Well 1

Select Input Data

WHP	W1_WHP	PSIA
WHT	W1_WHT	DEGF
DHGP	W1_DHGP	PSIA
DHGT	W1_DHGT	DEGF

Config

SamplesPerUpdate: 1000

Config OK

Load Config

Well #1

Analysis Enabled

Reserves Enabled

MLTO (DEGF)

Legacy MLTO (not used in rate calc)

VSSV Open

Ignore invalid events

No CalcRate Smoothing

Rate Calc: from Perm

Enabled

### Well 2

Select Input Data

WHP	W2_WHP	PSIA
WHT	W2_WHT	DEGF
DHGP	W2_DHGP	PSIA
DHGT	W2_DHGT	DEGF

Config

SamplesPerUpdate: 100

Config OK

Load Config

Well #2

Analysis Enabled

Reserves Enabled

MLTO (DEGF)

Legacy MLTO (not used in rate calc)

VSSV Open

Ignore invalid events

No CalcRate Smoothing

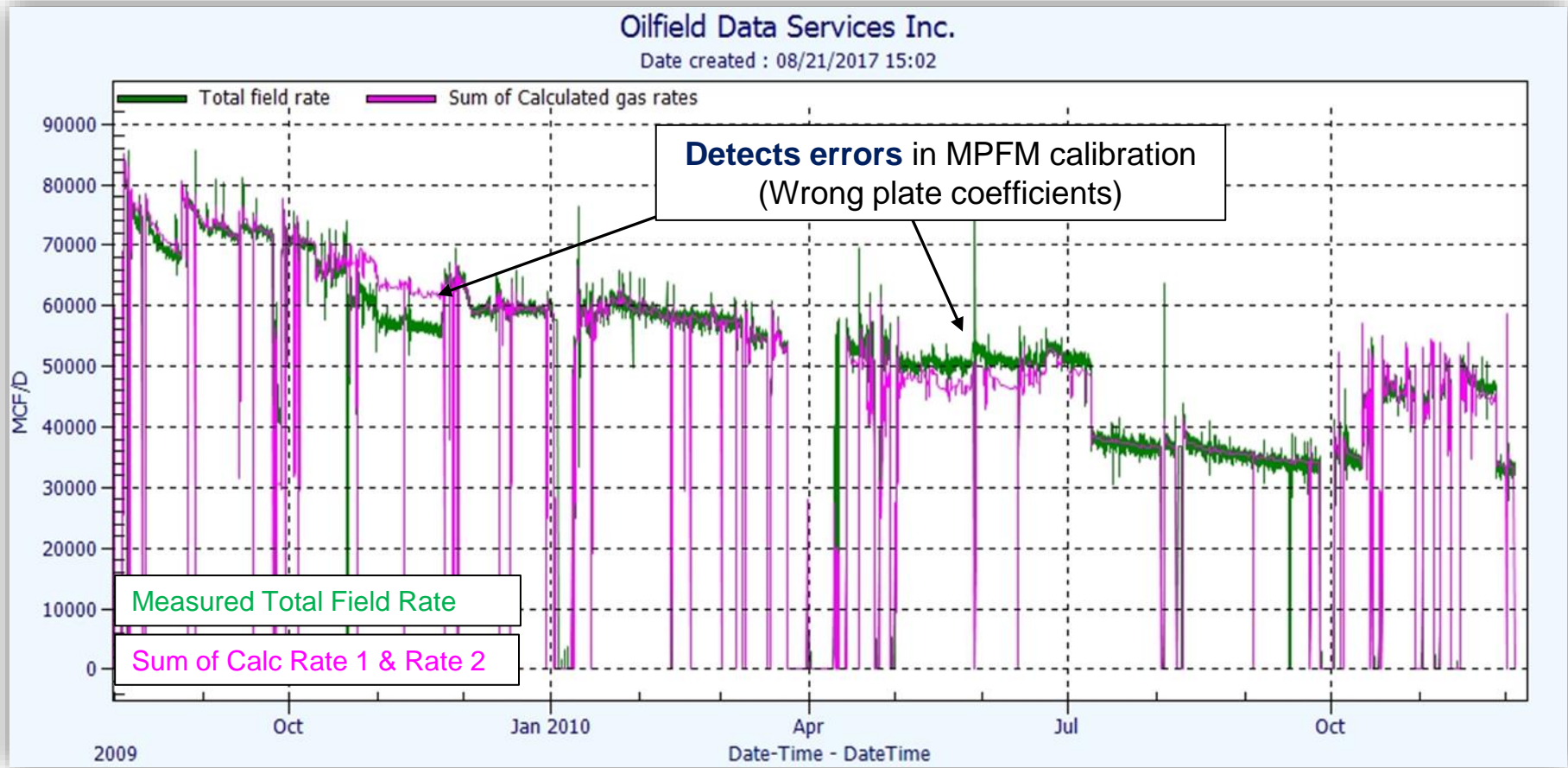
Rate Calc: from Perm

Enabled

Calculations  
Production Rates  
Analysis  
tion

# ODSI Solutions for Virtual Metering/Failed Subsea Flow Meters

- The operator **saved at least \$4M/well** by using ODSI's Virtual Metering and decided not to install subsea MPFMs for all future developments
  - Direct numerical integration to Mechanical Energy Balance eq. with rigorous PVT and phase-thermal model



Metered rate from Nov 2008-May 2009 was not valid  
Not stored in Database

- ✓ Hydrocarbon Volume Determination
- ✓ Well(s) Performance Tracking

- ✓ Life Of Well Surveillance/Analysis
- ✓ Automated PVT Calibration

Rate & BHP Calculations  
Gas Lift / Oil Production Rates

**Oilfield Data Services, Inc.**

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Visit: [www.odsi-energy.com](http://www.odsi-energy.com)

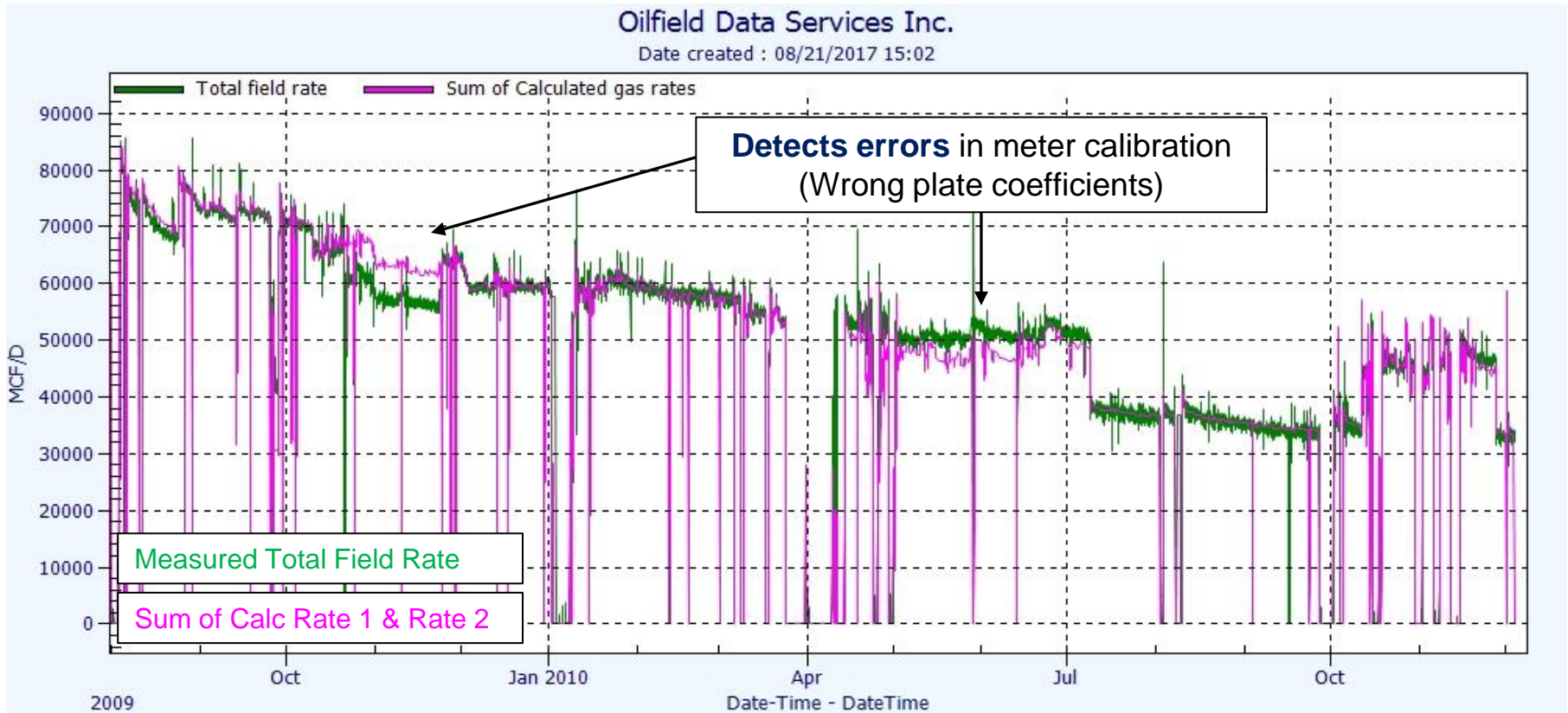


# ODSI Solutions for Virtual Metering

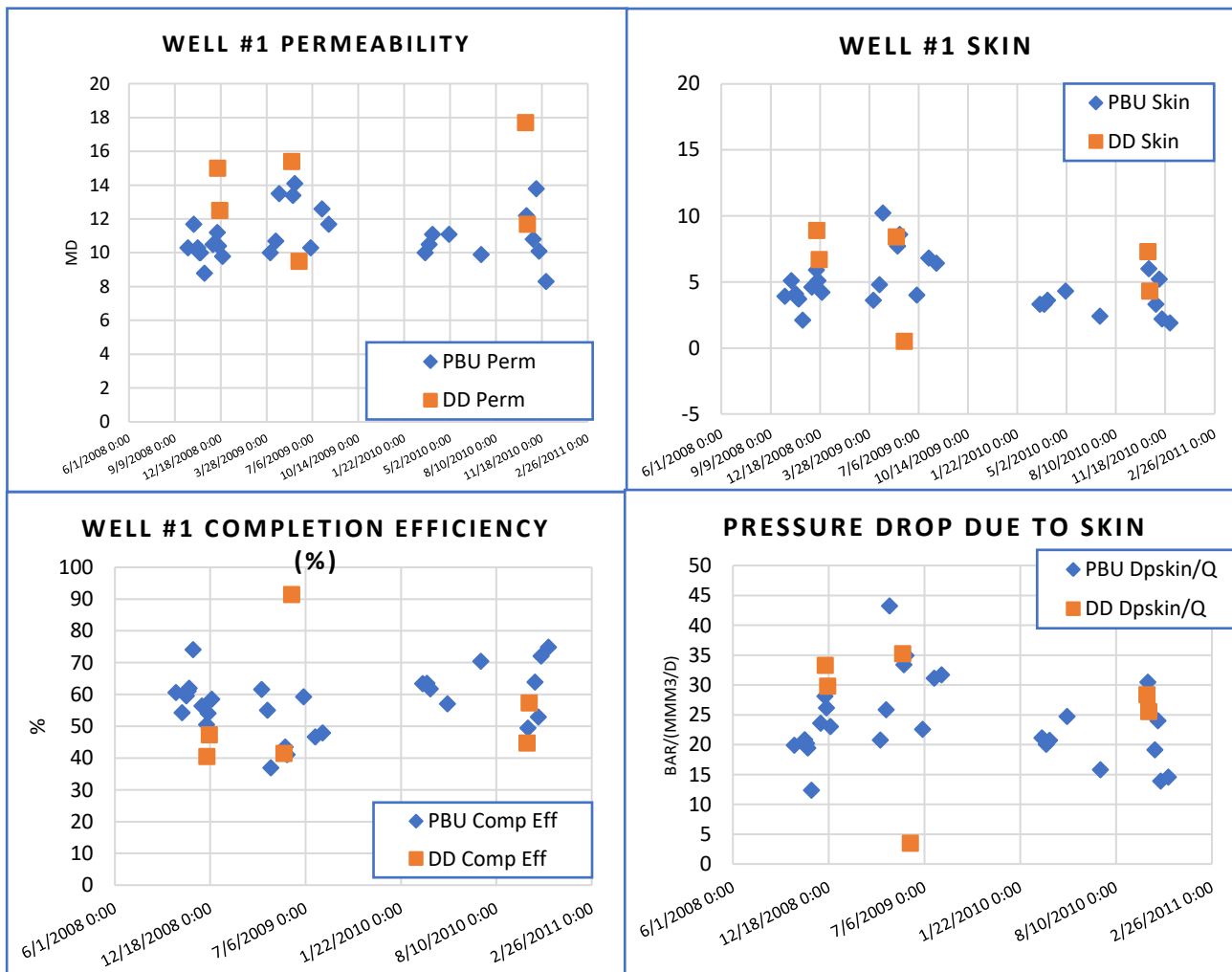
## Detection of Platform Meter Error



- The solution **detects Errors in Allocations** and **Meter Calibration**
- Once detected, the operator recalibrated the meter
- The solution is **independent** and uses dP in the wellbore and a direct numerical integration to Mechanical Energy Balance eq.



# Real-Time Diagnostic Auto-PTA



- Each PBU and DD are analyzed for diagnostic PTA parameters in real-time
- A **report** is generated for each test
- **Historic PTA** tables and plots are updated every time there is a new test
- **'Notification/Alarm'** tags are outputted if skin/perm reaches a certain 'reg flag' value (customized per well)

# Summary & Conclusions

- The gas rates for individual wells were accurately calculated
  - **The operator saved at least \$4M/well and decided to use ODSI's Virtual Metering for this field and all future subsea developments without installing subsea flow meters**
  - Direct Numerical Integration to Mechanical Energy Balance eq with rigorous self-calibrating PVT and phase-thermal model (**NO CORRELATIONS**)
- **Detects errors in allocations** and is used for meter calibration
- Used for **PVT calibration** and to **detect the onset of water production**
- Real-time well performance monitoring (**Auto-PTA**)
  - Fairly constant perm: 10 – 18 md (variation due to multiple zones)
  - Fairly constant skin: 4 – 7 (variation due to varying perm)
  - No major changes in well's performance with time