



# A New, Self-cleaning, Continuous, On-line Oil-in-Water Analyzer for the Petroleum Industry

**18<sup>th</sup> Annual Produced Water Seminar**

**Darrell L. Gallup, Chevron Energy Technology Co.  
Khalid Thabeth and Rik Dawson, Advanced Sensors, Ltd.**

**16 January 2008**

**Clearlake, TX**

# *Topics / Outline*

- **Unocal Thailand Operations**
- **Produced Water Treatment Process**
- **Improved OiW Monitor & Installation**
- **Conclusions**

# Introduction



## Gulf of Thailand

700 km in length

600 km in width

Shallow water:

Average depth  
20 m

(20 – 100 km  
offshore)

Maximum depth  
90 m

Chevron Fields



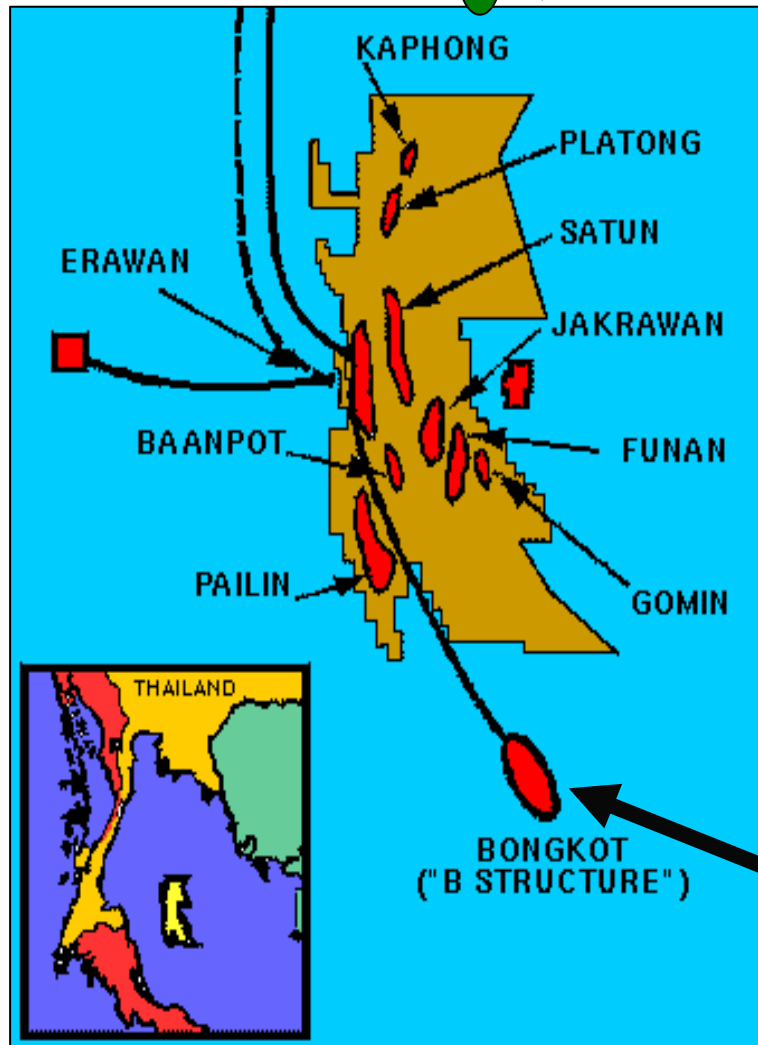
# Thailand Operations



Chevron Oilfields

## Exploration and Production:

- 13 Blocks
- 5 million acres (16,000 sq. kilometers)
- 1.5 bcf/d natural gas
- 100,000 bopd
- 40,000 bcpd



# *Thailand Operations*



## Offshore Facilities:

**> 2500 wells drilled**

**> 140 platforms**

**> 1000 kms interfield pipelines**

**3 FSOs**

**1 FPSO**

# *Produced Water Treatment*



## **Overboard discharge limits:**

- **30 ppm TPH**
- **10 ppb Hg**
- **250 ppb As**

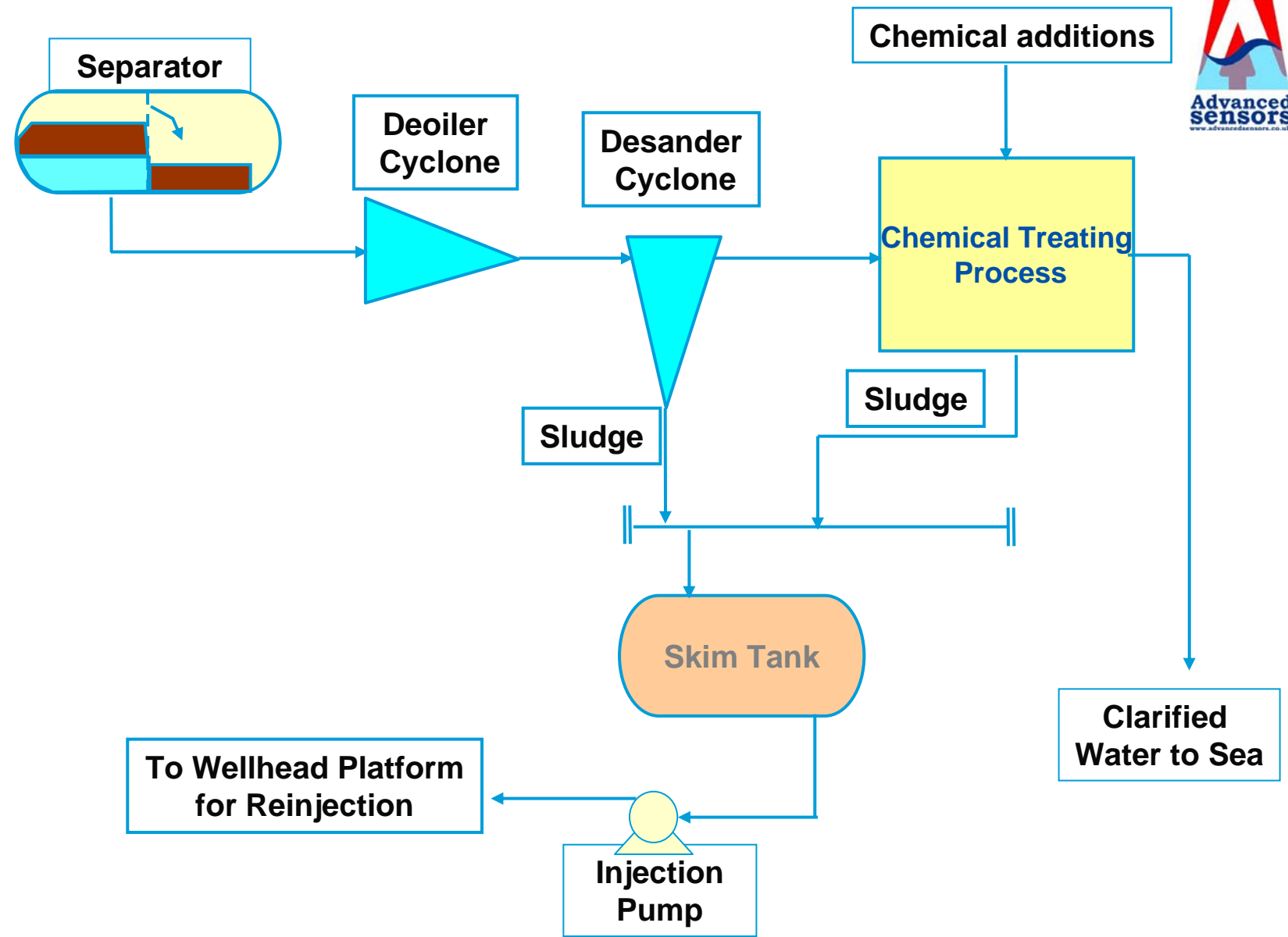
# *Thailand Operations*



## Water disposal:

- Seven fields currently inject 100% water
- By 2009, two additional fields to inject 100% water
- Two fields currently overboard water at rate of 10 – 30 kbwpd

# Produced Water Treatment Process





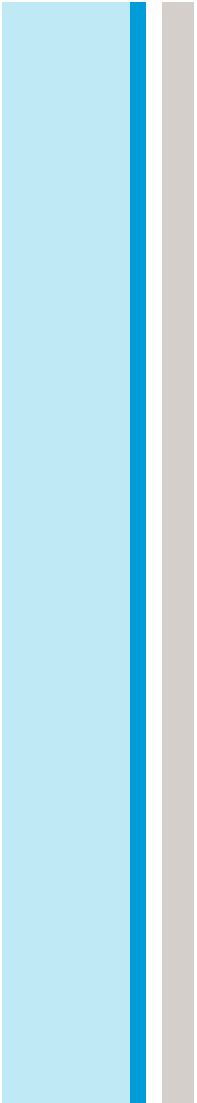
# *Produced Water Treatment Process and OiW Monitors*



- Precipitates from water treatment sometimes fouls conventional OiW monitors. Conventional OiW monitors required constant maintenance, optics cleaning and re-calibration.
- Frustrated operators – turn off conventional OiW monitors
- Need improved OiW monitor that is less susceptible to fouling by sticky precipitate
- Kontavisor OiW Monitor (Systektum) installed in Chevron Netherlands. Difficulty Exporting to Thailand.
- Advanced Sensors OiW Monitor



# *Advanced Sensor Presentation*



## Objective

*To produce an accurate, reliable (maintenance free) Oil in Water monitor for effluent discharge, re-injection and process management.*

In collaboration with StatoilHydro and Talisman Energy.



# OIW EX 1000 Oil in Water Analyser



# OIW EX 1000 Oil in Water Analyser

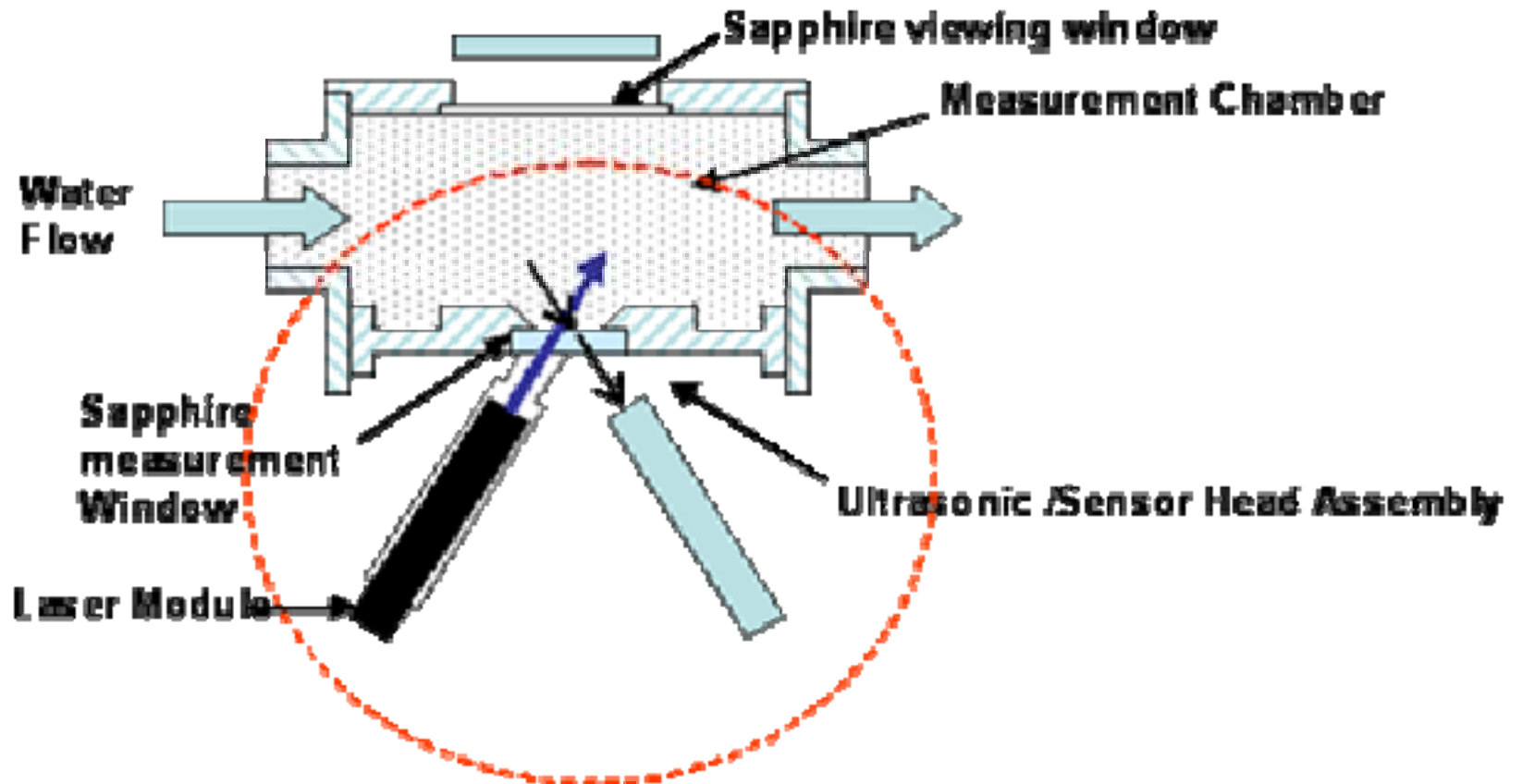


Installation  
StatoilHydro, Brage



# Measurement Technique

## Laser induced UV Fluorescence



# Online Analyser Challenges

1. Fouling
2. Oil Droplet Size Variation
3. Chemical Additive Interference
4. Operating Range
5. Accessibility





# 1. Online Analysis Challenges

- **Fouling**
  - Of measurement window
  - Chamber
  - Pipelines
- **Objective:** Stay clean. Without the need for manual intervention, use of acids, detergents or introduction of additives.
- **Solution:**
  - **Combined Ultrasonic transducer and optical sensor.**



## 2. Online Analysis Challenges

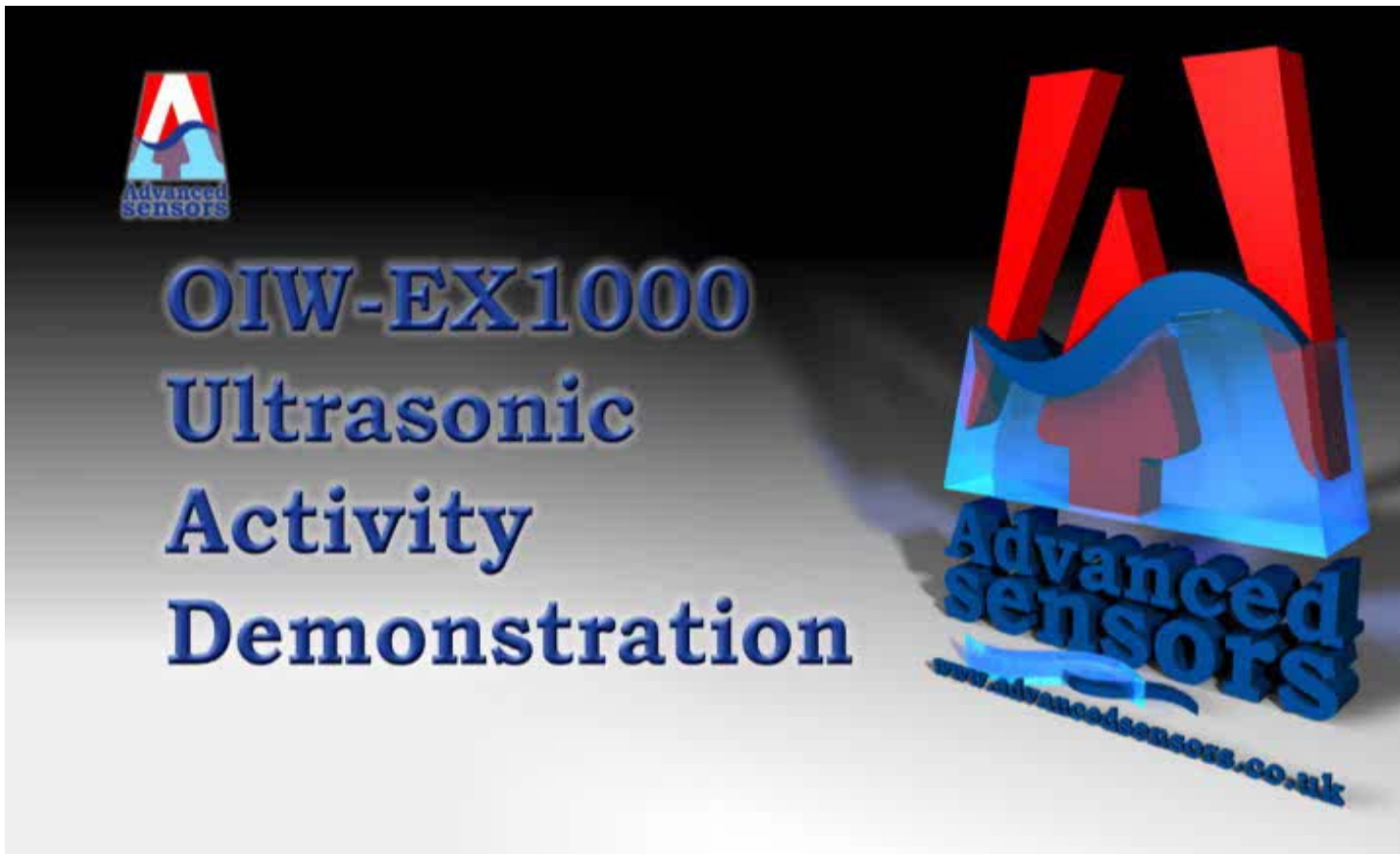
- **Oil Droplet Size Variation**

- Oil droplet size variation has direct impact to fluorescence measurement

- **Objective:** Standardisation of oil droplet size. Without the need for manual intervention, or additives.

- **Solution:** Ultrasonic sample homogenisation.

# Ultrasonic Activity Video



The combined Optical-Ultrasonic sensor head provides cleaning and sample homogenisation.



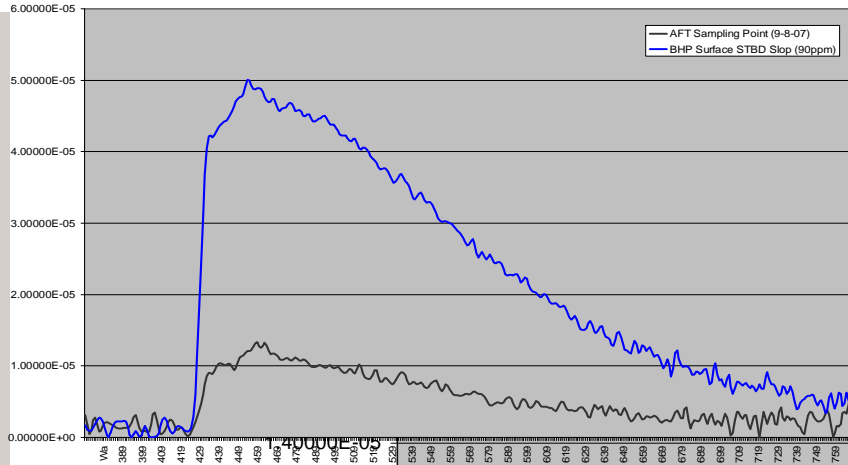
### 3. Online Analysis Challenges

- Chemical Additive Interference
  - Many process chemicals are now commonly known to fluoresce and corrupt oil in water measurement.
- Objective: Isolate effects of chemical additives from fluorescent measurement.
- Solution: Real Time UV Spectrometer built into unit.

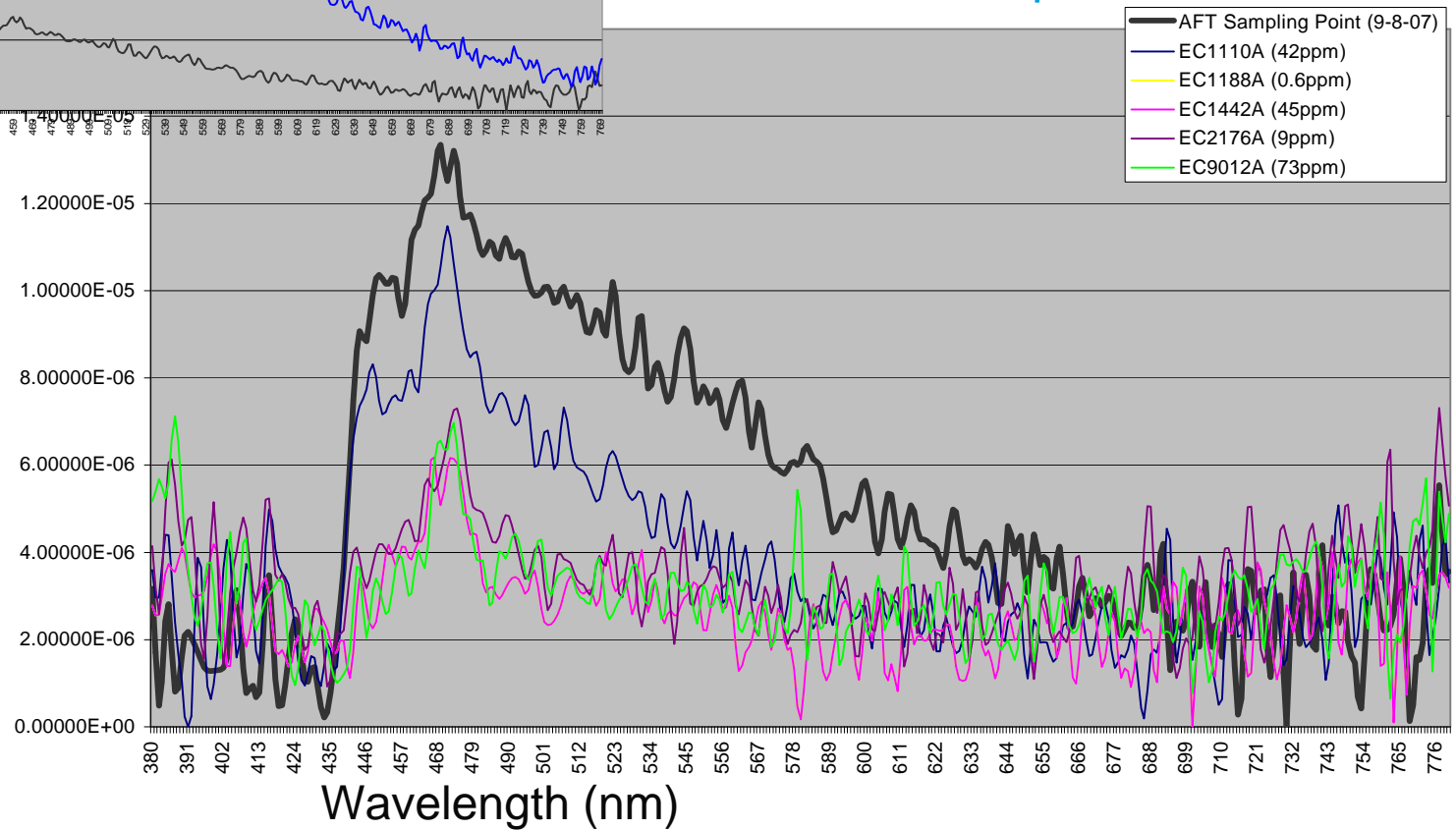
# UV Spectra results from inbuilt Spectrometer



## Crude oil



## Produced Water plus chemicals



# Measurement after chemical isolation



## Chemicals for testing and respective concentrations:

2/08/07

## Result

Tap Water  
(5.0)

0.2ppm

EC1110A satellite gas corrosion inhibitor

42 ppm

1.4ppm (14.9)

EC2176A Demulsifier

9 ppm

0.8ppm (10.5)

MEG Heating medium

181 ppm

0.2ppm (4.5)

EC1188A Heating medium Cl

0.60 ppm

0.2ppm (5.0)

EC1442A Export gas corrosion inhibitor

45 ppm

0.4ppm (7.0)

EC9021A H<sub>2</sub>S scavenger

73 ppm

0.2ppm (5.5)

EC6354A Coagulant/de-oiler

100 ppm

0.2ppm (5.5)

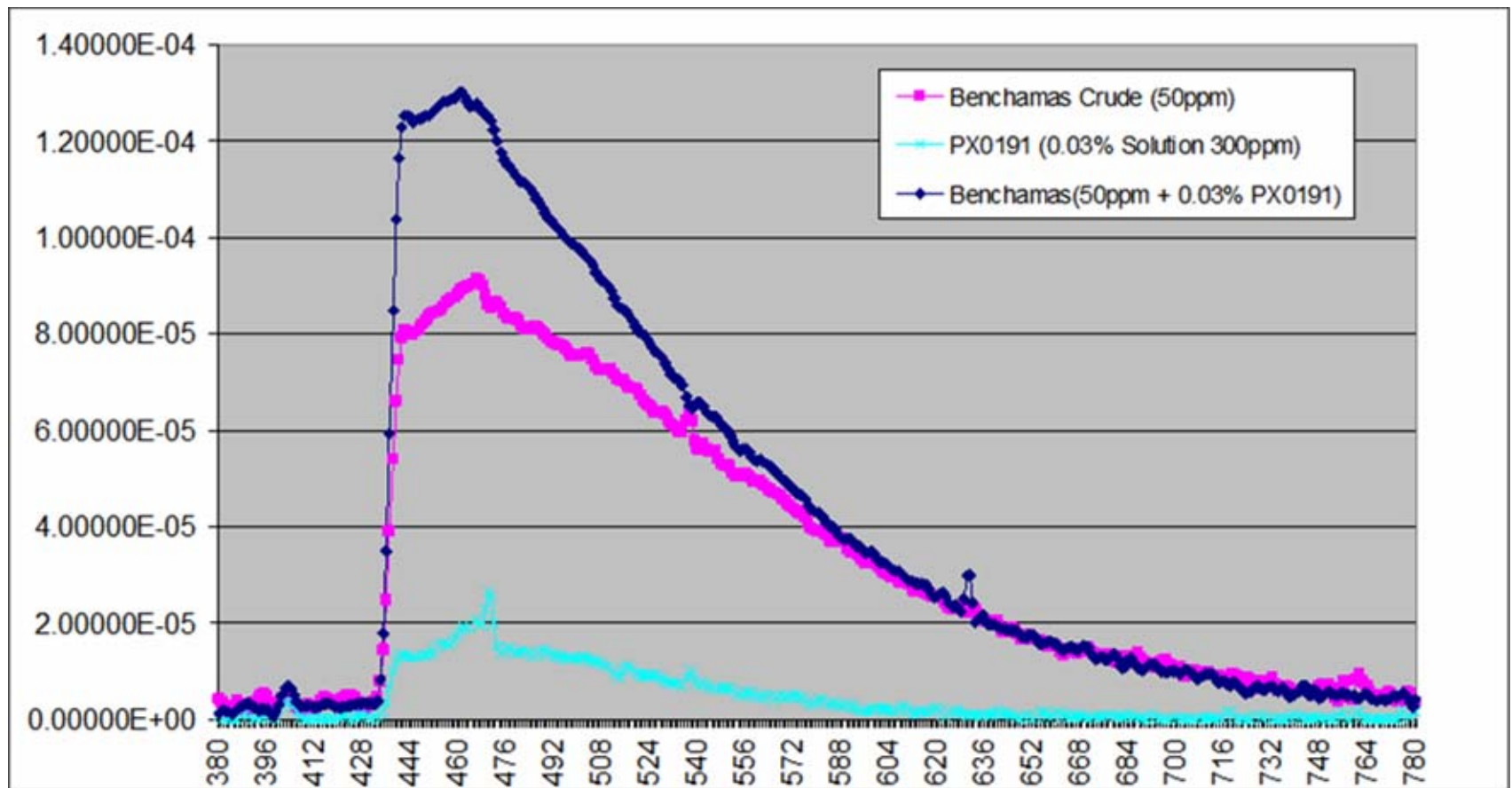
Methanol

5443 ppm

0ppm (1.1)

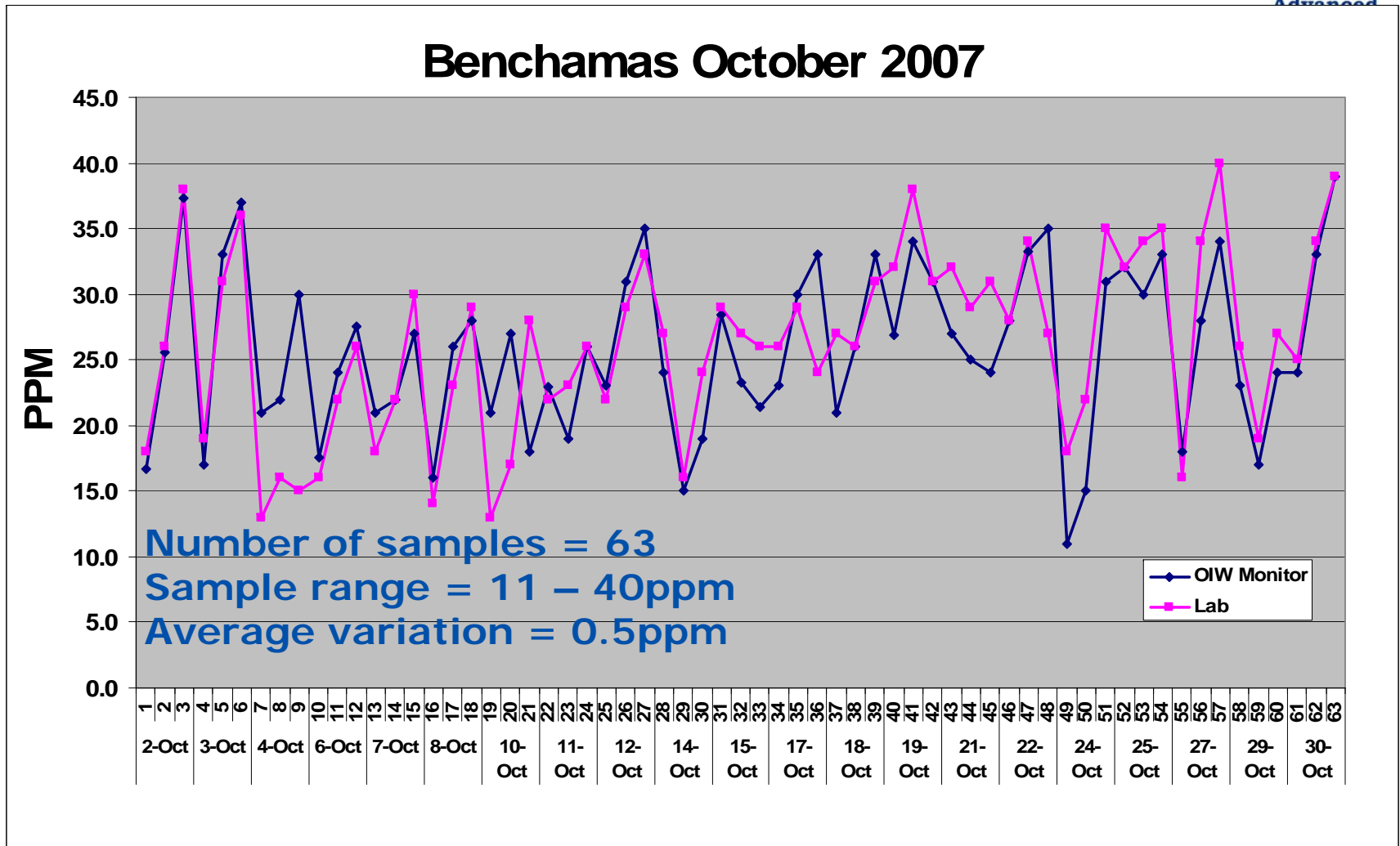
# Benchamas

## Crude Oil + 300ppm Corrosion Inhibitor PX 0191



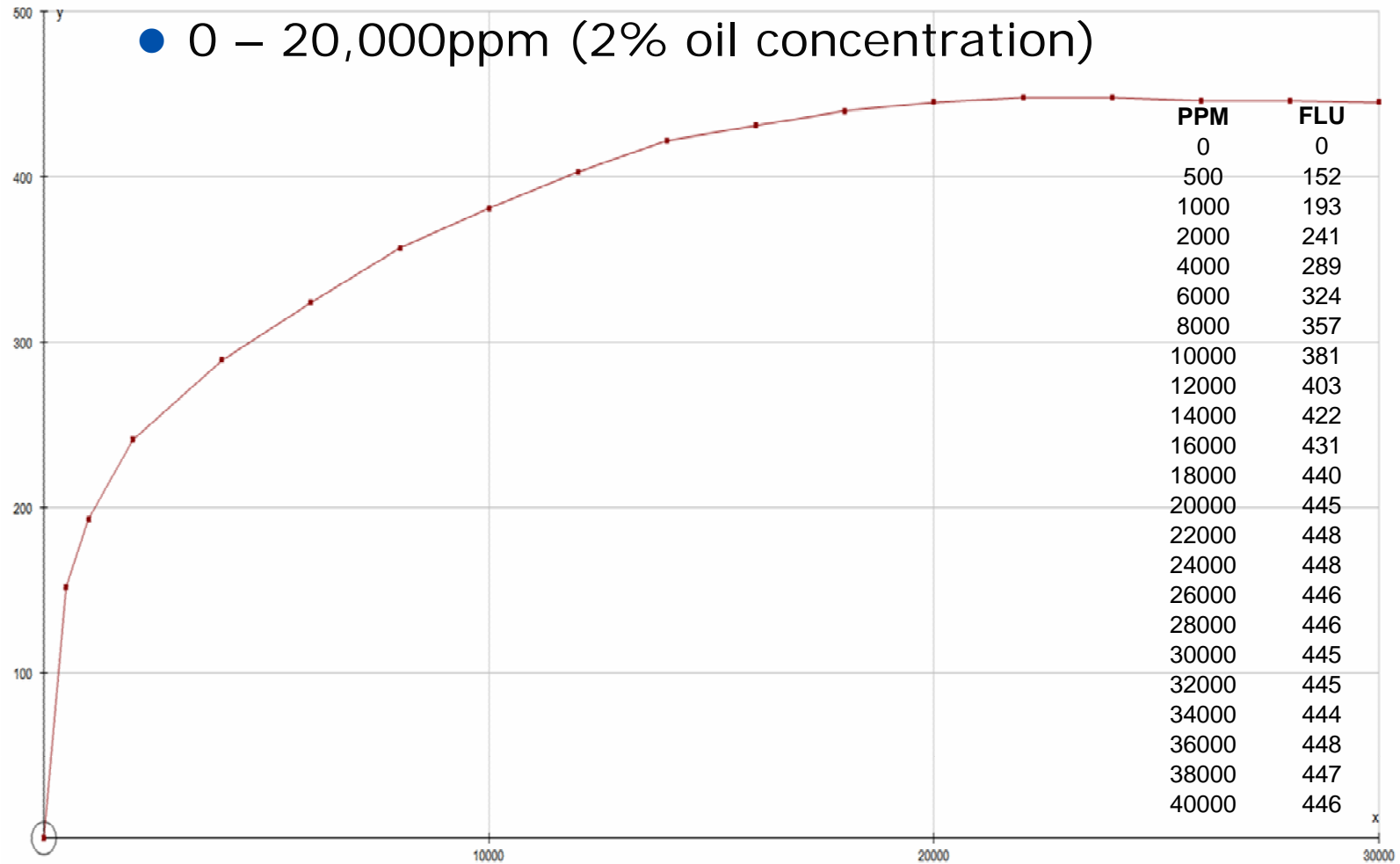
# Correlation of Instrument vs Lab

## Following chemical isolation



## 4. Online Analysis Challenges

- Operating Range







## Online Analyser Challenges

- **Remote Accessibility**

- Field mobilisation generally required for calibration, diagnostics and detailed analysis of water content.

- **Objective:** Complete remote reach through providing virtual presence.

- **Solution: Ethernet and ADSL connectivity.**

- Live Demonstration available during the week.

# *Conclusions*



- **EX-100 performs well after 13 months at FPSO**
  - Excellent agreement with grab samples – SX with Wilks IR
  - Operators love “maintenance free” monitor
- **EX-1000 performs well after 6 months at FSO**
- **EX-1000 required on FSO to eliminate interference from demulsifier treatment**
- **AS OiW monitors reduce lab technician time and solvent use/exposure**
- **AS OIW monitors alarm to Control Rooms to “early warn” of water system upsets**