



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

18th Annual Produced Water Seminar

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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

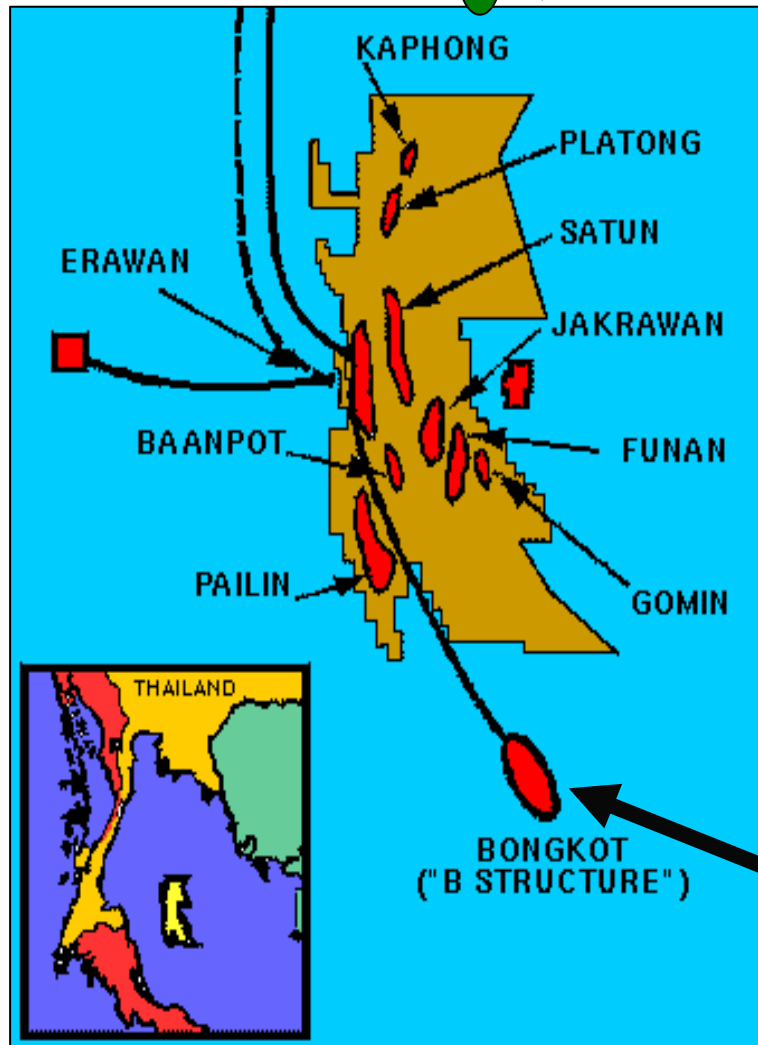
Thailand Operations



Chevron Oilfields

Exploration and Production:

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



PTTEP

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**

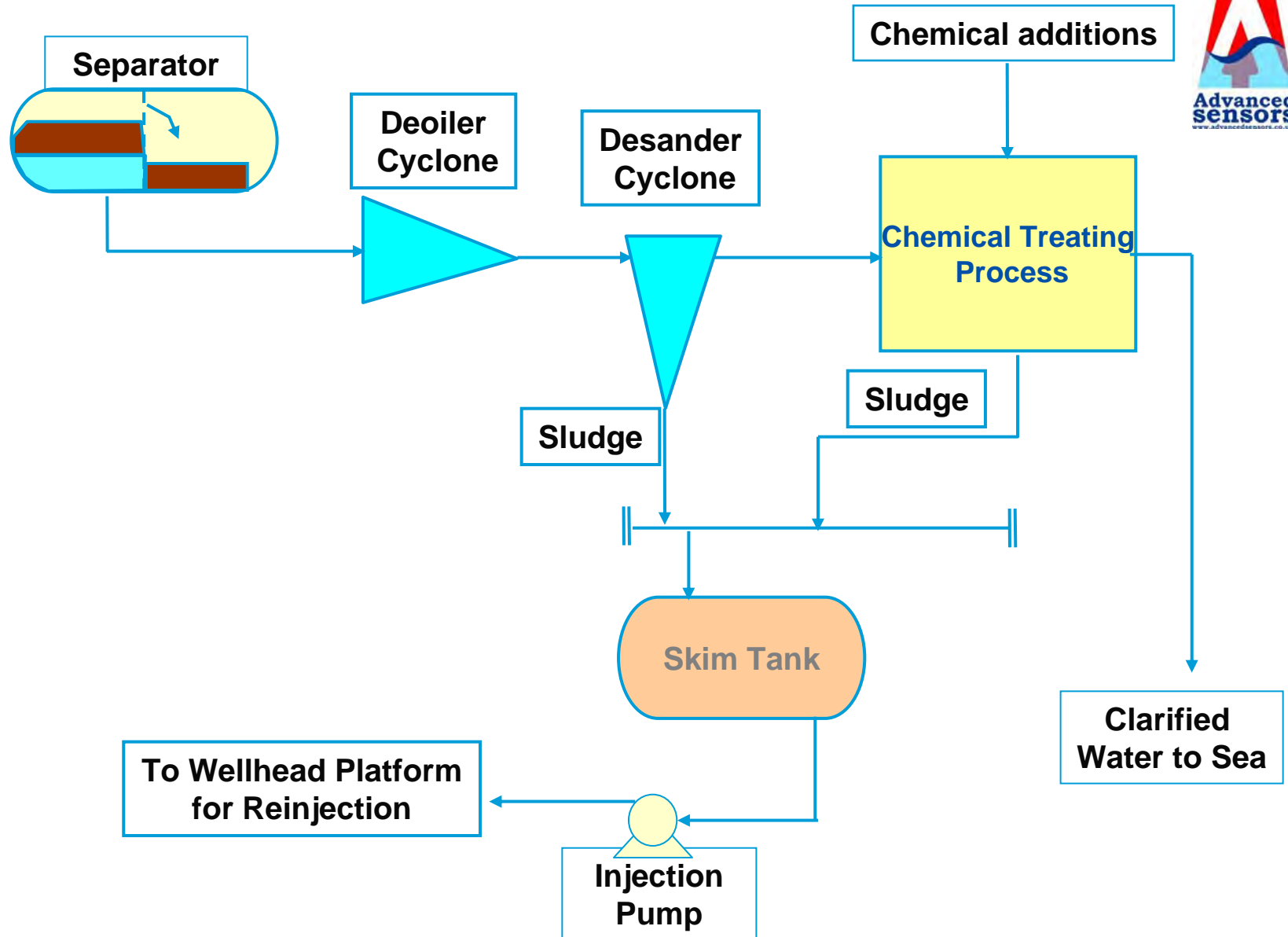
Thailand Operations



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



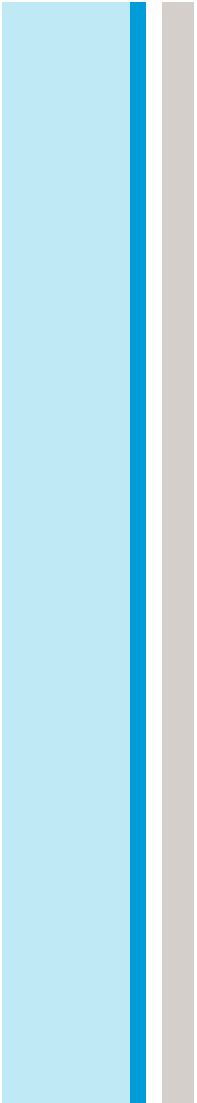
Produced Water Treatment Process and OiW Monitors



- 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

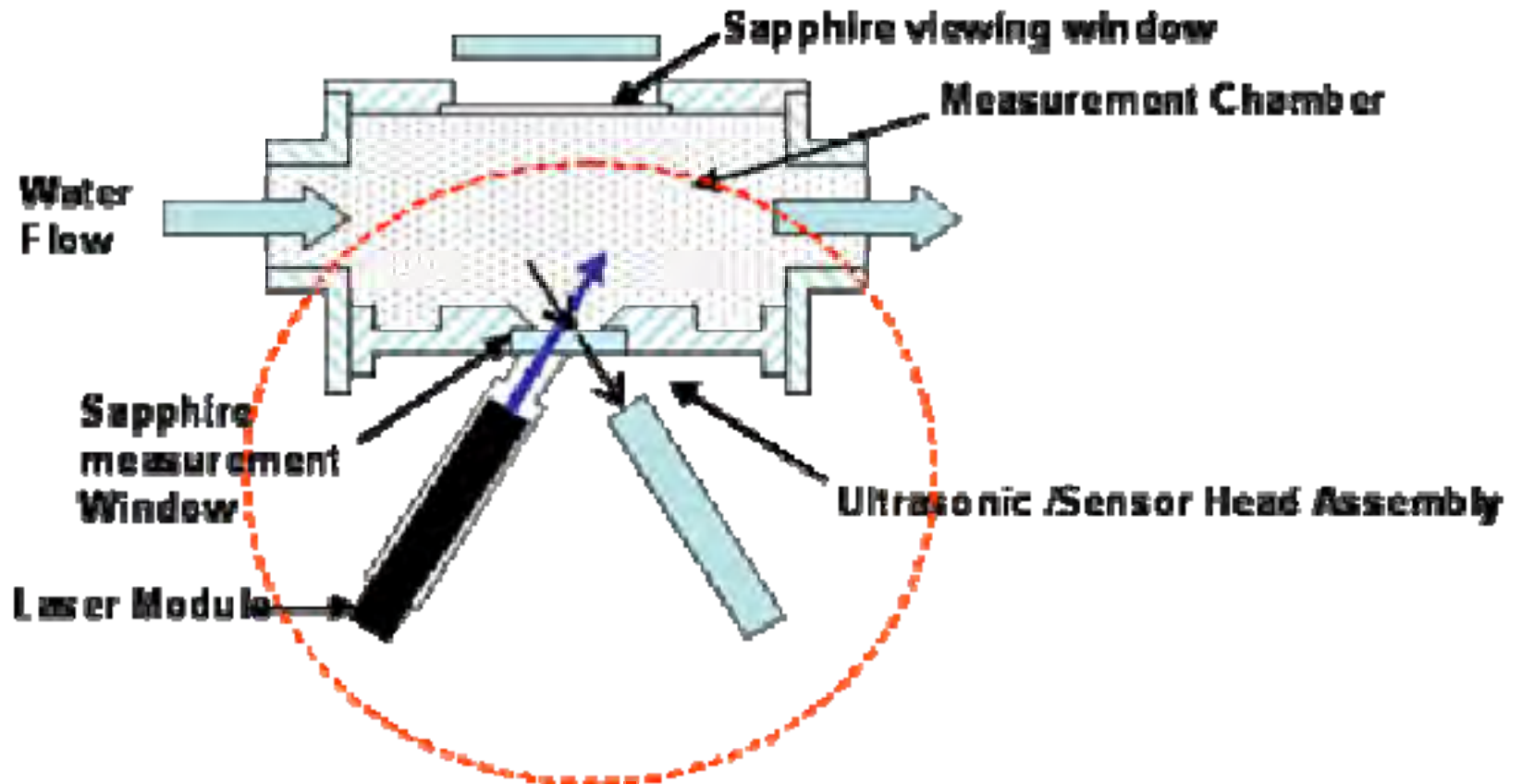


Installation
StatoilHydro, Brage



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

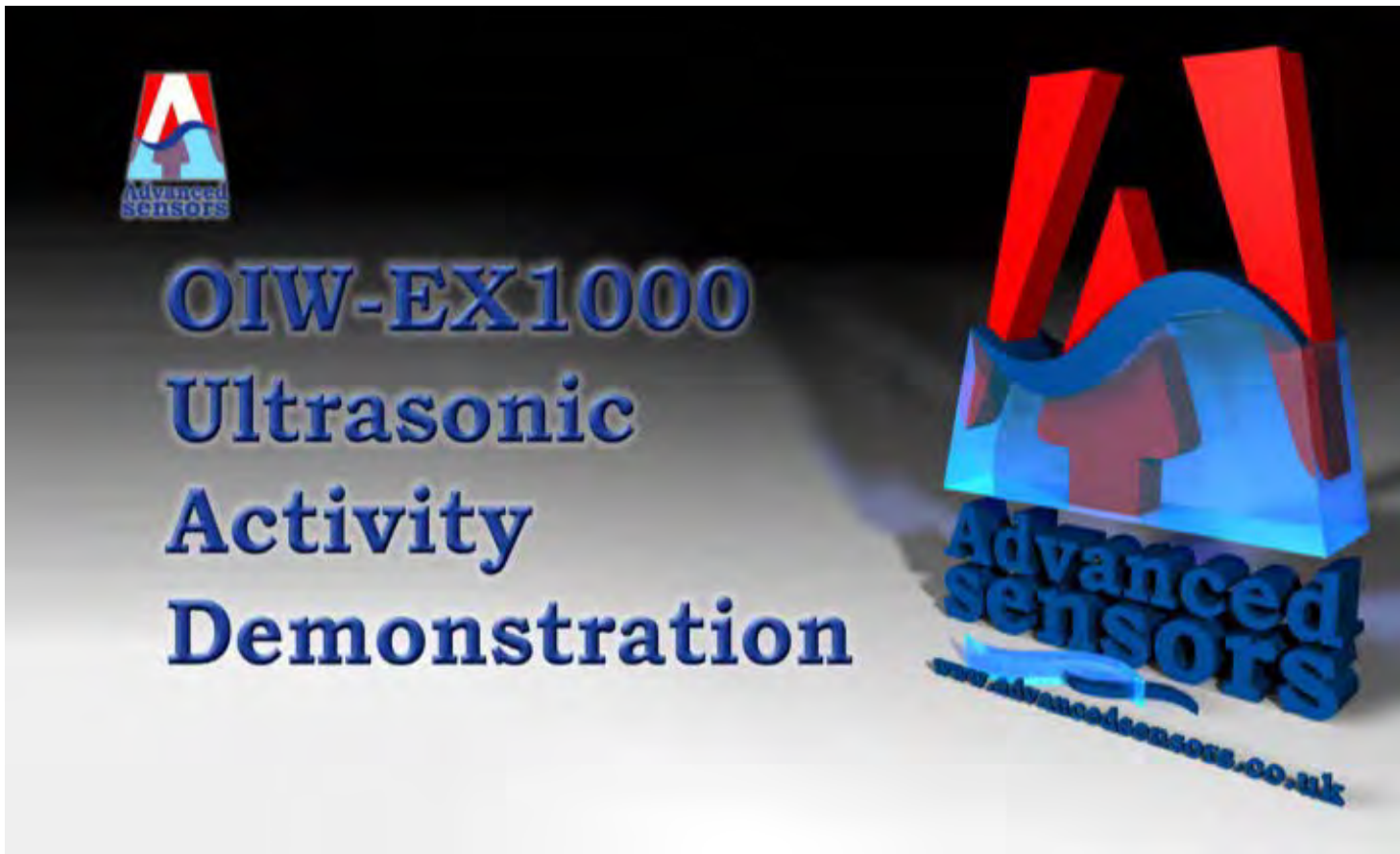
- **Oil Droplet Size Variation**

- 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.



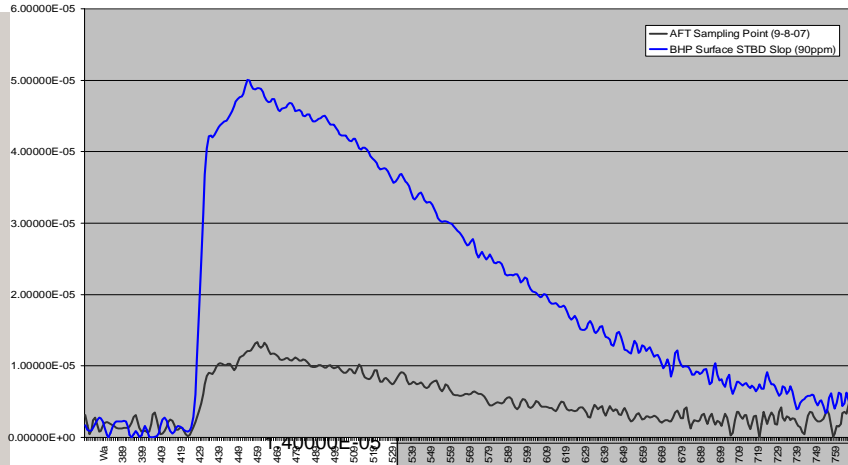
3. Online Analysis Challenges

- 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.

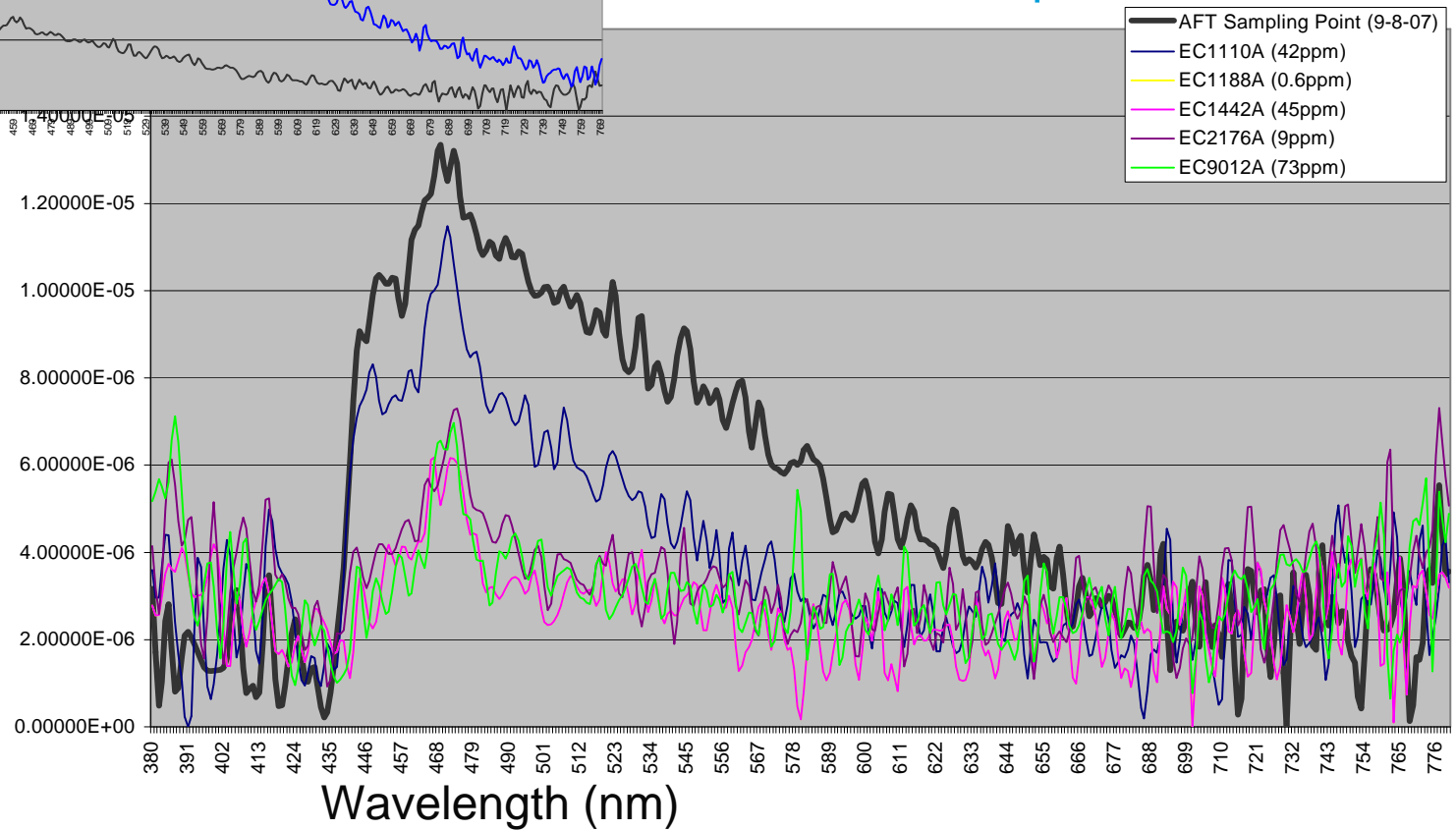
UV Spectra results from inbuilt Spectrometer



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 H₂S scavenger

73 ppm

0.2ppm (5.5)

EC6354A Coagulant/de-oiler

100 ppm

0.2ppm (5.5)

Methanol

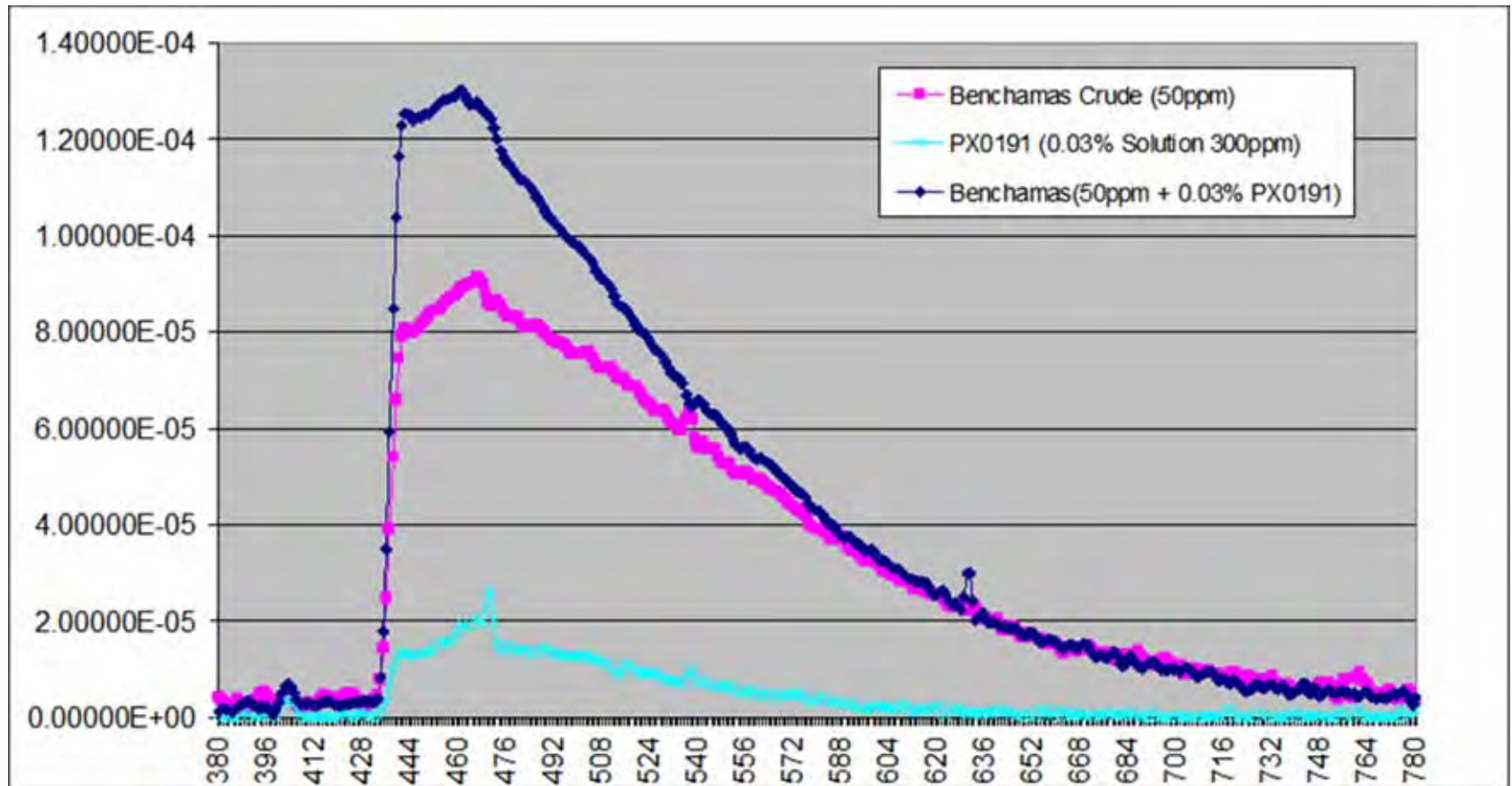
5443 ppm

0ppm (1.1)

Benchamas

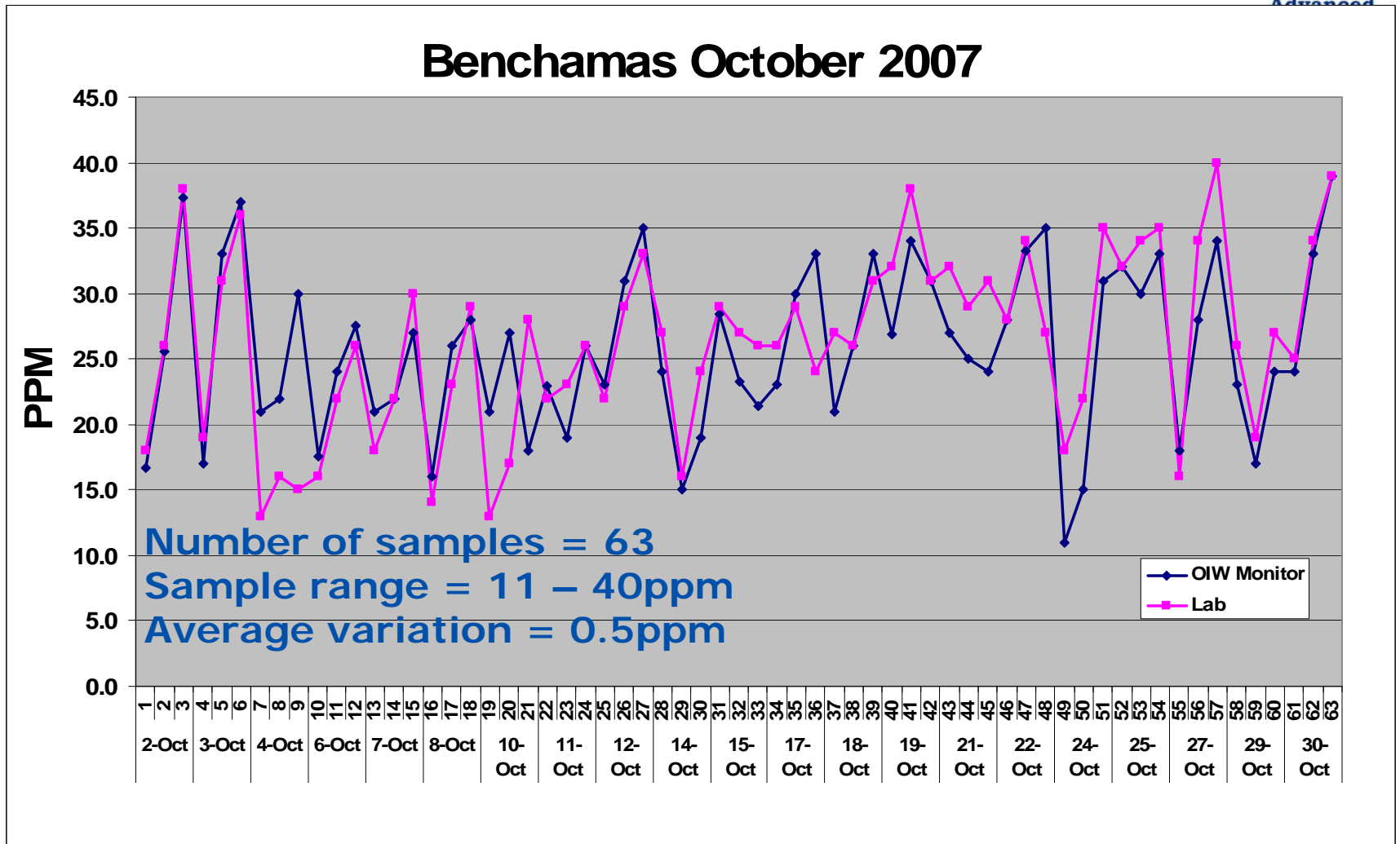


Crude Oil + 300ppm Corrosion Inhibitor PX 0191



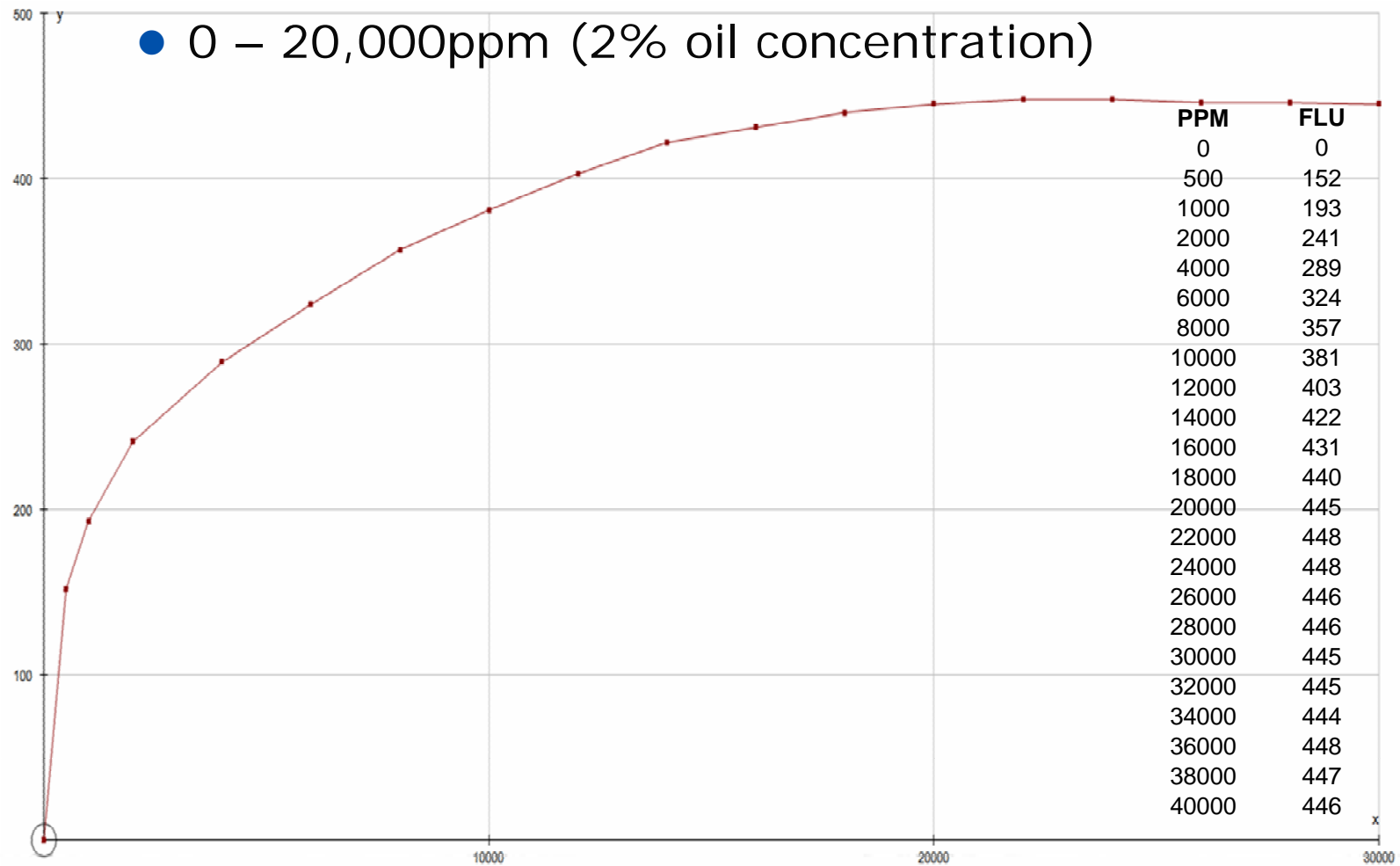
Correlation of Instrument vs Lab

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**