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

**18th Annual Produced Water Seminar**

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**Clearlake, TX**

# *Topics / Outline*

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

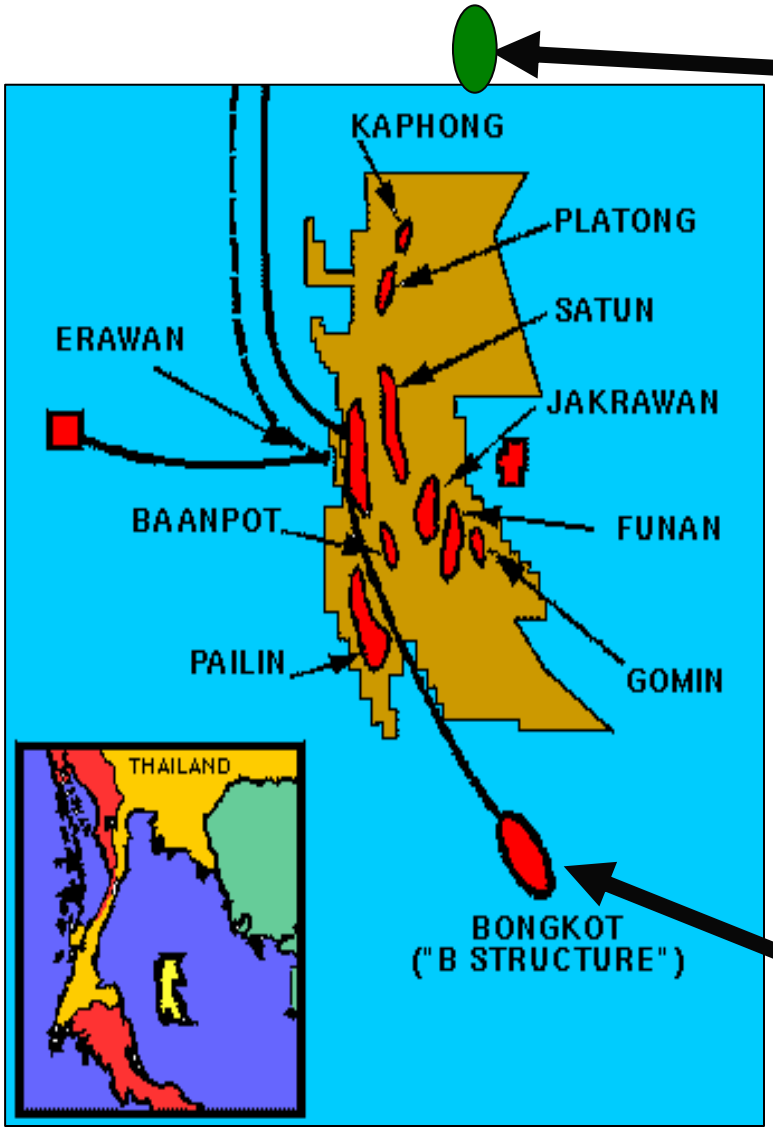
# Introduction


## 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**

**PTTEP**

**Exploration and Production:**

- 13 Blocks
- 5 million acres (16,000 sq. kilometers)
- 1.5 bcfd 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**

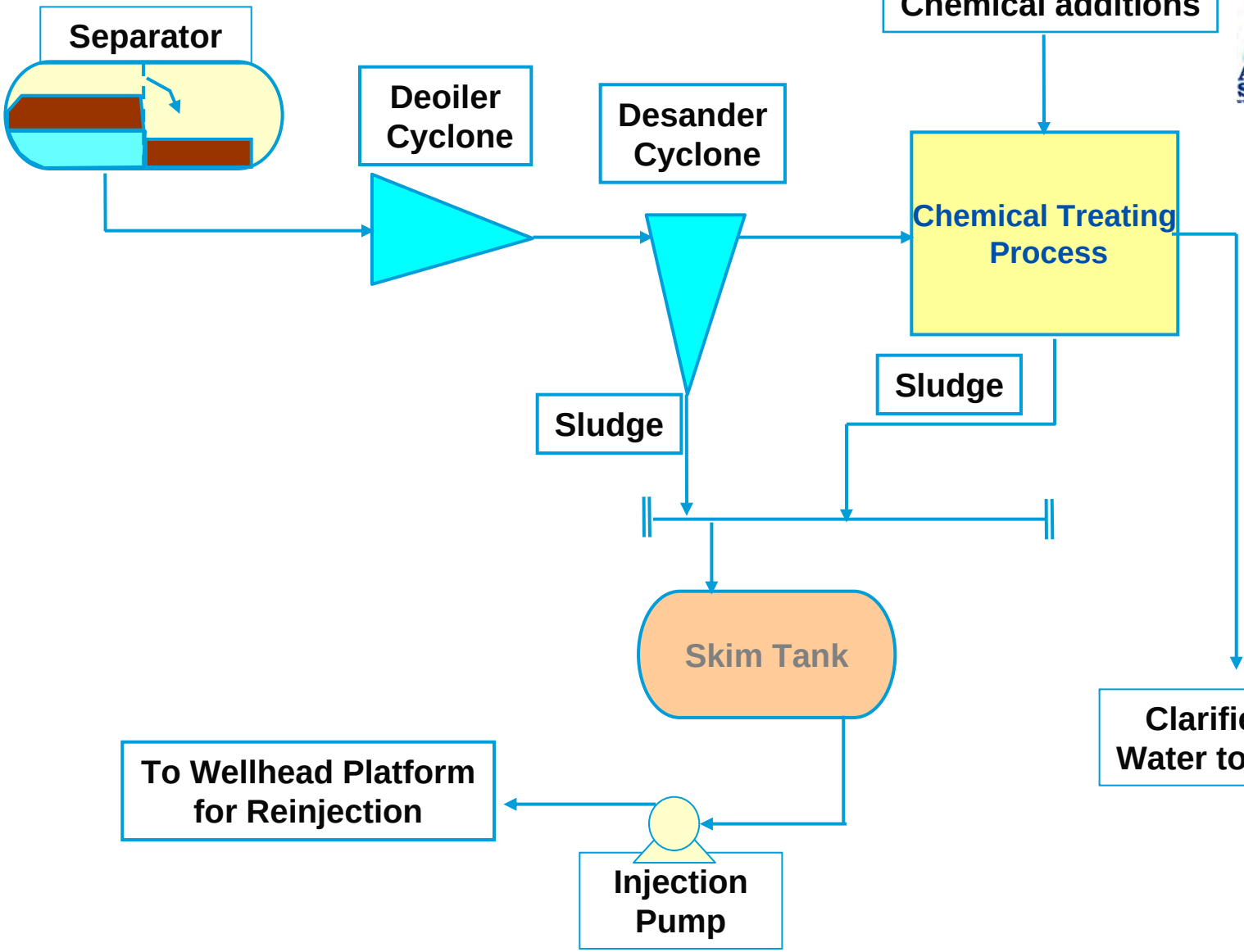
# Thailand Operations

## 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

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# *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*

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# Objective

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

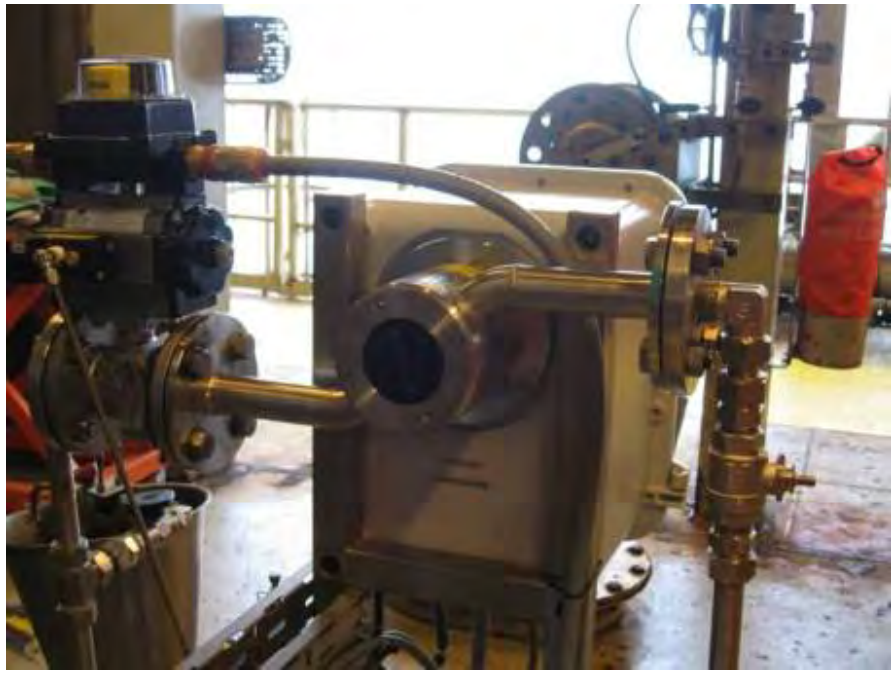
In collaboration with StatoilHydro and Talisman Energy.

# OIW EX 1000 Oil in Water Analyser


# OIW EX 1000 Oil in Water Analyser


## Installation

StatoilHydro, Brage



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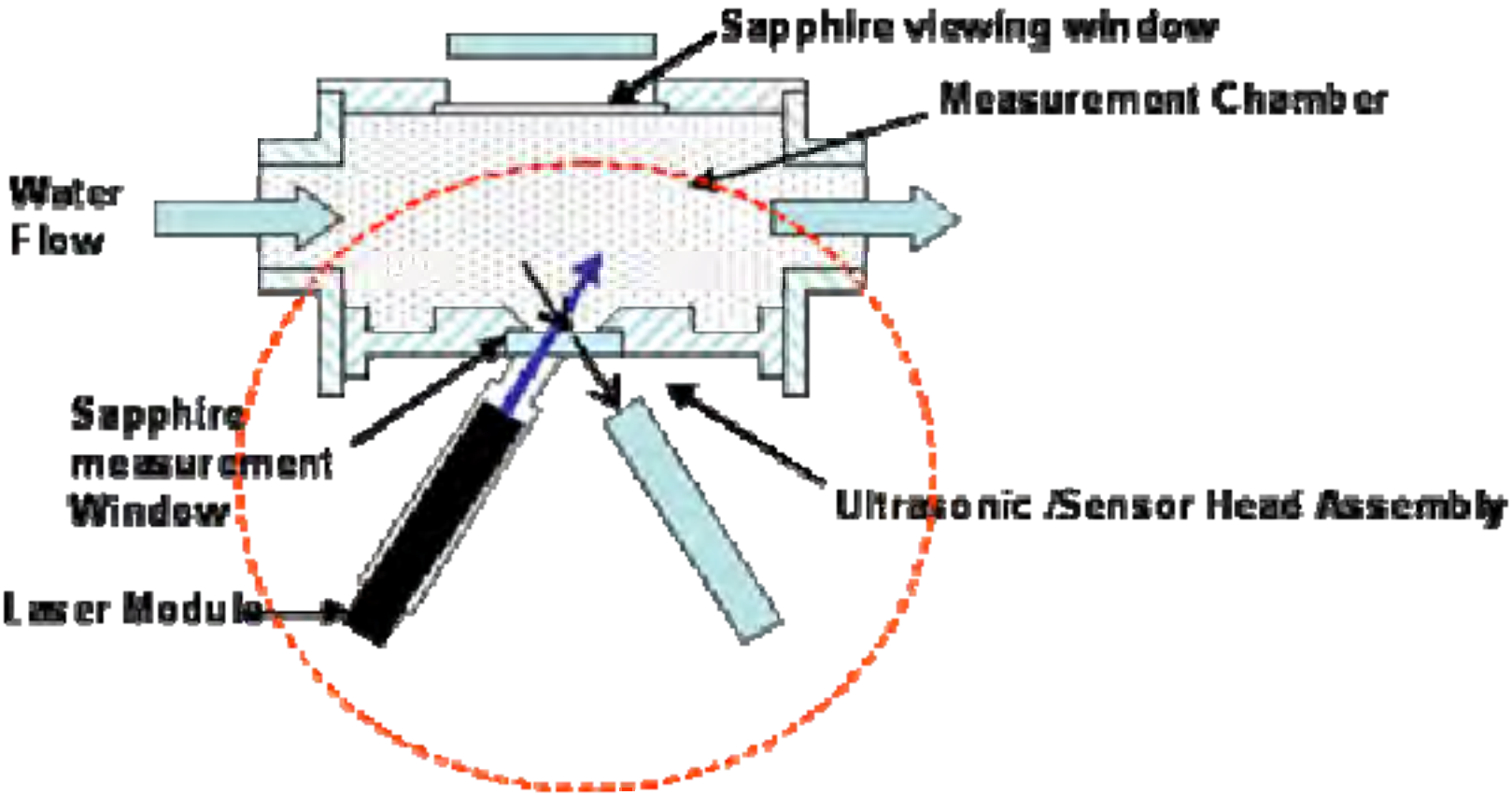
# Measurement Technique

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.**

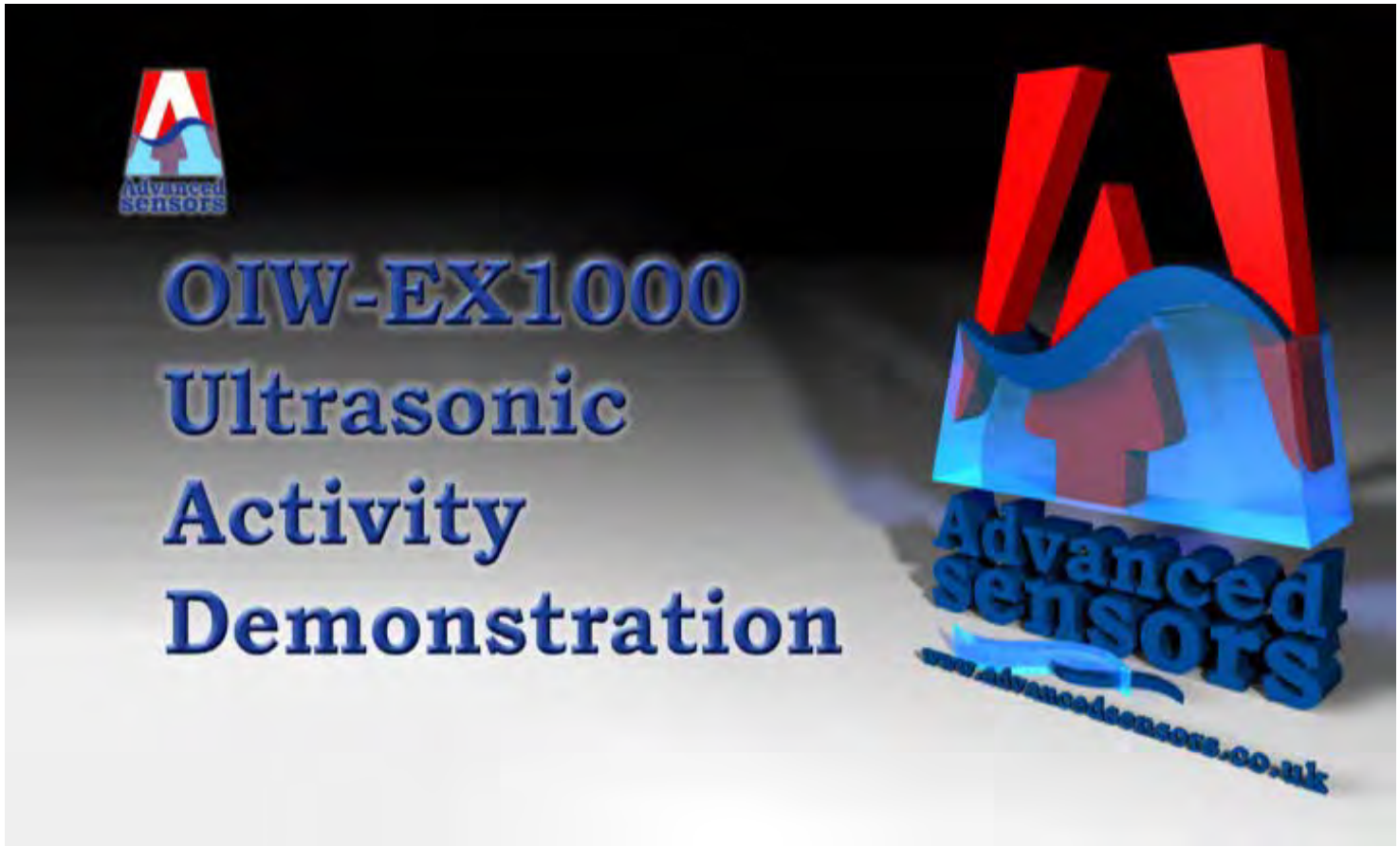
# 2. Online Analysis Challenges

- **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



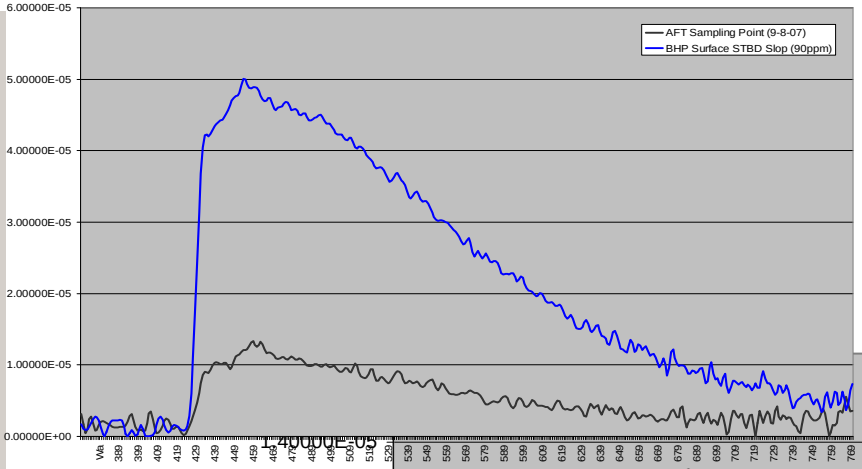

**The combined Optical-Ultrasonic sensor head provides cleaning and sample homogenisation.**

# 3. Online Analysis Challenges

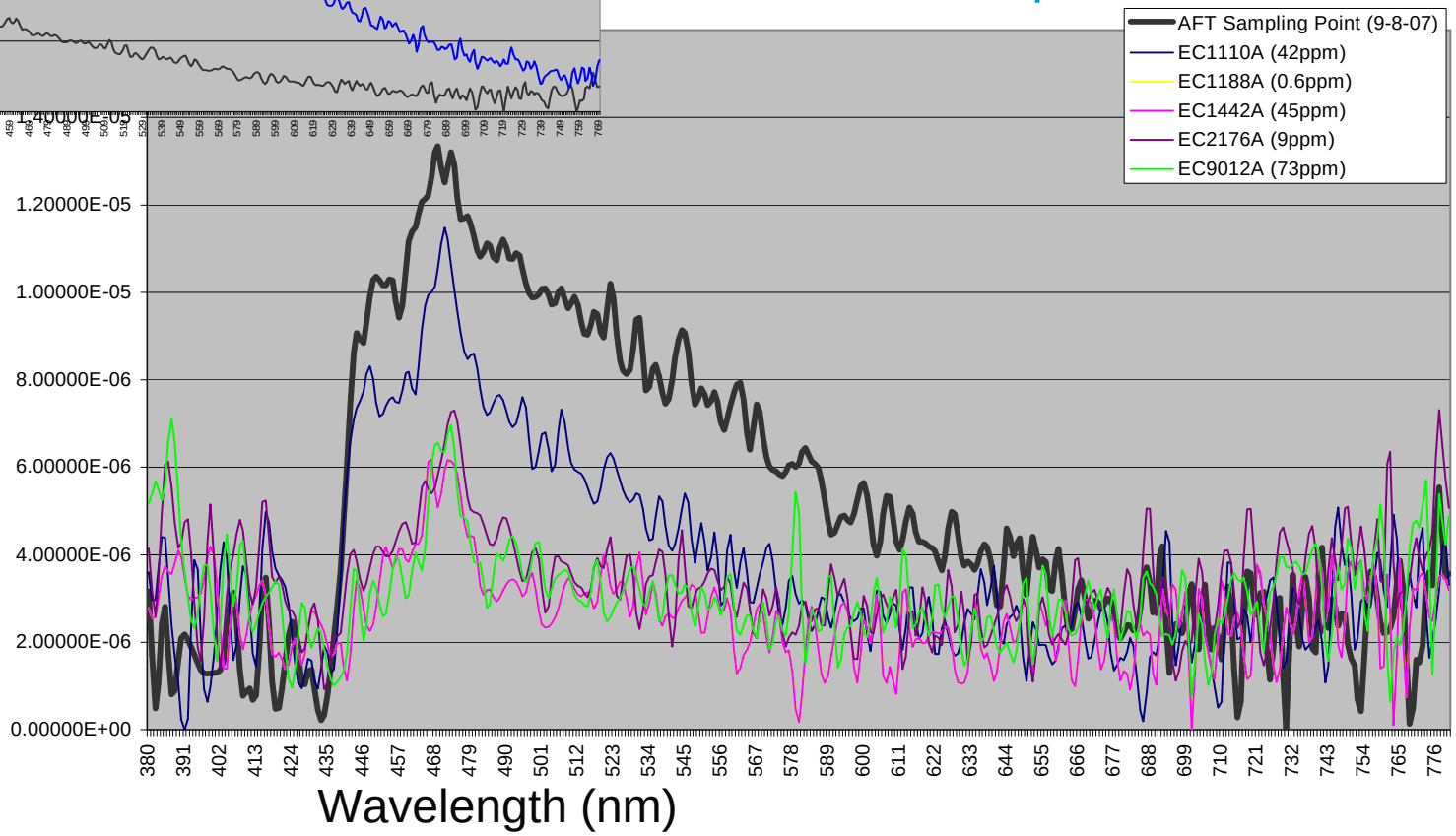
- Chemical Additive Interference
  - Many process chemicals are now commonly known to fluoresce and corrupt oil in water measurement.
- Objective: Isolate effects of chemical additives from fluorescent measurement.
- Solution: Real Time UV Spectrometer built into unit.

# UV Spectra results from inbuilt Spectrometer

## Crude oil




## Produced Water plus chemicals

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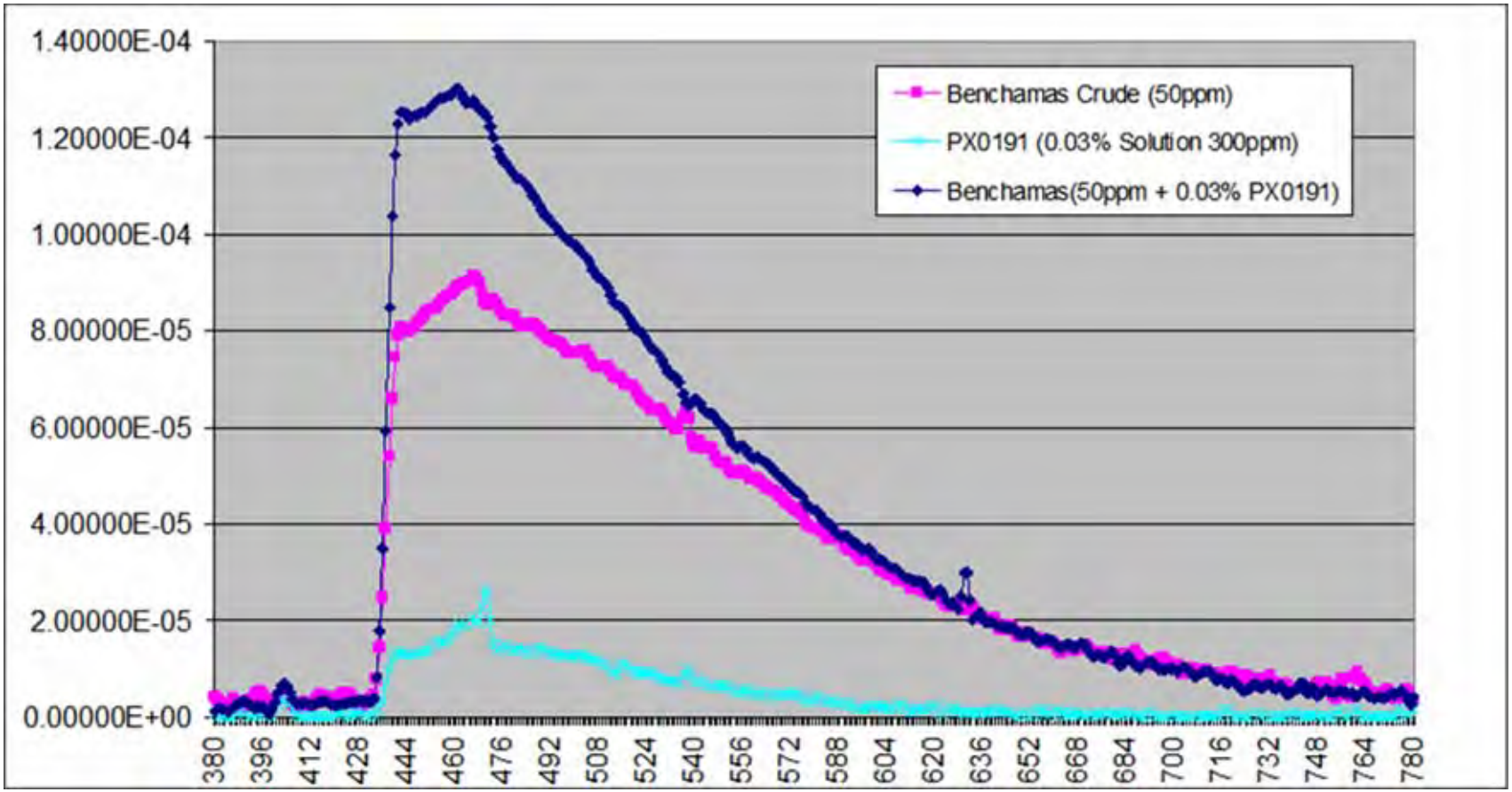
# Measurement after chemical isolation

| 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) |

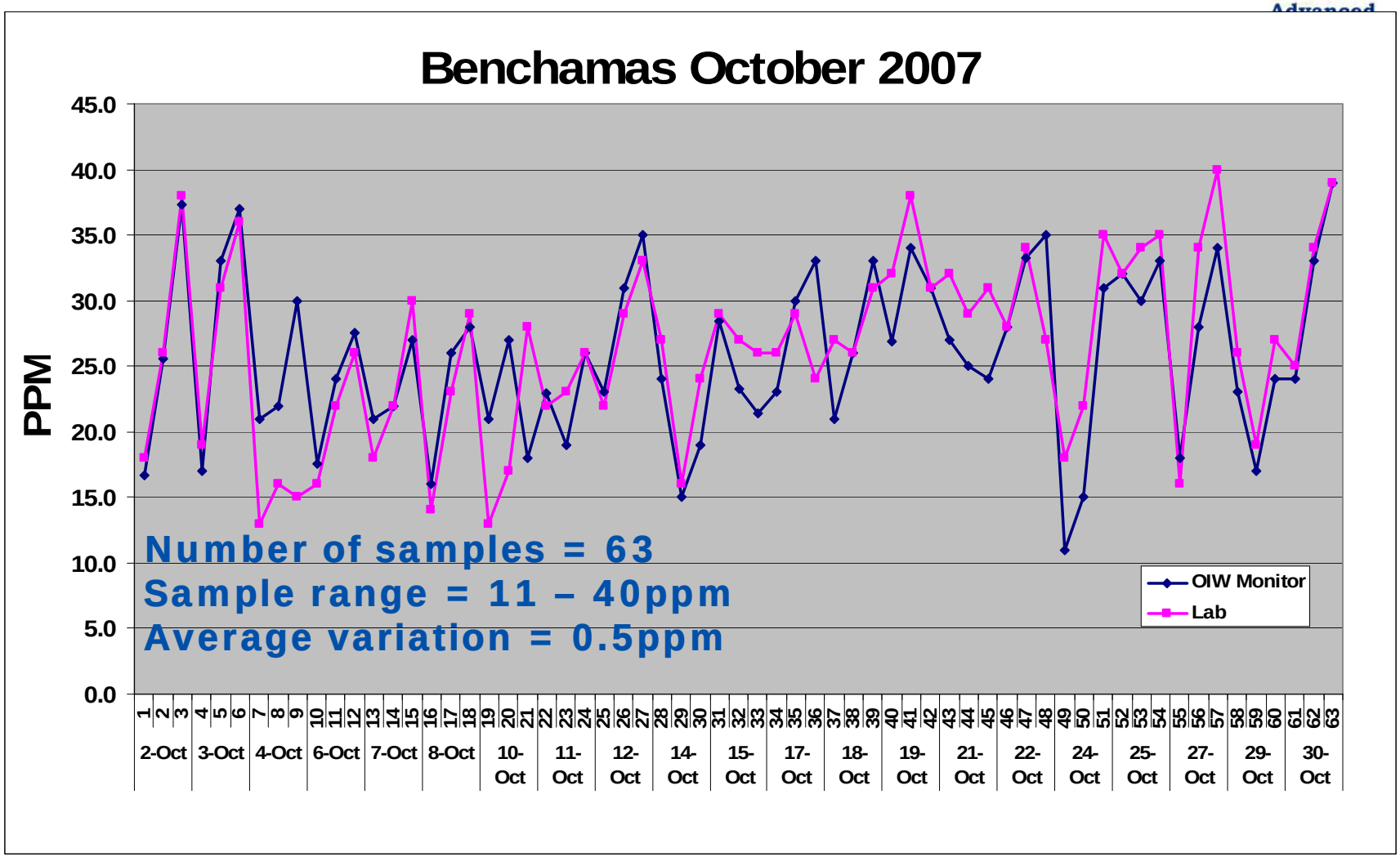
# Benchamas

## Crude Oil + 300ppm Corrosion Inhibitor PX 0191



# Correlation of Instrument vs Lab

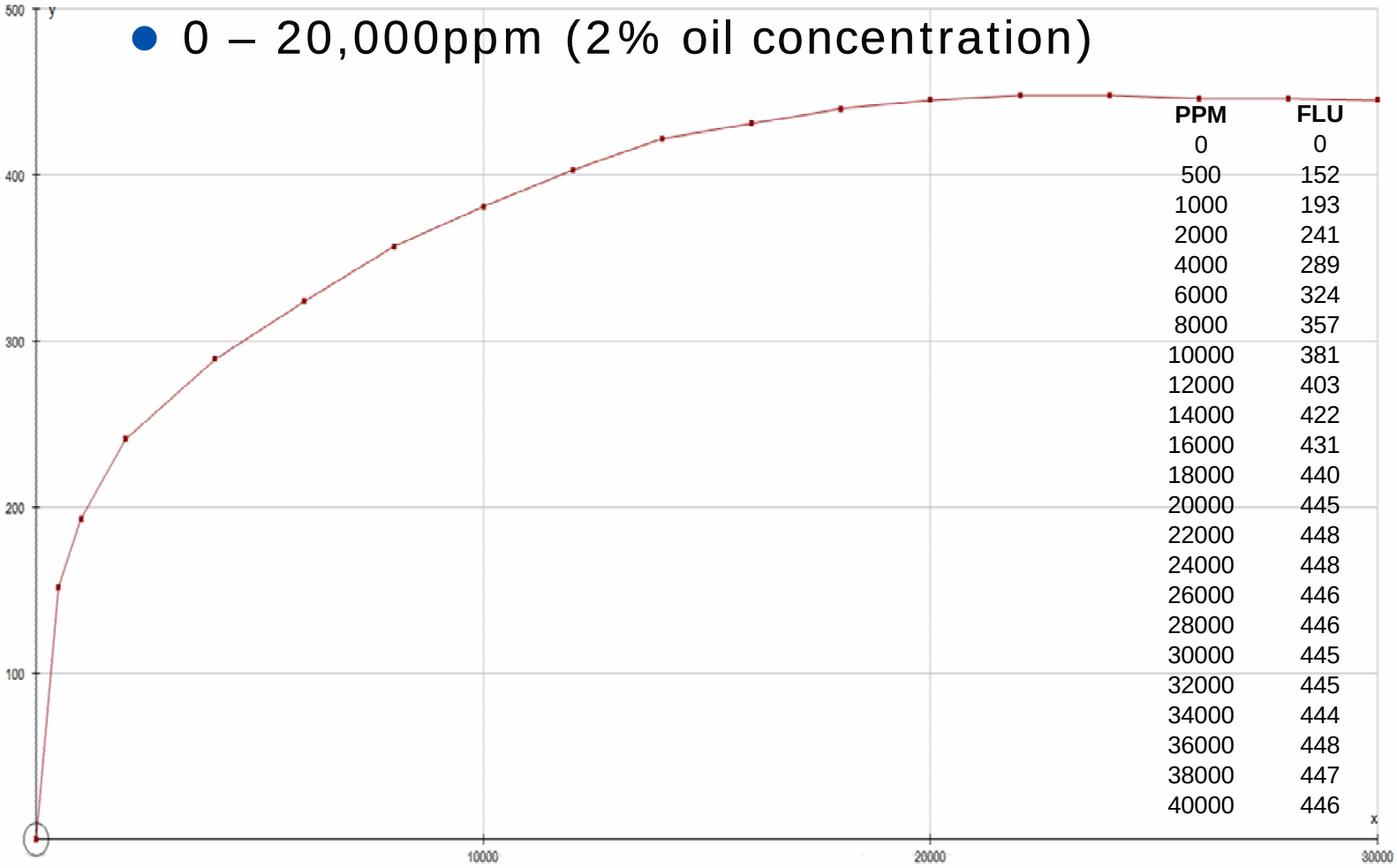
## Following chemical isolation



# 4. Online Analysis Challenges

- Operating Range
  - 0 – 20,000ppm (2% oil concentration)




| PPM | FLU |
|---|---|
| 0 | 0 |
| 500 | 152 |
| 1000 | 193 |
| 2000 | 241 |
| 4000 | 289 |
| 6000 | 324 |
| 8000 | 357 |
| 10000 | 381 |
| 12000 | 403 |
| 14000 | 422 |
| 16000 | 431 |
| 18000 | 440 |
| 20000 | 445 |
| 22000 | 448 |
| 24000 | 448 |
| 26000 | 446 |
| 28000 | 446 |
| 30000 | 445 |
| 32000 | 445 |
| 34000 | 444 |
| 36000 | 448 |
| 38000 | 447 |
| 40000 | 446 |

# 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**