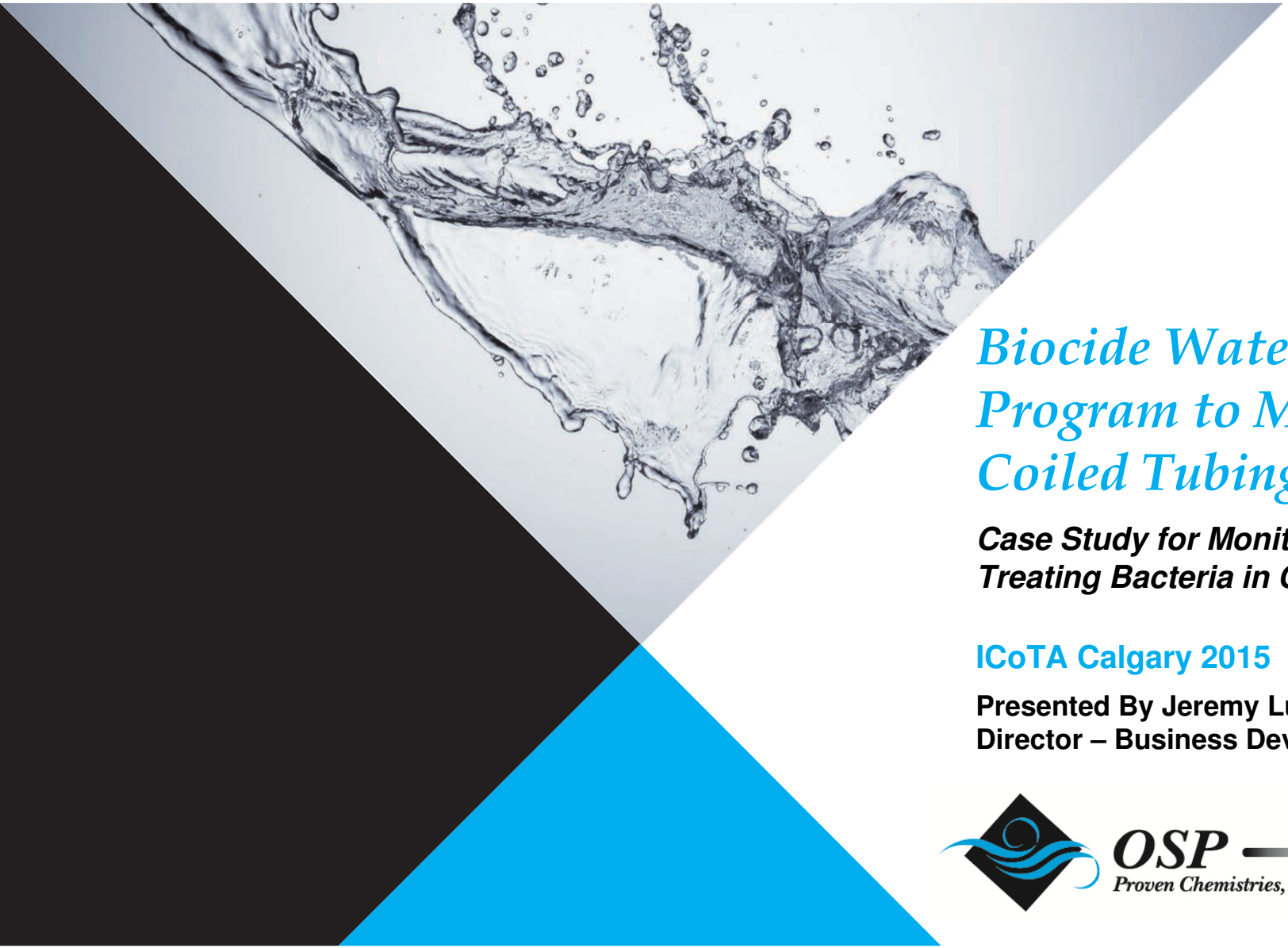


Biocide Water Treatment Program to Mitigate Coiled Tubing Failure

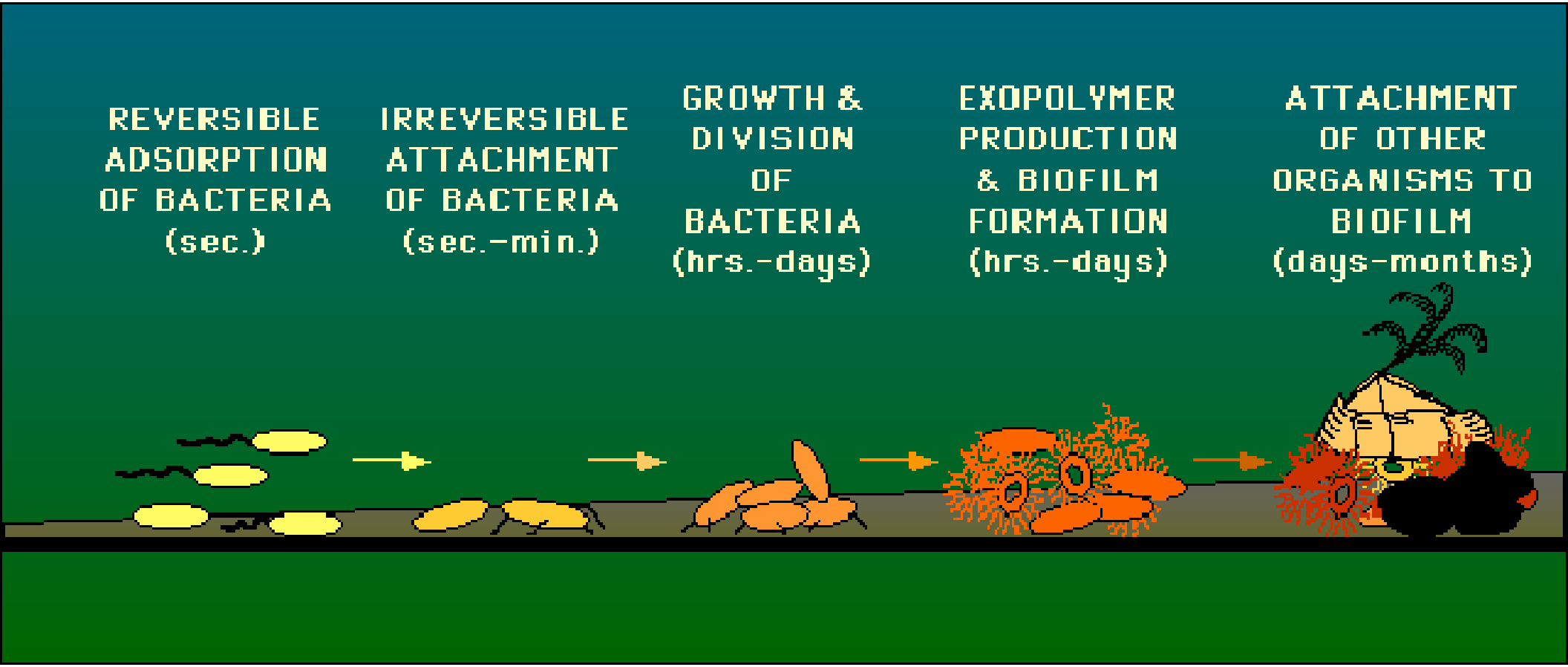
Case Study for Monitoring and Treating Bacteria in Coiled Tubing Fluids

ICoTA Calgary 2015

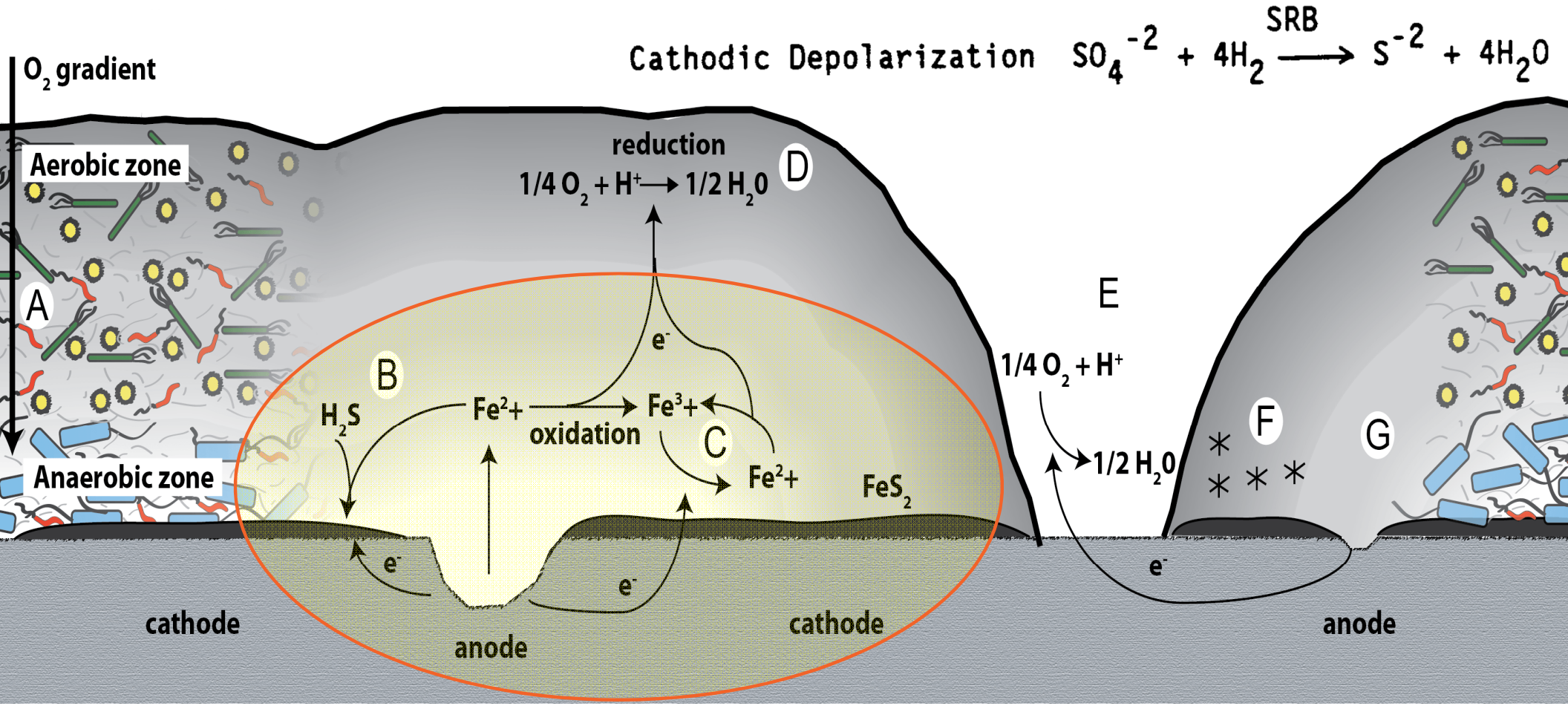
Presented By Jeremy Luth
Director – Business Development NA

OSP
Proven Chemistries, Intelligent Solutions

Biofilm Formation



Microbial Influenced Corrosion (MIC)



Coiled Tubing Failure

Results

Above: Interior biofilm buildup with clearly seen corrosion cell tubercle shell.

Left: Interior biofilm growth and exterior pinhole leak – at approximate two o'clock point on pipe wall.

Technologies

ATP Monitoring

Solid Biocide (powder and stick)

ATP Monitoring Method

ATP Measurements

Treatment based on pg/mL ATP

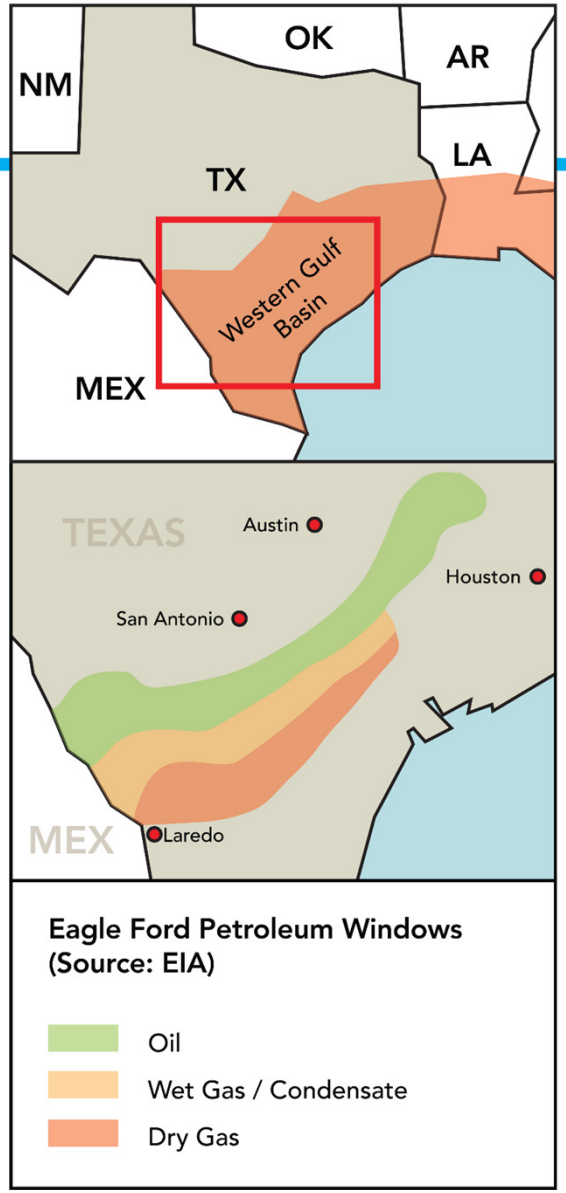
0 – 50 pg/mL	50 – 100 pg/mL	100 – 1,000 pg/mL	>1,000 pg/mL
No action is necessary	Develop plan for treatment	Execute moderate treatment	Execute aggressive treatment
Continue monitoring	Maintain monitoring frequency	Increase monitoring frequency	Double monitoring frequency

Execution

Quantity of Water On-Site, in barrels (bbl)	10	5000	10000
500	0.0	0.8	0.8
700	0.0	1.1	1.1
900	0.0	1.4	1.4
1100	0.0	1.8	1.8
1300	0.0	2.1	2.1
1500	0.0	2.4	2.4
1700	0.0	2.7	2.7
1900	0.0	3.0	3.0
2100	0.0	3.3	3.3
2300	0.0	3.7	3.7
2500	0.0	4.0	4.0
2700	0.0	4.3	4.3
2900	0.0	4.6	4.6
3100	0.0	4.9	4.9
3300	0.0	5.3	5.3
3500	0.0	5.6	5.6
3700	0.0	5.9	5.9
3900	0.0	6.2	6.2
4100	0.0	6.5	6.5
4300	0.0	6.8	6.8
4500	0.0	7.2	7.2
4700	0.0	7.5	7.5
4900	0.0	7.8	7.8
5100	0.0	8.1	8.1

Objectives for Pioneer Energy Services (PES)

- Increase operating life
- Add predictability
- Improve safety
- Increase profitability



Intro to PES Coiled Tubing Unit (CTU)

- 2.375-in. string
- 21,500 ft long
- Grade 100 steel
- Average failure = 20% fatigue / 12 trips

PES CTU – Case Study #1

- Avg. = 10,623 pg/mL ATP (9,235 & 12,010 pg/mL)
- On-site volume = 2,500 bbl
- Treatment = 4 units of biocide
- 12 hours post-treatment = 147 pg/mL ATP
- Circulating pressures dropped from 7,250 psi to 5,750 psi (50 MPa to 39.6 MPa)

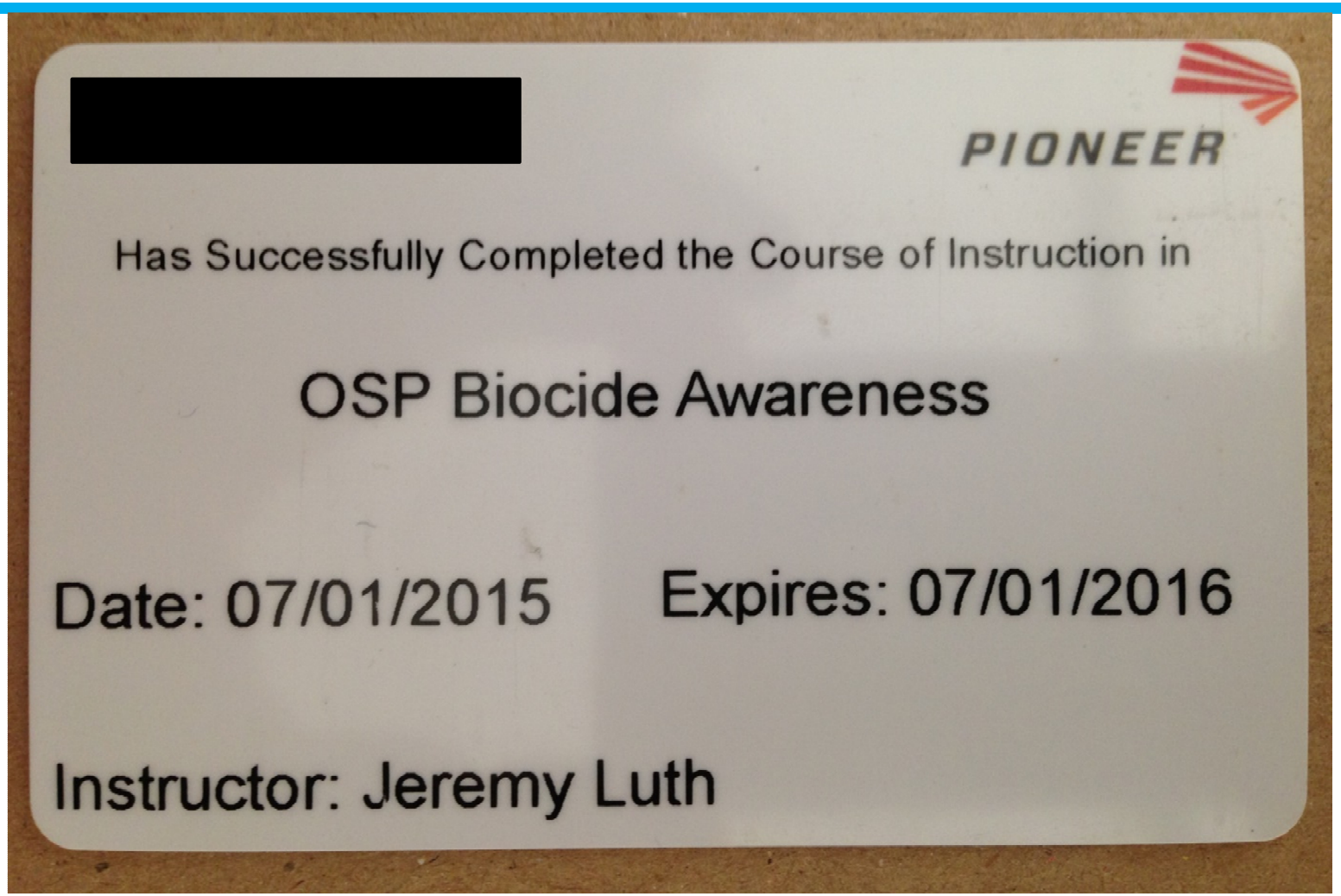
PES CTU – Case Study #2

- Start = 1,536 pg/mL ATP
- On-site volume = 2,800 bbl
- Treatment = 1 unit of biocide
- Six hours post-treatment = 78 pg/mL ATP
- “Fresh” water increased to = 607 pg/mL ATP

Results

- Increased string life by 3X
- Strings retire at expected fatigue
- No failures since treatment program implementation
- Increased revenue by $750,000/string

Implementation



MIC Areas

Papers regarding MIC in CT operations:

1. SPE 173675
2. SPE 173658
3. IPTC 18032

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Thank You

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