smart fibres™

Pioneering Optical Fibre Sensing

# Fiber Optic Sensing for Artificial Lift Pump Condition Monitoring and Optimisation

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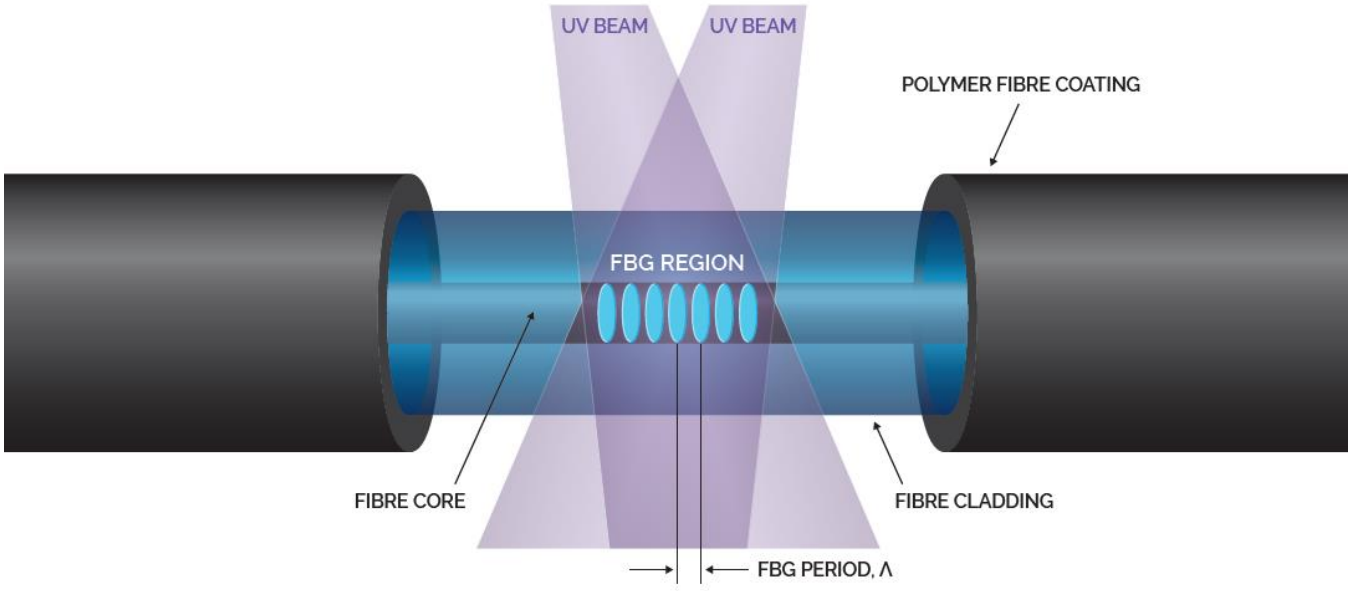
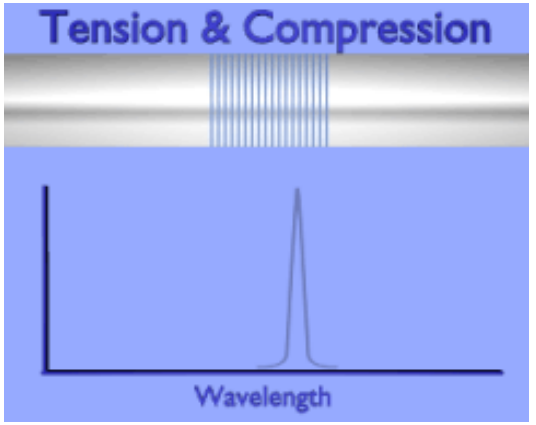
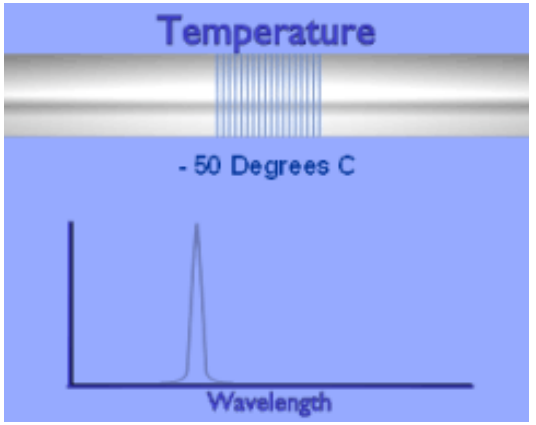
# The Fibre Bragg Grating (FBG)

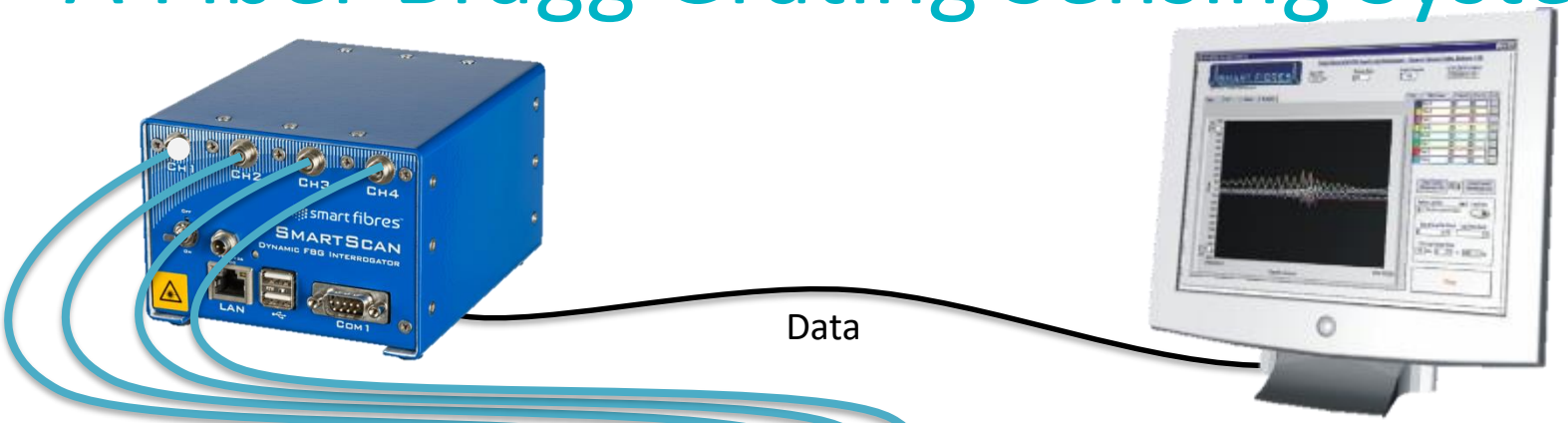
- A point fiber optic sensor that reflects light
- Recorded with UV laser light
- Reflected wavelength varies with strain and temperature



# A Fiber Bragg Grating Sensing System



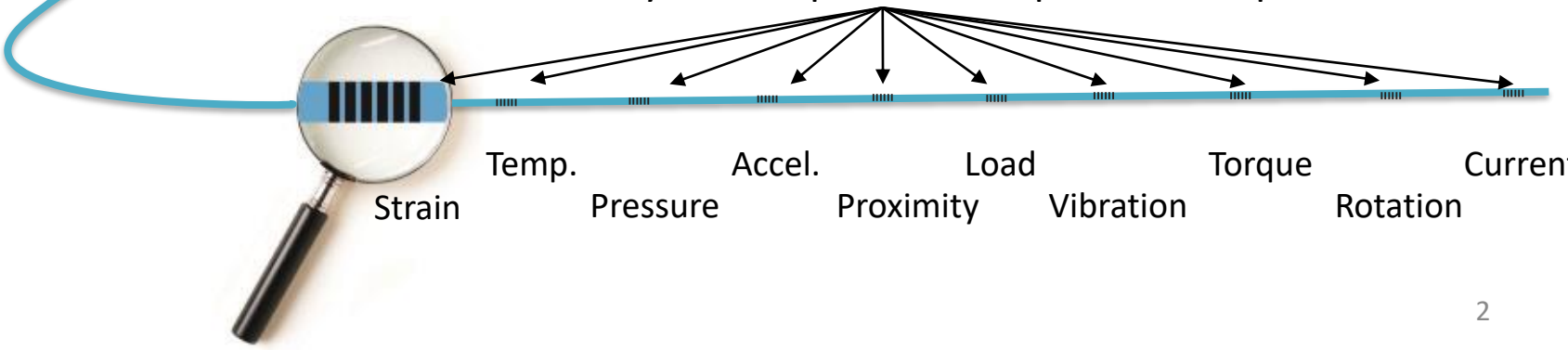

Data

Tuneable Laser Interrogator

Processing Unit

Fibre

FBG Sensor Arrays: multi-point, multi-parameter, quasi distributed

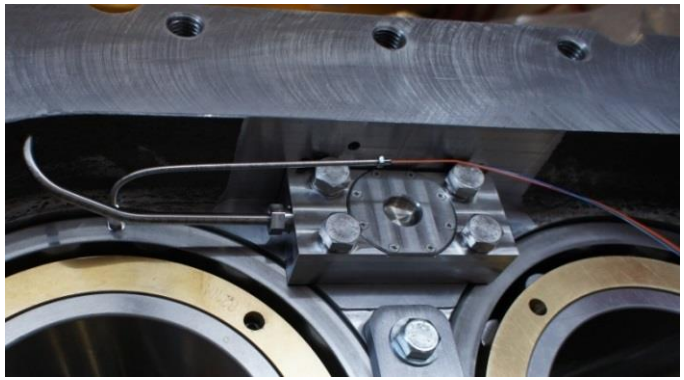


# Pump condition monitoring case study

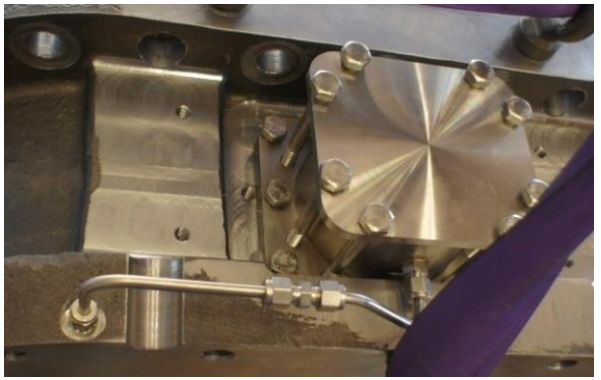

Twin screw, high boost subsea oil pump

Bearing race strain…

Motor winding temperature

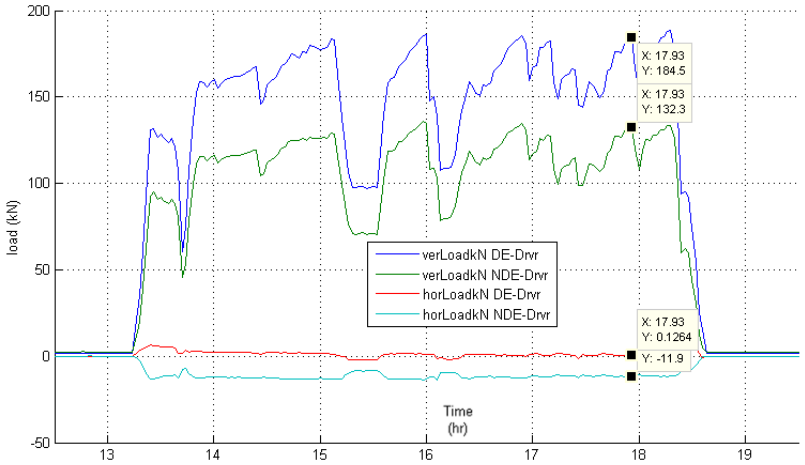


Lube oil pressure / temperature

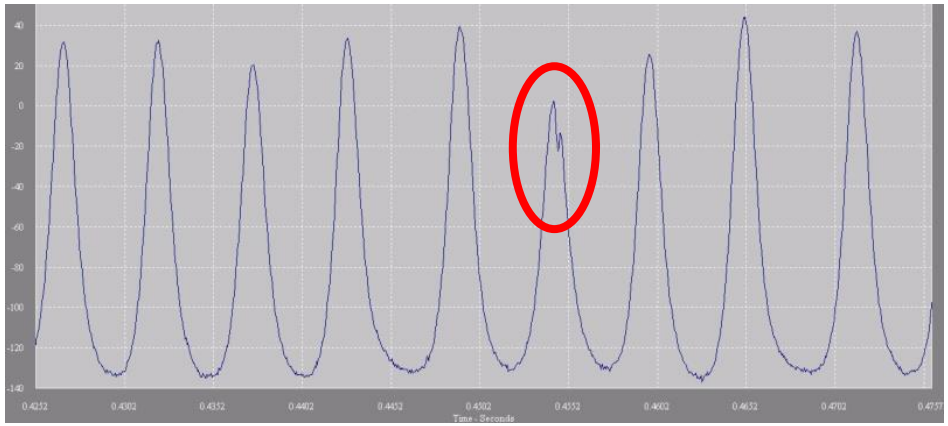


Bearing housing acceleration

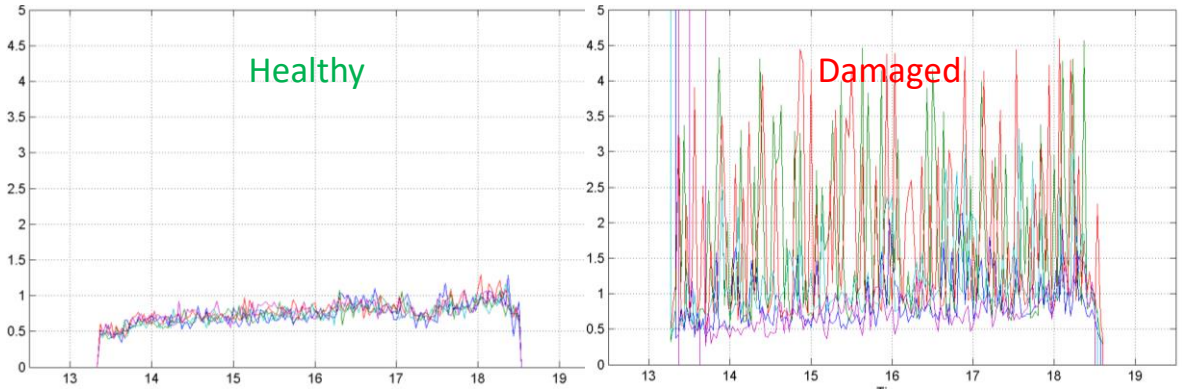
# Pump condition monitoring case study




Static data:
Vertical and Horizontal shaft loads match FE model

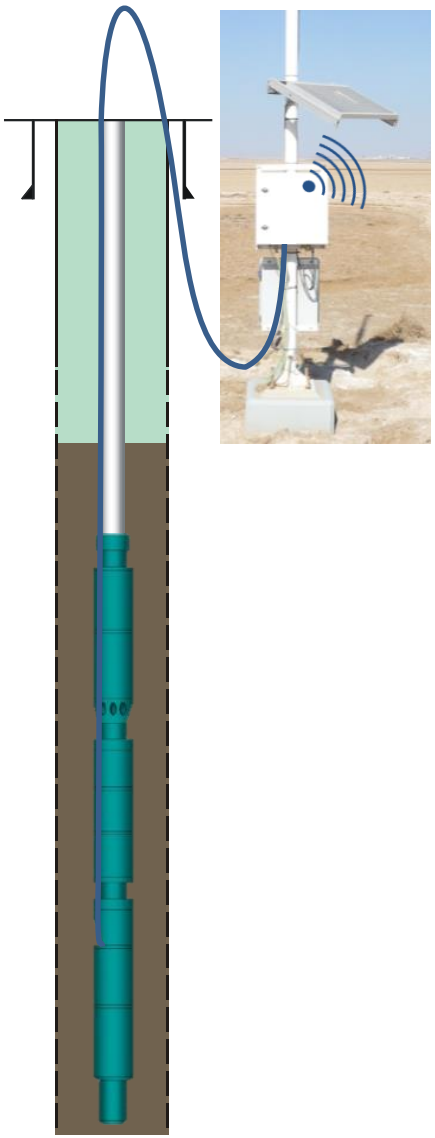


Dynamic data:
Signatures identify damaged roller




2 micron roller scratch detected from 10 Km

# Why Monitor ESPs?



- Identify ESP faults as they develop
- Manage ESP deterioration with changes in operating parameters
- Keep ESP producing until a scheduled ESP exchange can be made

## Why use an FBG monitoring System?

| FBG System Feature | Benefits for ESP Monitoring |
|---|---|
| Multiple measurands, single surface instrument | Fewer connections<br>Simpler interface<br>Lower cost |
| All optical data | Measurements immune to EMI<br>Insensitive to cable impedance |
| Zero Power on fiber | ATEX certified for explosive environment use |
| No downhole electronics | Long survival in harsh environments<br>i.e. monitoring system outlasts pump |

# ESP Monitoring Potential

## Internal to ESP

- ➢ Motor winding temperature
- Motor oil temperature
- Motor oil pressure
- Motor current draw
- Radial bearing temperatures and loads
- Thrust bearing loads
- Pressure drops across pump stages
- Shaft angle and speed
- Shaft torque and orbit
- Vibration at key locations
- Acoustic noise

*With loose tube FBG temperature sensors*

## External to ESP

- Wellbore fluid level
- Intake and discharge pressures and temperatures
- Motor casing strain

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*With diaphragm pressure transducer*

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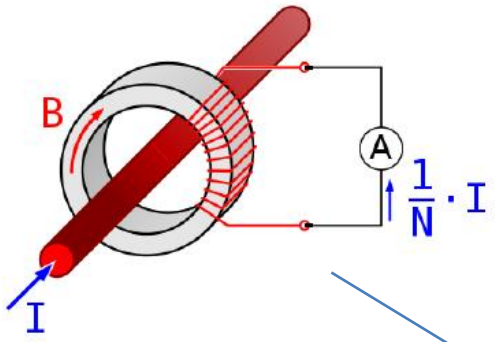
*With FBGs measuring secondary current via temperature or magnetostrictive effect*

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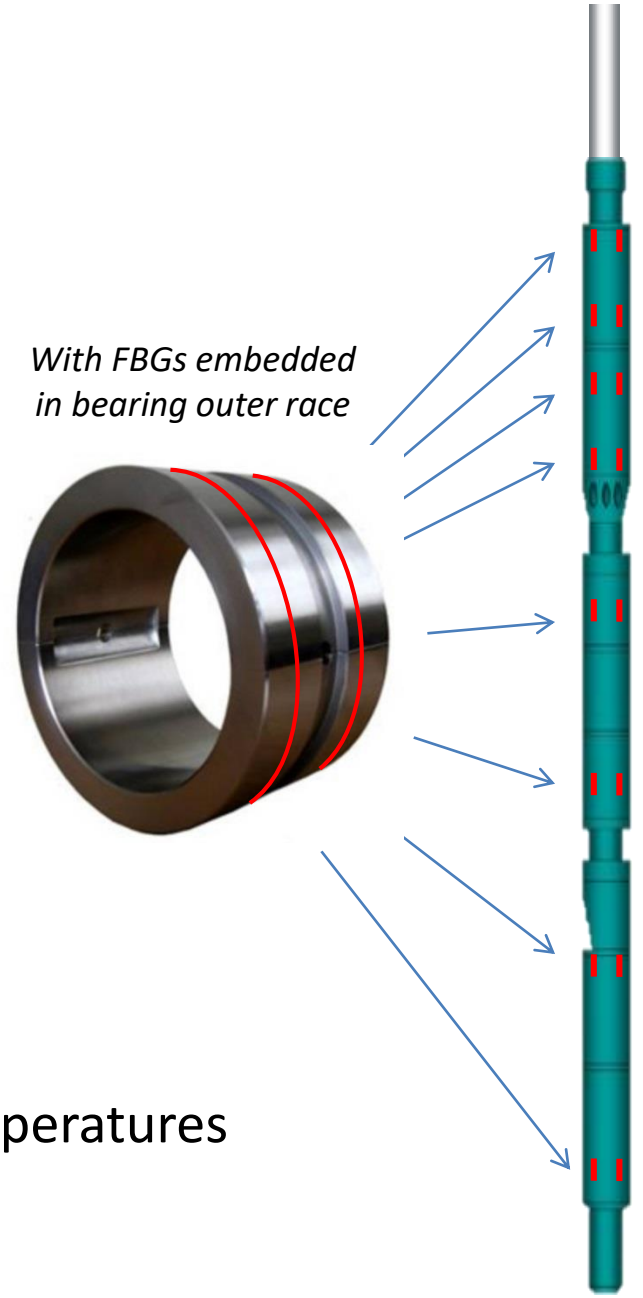

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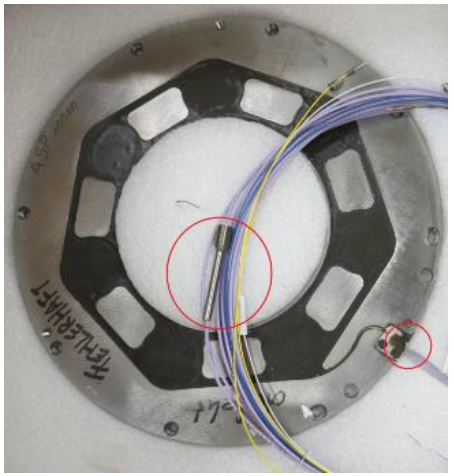
*With strain FBGs on load bearing plate*



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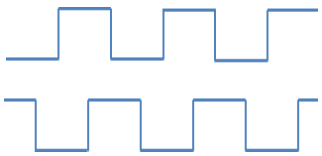
*With magnetostrictive FBG proximity sensor*



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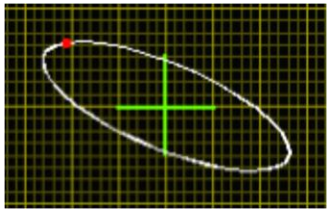
*With same magnetostrictive FBG proximity sensor*



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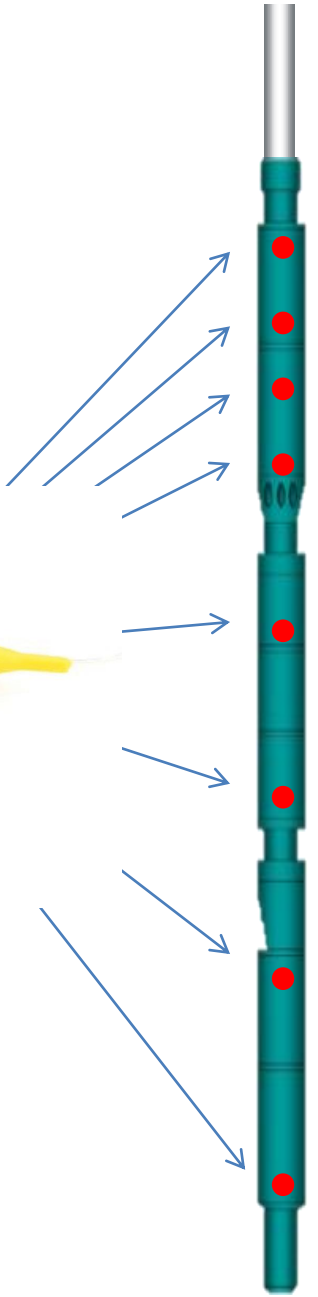
*With FBG acceleration transducer*



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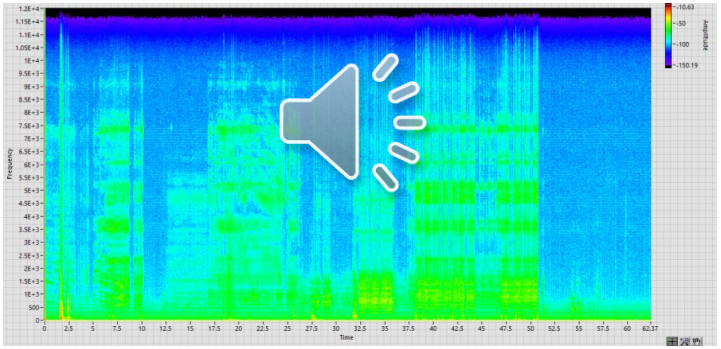
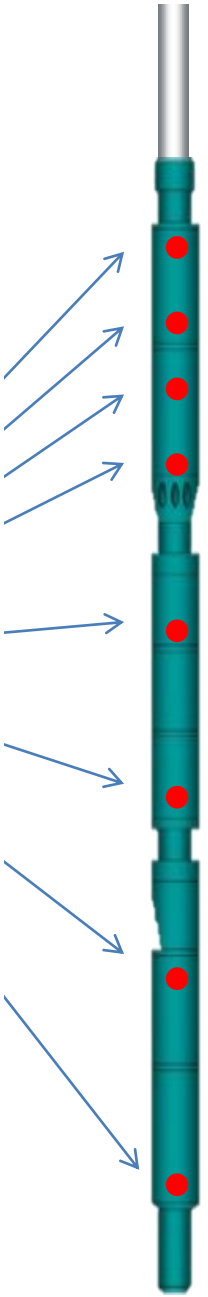
*With quasi-distributed acoustic sensing (QDAS)*





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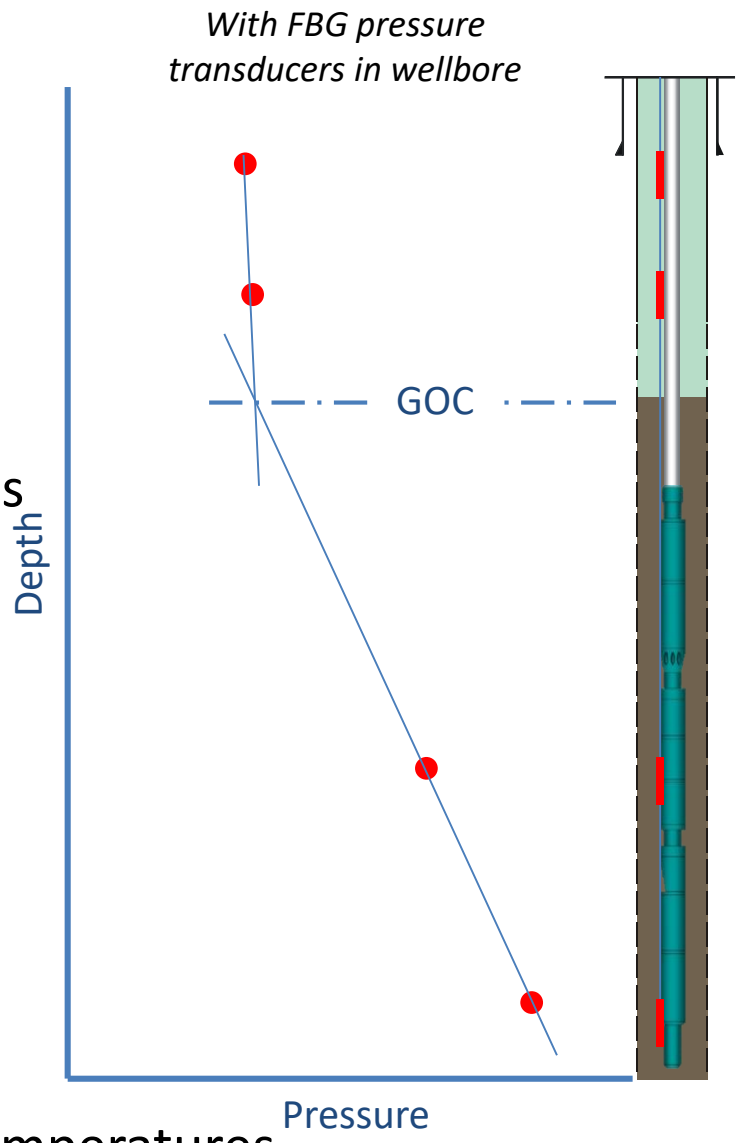

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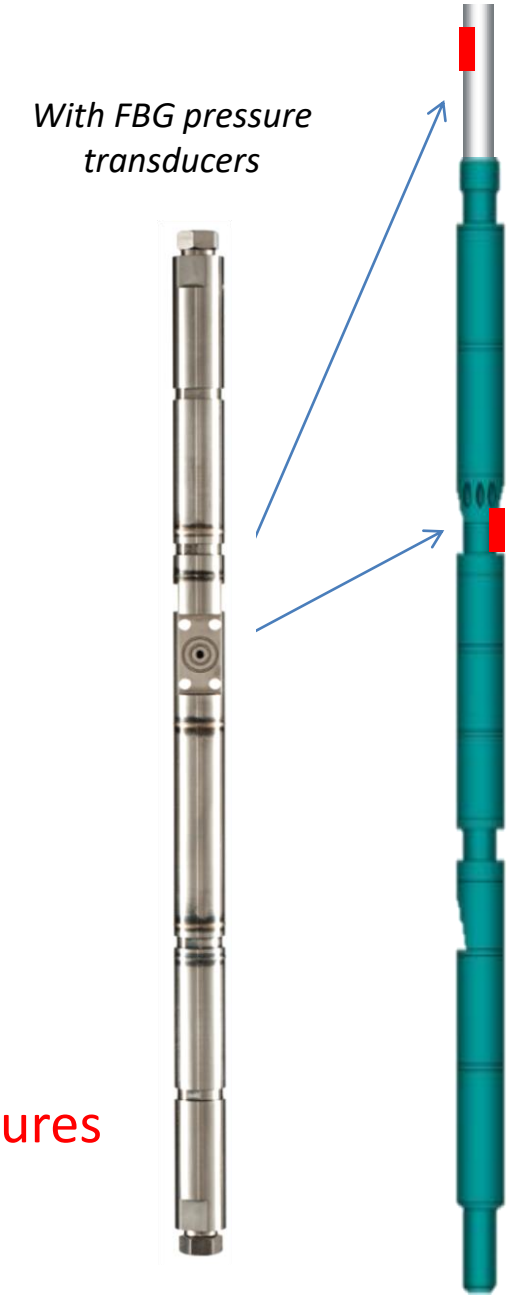

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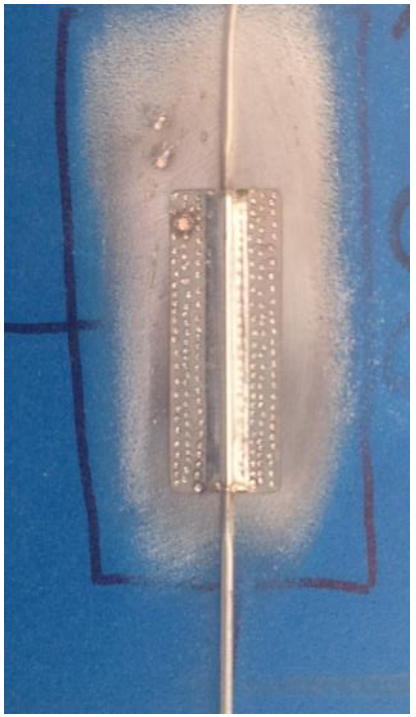
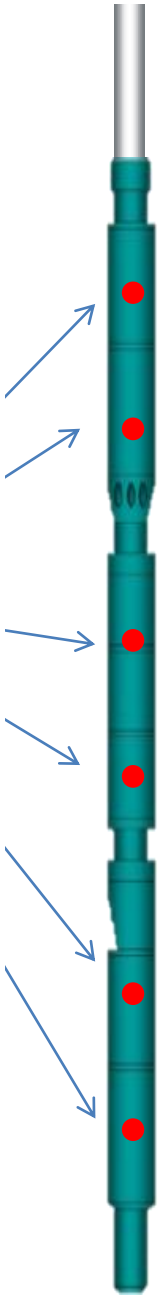
- ➢ Motor casing strain

*With weldable FBG strain gauges*





# Conclusion

All the component parts exists to develop a fully integrated, multi-parameter ESP condition monitoring system using optical fiber Bragg grating technology

# Thank You

smart fibres™

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