Flooding Detection System for Flexible Annulus Integrity Monitoring

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AGENDA

• Interest of DTS monitoring
  • Annulus Flooding Detection
  • Global SURF surveillance system

• TechnipFMC complete DTS offer
  • From the instrumented riser to the Monitoring software
Optical fiber distributed sensing (DTS) integrated in flexible risers increase safety & revenues
What DTS Monitoring will bring to operators

1- OPEX reduction
- Digitalization: better productivity
- ROV cost cutting
- Inspections cost cutting

2- HSE improvement
- Better knowledge of riser condition
- Riser integrity improvement
- Early leak detection

3- Production improvement
- Hydrates plugs detection
- Flow management improvements

DTS is your permanent subsea vision:
DTS reduces OPEX: a single sensor for all

<table>
<thead>
<tr>
<th>№</th>
<th>Parameter of interest</th>
<th>By ROV</th>
<th>By topside Inspection</th>
<th>By DTS</th>
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<tbody>
<tr>
<td>1</td>
<td>Temperature under stiffener</td>
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<td>2</td>
<td>Bend stiffener presence</td>
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<td>3</td>
<td>Annulus flooding condition</td>
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<td>4</td>
<td>Marine growth thickness</td>
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<td>5</td>
<td>Hydrate presence</td>
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<td>6</td>
<td>Buoyancy clamp sliding</td>
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<td>7</td>
<td>Vertical anchor integrity</td>
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<td>8</td>
<td>Touch down point stability</td>
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<td>9</td>
<td>Riser trenching</td>
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DTS: Comprehensive and single digital source information

[Image: Diagram showing various parameters and their detection methods]
DTS improves HSE: a single sensor does better

(Source: Sureflex_2010)

DTS: real time surveillance of key integrity concerns
DTS improves production:

- With DTS temperature along the riser, bore temperatures in the full riser section can be calculated and allow:
  - Detection and localization of hydrates and wax plugs
  - Maximum temperature capacity of the riser system (cold & hot spot surveillance)

- DTS will be useful during shut down & restart operations
TechnipFMC: 15 years of experience in DTS

DTS: Distributed Temperature Sensing with optical Fiber

15 years ago:
First qualified prototype with DTS

10 years ago:
First operational risers with DTS

3 years ago:
DTS qualification for flooding detection

Today:
Real time DTS condition monitoring
Flooding detection qualification

• 1 year full scale test campaign to validate annulus flooding models
• 6” Riser tested with real operating condition
• 0,5 l/min water ingress flowrate is sufficient for detection
• 5°C temperature difference between bore and seawater is sufficient
• 64 configuration tested in blind mode to benchmark algorithm
The offer: TechnipFMC DTS-ready Riser

- The riser is delivered with two integrated steel tube in one armour layer
- The cost impact on the Riser procurement CAPEX is optimized
- More than 80 risers have been manufactured in 5 years
The offer: TechnipFMC DTS system

- TechnipFMC will deploy an optical fiber in the riser offshore
- TechnipFMC offer will include a DTS monitoring unit designed by Omnisens
- Omnisens has been part of the full scale flooding test
- Long term agreement plan
- Omnisens has a significant oil & gas track record including offshore deployed systems
The offer: TechnipFMC real time monitoring software

- e-surf real time monitoring software
- Outer sheath breach detection
- Water diffusion in annulus detection
- Secured HTTP based software accessible from any web browser
- HTML5 interface deployable on all types of supports
Conclusions

Investing in a DTS monitoring for flexible risers will benefit to operators:

- Integrity Management OPEX cost will be reduced
- IM productivity will be improved
- Riser operation safety will be improved
- Riser production capacity will be improved

Operators should now ask riser project teams to request DTS option in tender

**RISERS AND FLOWLINES MONITORING SYSTEM SPECIFICATION**