Subsea inspection of vibration and acoustic noise

Subsea Expo 2017
Baard Brattebø – ClampOn

Always Numero Uno!
FIV (Flow induced Vibration)

- Multiphase flow causing vibration to flow lines, flex loops, etc.
  - Medium frequency, typically 2-50Hz
  - Vortex shedding
  - Slugging
  - Turbulence
  - Fluttering / Galloping
FLIP (Flow Line Induced Pulsation)

- Flexible risers or flexible connectors
  - High frequency, typically 50-1000hz

Source:
OTC 18895

Internal Flow Induced Pulsation of Flexible Risers
R. Swindell, Bureau Veritas, and S. Belfroid, TNO TPD
VIV (Vortex induced Vibration)

- Ocean current causing low frequency vibration to structures, flow lines, jumpers, risers etc.
  - Low frequency, 0.01 – 2Hz
Structural and CFD modelling

- **Structural and CFD Modeling**
  - Identify areas of criticality
  - Design to minimize risk of vibration
  - Calculate vibration force and fatigue rate
  - Calculate safe operational window
Monitoring

- Actual monitoring combined with CFD.
  - Monitor in areas of criticality
  - Verify vibration force at different operational conditions
  - Data from one location -> CFD = Knowledge of complete sections.
Microelectromechanical systems

- Accurate
- Sensitive
- Power friendly
- Very Small

Mite on top of MEMS mechanic
Permanent/Integrated solution

- Real-time data
- Instant alarm
- Always present
- Data from 0-day
- Fatigue estimate
- No running costs
- SIIS L2 and 3

Monitor installed on 2” injection line
Temporary / inspection

- Stand-alone
- No integration
- Internal battery
- Up to 6 month operation per charge
- Local indication
- Light weight
- Mechanical and magnetic fixtures
- No bandwidth restrictions
- Continuous raw data logging
Phase relationship
LPHP (Pure vibration monitor)
CASE STUDY
Field Case – Statoil – Oseberg DII

Potential risk of singing flexible
Risk of resonance on 2” injection line on P template

3 weeks delivery time
Permanent installed
30 years design life
TR requirements

Installed on template 30th May
Template mobilization date 1 June
Field Case – Statoil – Oseberg DII

Vibration monitor location
Field Case – Statoil – Oseberg DII

Permanently installed on flow lines 2”
Material instrument: Titanium gr2
Material fixture: Titanium gr2, peek sleeve
Isolated from CP
Oil filled harness docking station
Field Case – Statoil – Oseberg DII

Instrument installation
Field Case – Statoil – Oseberg DII

Docking/interface installation
Conclusion

• Important tool for verification of actual vibration forces
• Ideal for permanent monitoring on critical components
• Reliable
• Rapid installation and retrieval
Thank you for your attention!

Any questions?

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