Benefits of the use of high-bypass de-sanding pigs in conjunction with brush pigs for operational pipeline cleaning

18th November 2015

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Key findings of case study

• Recent field evidence suggests that
  • Significant cleaning benefits can be obtained by use of high-bypass de-sanding pigs in liquid lines with soft waxy debris
  • Efficiency of de-sanding pigs may be optimised when run with brush pigs
    • Limited data to prove this conclusively
    • May be equally effective when run in isolation

• Encourage further use of high-bypass pigs in liquid lines
  • Further field experience is vital in validating findings
  • Sharing of data between operators and support companies
Overall project requirements

- Engineer an operational pigging capability for five deepwater flowline loops from two FPSOs
  - Define pigging strategy for the region
  - Define SoRs for pigs and services to be supplied by pig vendors
  - Cleaning pig tender review and evaluation
  - Technical assurance of pig designs
  - HAZOP of new pigging procedures and operations
  - Assistance to topsides readiness activities ahead of first campaign
  - Offshore oversight and technical support to initial pigging operations

- Case study reviews pigging in one of these lines
Case study: System configuration

- 12” line
  - 14” topsides sections
  - Significant ID variation between subsea service and production systems
  - Tight configuration in turret
- Hybrid risers
- CRA cladding
- 2000 m water depth
Case study: Pigging requirements

- Reduce risk of under-deposit corrosion at water cuts >5%
- Regular operational pipeline cleaning
  - Wax
  - Sand
  - Other contaminants
- Reactionary pipeline cleaning
  - Response to sand events due to gravel pack failure etc.
- Pre-ILI cleaning operations
Case study: Requirements and pig types

- Wax composition unknown
  - Hard wax not expected
    - Operating T >WAT except during shutdowns
    - No long-duration shutdowns
  - Soft wax probable
- Metallic debris possible
  - Incomplete commissioning pigging
- Brush pig proposed
  - Bi-di brush pigs
  - Brushes in front and rear disc packs
  - Magnets for any commissioning debris
Brush pigs
Case study: Requirements and pig types

• Sand and particulates possible
  • Uncertainty over sand screening and monitoring
  • Need capability to manage sand deposition in flowline (at bends etc.)

• De-sanding pig proposed
  • Typically used in dry gas lines not liquid lines
  • No brush components
  • Cups for sealing rather than discs
  • High levels of bypass creating turbulent flow
    • c. 1.5% by CSA
    • c. 12.5% by flowrate at 1 bar DP
High-bypass (de-sanding) pigs
Case study: Ops pigging 2014

- Three pigs run
  - Wire brush foam pig
    - First operational pig run since start-up
    - Primarily run for bore proving prior to hard-bodied pigs
    - No measurable debris returns
  - Brush cleaning pig
  - De-sanding pig
Case study: Ops pigging 2014

- Brush pig returns
  - c. 300 ml soft sludgy wax in receiver barrel
  - c. 500 ml of soft sludge and metallic filings on magnets

- Conclusions
  - Flushing and purging of receiver
    - Debris likely lost to drains
  - Minimal waxy debris in pipeline
  - Some metallic particulates
  - Expectation that de-sanding pig would also return insignificant debris quantities
Case study: Ops pigging 2014

- De-sanding pig returns
  - c. 10 kg of sludgy wax in receiver barrel with entrained particulates
  - 15x more than brush pig

- Conclusions
  - Comparable data
    - Same flushing and purging operation as brush pig
  - De-sanding pig may have brought back debris disturbed by brush pigs
Case study: Ops pigging 2014 findings

- Debris return analysis limited by flushing and purging
- Surprising performance of de-sanding pig
- De-sanding pig possibly more efficient than brush pig
  - Soft wax
  - Particulates
- Comparative performance possibly related to order of pig runs
- More data needed to draw firm conclusions
  - Single dataset
  - Repeatability of results required
Case study: Pre-ILI cleaning 2015

- Foam and wire brush foam pigs run before hard-bodied
  - No measurable debris returns
- De-sanding pig
  - First hard-bodied pig run
- Brush pig
  - Run after de-sanding pig
- Opposite order to operational pigging in 2014
Case study: Pre-ILI cleaning 2015

• De-sanding pig returns
  • c. 15 kg of sludgy wax in receiver barrel with entrained particulates

• Conclusions
  • More debris returned than in 2014
  • Still efficient even though run before brush pig
  • Still efficient despite more flushing and purging than 2014 due to benzene
Case study: Pre-ILI cleaning 2015

- Brush pig returns
  - No debris in receiver barrel
  - Pig very clean
- Conclusions
  - Brush pig less efficient than desanding pig for this line and debris type
  - 2014 findings corroborated despite reversing run order
Benefits of high-bypass pigs in liquid lines

- Improved efficiency of operational cleaning
  - Combinations of pig types
  - Suitable for certain expected debris types
- Reduced risk of failed ILI runs
  - Brush pigs may have come back clean but debris still in the line
- Increased suitability for use in multi-diameter lines
  - Increased flexibility in pig design
    - Cups
    - No brushes
- Reduced cleaning aggressiveness for vulnerable pipeline components
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Thank you for listening

Any further questions?

Paul Otway