

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

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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

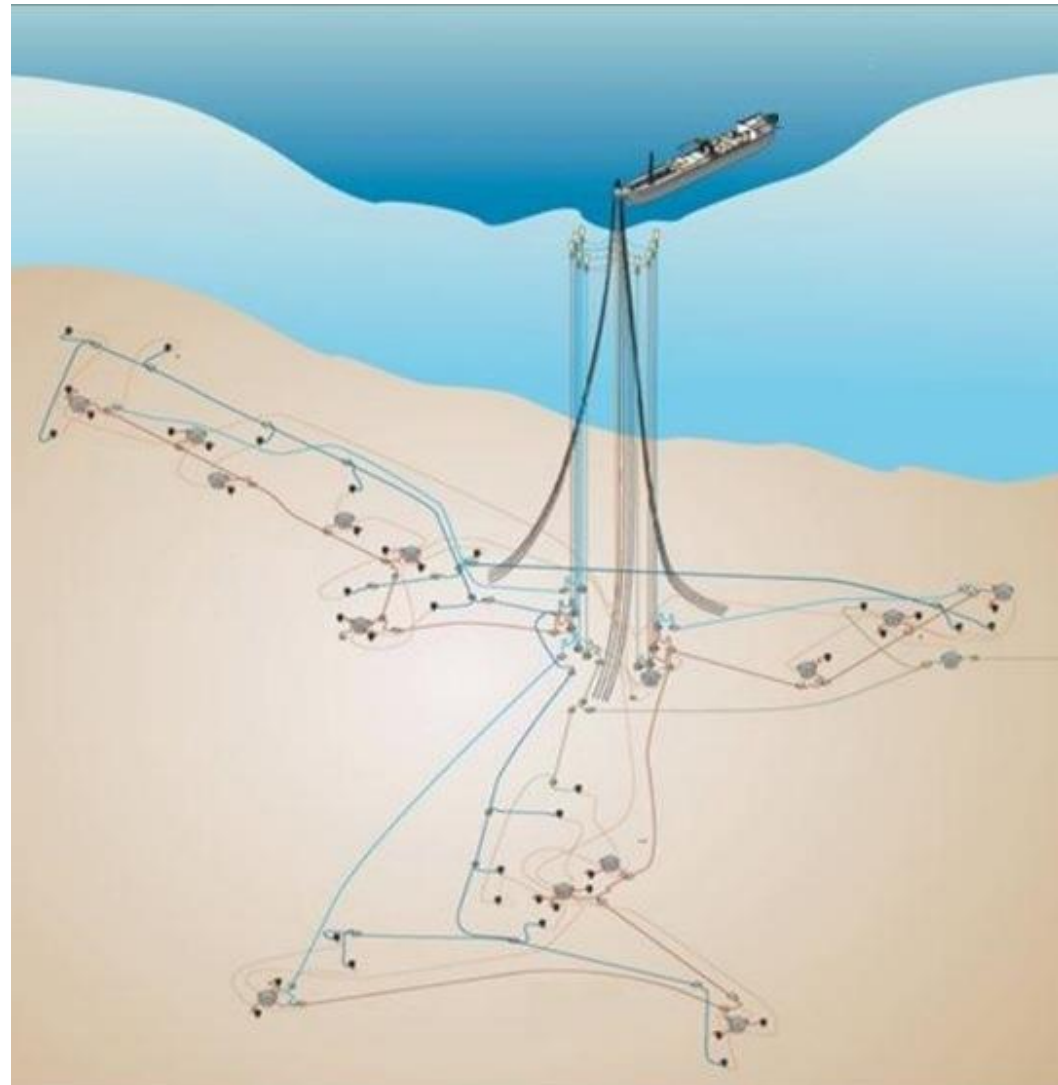


- Engineer an operational pigging capability for five deepwater flowline loops from two FPSOs
 - Define pigging strategy for the region
 - Define SoRs for pigs and services to be supplied by pig vendors
 - Cleaning pig tender review and evaluation
 - Technical assurance of pig designs
 - HAZOP of new 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

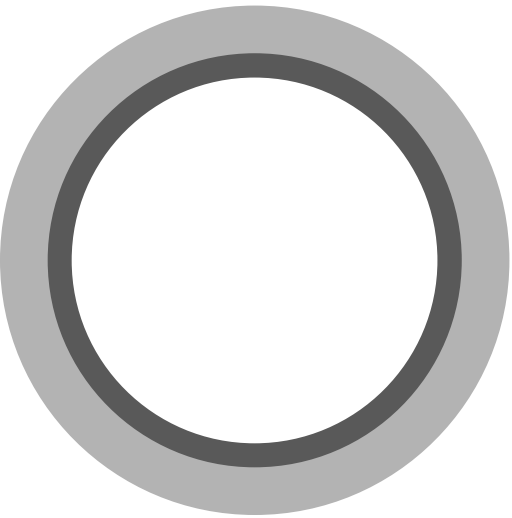
- Reduce risk of under-deposit corrosion at water cuts >5%
- Regular operational pipeline cleaning
 - Wax
 - Sand
 - Other contaminants
- Reactionary pipeline cleaning
 - Response to sand events due to gravel pack failure etc.
- Pre-ILI cleaning operations

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



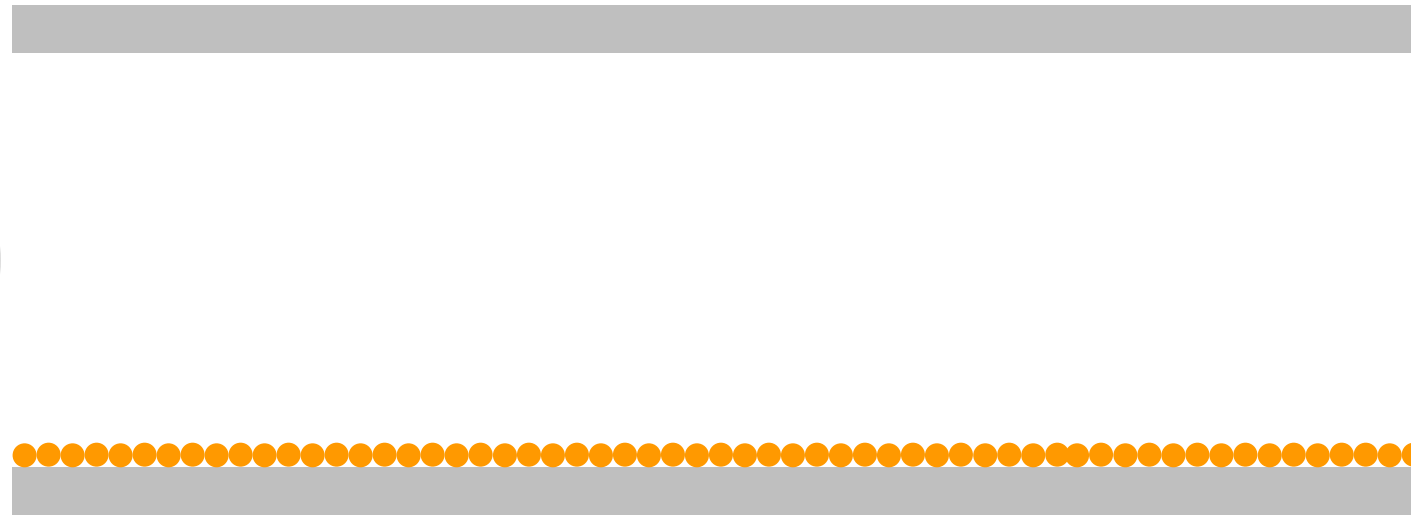
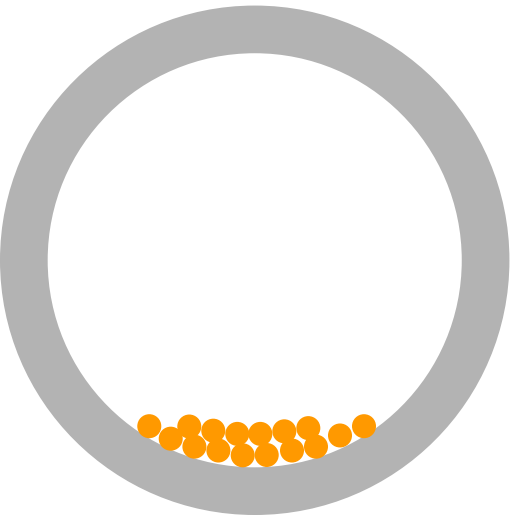
Case study: Requirements and pig types



- 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





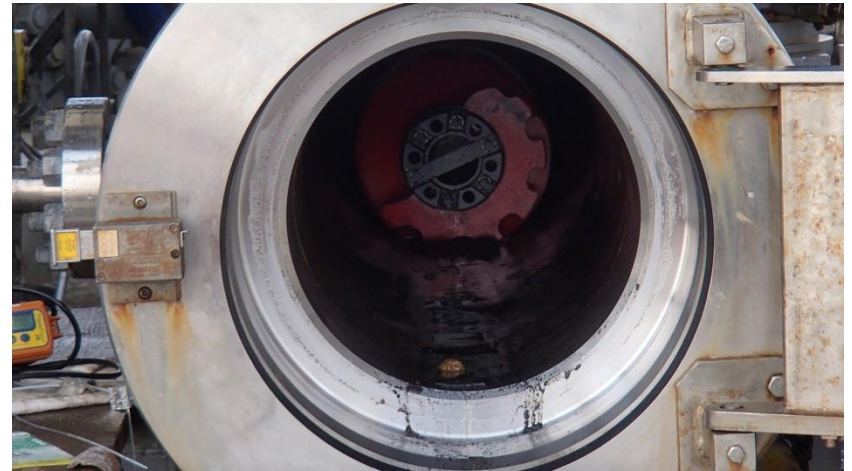
Case study: Ops pigging 2014

- 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

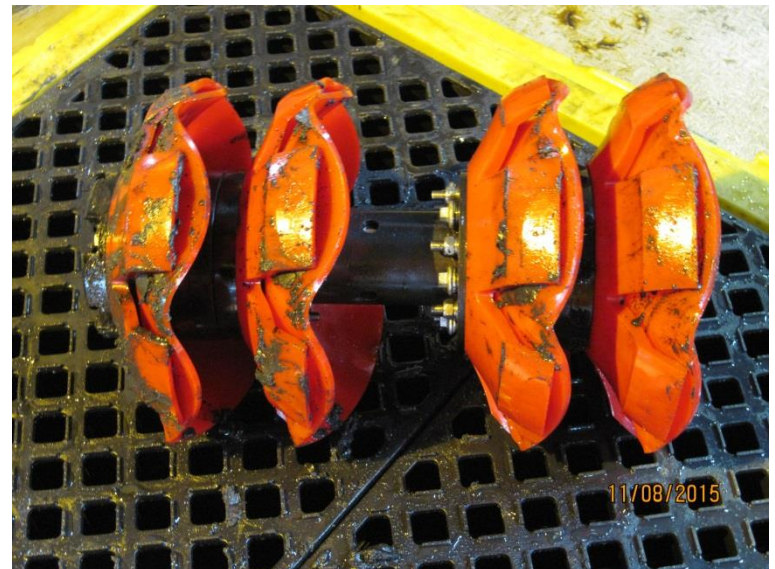
Case study: Pre-ILI cleaning 2015

- 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?

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