An example of applying the HOIS non-intrusive inspection guidance document

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Agenda

- Introduction
- Non-intrusive inspection philosophy
- Slugcatcher deferment
- Subsequent slugcatcher internal examination
- Lessons learned
- Conclusion
Non-intrusive inspection philosophy

- We use the Internationally recognised NII guidance document DNV-RP-G103 developed by HOIS
- The document gives us a framework for
  - The correct selection of NII verses IVI
  - Defining a suitable & sufficient NII workscope
  - Assessing results
- Utilising NII as part of the risk optimisation process can
  - Avoid personnel risk associated with opening vessels
  - Avoid damage to linings etc during intrusive inspection
  - Have an enhanced probability of detection where access poor
  - Reduce shut-down durations
  - May reduce cost (but note can be time consuming & high day rates for specialist NDT)
Deferment of slugcatchers - why

Due for examination in 2008 as part of WSE under PSSR 2000

But, desire to align intrusive visual examination with 2009 workscopes

Length = 30m & Ø = 3m
Deferment of slugcatchers – initial assessment

<table>
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<tr>
<th>Vessel</th>
<th>Diameter [m]</th>
<th>Length [m]</th>
<th>Shell area [m²]</th>
<th>Number of strakes per nominal:</th>
<th>Area per nominal [m²]:</th>
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- NII versus IVI applicability assessment to HOIS NII guidance document
  - Vessel design and operating data
  - Corrosion assessment
  - Degradation mechanism review
  - Inspection history & capability
Deferment of slugcatchers – workscope

- Inspection workscope based on HOIS NII guidance document
  - External CVI
  - Shell, nozzles and end-caps via manual & automated ultrasonics
  - Construction welds via TOFD
  - Nozzle flange faces via shear wave ultrasonics
  - Vessel trim via radiography
Deferment of slugcatchers – NII output

- Inspection results review based on HOIS NII guidance document
  - Minor external corrosion on flanges
  - Minor internal corrosion noted to shell and welds (< 6mm corrosion allowance & << API 579 limits)
  - Flange faces & trim clear
Deferment of slugcatchers - assessment

- Deferment assessment based on HOIS NII guidance document
  - Included extreme value analysis of shell ultrasonic thickness checks
  - Risk assessed as part of Safety Critical Element Deferment Risk Assessment process
One year on - internal examination

- Removal of a significant quantity of debris
- No linear indications on welds identified via ECI
- Most internal surfaces “pristine”
- Two areas of minor weld degradation & one minor pit on vessel shell
  - unexpected result, although within corrosion allowance less than one in a million according to NII EVA
  - negligible effect on vessel integrity (<< MAWT from NII assessment)
One year on - internal examination

- One area of pitting on a nozzle bore at bottom of vessel
  - unexpected result, not covered by NII EVA / nozzle sampling exercise
  - repaired

- Weld corrosion on N2 purge lines
  - unexpected result, extensive radiography in 2008 did not identify weld issues on other types of trim
  - but, purge lines were not included in NII exercise as were covered by piping RBI
  - opportunity taken to blind off or replace
One year on - internal examination

- Flange face corrosion identified
  - expected result, a defined life repair had been installed on a N2 purge line flange suggesting flange face corrosion may be an issue
  - repaired

Removed 2009
Lessons learned from slugcatchers

- Reinforced need to include the following as part of the RBI process
  - Optimisation of NII verses IVI decision via the HOIS NII guidance document
  - NII & IVI technique limitations (eg probability of detection)
  - Design improvement opportunities (for example, dead-leg elimination)
  - Link between pipework & vessel RBI

- Include all vulnerable nozzle bore as part of future NII exercises
  - Minimal cost impact
  - Vulnerable as typically thinner
  - May avoid need to include in extreme value analysis

- Resource allocation
  - Rigorous application of HOIS NII guidance document requires time and effort
Conclusions

- ConocoPhillips continue to successfully use the NII guidance document DNV-RP-G103 developed by HOIS

- Issues with access for inspection encountered as part of other vessel NII exercises addressed as part of the HOIS NII guidance document update

- At present, alternating NII and IVI is likely to be an optimal strategy

- Industry should continue to drive improvements in both RBI assessment techniques & inspection technologies to develop the NII process