Case History: the NAM K-08 FA 103, the Offshore Installation of a Chemical Injection Safety Valve system in the North Sea

Rodger Lacy, Weatherford International
Bert Lugtmeier, Dick Klompsma - NAM
A Case History: the NAM K-08 FA 103. The Development and Successful Installation in a North Sea Offshore Well of a Complete System to Allow Continuous Downhole Chemical Injection Without Affecting the Subsurface and Surface Safety Systems

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B. Lugtmeier, D. Klompsma Nederlandse Aardolie Maatschappij (NAM); Stuart Hamilton (Shell); R. Lacy, W. Hearn, S. Dennistoun, E. Calzoncinth, J.L. Jacob (Weatherford International)
Current State of Art in NAM (Onshore)

- Retro-fit via and including SC-SSSV using existing controls
  - (Late ‘90’s concept; Shell patent)
Continuous foam injection valve blockage:  
...Still an issue...

Foam

Foam

~1 inch diameter

Magnetite (corrosion product)

Seat corroded

Shattered Tungsten-Carbide seat

Ball ‘wedged’ into seat

Pitting found in Inconel 625 capstring
Issues Summary

• Corrosion
  • Retro fit => flow path not completely corrosion resistant

• Reliability
  • Failures require frequent wire-line interventions

• High Working Pressure
  • WP makes dosing difficult
  • Back pressure valve design difficult
Continuous Foam Injection Offshore

• New State of Art

• Initial design requirements (mitigating current issues):
  • Reliable
  • Use existing SC-SSSV landing nipple/control
  • Existing control system to remain unaltered
  • Multiple installation/retrieval with Wire-line
  • No corrosion
  • Good injection control
  • Wider choice of chemicals
Continuous Foam Injection Offshore

- Basis for design:
  - System for installing a safety valve in wells with a damaged or blocked control line developed by NAM and Weatherford

- Wireline Damaged Control Line Safety Valve

  - WDCL\textsuperscript{(Weatherford)}
    - NAM-Weatherford (CIW-FMC)
    - 3 successful installations (L13, Gannet, K17)
    - 2 planned installations (Barque)

- Proven Technology
L-13 First Installation
• May 2009
• Blocked Control Line
• Still in place
WDCL- Detail 2
Hanger Nipple CL-Plug

- Fishing Neck
- Top Seals
- Pressure Port
- Bottom Seals
- Locking Sleeve
- Locking Keys
- Internal Control Line
- Body
- Gas Flow Ports
- Control-line Hanger
- 1/4" Control-line
- P-seals
- Drilled Control-line Port
- Control-line valve
- Metal to Metal seal
- Wellhead assembly
- Seal assembly
- Original Control-line feed through
- Hanger Nipple
- 1/4" By-pass Control-line
- Solid block X-mastree
WDCL - Detail 1
Stinger Assembly
Continuous Foam Injection Offshore

- **Latest development WDCL** (Weatherford):
  - Included in Gannet, K17 and Foam String Design

- **Injection via Lower Master Valve**
  - Adjustable Wet Connection (hanger neck)
  - Less dependant on drawings and wireline measurement
Install Gate assembly, modified bonnet assembly, pressure fitting and hand wheel. The bonnet has both an external needle valve and a tangential internal needle valve giving two barriers.
Continuous Foam Injection Offshore

Fluid inlet

QX style lock with dogs to land in BPV profile, type H threaded or premium wireline locking groove

Adjustable Length
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- Capillary Line Connector
- WET CONNECTOR
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Continuous Foam Injection Offshore

New State of the Art Foam Injection

- Wireline Retrievable
- Operated by Existing control systems
- Corrosion resistant flow path
First installation K08-FA 103
(NAM Offshore NL) November 2010

- Restored production of 90,000 m$^3$/d
  (3.18 mmmscf)

- This development process is an excellent example of what can be achieved by Operator and Supplier working in concert to address a problem and generate a viable solution
Continuous Foam Injection Offshore - Conclusions

Scope: 36 wells (Shell UIE Offshore)

- 2011: 9 wells
- 2012: 13 wells
- 2013: 2 wells
- 2014: 6 wells
- 2015: 6 wells
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