Continuous Surfactant Injection to Remediate Liquid Loading at Satellite Installations in the SNS

Alistair Agnew, Kirsten Agnew, Iain Brown, Brian Marr, Tom Moore, Mark Oatey
Agenda

- Field Background
- Well Liquid Loading
- Weatherford Retrofit Capillary Injection System
- Capillary String Deployment
- Process Modifications
- Results
- Summary
Field Background

- V-Fields comprise of 4 separate gas accumulations:
  - North Valiant
  - South Valiant
  - Vanguard
  - Vulcan

- All produce through normally unmanned production platforms via the Lincolnshire Offshore Gas Gathering System (LOGGS) complex to Theddlethorpe Gas Terminal

- Production commenced in Oct 1988 and current production rates are 50 MMcfd gross
Well Liquid Loading

- 13 out of 16 V-Field wells in varying stages of liquid loading
- Typical load rate 4-5 MMcfd at 12 barg WHP (5 1/2” tubing)
- Options considered to remedy:
  - Suction Pressure Reduction
    - High cost of rewheel and capacity limitation - no additional value add
  - Velocity Strings
    - Three previously installed in 2002 with mixed success
  - Capillary Strings
    - Preferred option, results backed up by success of batch surfactant campaigns
V-Fields Capillary String Project

- Install 10 capillary strings at three V-Field satellite installations 2012 – 2014

- Topsides modifications at LOGGS and satellites;
  - Chemical pumps
  - Spillback loops
  - Filter packages
  - IRCD’s and SDV’s

- Well candidates selected based on:
  - Remaining reserves and flowrate
  - Clear access to top perforation
  - Suitable well trajectory

- GMS Endurance jack-up vessel (on site for fabric maintenance campaign) utilised to support 24 hour well intervention operation
Three capillary injection systems considered

Weatherford Retrofit System selected

— Engineered and developed for deploying into mature wells that were not originally designed to accommodate chemical injection

— Maintains safety valve integrity and operability with existing control line and enables injection of foaming agent below WR-SCSSV

— Deployed on slick-line and does not require rig intervention
Key Components

**Lower Master Valve - LMV**

- New LMV is installed with modified seat to allow:
  - Injection point below gate
  - Provide No-go for CLH

- Modified LMV bonnet provides tie-in point to topsides surfactant system

**Control Line Hanger - CLH**

- CLH provides hang off point for upper capillary string
- Seals of CLH straddle the modified LMV seat the CLH is locked into the tubing hanger neck BPV profile
Key Components

**Downhole Safety Valve**

- New, modified WR-DHSV is installed which:
  - Provides flowpath for chemical around closed DHSV flapper
  - Incorporates integral pod for stinger to latch
  - Provides hanger for lower capillary string
  - WDB activated packing system
**Capillary String Deployment**

**Operations Sequence**

1. Rig up slickline. Drift to HUD and set tubing plugs.
2. Change-out lower master valve.
3. Pull tubing plugs on slickline and lock out TRDHSV (if required).
4. Run lower cap string and set WRDHSV.
5. Run upper cap string and set CLH.

**Significant improvement in operational efficiency with each campaign as learnings applied**
Surfactant Storage and Distribution

- Redundant subsea methanol pipeline from LOGGS complex to satellites modified to inject surfactant and redundant chemical storage tank on LOGGS re-utilised as a means of surfactant storage
  - Negates need for additional satellite visits to re-fill surfactant stores
  - Cost effective tie-ins for future satellites
- Installation of antifoam injection system to inlet separators to control separation of gas/liquid
Results

- 10 strings deployed to date
- 3 awaiting commissioning after August 2014 installation
  - 1 well is awaiting further tests on DHSV control line to allow sufficient time for DHSV swellables to expand.
- Of the seven wells in operation:
  - 2 will not flow unless surfactant injection is online
  - 2 see an incremental benefit when surfactant is online
  - 2 are currently not experiencing liquid loading issues (installed proactively)
  - 1 capillary string is air-gapped awaiting topsides maintenance
- Significant benefits noted across all wells when operating at higher WHP (during periods of process instability)
Capillary strings are successfully operating at V-Fields with continuous surfactant injection into liquid loaded wells.

Significant production benefits have been observed.

Potential candidates under assessment at other locations.