Latest developments and applications of spoolable CT connector technology

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Agenda

• Introduction

• Overall design drivers - specific requirements

• Latest developments

• Plastic bending performance

• Type of applications performed

• Track record

• Summary
Introduction

- CT Spoolable connector
  - Allows joining of two or more sections of CT
  - Development initiated in 2002
  - First application in October 2003 - ongoing since
Overall drivers

- Reduce weight of CT reel – offshore and onshore
- Provide on-site connection method not involving welding
- All work performed by CT crew – no specialized verification procedure after making connection (i.e. X-ray)
- Proof-up only requires internal / external drifting and pressure testing
- Easy to follow in between run checklist, for verification of fit for service
- Increase CT utilization – alternative repair method – avoid specialized CT strings with low utilization (length)
- Apply correct size of CT for the job – extend CT market
Crane limit 32t
7505 m of 2 3/8” CT - 24620 ft
1 x 31t + 1 x 25t - 1 connector
Single lift would be 49t
Alternative CT size = 1.5”
1.75” CT application

- Small platform – 12 t limit
  - Welding and inspection would have been difficult
  - 1.75” CT required to shift sleeves in horizontal wells
Specific design requirements

- Specifics
  - Up to 4000 psi (27.6 MPa) dynamic pressure rating
  - 10 000 psi (69 MPa) static pressure rating (or 80% of yield)
  - Up to 200 deg C temperature rating of seals
  - 80% safe pull rating (same as CT)
  - Torque capacity in line with BHA end-connectors
  - Sufficiently large ID for passing of standard sizes BHA activation balls
  - Acid and H2S compatible
**Latest developments**

- **Enhancements**
  - Increased fatigue life by better matching CT and connector
  - Increased internal diameters ID for passing of standard sizes contingency cutters (chemical / explosive)
  - Compatibility with internal cable to pass through without effecting cable
  - Machined from one piece – no loose or attached parts – no O-ring grooves (stress raisers)
  - Multigrade connector, suitable for CT of 80, 90 and 100 CT
  - Can be used on standard CT equipment (tight bend forms) – no modifications required
Plastic bending performance

- Plastic bending simulation – put the major stresses where connector is defined best – reduce stress in CT-connector interface and seal area
Plastic bending performance

- 2.0” CT        4000 psi (27.6 MPa)    55” bend radius
Pull test connector with 2.0" CT800 x 0.156"

- Pull Force
- Dimple section displacement (from compression to tension - double sided)

- 50% of CT yield
- 60% of CT yield
- 70% of CT yield
- 80% of CT yield
- 90% of CT yield
- 100% of CT yield

Time (min)

- Connection section displacement (mm)
**Type of applications performed**

- Applications:
  - Cleanouts
  - Scale milling
  - Open hole drilling
  - Acid fracing
  - Perforating
  - Chemical washes – scale squeezes
  - Fishing
  - Water shut offs – chemical and plug setting
Spoolable connector track record

- 32 jobs (wells) completed
  - 178 runs completed
  - 35 installations
  - Max. number of runs for one 2 7/8” connector = 19 runs
  - Max. number of runs for one 2 3/8” connector = 17 runs
  - Max. number of runs for one 1.75” connector = 11 runs
  - Typical weight reduction 30 – 40% - maximum achieved was 53% (with 2 connectors)
  - Current sizes available from 1.75” – 2 7/8” CT
Summary

- **Enabling technology**
  - Have created CT applications that did not exist before
  - Many are high end applications, representing new grounds for CT
  - Increased safety - especially for 2 3/8” and 2 7/8” CT
  - Increased utilization of CT – less inventory – less specialized CT strings (length)
  - Used technology as alternative CT repair method
  - Latest developments increased suitability of spoolable connector technology, while also providing contingency options
Thank you!

Questions?