Latest on deepwater installation with HMPE rope

Jorn Boesten
Segment Manager Offshore for DSM Dyneema
MCE Deepwater Development
Madrid, April 9 2014
Why?

- Industry needs to install larger components in deeper waters
  - 4000 meters now the target
- Many developments have taken and are taking place
- Overview needed on the state of the art
  - Technologies that are out there
  - Status of the development projects at rope level
Why HMPE?

**Case 1 “Crane”**

- 50 mm wire  
  MBS = 212 tons
- 3 km weighs 34 tons
- 3 km HMPE weighs 5 tons  
  (neutral in water)
- Lift capacity: 70 tons  
  @ 3000 meter: 45
- Lift capacity: 70 tons  
  @ 3000 meter: 70  
  >50% payload increase
- @ higher safety factor (3.5)  
  Payload @ 3000m: 61 tons  
  >35% payload increase

**Case 2**

“System designed for payload at 3000 meters”

- Diameter: 30mm
- Diameter: 20mm
- Smaller winch
- Smaller sheaves
- Lower investment
Deepwater lowering technologies
Deepwater lowering technologies

Discuss technologies which are already out there
- Hangoff systems by NOV and MacGregor
- Traction winch
  - ODIM CTCU
  - Logan winch on Shells Perdido Spar
- Drum winch
  - Deeptek adapted drum winch profile, on Expro’s AX-S system
  - Seabed worker
Hangoff

Subsea7 example

- Extension of a deep water installation line offshore West Africa
- Buoyant rope with Dyneema® adds no load to the existing winch
- Pennant of 750 meters, 1250 tons MBS
  Weight: 6.5 tons only (wire: 50%) (almost weightless in water - PET cover!)
- Wet-stored vertically at the sea bottom between deployments
- Now more automated via MacGregor and NOV
Systems in operation
Traction winches

ODIM CTCU
• 46 tons - 3000 meters
• Almost 10 years field experience
• 125 tons, since 2010

Logan
• 40 tons - up to 2700 meters
• Shell Perdido Spar
• Used for servicing subsea equipment
• In operation since 2010
Systems in operation
Drum winches

Deep Tek drum winch
• 85ton - 3000 meters
• Expro AX-S system
• Light well intervention
• Successfully tested in deep waters
• Uses a ‘chevron’ pattern for rope spooling

Swire Seabed
• ~25 ton >6000 meters
• Salvage operations
• Apollo 5 engine @ 4600m
• 1400 tons of copper @ 3200m
Also in mobile cranes...
Technology developments on rope performance
Developments

3 technologies for enhanced bending performance

Fiber level - XBO Technology
- Improved bending through overlay finish
- Permanent, will not wash off
- Several times improvement on bending in a rope

Coating technology - IcoDyn10
- Coating technology for enhanced bending resistance
- Several times improvement on bending in a rope

Rope construction
- Optimized for bending

The combination of these technologies allows an engineer to design the rope and balance CBOS performance with other properties
Technology developments
CBOS in large diameter rope on par with SWR

Cyclic Bending Over Sheave
- 10 years ago CBOS performance of steel wire rope was better than HMPE rope
- New technologies developed that bring HMPE rope performance on par with SWR. also at rope diameters >100mm

- Life factor = DSF*(D/d)
  - DSF=3
  - D/d=20
  - LF=60 (severe) and 120 is less severe
Technology developments
CBOS in large diameter rope on par with SWR

- 80 mm SK75 - regular coating
- 80 mm HMPE/LCP - regular coating
- 80 mm SK78 - optimised coating
- 80 mm SK78 - optimised coating - ePTFE
- 90 mm 6x36 SWS IWRC Wire Rope 19D/d
- 35 mm IWRC 16-20D/d
- 32 mm DNV Mooring line 20-30D/d

Life Factor (SF*D/d)

Rope bending cycles to failure

Life Factor 60
Technology developments
Temperature prediction tool for rope > 130mm

- HMPE fiber will melt at 140°C
- Max recommended temp: 70°C
- Heat generated in cross over area
- Temperature increase function of
  - Rope diameter
  - Environment + location (DB,SB)
  - Rope tension
- Being validated at this moment

Cross-over area

Heat flow in radial direction only

Heat zone

Core

Zones of heat input (2 seconds)

Heat transfer to air or winch

t=0s: rope is at uniform temperature
Technology developments
DM20 fiber for extremely low creep

- Rope will heat up in CBOS (heave comp)
- Avoid heat generation and rope heat up through technologies for enhanced bending performance

- HMPE ropes will creep (non reversible elongation over time)
- Creep is enhanced with temperature

- HMPE DM20 fiber offers significantly lower creep rate than any other HMPE fiber, and longest creep lifetime

- DM20 will be available with XBO technology
Technology qualification
Technology qualification
The dilemma

- No standards available yet
- Certification to standards is used for building trust and confidence in proven Technology.
- When standards are lacking, Assurance using Technology Qualification systematics enables certification of Qualified Technology before standards are developed.
- This enables innovation without relaxing certification Requirements.
Technology qualification
No standard available yet, use DNV assurance case

- Drum winch
- 110 mt @ 3000 meters
- Goal is “an integrated deployment and recovery system with Fibre Rope as an engineered mechanical element”
- Using DNV-RP-A203 “Technology Qualification”
- Using claim - argument - evidence methodology
- Joint development by Deep Tek, Jebsen & Jessen, Jaya, Lankhorst Ropes and DSM Dyneema, supported by DNV
Conclusion / Questions

- Several deepwater lowering and lifting systems are operational with HMPE fiber rope
- Fiber, coating and rope construction technologies available to enhance CBOS performance
- CBOS properties of rope made with HMPE on par with SWR
- DM20 will also be available with XBO technology
- DNV RP-A203 enables certification of Qualified Technology before standards are developed.

Jorn Boesten
Segment Manager Offshore for DSM Dyneema
jorn.boesten@dsm.com

Acknowledgements:
Samson Ropes, Hampidjan, Lankhorst Ropes, Logan, ODIM, Deep Tek, DNV