Latest on deepwater installation with HMPE rope

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Why?

• Industry needs to install larger components in deeper waters
  - Cost efficient
  - 4000 meters now the target
• New technology required
  - Is it really so new?
  - What approach to take given conservatism
• Overview on the state of the art
  - Technologies that are out there
  - Status of the development projects at rope and winch level
• Multi layer drum winch - AHC - system introduced
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 @ 3000m: 70 tons
  >50% payload increase

Case 2

“System designed for payload at 3000 meters”

- Diameter: 30mm
- Diameter: 20mm
- Smaller winch
- Smaller sheaves
- Lower investment
Deepwater lowering technologies with synthetic fiber rope.....new? (not really)
Deepwater technologies with synthetic fiber rope

Examples of commercial systems
• 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

• Total length of synthetic rope used on deepwater winches ......
Hangoff

Subsea7 example
• Extension of an installation line offshore
  West Africa
• Buoyant rope with Dyneema® adds no load
• Pennant of 750 meters, 1250 tons MBS
  Weight: 6.5 tons only (wire: 50!)
  (almost weightless in water)
• Wet-stored vertically at
  the sea bottom

Now automated systems
available through MacGregor
and NOV
Traction winches

Rolls-Royce (ODIM) CTCU
- 50 tons - 3000 meters
- Almost 10 years field experience
- 125 tons - 3000 meters
  since 2010 on Skandi Santos
  2\textsuperscript{nd} one - 150 tons - in 2015

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

DeepTek 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 Worker (2010)
- ~25 ton >6000 meters
- Salvage operations
- Apollo 5 engine @ 4600m
- 1400 tons of copper @ 3200m
IMCA fiber rope workshop
Are we ready?

User feedback:
• Lifetime of a fibre rope is longer than a wire rope*
• Use of the rope are far above the original limits set*
• Most operations are not close to system limit*
• New splice is performing well in operation onboard Skandi Santos*
• No issues with fibre rope
• Ropes taken out of service after 5 years with no damage
• “100% satisfactory level”#

* Rolls-Royce presentation
# Doedijns / Logan presentation
IMCA rope workshop
Amsterdam (Oct 29)

My! reflections from Workshop
- Many questions but also many answers
- Several systems are out there with no complications
- Conservative industry
Also in mobile cranes...
Introducing: Multi layer AHC drum winch with soft rope, certified by DNV-GL
110Te in air – 110Te @ 3000 mwd
3 Companies team up

Deep Tek
a system integrator with onsite deployment and recovery experience

Lankhorst Ropes
a world leading synthetic rope innovator and manufacturer

DSM Dyneema
the producer of Dyneema® ultra-high molecular weight polyethylene fiber
Three-Party Cooperation

Deep Tek, a system integrator and implementer with a background in deep water operation; Lankhorst, manufacturer of quality synthetic ropes for cranes and winches; and DSM Dyneema, manufacturer of Dyneema®, the world’s strongest fiber™, have combined their respective expertise to develop a multi-layer, soft rope, AHC, drum winch system that can be installed in offshore cranes.

Collectively, they brand the products and services they supply as ‘Soft Rope Systems’.
Introducing new technology

- Design to standard not possible - prescriptive and not available
- Qualification process extremely time consuming

- The 3 partners chose DNV-GL assurance case methodology for new technology introduction DNV-RP-A203
- User, owner and system integrator together are responsible for safe operating conditions in a staged Technology Qualification process
- Assurance case developed for each TQ step 1-2-3
- Requirements on service context, system and sub-systems
- In line with DNV-OS-407 (underwater deployment and recovery systems)
Maximizing Jaya’s vessel output

- 110 Te in air - 110 Te @ 3000 mwd
- Two sold to Jaya (Mermaid Group)
- Maximizing the output of the 88 meter long vessels
Background: technology developments

Developments to improve rope bending performance
- Fiber: DM20 XBO
- Rope construction: 12x3
- Coating: IcoDyn10

Winching developments
- DeepTek chevron winch spooling
Background: rope developments

Wire rope data (Venneman)
Dyneema® @80mm (improvement last decade)
Dyneema® and wire rope > 100mm

CBOS of rope with Dyneema® XBO on par with SWR

Also tested on par for rope over 100mm diameter
Background: winch developments

Winching developments
- Deep Tek chevron winch spooling

Ensuring proper winching on drum winch
Scope of supply to Mermaid Marine

110 Te in air / 110 Te @ 3000 mwd, AHC, Knuckle Boom Crane by Jebsen and Jessen Offshore

Deep Tek soft rope drum winch

Rope lifeTIME management system

3 kilometer 76mm LankoDeep® AHC 12x3 strand rope. Made from Dyneema® DM20 XBO fiber

Certified by DNV-GL
Conclusion

• Several systems are in use with HMPE fiber rope
• Subsea construction ropes and winches are key enablers for cost efficient operations
• When installing in deep waters the advantage of fiber rope over wire rope is crystal clear
• Lankhorst, DeepTek and DSM Dyneema teamed up to commercialize AHC drum winch, 110 tons @ 3000 meters water depth, DNV-GL certified
• Larger systems are under development: 165 and 275 tons

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