

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

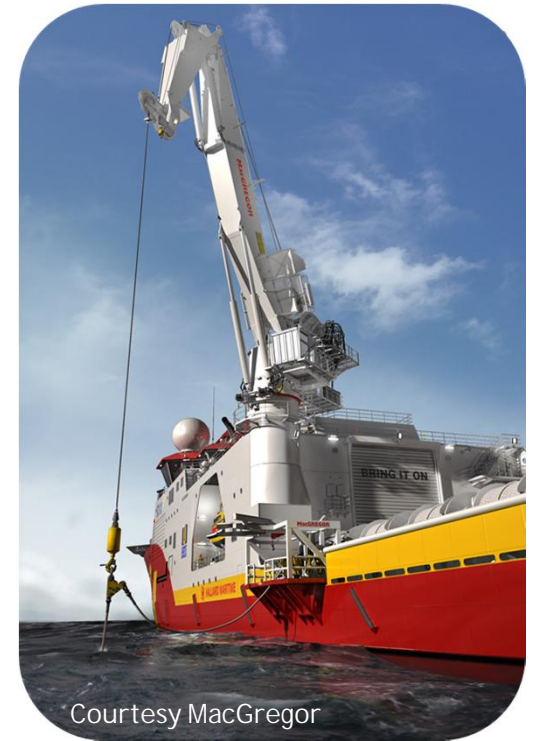
Discuss technologies which are already out there

- 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

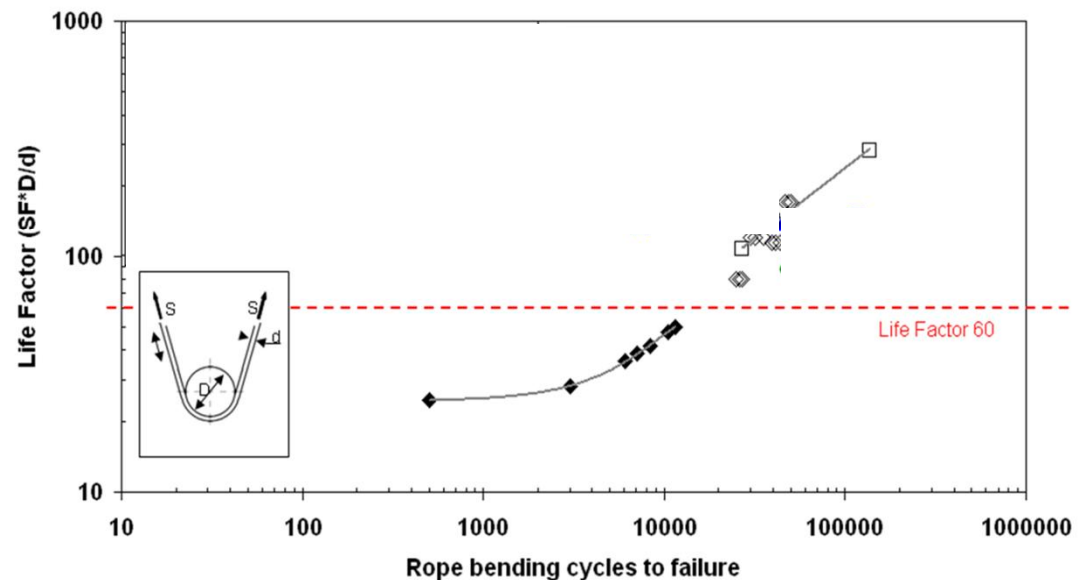
CBOS in large diameter rope on par with SWR

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 = $DSF \cdot (D/d)$
 - $DSF=3$
 - $D/d=20$
 - $LF=60$ (severe) and 120 is less severe

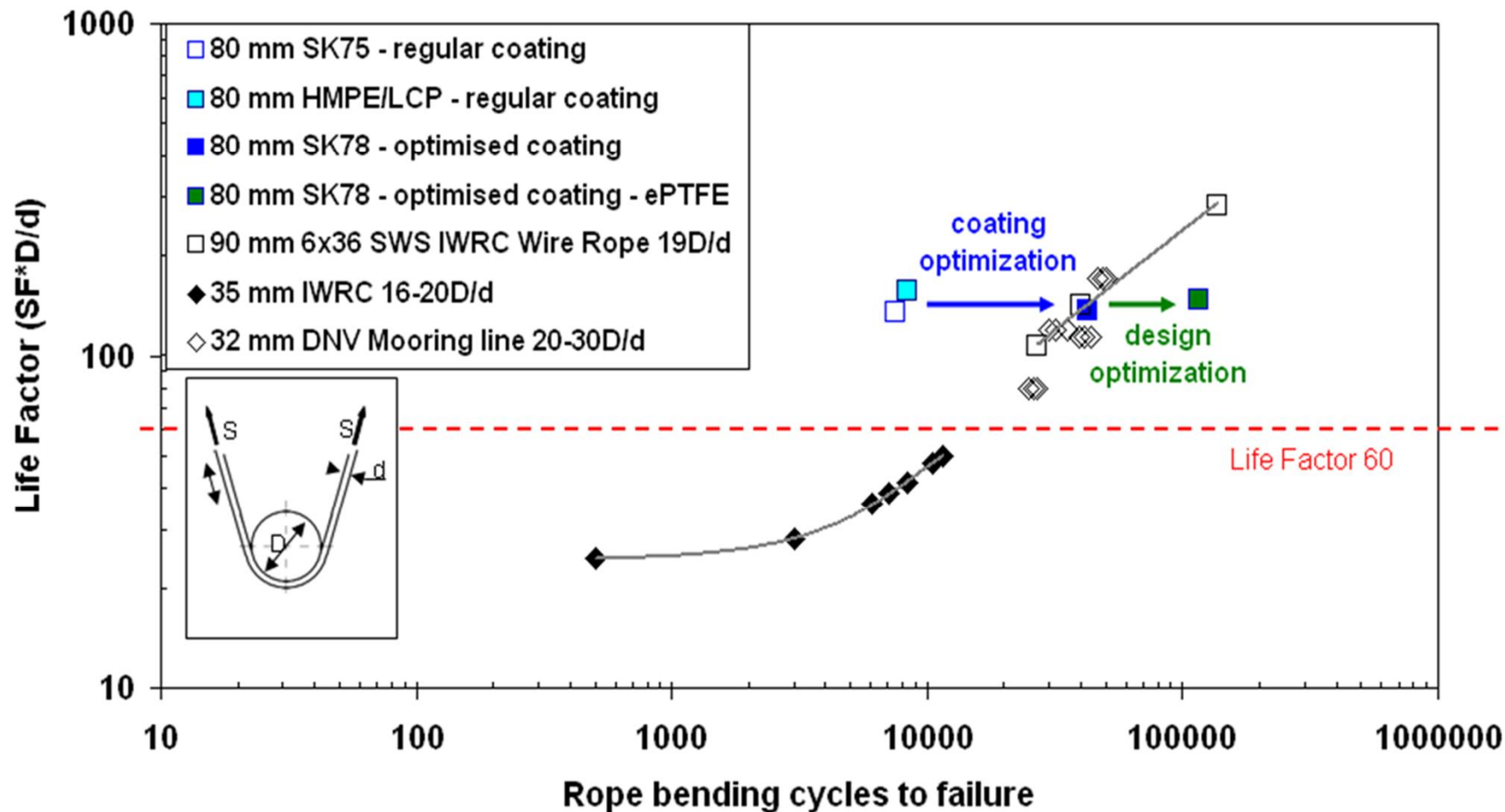
Bending fatigue improvement by optimized coating and rope design





Technology developments

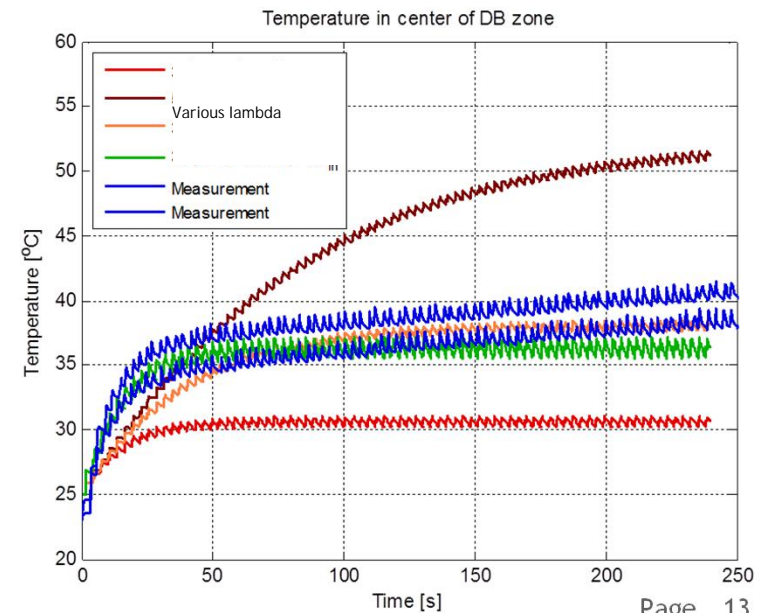
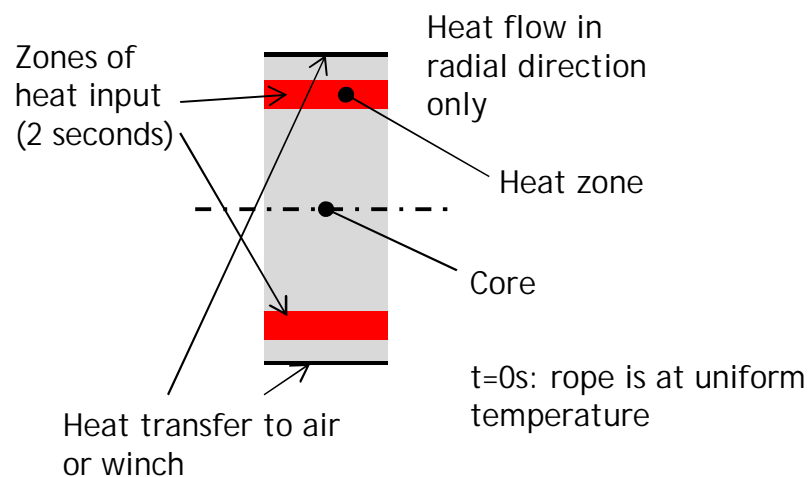
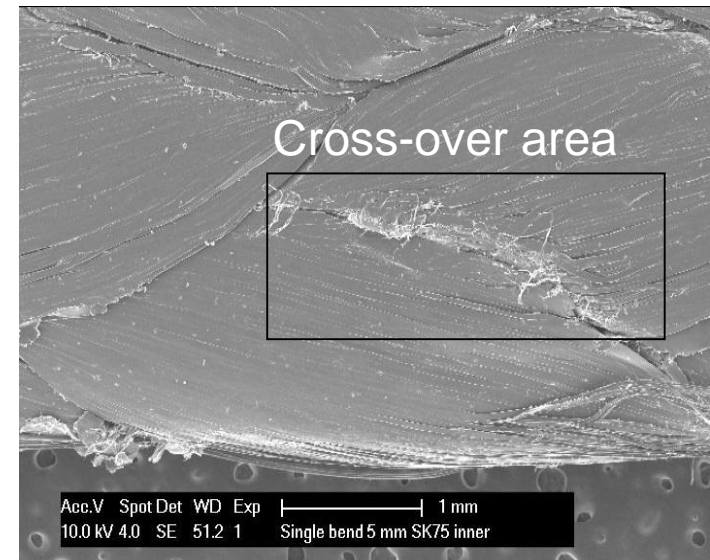
CBOS in large diameter rope on par with SWR



Technology developments

Temperature prediction tool for rope > 130mm

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





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



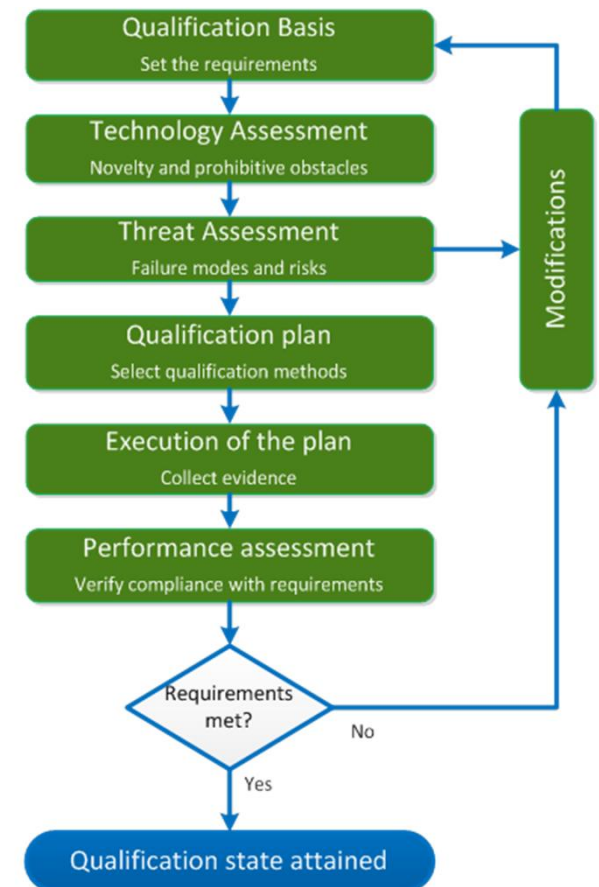
Technology qualification



Technology qualification

The dilemma

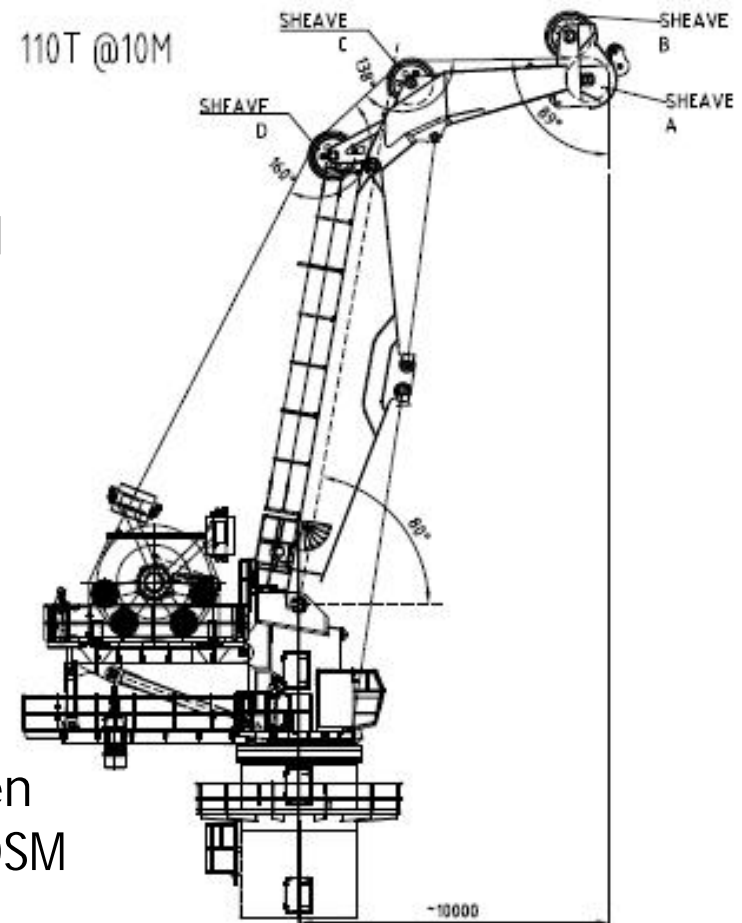
- No standards available yet
- Certification to standards is used for building trust and confidence in proven Technology.
- When standards are lacking, Assurance using Technology Qualification systematics enables certification of Qualified Technology before standards are developed.
- This enables innovation 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



BRIGHT SCIENCE. BRIGHTER LIVING.™