Developments in Deepwater Handling Systems

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Caley Ocean Systems

Glasgow based, over 45 years experience of building bespoke handling systems for the Offshore industry

Deepwater lowering systems - to 2,200Te and 2,000msw
Friction clamps - to 1,200Te and 36”
Dive handling systems - DNV, LR & ABS; Hyd/VSD
Heavy weather boat handling - 15Te and 6m sig.
Carousels and reels - to 7,000Te and 30m OD
Zoned well intervention – MARS; IWOCS; 2,000m
Synthetic rope systems - to 10,000m
Integrated tensioner systems - Multi-track
A-frames - to 200Te and 21m wide

Core competencies:
Innovative supplier of marine handling systems
Design consultancy
Project Management
Worldwide manufacturing
Engineering Services
Seanamic Group

Seanamic Group provides integrated surface to subsea systems to the oil and gas, offshore cabling, diving, oceanographic, seismic and naval defense industries.

Caley Ocean Systems, and Umbilicals International - a leading designer and manufacturer of custom dynamic thermoplastic subsea umbilicals and cables for use in harsh environments

Seanamic Synergies

• Opportunity for single source supply that simplifies supply chain management – provides the platform for innovation in surface to subsea engineering, enhance customer project performance.

• No compromise on technical / engineering capability – products / services designed to work together.

• Access to the Group’s ‘problem solving’ resource and engineering skills to deliver customised solutions.
Developments in Deepwater Handling Systems

Deploying subsea processing equipment to deepwater depths, in excess of 1,500m, is challenging the industry to reassess long held assumptions on the performance of steel wire and synthetic fiber ropes, together with winch technologies. Here we review:

• Offshore handling systems design

• Offer some guidance on steel wire and fiber rope selection

• Show how ropes developed to use existing winch technology may hold the key to the successful deployment of future deepwater installation systems.
Handling Systems Design

Water depth

Requirement for lifting, as well as lowering

Deployment vessel’s characteristics

Deck and manual handling

Package size, weight and shape.
Handling Systems Design

Deployment medium: steel wire, fiber rope, riser or umbilical

Operational requirements and mobilization time

Fixed vessel installation or portable modular system

Client, Class and Factors of Safety (FoS).
Winch Technology Options

Single Drum Winch
Simple to operate and widely used
Steel wire, umbilicals, cable and fiber rope
Highly responsive (active heave compensation)

Traction Winch
Allows even spooling tensions on long lengths
No fleeting angles provide layout flexibility
Good for steel wire and some synthetic ropes
Relatively complex.
Deepwater Lowering System

Requirements:

Lower subsea structures weighing up to 950Te in 1,300m water

Steel wire selected – self-weight less than 40% of full depth load

Limited deck space – compact traction winch selected

Fully self-contained system to minimize mobilization time

Crane block must not enter water.
Deepwater Lowering System

Key points:
- Standard traction winch technology
- Novel connector and lowering beam
- Multi-fall system with wire rope training.
Intervention Tool Deployment

Requirements:

Deploy a tool for well intervention (scale squeeze) using riser as deployment medium to 1,600m

Avoid cyclic loading - Riser 10 times weight of tool in water

Must be transportable, modular and suitable for vessels of opportunity

Application clearly demanded a full FMEA.
Concept of operation:

Tool to be skidded to a workstation positioned either over a moonpool or the vessel’s stern, where it could be safely worked on before overboarding.
Intervention Tool Deployment
Intervention Tool Deployment

Key points:

Lazy ‘S’ riser profile creates a passive heave compensation system – simpler than active heave compensation

Single drum winch, large overboarding wheel acts like A-frame

Minimal deck space, while respecting riser limitations

Riser far heavier than tool demanded a detailed Conops

Safe DP run off strategy developed.
IWOCS Deployment System

Requirements:

Deploy IWOCS deployment system on multiple vessels of opportunity

Self-contained and portable

Minimise manual handling / intervention.
IWOCS Deployment System

Key points:

Dedicated A-frame and docking unit

Portable and smaller footprint than conventional IWOCS deployment systems

Equipment is fully captured during in-boarding and outboarding with minimum manual intervention

Handling system for ease of deployment and retrieval of flying leads.
Offshore Handling Systems – Going Deeper

Choice of media: steel wire, fibre rope, umbilical and riser

Deepwater deployment limits choice to steel wire and fibre rope

Weight of packages rising in line with trend towards increased subsea processing
Deepwater Deployment – Steel vs Fibre

Current state of the steel wire vs synthetic fiber debate:

Preference for steel wire - it’s known and proven – industry remains unsure about synthetic fiber (service life and inspection)

Focus has been on winch technology to overcome rope limitations

*More pragmatic approach needed.*
Steel Wire vs Fiber Rope

Steel wire:
- At greater water depths, self-weight of steel wire becomes increasingly dominant
- Proven technology, but payload capacity diminishes

Synthetic fiber ropes:
- Neutral buoyancy keeps equipment sizes down at greater working depths
- Qualification improvements mean lower risk

Large cost difference (3:1).
Steel Wire or Fiber Rope?

Note - ‘Significant’ is subjective but may be when it contributes 40% or more of full depth load

Is the self weight of the wire rope significant?

Yes

Is the package weight high?

No

Consider synthetic rope

Note - No specific reference to water depth at this stage

Yes

Remember that the splice SWL and design can be a driver not just in terms of SWL and D:d ratio but also length (docking head etc. need to accommodate the diameter increase).

Consider wire rope
Applying normal DNV/LR safety factors on 1960 grade wire rope

Single fall systems, with no sheave losses

In reality, tipping point percentage lowers as the payload increases.
Historical context

Early 2000s: DISH JIP - Some inherent limitations overcome by CBOS testing and blending (e.g., BOB rope)

Others limitations, however, remain:

- Low friction combined with low melt point
- Vulnerable surface abrasion
- Poor radial strength leads to flattening

Therefore limited take up over the past 15 years, and special handling systems where fiber ropes have been used.
Steel-like Fiber Ropes

New generation synthetic ropes with ‘steel-like’ properties from Hampidjan

Tight dimensional tolerances through pre-stretching

Retained roundness under compression - i.e. no flattening

Tough i.e. high resistance to surface abrasion

Good friction characteristics - much better than straight Dyneema 12 x12

Good MBL ratio - supported by extensive CBOS testing.

Fig: Hampidjan 38mm DynIce Warp (99Te MBL)
Conclusions

Deepwater deployments – synthetic fiber ropes are now a viable alternative in overcoming the self-weight limitation of steel wire

Cost and perceptions around handling complexities have limited the uptake of fiber rope

‘Steel-like’ fiber rope can be readily retro-fitted to existing handling systems

Growing knowledge of multi-fall applications for wire ropes make ultra-deep, high load installations increasingly viable.