ROPS: An Alternative to the Industry Standard

SUB SEA SERVICES AS

SERAJ HELU, AFTERMARKET MANAGER
Sub Sea Services AS

- 26 Years in Drilling Equipment
- OEM for a wide array of Equipment
- Head Quarters
  - Stavanger, Norway
- Offices
  - Kristiansund, Norway
  - Mongstad, Norway
  - Aberdeen, United Kingdom
  - Macae, Brazil
- Partnerships
  - Bay Bulls, Canada
ONE STOP FACILITY & CONTROLLED VALUE CHAIN TAKES THE HASSLE OUT OF MARINE RISER REPAIR

IN HOUSE SERVICES

- INSPECTION & REPAIR
- BUOANCY REPAIR
- SPARE PARTS
- WELDING
- PAINT & BLAST
- INDOOR STORAGE

Facility based on the successful marine riser maintenance facility model in Norway

TOUR THE FACILITY HERE
MOONPOOL UPGRADES
FOR IMPROVED SAFETY & EFFICIENCY
BOP UPGRADES
FOR IMPROVED SAFETY & EFFICIENCY
ROPS Operation
# Proven Track Record

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<tr>
<th>Drillships</th>
<th>Semi submersibles</th>
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<th>Fixed installation</th>
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<td>Stena Drillmax</td>
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ROPS - Development

Mark I
• 1997
• Partial Hydraulic Automation

Mark II
• 2004
• Increased Hydraulic Automation

Mark III
• 2007
• Full Hydraulic Automation
Mark I – Starting Framework

- Joint R&D venture funding from Norwegian Operator and U.S. Drilling Contractor
- Increase safety and efficiency of operations
- 1st Delivery 1997
- 10 units delivered
- Basis for future development: Tungsten Carbide and 180 deg sweeps
- Remote Controlled Operations: Stop Collar, Latch, Piston
Mark I – Starting Framework
Mark II – Drive to Remote Operated

- Continued drive towards safety and efficiency in operation
- 1\textsuperscript{st} Delivery: 2004
- 4 units delivered
- Basis for future development: Male & Female stabs, Park Head
- Remote Controlled Operations: Tilt, Extend, Lock/Unlock from terminal and park head
Mark II – Drive to Remote Operated
Mark III – Remote Operated Pull-In System (ROPS)

- No man riding or basket use
- Connection time 1 hr
- 1st Delivery: 2007
- 39 units delivered
- Full hydraulic operations
- Critical interfaces – field interchangeable
Mark III – Rig Operation on the Quay
High Pressure Equalized (HPE) Swivel

- R&D project
- Increases longevity of moon pool hoses
- More maneuverability of rig
- 1st Delivery: 2005
- 623 units delivered
- No bearings or grease
- Multiple applications
  - Christmas Tree, Tensioning System, MPD
HPE Swivel – How it works
Development – Reliability and Durability

- ROPS Body
- ROPS Terminals
- High Pressure Equalized Swivels
Development – ROPS Body + Terminal

- Pin – Pins
  - Tungsten Carbide via High Velocity Oxygen Fuel
  - Sintering > Laser Clad Tungsten Carbide

- Cylinders
  - Composite bearing and stainless steel ring
Development – ROPS Body + Terminal

- Rails
  - Guiding via pins from terminal

- Male & Female Stabs
  - Tungsten Carbide via High Velocity Oxygen Fuel
Development – HPE Swivel

- Reduced Inner Body Length
- Wear Bands
- Swivel polypak seals
- O-rings: N-90 > H-NBR
- Back Up Rings: POM > Peek
Key Learnings

- Regulatory / Operator / Drilling Contractor
- Man-riding operations
- Connection time
- HPE Swivel
- Tungsten Carbide