

Tie-in Systems Development Quick & Easy Installation

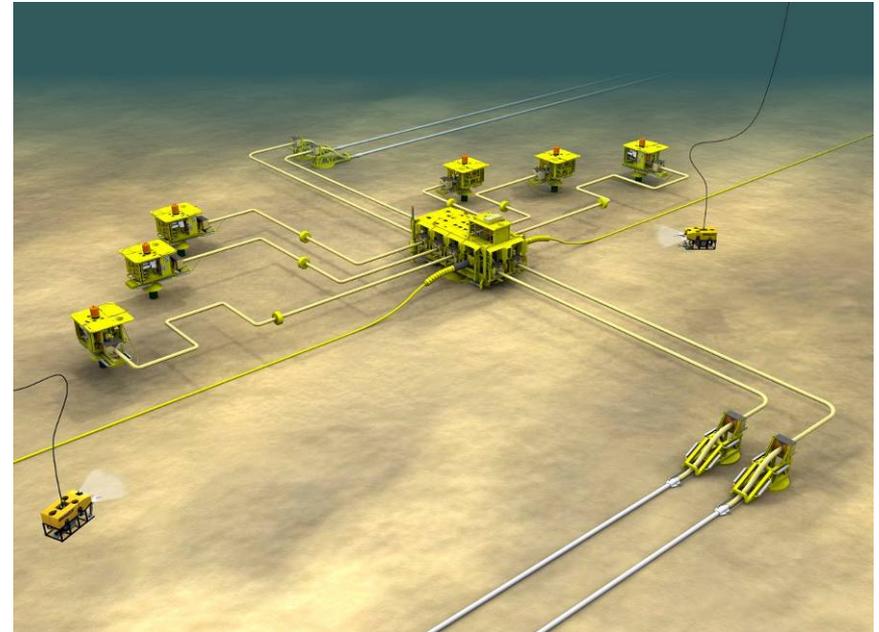
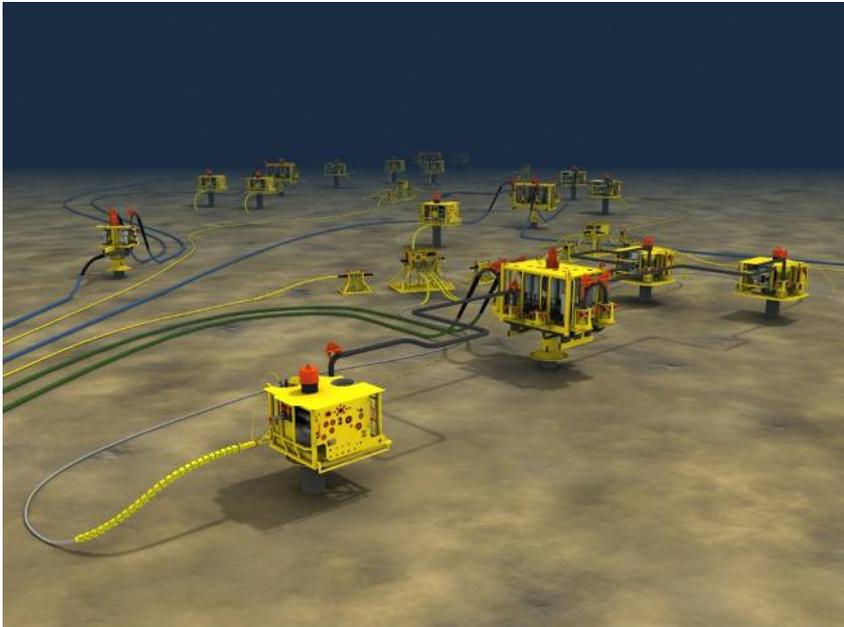
28 January 2010

Bård Kristiansen, Product & Concept Manager, Tie-in & Structures

E-mail: Baard.Kristiansen@akersolutions.com

Introduction

As subsea developments are going deeper with higher pressure and increased temperatures, the cost increases accordingly. In the past few years Aker Solutions has developed connection systems to meet market expectations in terms of cost as well as safety and reliability for any conditions.



Aker Solutions Tie-in Systems Developments

Tie-in Systems Development:

- Vertical Connection System (VCS) - 2008/2009
- Horizontal Connection System (HCS) - 2010

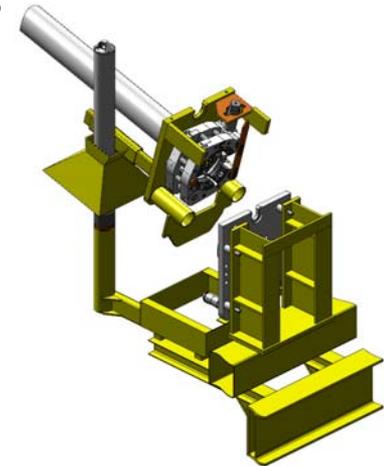
Main benefits:

- Reduce overall cost during installation
- Minimum requirement of installation tooling
- Minimum offshore service hands
- Quick & Easy installation
- Less mobilization time for tooling

VCS



HCS



Vertical Connection System (VCS)

- Seal retained in upper hub/connector well protected
- Seal Replacement and Hub cleaning without retrieving the jumper
- No Large Running tool required
- Minimum requirement of ROV tools
- Fast Installation
- Multiple jumper installations can be performed with connection tools remaining subsea
- No guide rail on structures required
- High Load capacity
- Applicable for Rigid, Flexible & Umbilical lines
- ± 8 deg alignment capacity for rigid jumpers and up to ± 15 deg for flexible/umbilical



 ***Quick & Easy
Installation***

VCS Qualification Testing



- **Qualification testing according API 6A/17D + additional requirements from customers**
- **Witnessed and approved by ExxonMobil, Anadarko & Installation Contractor**

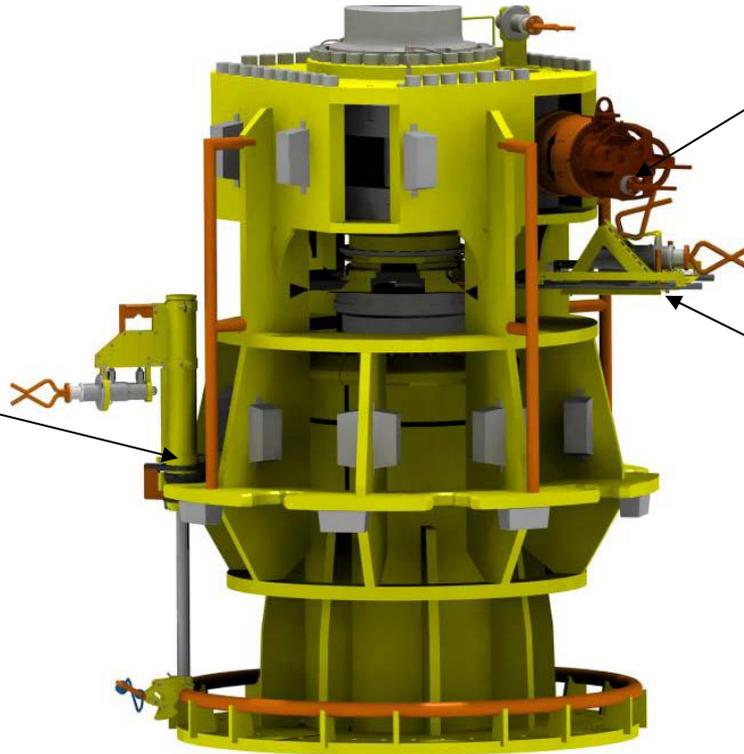
**Full 8 deg
misalignment**



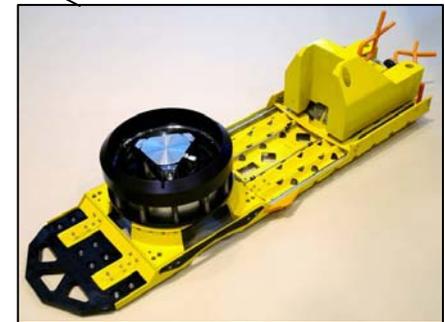
VCS Tooling



**Stroke Tool
(Contingency)**



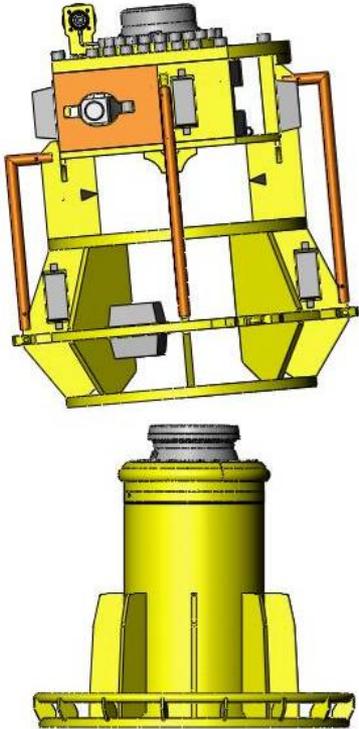
Torque Tool – Make-up tool



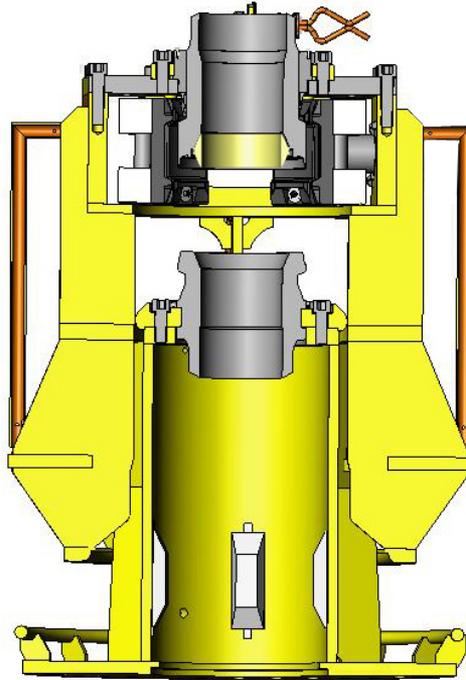
**Seal Replacement Tool
(Contingency)**

VCS Installation Sequence

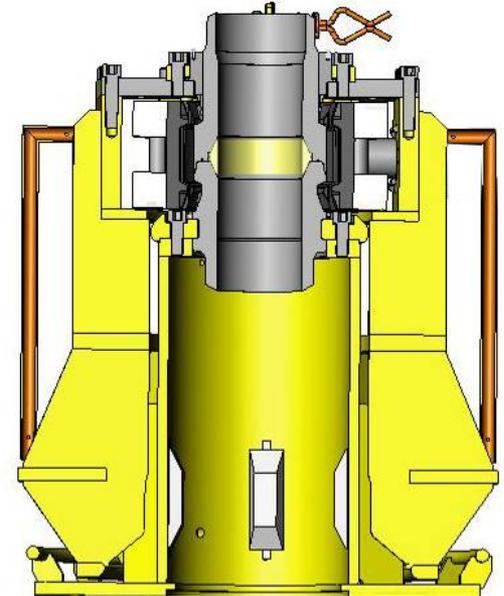
1



2



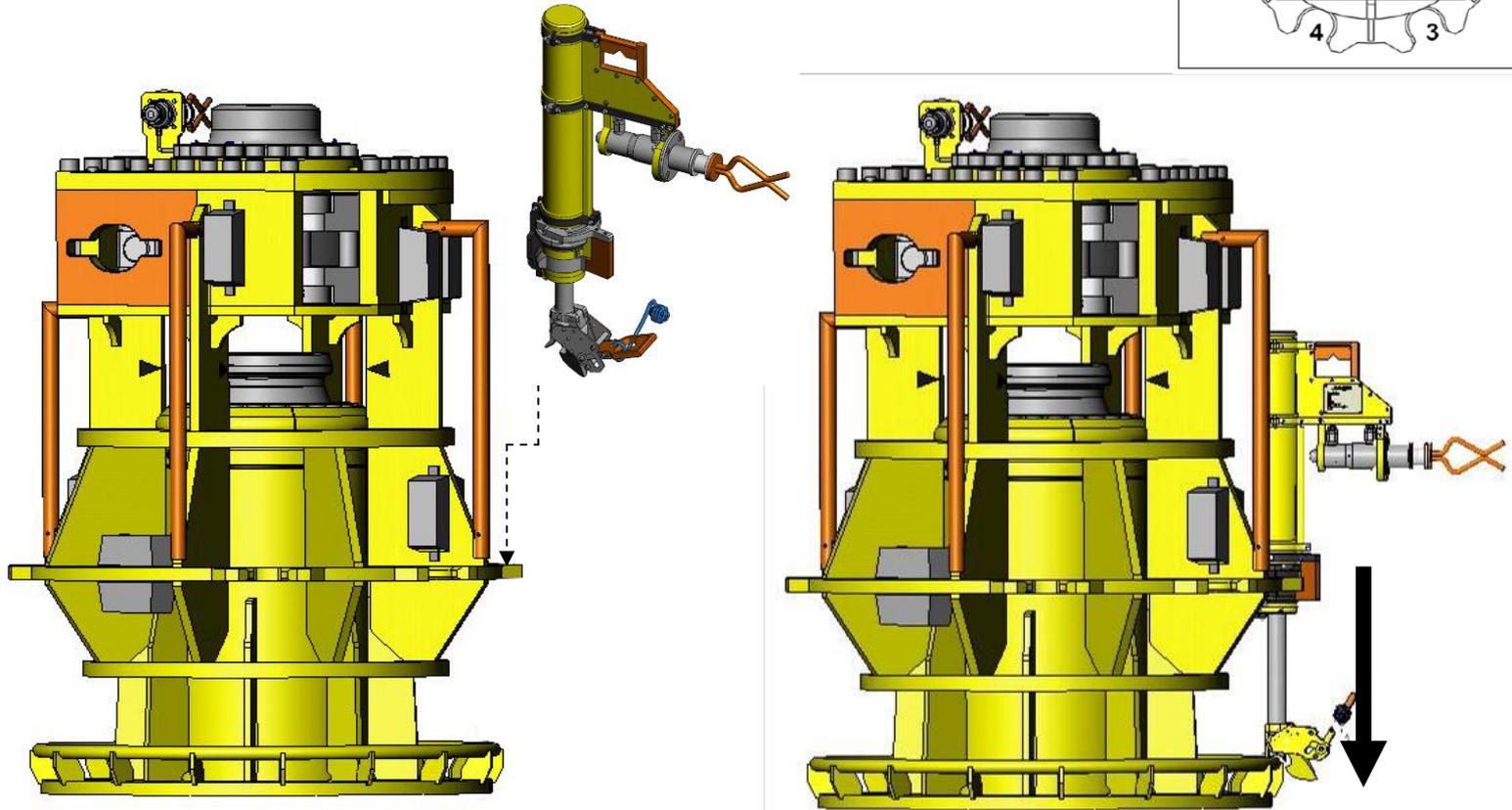
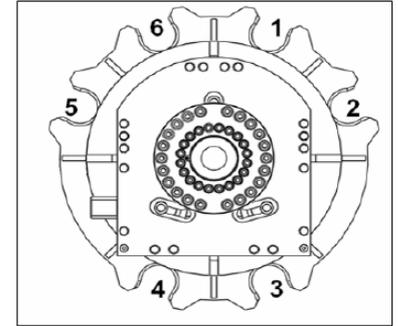
3



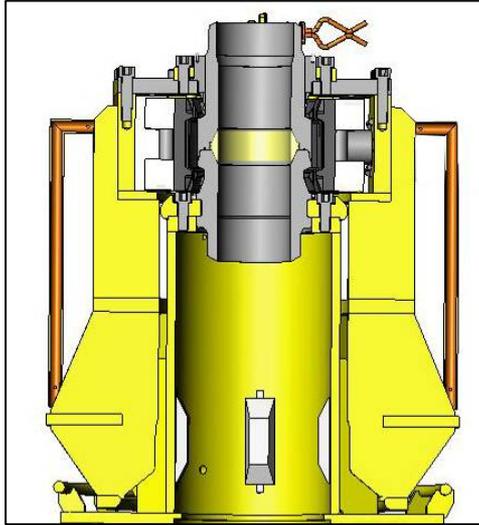
[Link to VCS Animation](#)

VCS Installation Sequence (contingency pull-down)

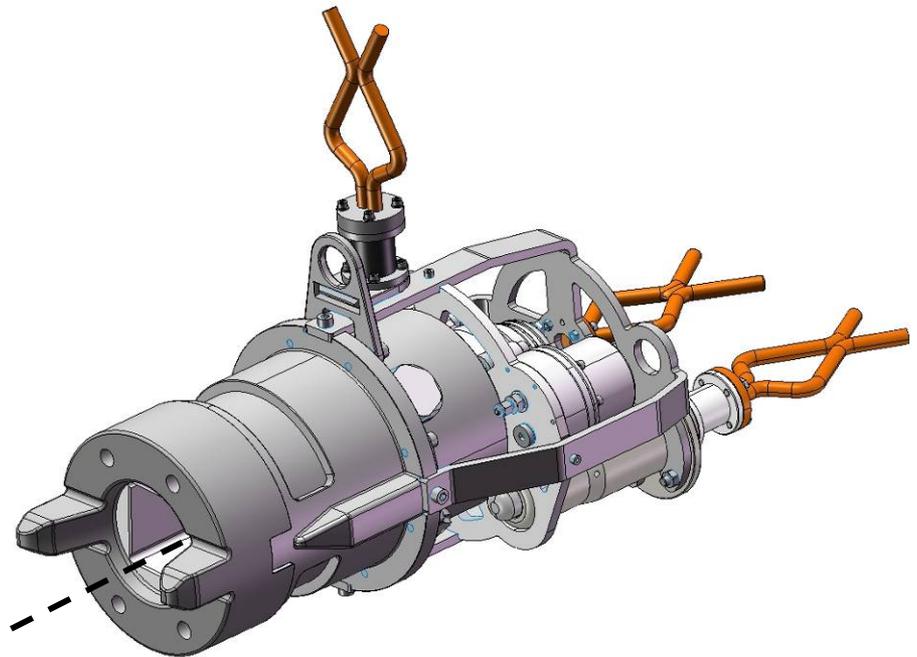
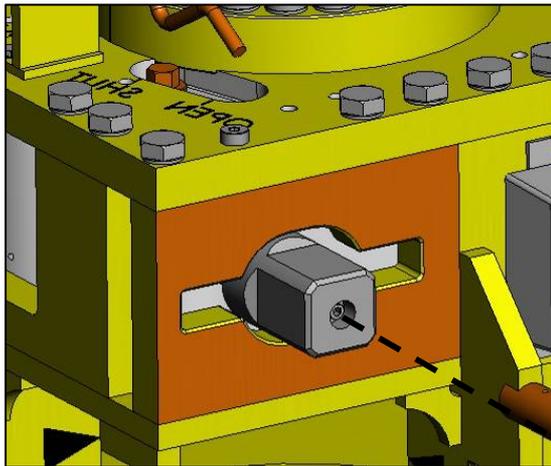
- Contingency: If friction lock occurs during landing, the stroke tool is installed in any of the 6 slots to pull the connector completely onto the porch



VCS Installation Sequence



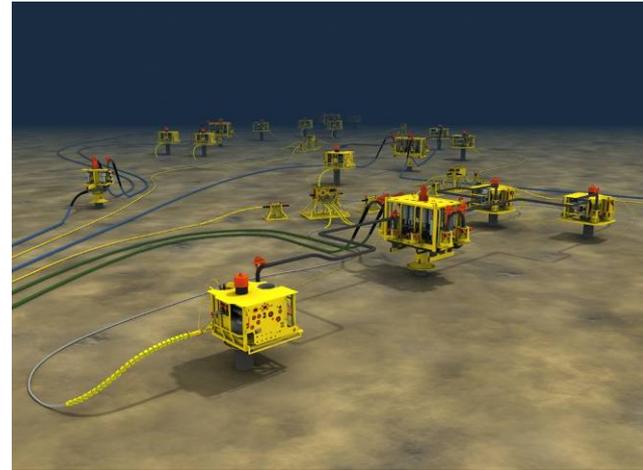
- ROV picks up Torque tool from subsea Tooling Basket
- Back seal testing is performed to verify the connection
- Connection completed



ROV Torque Tool, class 7 (modified)

Reference projects - Vertical Connections

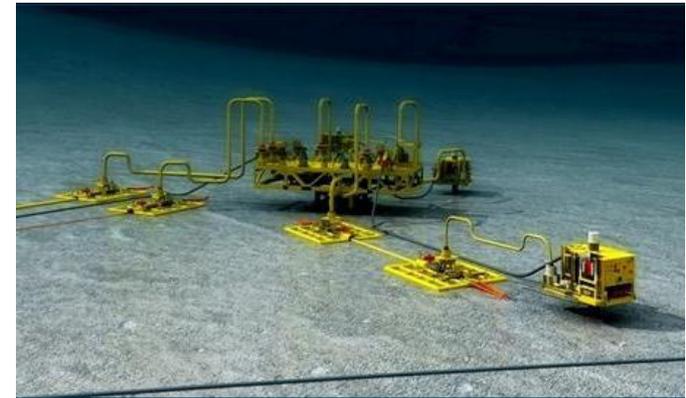
- Jubilee, Ghana, Anadarko (2009)
- Oyo, Nigeria, ENI (2009)
- Longhorn, GOM, ENI (2008)
- MA-D6, India, Reliance (2007)
- KG-D6, India, Reliance (2006)
- Kikeh, Malaysia, Murphy (2005)
- Laminaria, Australia, Woodside (1998 & 2002)
- Marimba, Brasil, Petrobras (1998)



Murphy Kikeh



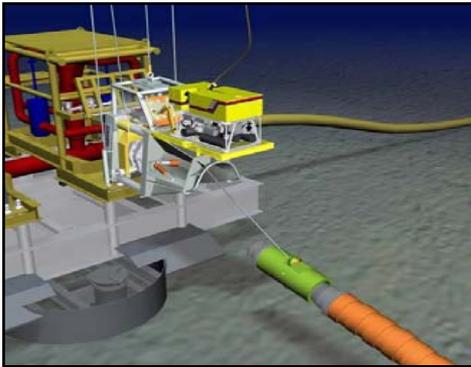
Reliance KG-D6



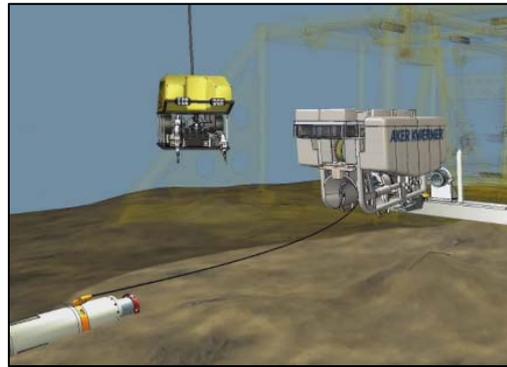
Reliance KG-D6

Horizontal Connection systems

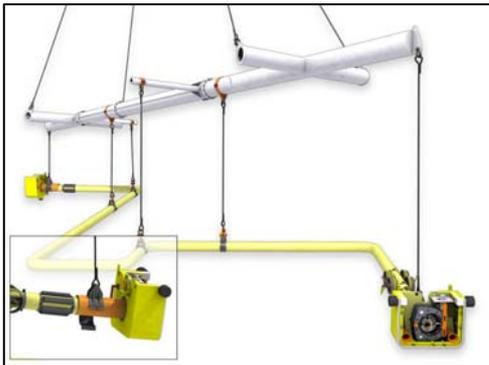
- Big Brother RTS (BBRTS)
- ROV operated Tie-in System (RTS)
- Guide & Hinge-Over (GHO)
- Horizontal Connection System (HCS)



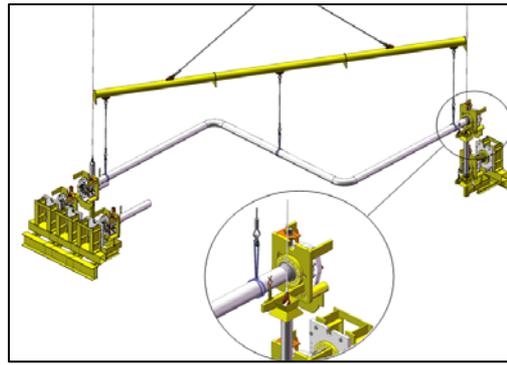
BBRTS



RTS

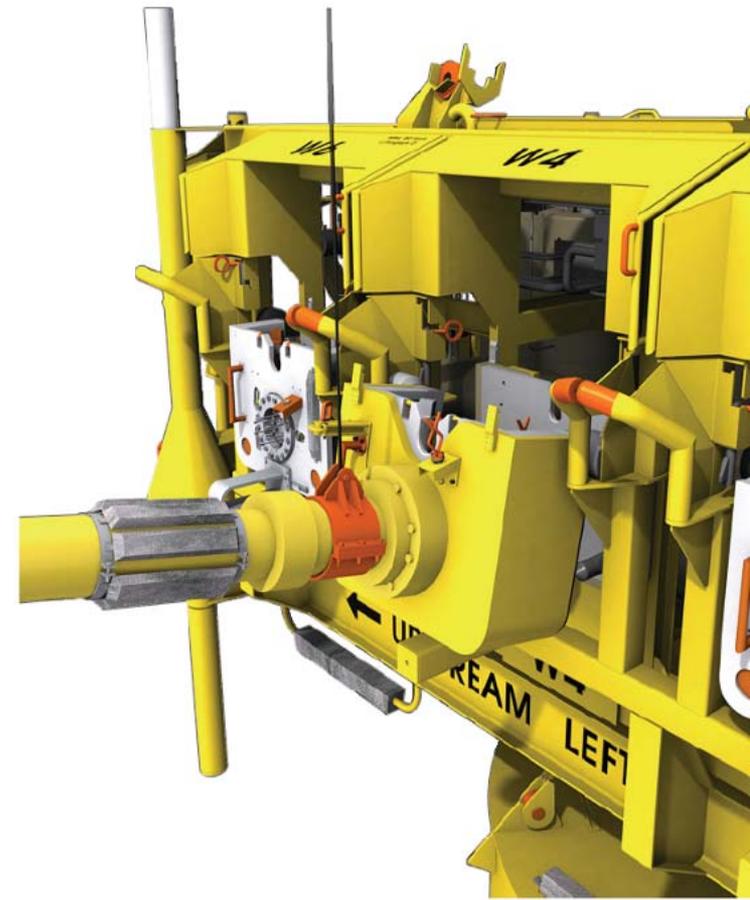


GHO



HCS

Guide & Hinge Over (GHO)

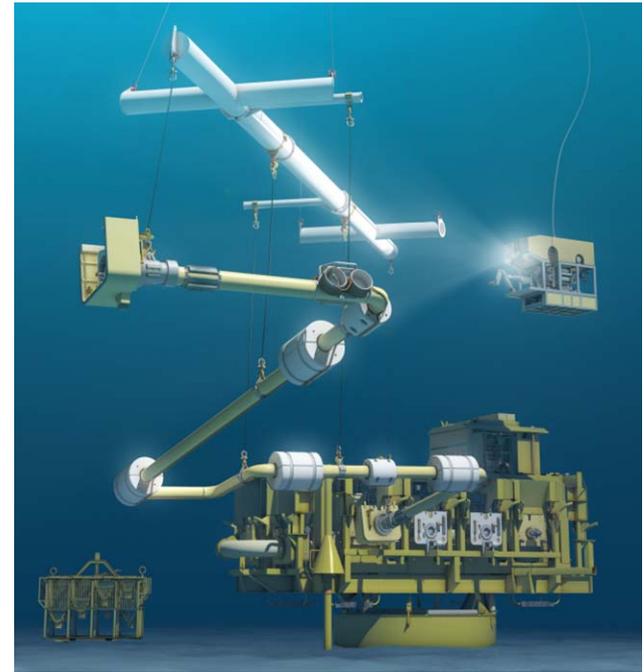


Guide & Hinge Over (GHO)

- Allow retrieval of XT/ manifold without removal of the spool/jumper
- Seal Replacement and Hub cleaning without retrieving the jumper
- No Large Running tool required
- Utilizing Lightweight ROV Carried Tools
- Fast Installation; 3-4 hours per jumper, both connectors (landing + connecting + back seal test)
- Multiple jumper installations can be performed with connection tools remaining subsea
- Guideline less connection system
- High Load capacity
- Applicable for Rigid, Flexible or Umbilical lines



***Quick & Easy
Installation***



First Jumper installation on Dalia



GHO Tooling



Stroke Tool



Torque Tool



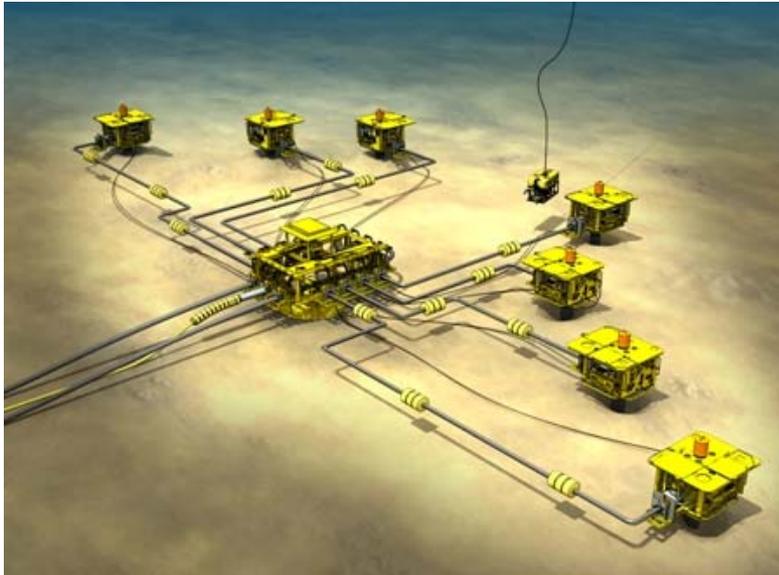
**Hub Cleaning Tool
(Contingency)**



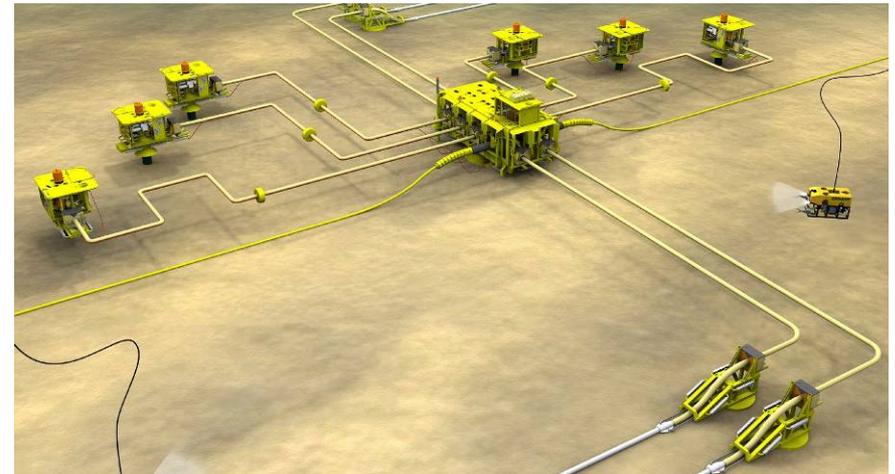
**Seal Replacement Tool
(Contingency)**

Reference projects – Guide & Hinge Over

- USAN, Nigeria, Saipem/Total (2010)
- Montanazo/Lubina, Spain, Repsol (2009)
- OYO, Nigeria, ENI (2009)
- Gimboa, Angola, Sonagol (2007-2008)
- Dalia, Angola, Total (2004-2008)

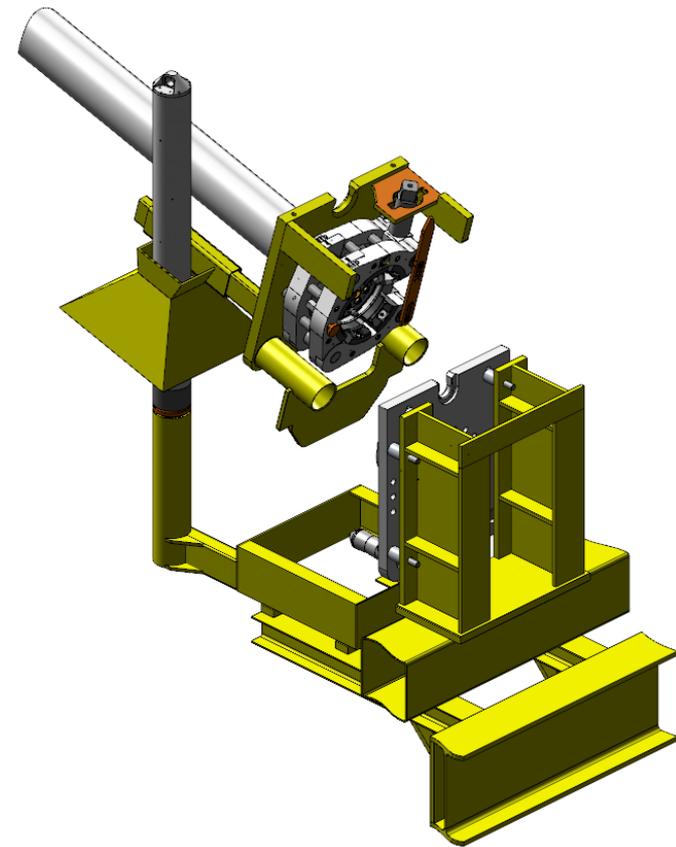


Gimboa, Sonagol



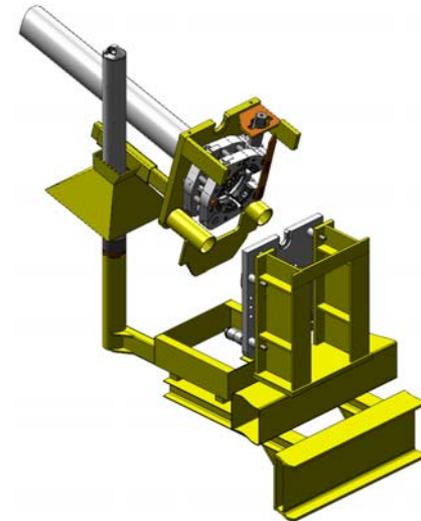
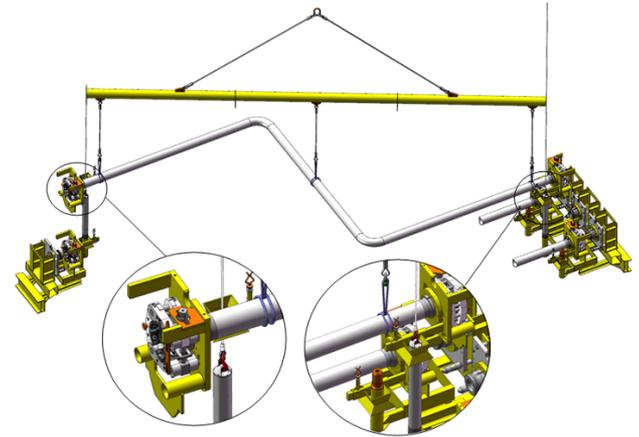
Dalia, Total

Horizontal Connection System (HCS)



Horizontal Connection System (HCS)

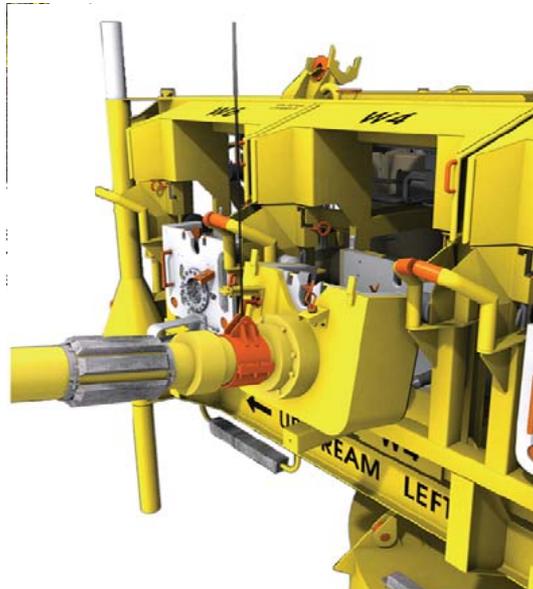
- High degree of re-use from field-proven GHO (Dalia) design.
- Designed for installation with guidewire to accommodate for harsh weather conditions
- Applicable for guidewire-less installation
- Quick, easy changes to switch between guidewire and guidewire-less
- Applicable for Shallow Water and Deep Water
- High load capacity compared to RTS
- Applicable for Rigid, Flexible or Umbilical lines
- Allow retrieval of XT/ manifold without removal of the spool/jumper
- Seal Replacement and Hub cleaning without retrieving the jumper
- Only using lightweight ROV carried tools



GHO vs HCS Comparison

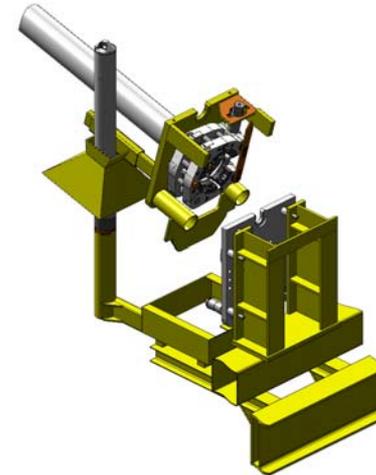
Guide & Hinge Over

- C-C distance 2500mm
- Designed for calm weather conditions in Africa
- Guidelineless installation
- Utilize low weight ROV operated tools

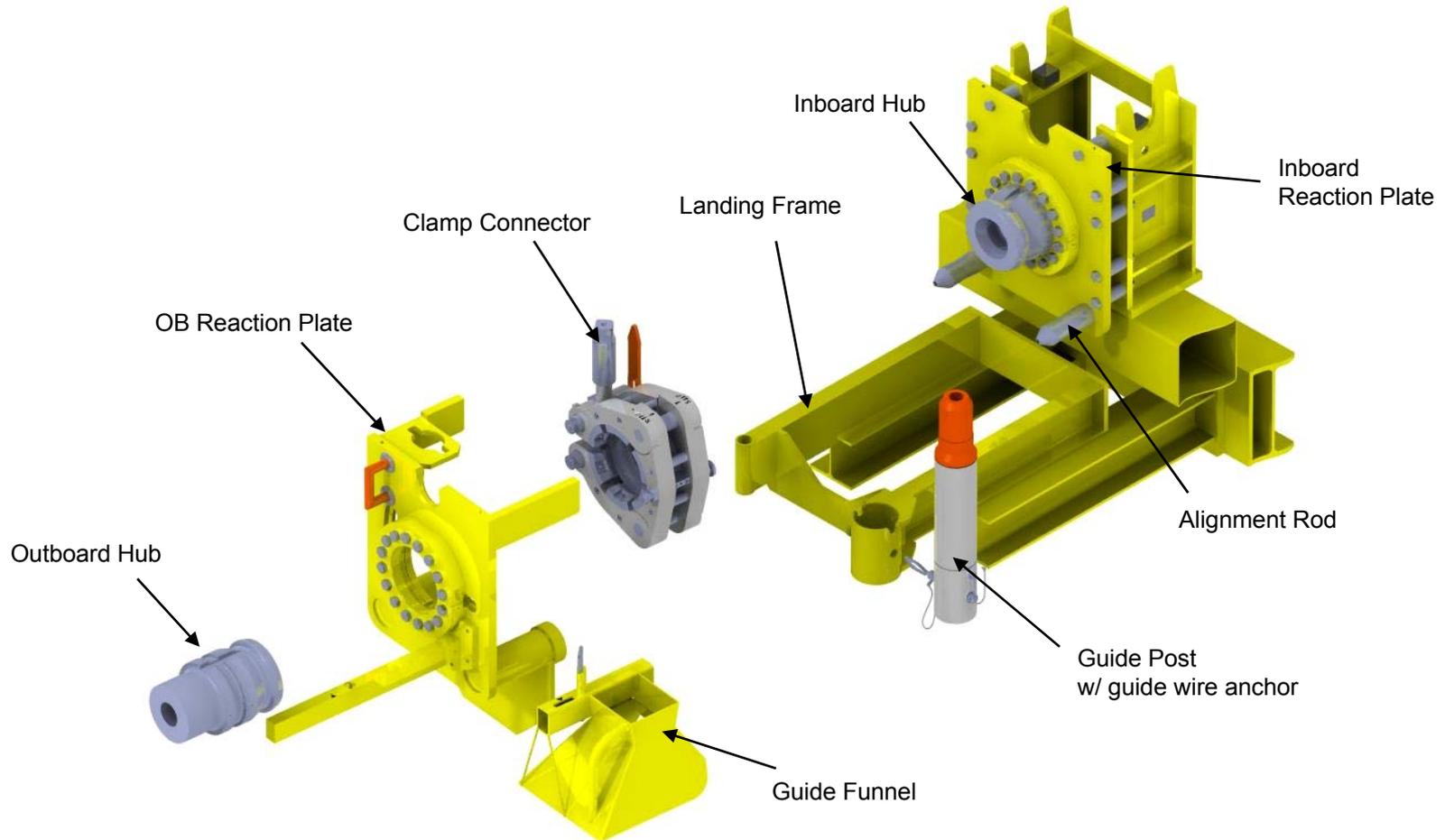


Horizontal Connection System

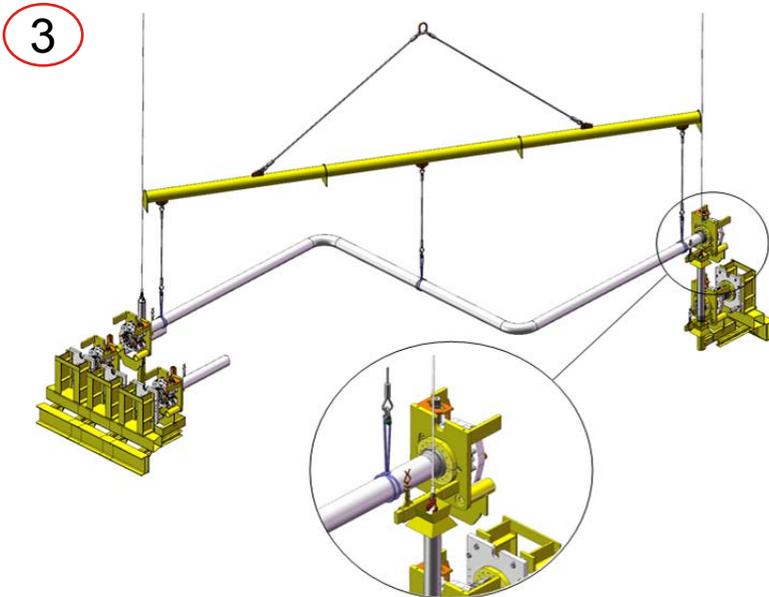
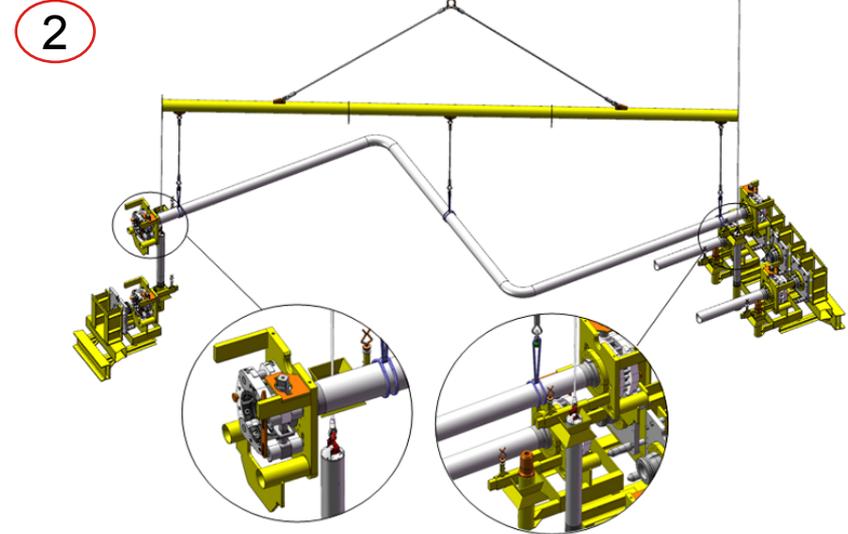
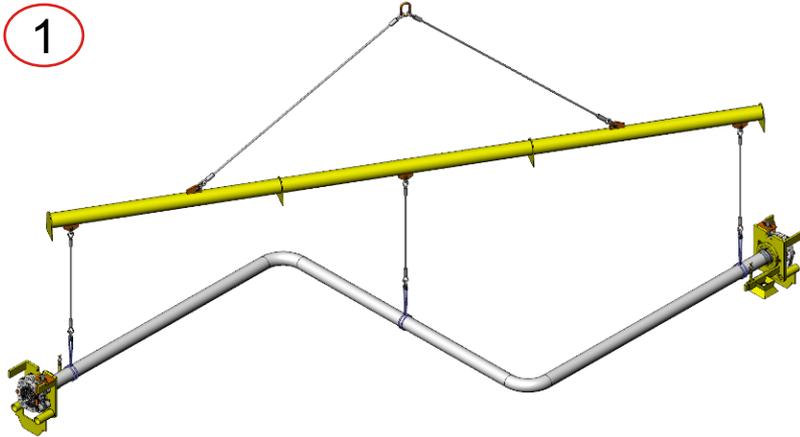
- C-C distance 1300mm
- Designed for harsh weather conditions (NCS or similar)
- Can be installed with or without guide wires
- Utilize the same lightweight ROV tools as GHO
- 1st and 2nd connections are identical



HCS Rigid Spool – System Components



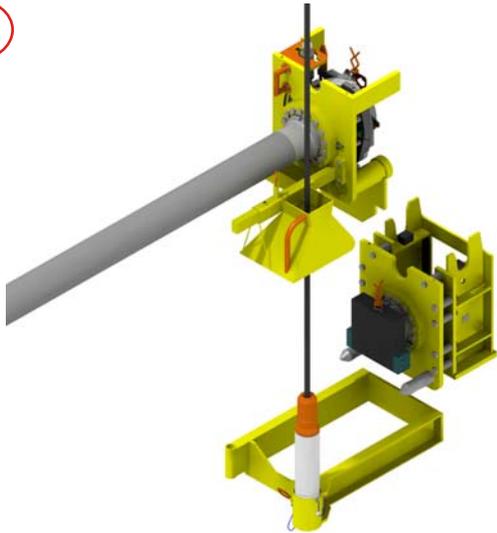
HCS Rigid Spool Installation Sequence



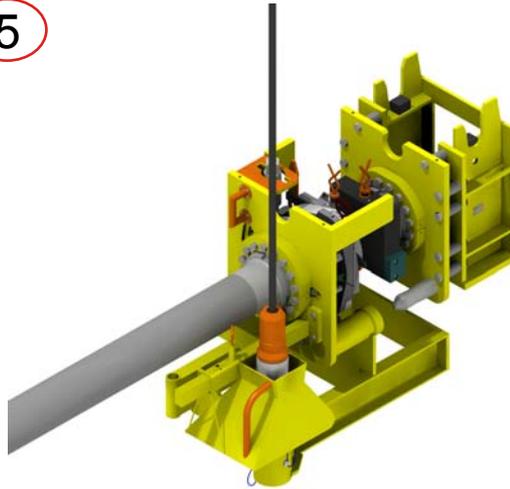
1. Attach spreader beam. Lift off and lower jumper to seabed. If required attach guide wires.
2. 1st end entry (alternative landing 1st & 2nd at same time)
3. 2nd end entry.

HCS Rigid Spool Installation

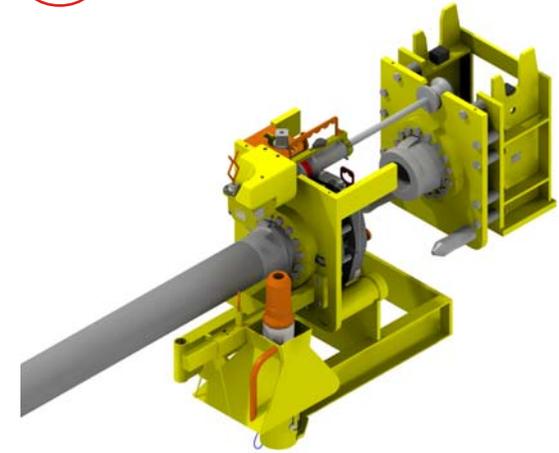
4



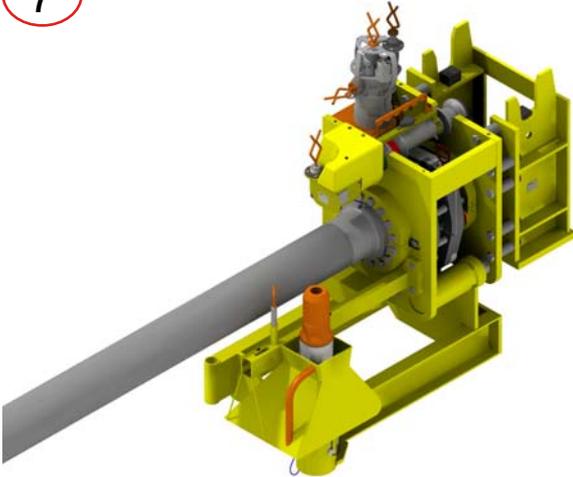
5



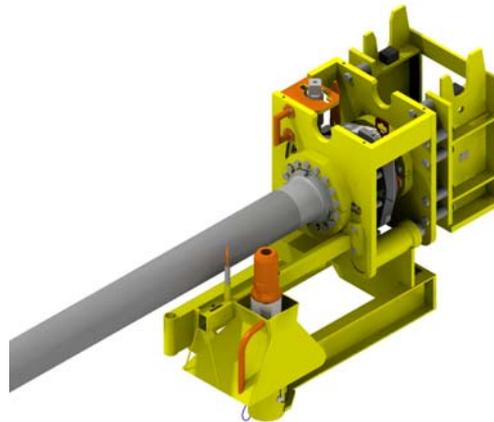
6



7



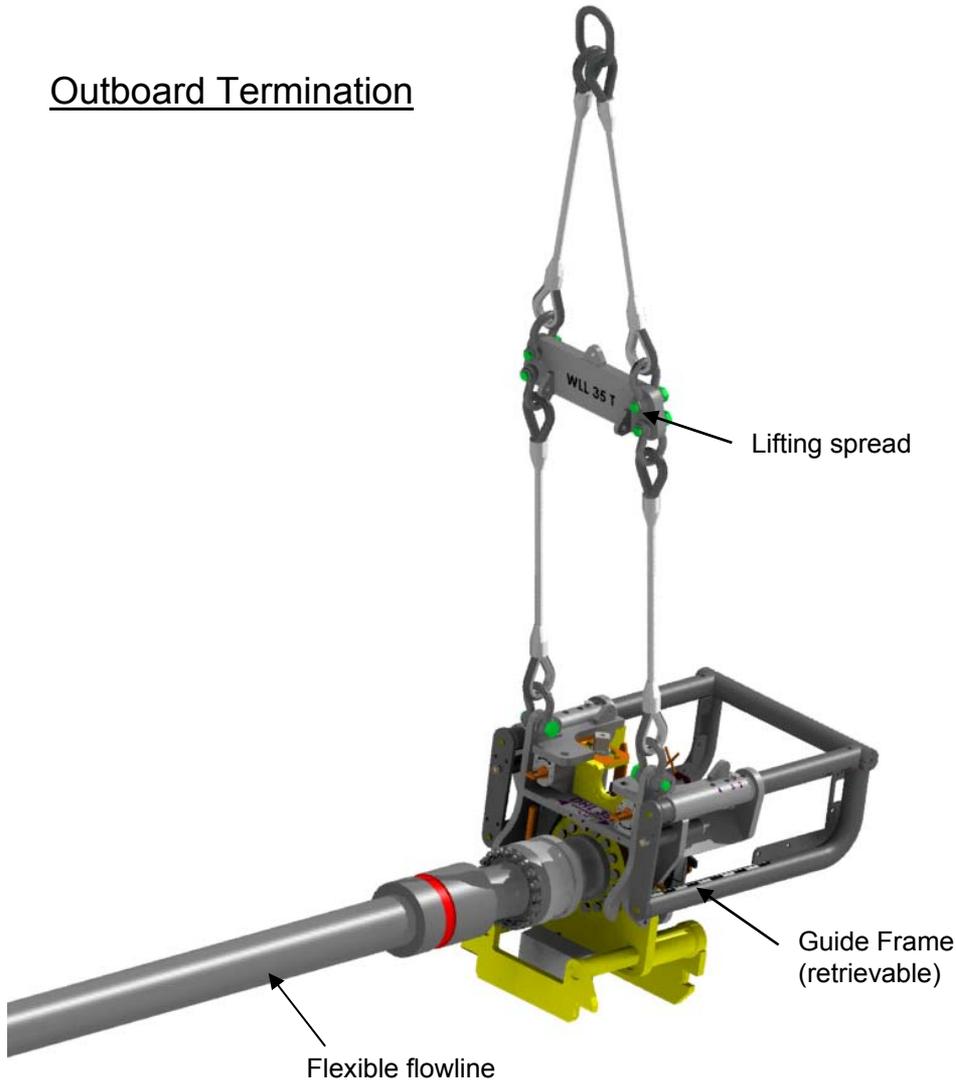
8



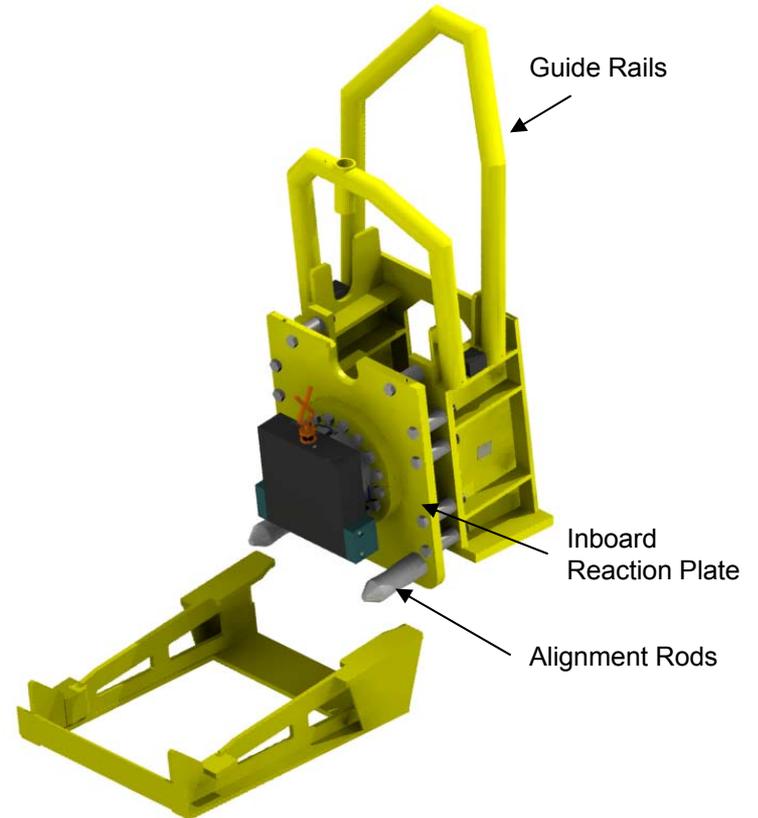
4. Lower termination until landed on porch
5. Disconnect spreader beam
6. Stroke termination towards IB hub using ROV carried stroke tool
7. Close clamp with ROV carried torque tool
8. Perform back-seal test – connection completed

HCS Flexible/Umbilical – System Components

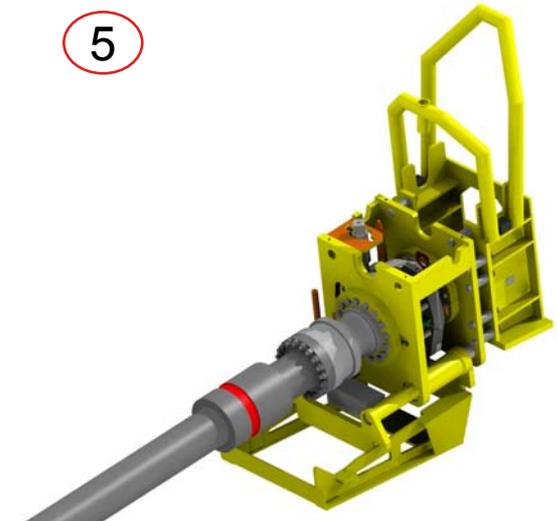
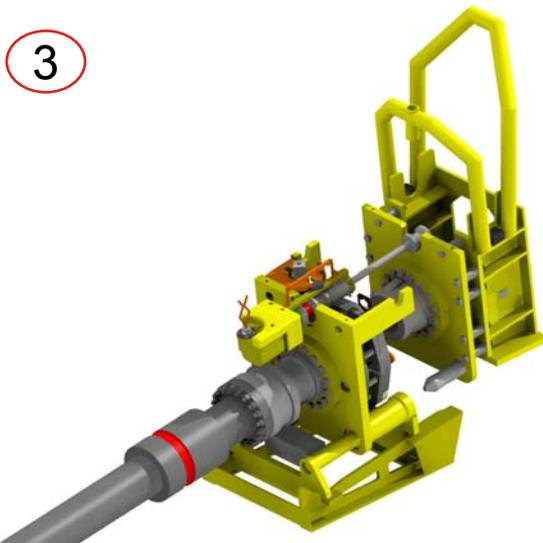
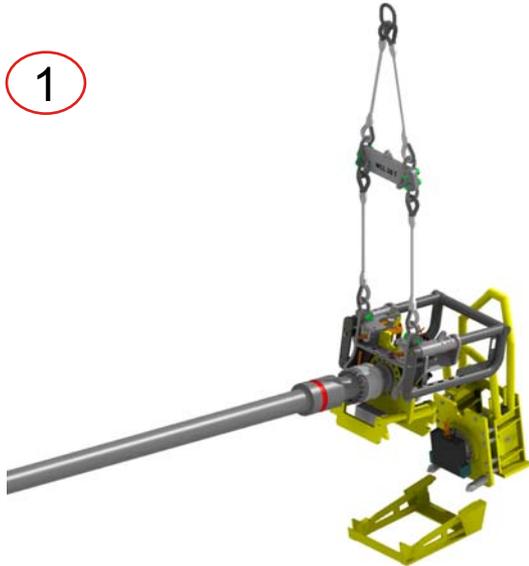
Outboard Termination



Inboard Porch



HCS Flexible / Umbilical Installation



1. Lower termination until landed on porch
2. Disconnect guiding frame
3. Stroke termination towards IB hub using ROV carried stroke tool
4. Close clamp with ROV carried torque tool
5. Perform back-seal test – Connection completed

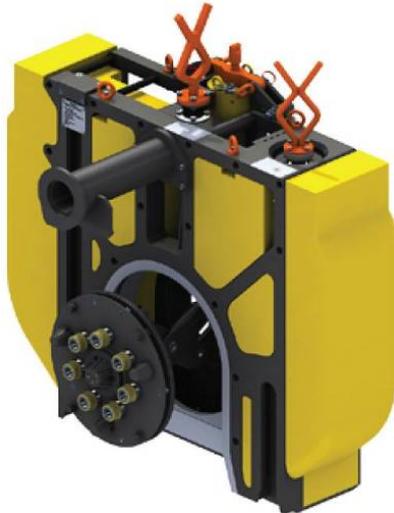
HCS Tooling



Stroke Tool



Torque Tool

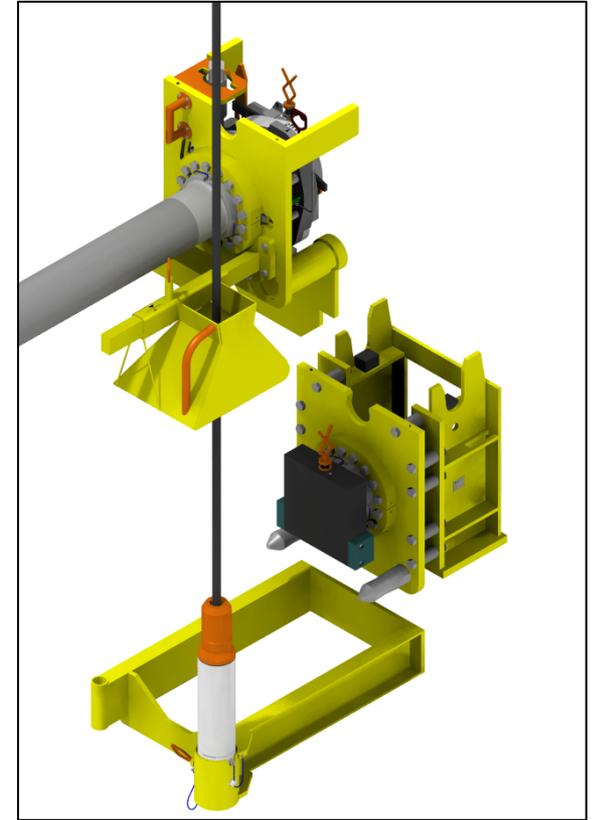
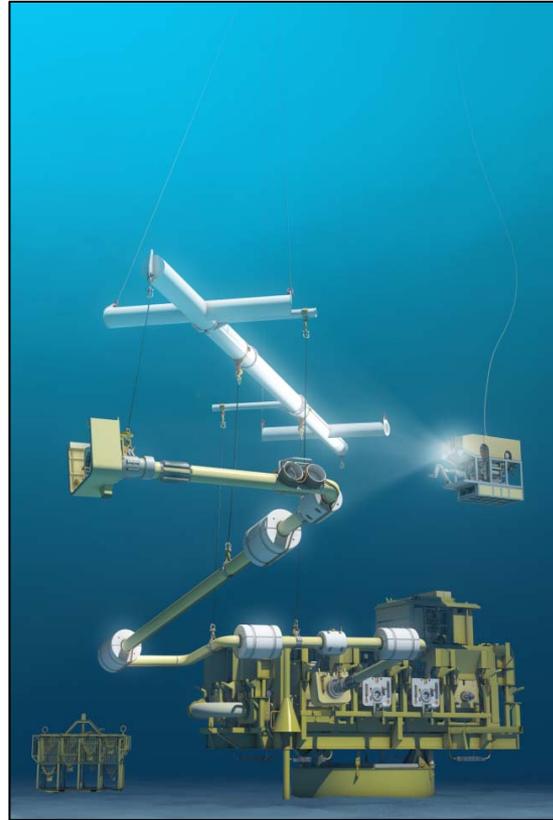


**Hub Cleaning Tool
(Contingency)**



**Seal Replacement Tool
(Contingency)**

Thank you for listening!



Copyright

Copyright of all published material including photographs, drawings and images in this document remains vested in Aker Solutions and third party contributors as appropriate. Accordingly, neither the whole nor any part of this document shall be reproduced in any form nor used in any manner without express prior permission and applicable acknowledgements. No trademark, copyright or other notice shall be altered or removed from any reproduction.

Disclaimer

This Presentation includes and is based, inter alia, on forward-looking information and statements that are subject to risks and uncertainties that could cause actual results to differ. These statements and this Presentation are based on current expectations, estimates and projections about global economic conditions, the economic conditions of the regions and industries that are major markets for Aker Solutions ASA and Aker Solutions ASA's (including subsidiaries and affiliates) lines of business. These expectations, estimates and projections are generally identifiable by statements containing words such as "expects", "believes", "estimates" or similar expressions. Important factors that could cause actual results to differ materially from those expectations include, among others, economic and market conditions in the geographic areas and industries that are or will be major markets for Aker Solutions' businesses, oil prices, market acceptance of new products and services, changes in governmental regulations, interest rates, fluctuations in currency exchange rates and such other factors as may be discussed from time to time in the Presentation. Although Aker Solutions ASA believes that its expectations and the Presentation are based upon reasonable assumptions, it can give no assurance that those expectations will be achieved or that the actual results will be as set out in the Presentation. Aker Solutions ASA is making no representation or warranty, expressed or implied, as to the accuracy, reliability or completeness of the Presentation, and neither Aker Solutions ASA nor any of its directors, officers or employees will have any liability to you or any other persons resulting from your use.

Aker Solutions consists of many legally independent entities, constituting their own separate identities. Aker Solutions is used as the common brand or trade mark for most of these entities. In this presentation we may sometimes use "Aker Solutions", "we" or "us" when we refer to Aker Solutions companies in general or where no useful purpose is served by identifying any particular Aker Solutions company.