“An advance in primary solids control will reduce drilling waste volumes at source without compromising solids removal efficiency”

CUBILITY – Terje Vastveit, Regional Manager Far East
Executive summary - Operational experiences

Cubility in brief

- Developed and introduced the MudCube, a step-change technology for solids control and mud treatment
- Achieved first commercial sale of the MudCube in 2012
- Orders for a large number of MudCubes received in 2013 and 2014 from a number of different customers
- Founded in 2005, located in Sandnes, Norway
- Acquired by Triton, April 2014

HSE & operational highlights

- Improved drilling efficiency
- Reduced noise levels
- Eliminated vibration
- Reduced oil vapour & oil mist
- Reduced filter-cost
- Reduced drilling waste volumes
- Reduced consumption of drilling fluid
- Reduced weight
- Reduced NPT

The MudCube

- The MudCube is an enclosed system for solids control and mud treatment
- Excellent track record from offshore drilling operations in the North Sea
- More effective and cost reducing than existing technology
- Significant proven Opex benefits such as reduced waste and more re-use of drilling mud
- Enclosed system with compelling HSE advantages
- Opex savings give a very short payback time for a MudCube system
- MudCube system extensively tested by Statoil, Chevron, ConocoPhillips, Petrobras and Saudi Aramco
- Achieved strong patent protection for the system

Projects as per January 2017

- Maersk Giant
- Statoil Cat – J ( Samsung HI ) ( #1 / #2 )
- Chevron, onshore trial US
- Maersk Gallant
- Scarabeo 5
- Statoil Peregrino A ( Brazil )
- Noble, Mariner ( Cat-J, Jurong )
- Mariner Jacket, Statoil
- Saudi Aramco, Sino 7
- Maersk Resolve, Maersk Drilling
- Shell Sarawak, Malaysia
- BOS Solution, onshore US / Canada
- Sichuan / CNPC, onshore China
- Petrobras, onshore Brazil
- Johan Sverdrup, Statoil
- Naga 8, HESS Malaysia
- Murpy, Canada
- EQT, USA

Cubility head office and sales offices
The MudCube

- Flow inlet
- Finger board (flow distribution)
- Microvibrators
- Vacuum table
- Filterbelt
- Water-knife
- Air-knife
- Suction aera
MudCube – The Filterbelt

<table>
<thead>
<tr>
<th>Technical highlights - Filterbelt</th>
<th>The Filterbelt</th>
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<tbody>
<tr>
<td>Rotating non-tensioned screen</td>
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<tr>
<td>Stainless Steel</td>
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<tr>
<td>Full API RP 13C Mesh Ranges are available</td>
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<tr>
<td>Variable rotating speed</td>
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<tr>
<td>Micro-vibrators used as needed to improve conductance</td>
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<tr>
<td>Air knife used to clean the screens</td>
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<tr>
<td>Any screens failure monitored</td>
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<tr>
<td>Use velcro to connect the filterbelt</td>
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<tr>
<td>Replacement time : 2 minutes – no additional working area needed</td>
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<tr>
<td>Less Inventory weight than conventional shaker screens</td>
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<tr>
<td>No need for external Screen Washer – “self-cleaning”</td>
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</tbody>
</table>
MudCube in operation.
MudCube – Remote operation and automatisation

Automatisation

- The MudCube can be controlled and operated remotely due to camera, sensors and control system
- Cameras installed inside the MudCube, allowing for visual monitoring process without moving away from control room
- Operator panel connected via Ethernet to PLC for visualizing and controlling / monitoring of the process

MudCube allows for remote operation
Installation on Maersk Giant

Maersk Giant – before and after

- 4 shale shakers original design
- Ventilation issues
- 3 MudCubes replacing original design
- No ventilation issues

Fast and efficient installation of the MudCubes
Installation on Maersk Giant

Maersk Giant – Cubelounge
Operations on Maersk Giant

Drilling program since installment of MudCube:

- **Well 16/10-5 “Isbjørn”**
  - Operator: Talisman Energy
  - Licence: 568 (Talisman 40%, Petoro 20%, Det norske 20%, Skagen 10%, Edison International 10%)
  - 2 Oct 2012 – 8 Nov 2012 (37 days of drilling)
  - TMD: 3,033m drilled

- **Well 3/7-8 S “Trym Sør”**
  - Operator: Dong Energy
  - Licence: 147 (Dong E&P 50%, Bayerngas 50%)
  - 4 Dec 2012 – 8 February 2013 (66 days of drilling)
  - TMD: 4,189m drilled

- **Well 3/7-9 “Musling”**
  - Operator: Dong Energy
  - Licence: 289 (Dong E&P 40%, Bayerngas 30%, Talisman 30%)
  - 14 March 2013 – 30 April 2013
  - TMD: 3,610m

- **Well 2/1-16S “Frode”**
  - Operator: Talisman Energy
  - Licence: 299 (Talisman 31.5%, Agora Oil & Gas 28.5%, North Energy 20%, Dong E&P 20%)
  - 10 May 2013 – 12 July 2013
  - TMD: 3,891m

- **Well 2/1-15 “Augunshaug”**
  - Operator: DetNorske
  - Licence: 542 (DetNorske 60%, Tullow Oil Norge 40%)
  - 18 July 2013 – 26 August 2013
  - TMD: 3,554m

- **Maersk Giant**
  - Maersk Giant is under contract for a drilling program for several different operators on the Norwegian Continental Shelf until 4Q 2014

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2013

- 16/10-5
- 3/7-8 S
- 3/7-9
- 2/1-16S

2014

- 2/1-15
- 3/7-8 S
- 2/1-16S
- 3/7-9
Working environment on Maersk Giant

Shaker room on Maersk Giant*

- Vapor and oil mist are eliminated in the shaker room (renamed “Cube-lounge”) due to the enclosed system and airflow through the MudCube
- The noise from the MudCube system is significantly lower than from the previous system
  - Noise level tested to maximum 74 dBA in the upper shaker house by Lloyd’s Register ODS
  - No restriction on maximum working time or required hearing protection
- The structural vibration is eliminated
- The MudCube system is the only solids control system which today meets the given regulations with regards to the working environment on the NCS

“I went to get a coffee and brought it back to the MudCube lounge because this is the nicest place to be” - Roughneck

Measurement of oil mist and vapours during operations

**Oil mist measurements, mg/m³**

- Accept criteria NCS: 0.6 mg/m³
- Average measurement Maersk Giant: 0.087 mg/m³

**Oil vapour measurements, mg/m³**

- Accept criteria NCS: 30 mg/m³
- Average measurement Maersk Giant: 13.65 mg/m³

Tester: Intertek
Date: 5-6th Jan 13
Flowrate: 3 500 ltr/min
Mud: Versatec OBM
Flow-line temp: 60 deg. C
Locations: 14 samples from the shaker room

* 3 MudCubes in operation on Maersk Giant since October 2012 (16 wells)
63 m³ of lubrication mud was used in the 17 ½” section to lube the screw-conveyor

Mud On Cuttings in each section:
- 17 ½”: 6,6 vol% MOC
- 12 ¼”: 57,2 vol% MOC
- 8 ½”: 133,2 vol% MOC

Mud On Cuttings for HA-4: **36,5 vol%**
**Oil On Cuttings on HA-4 (OOC) – M Resolve**

- Average Oil On Cuttings measurements in each section:
  - 17 ½”: 5.0 wet wt%
  - 12 ¼”: 6.13 wet wt%
  - 8 ½”: 11.4 wet wt%

- Weighted Oil On Cuttings on HA-4: **6.11 wet wt%**
Savings from less waste disposal & less lost mud

Savings vs. Statoil’s best practice target (70% vol% loss) vs. “normal” waste volume (100% vol% loss)

Significant cost savings from less waste disposal and drilling fluid use.
Payback on MudCube investment in a few wells (not including any other savings than waste and drilling fluid)

Assumptions: Waste disposal cost: USD 1,750 / ton, Drilling fluid cost: USD 1,300 / m3
Extrapolation of data to typical well:

- 12¼” hole section from 4000’ – 12500’
- 8½” hole section from 12500’ – 15,000’
MudCube Trial Objectives

- Mud lost on cuttings to be less than 0.7 : 1.0 by volume. Geoservices CFM system will be used to weigh the drill cuttings coming off the MudCube.
- Provide sound level measurements less than existing shale shakers
- Filterbelt life to be no less than 40 hours
Conclusions

- Performance criteria met or exceeded
  - Noise levels for MudCube 74dBA compared to 77dBA for shakers
  - Filterbelt life averaged 61.5 hours
  - Rock to mud ratio was 1 : 0.29. Target was less than 1 : 0.70
SINO 7 MudCube Trial – Typical Well

Drilling Cuttings – Standard Shakers vs MudCube (bbls)

- Vol Rock
- Vol Mud
- Total

<table>
<thead>
<tr>
<th></th>
<th>Shakers</th>
<th>MudCube</th>
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<tbody>
<tr>
<td>Vol Rock</td>
<td>1500</td>
<td>400</td>
</tr>
<tr>
<td>Vol Mud</td>
<td>1000</td>
<td>400</td>
</tr>
<tr>
<td>Total</td>
<td>2500</td>
<td>800</td>
</tr>
</tbody>
</table>
Drill Cuttings Reductions and Mud Savings on Typical Well

Standard Shakers

- Volume Rock = 1413 barrels
- Volume Mud (1 : 1 ratio) = 1413 barrels
- Total Drill Cuttings = 2826 barrels

MudCube (as per SINO 7 trial)

- Volume Rock = 1413 barrels
- Volume Mud (1 : 0.29 ratio) = 410 barrels
- Total Drill Cuttings = 1823 barrels

Mud Savings

- 1003 barrels
- $250,750.00 (assumes mud cost of $250.00 / barrel)
Operational reliability

Four projects using MudCubes are currently ongoing:

- Maersk Resolve (4 MudCubes)
- Maersk Gallant (3 MudCubes)
- Maersk Giant (3 MudCubes)
- Scarabeo 5 (4 MudCubes)

Total MudCube running-hours on installations in operation per February 2016: 68,185 hours

No None Productive Time (NPT) on the rig has ever been reported due to failure on the MudCube.

“I hereby confirm that in almost 2 years of operation MudCubes have not caused any down time to Maersk Resolve, nor NPT for the Client. Rig crew has in short time became fully competent and trained for operation and maintenance of MudCubes, hence change out of parts or consumables is a routine task.

Spare parts and consumables required were always available of the shelf with extremely fast delivery, and the online support from Cubility Technical team was first class, allowing us to maintain close dialogue and deliver additional value to the Client.”

Predrag Berlafa, Rig Manager Maersk Resolve, February 19th 2016