State of Art in Mooring Technology

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MCE Deepwater London, 24th March 2015
1. Brief Introduction
2. Mooring Technology updates
3. Response to Mooring Failure – Remote Area

▷ Collaboration driving Value
SBM Offshore in brief

Focus on top-end segment
- FPSOs
- Turret Moorings
- Turnkey Sale or Lease & Operate
- Semisubmersible & TLP production units
- FLNG
- Technology Development

SBM Vision
To be a trusted partner, delivering reliable floating production solutions that create value for our clients, by sustainably and passionately leveraging our technology and operating experience.
A History of Innovation
Spanning 55 years

<table>
<thead>
<tr>
<th>Year</th>
<th>Event</th>
</tr>
</thead>
<tbody>
<tr>
<td>1862</td>
<td>A.F. Smulders Machine Factory</td>
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<tr>
<td>1905</td>
<td>Start of Gusto Shipyard</td>
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<tr>
<td>1959</td>
<td>CALM Buoy*</td>
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<td>1960</td>
<td>Drilling Jack-up*</td>
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<td>1969</td>
<td>SBM Inc. established in Switzerland</td>
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<tr>
<td>1972</td>
<td>DP Drillship*</td>
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<td>1973</td>
<td>SS5 Mooring System*</td>
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<tr>
<td>1974</td>
<td>Semi-submersible pipelay vessel*</td>
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<tr>
<td>1977</td>
<td>SAL5 Mooring System*</td>
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<tr>
<td>1978</td>
<td>Start of Gusto Engineering</td>
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<tr>
<td>1981</td>
<td>Leased FPSO*</td>
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<tr>
<td>1985</td>
<td>Jacket</td>
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<tr>
<td>1986</td>
<td>External Turret*</td>
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<td>1988</td>
<td>MSC re-joined the Group</td>
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<td>1990</td>
<td>Acquisition of Imo doco</td>
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<td>1993</td>
<td>North Sea Internal Turret*</td>
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<td>1996</td>
<td>Tamkey</td>
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<td>1999</td>
<td>Deepwater CALM Buoy*</td>
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<td>2001</td>
<td>Acquisition of Atlantia</td>
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<td>2002</td>
<td>Delivery of the first generic FPSO</td>
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<td>2003</td>
<td>Acquisition of Ocean Design Associates Inc.</td>
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<td>2005</td>
<td>Delivery of the largest Seastar® TLP</td>
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<td>2006</td>
<td>Company name change to SBM Offshore N.V.</td>
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<tr>
<td>2006</td>
<td>Leased MOPO*</td>
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<td>2007</td>
<td>Deepest Semi-Submersible in the GOM*</td>
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<td>2008</td>
<td>Offshore Offloading Line: Treliner™ Installed*</td>
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<td>2009</td>
<td>GAP™ mid water Fluid Transfer System*</td>
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<tr>
<td>2010</td>
<td>Largest Internal Turret with 75 risers</td>
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<td>2011</td>
<td>First DeepDraft Semi® with PMA contract</td>
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<td>2012</td>
<td>First turret-moored FPSO using steel caisson risers</td>
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<tr>
<td>2012</td>
<td>First FPSO with over 66% Brazilian content*</td>
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<tr>
<td>2012</td>
<td>COOL™ LNG Transfer System*</td>
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<td>2013</td>
<td>Company rebranding</td>
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<td>2013</td>
<td>HV-AC Electric Swivel rated at 65kV and 150 MW*</td>
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<tr>
<td>2013</td>
<td>VHP Swivel rated at over 800 bar*</td>
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<tr>
<td>2013</td>
<td>Deepest FPSO</td>
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</tbody>
</table>

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Turret Mooring key components

- Turret
- Flexible risers
- Swivel stack
- Mooring legs
- Anchor point
Top Mounted Internal Turret (TMIT)

- Virtually no limit on riser number – scalable
- Virtually no limit on mooring loads
- Bogies and radial wheels are inspectable and replaceable
Top Mounted Internal Turret (TMIT)

Bogies support axial loads

Radial wheels support radial loads

Dry access in turret for inspection and maintenance

The bogie design is standard

The number of bogies is selected to accommodate the design loads (N+1)
Espírito Santo employs steel lazy wave risers

Steel Lazy Wave Risers terminate at lower cylinder deck

Umbilicals terminate at upper cylinder deck

Weathervaning system unaffected
Swivels transfer fluids, utilities, power and signals between the geostationary turret and the weather-vaning vessel.
Since 1977, SBM has delivered 70+ Swivel stacks, representing:

- 300+ Production swivels from 4 to 532 bar
- 40+ Utility swivels from 5 to 517 bar
- 63+ Electric swivels from 3.5 kW to 30 MW

→1/3 of swivel stacks in production worldwide
Lower Seal Replacement

Seal Replacement
Very High Pressure Swivels
Introduced in 2014

12” VHP swivel qualified to 830 bar
Further qualification to more than 1000 bar
Large Scale Power Import or Export

2011

Spotlight on new technology

HVAC swivel rated at 65 kV and 150 MW
FPSO Turritella

- Disconnectable FPSO in 2,900 meters
- Steel lazy wave risers
- Worlds deepest production unit
Able to disconnect under loads (600 tons per locking device)

Able to transfer up to 900 tons per locking device when connected
SBMO Expertise – the FULL LIFE CYCLE of FPSO’s

**Engineering**
- 50 years of industry firsts
- Leading edge technology

**Procurement**
- Integrated supply chain
- Global efficiencies
- Local sourcing

**Product Life Extension**
- Leader in FPSO relocation
- World class after sales

**Operations**
- 200+ years of experience
- 99+% production uptime
- Largest international FPSO fleet

**Construction**
- Strategic partnerships
- Unrivalled project experience

**Installation**
- Dedicated fleet
- Unparalleled experience
- Extensive project capability

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SBM Offshore Installation history

1984

==////////==

2002

2006

2013

Dynamic Installer

CALM installation (>100) and External Projects

Normand Installer

Interco and external Deepwater FPSO: Mondo, Saxi, Kikeh, BC 10, Frade, etc..

SBM Installer

Interco and external FPSO installation and Sat. diving works
Mooring Failure
West Africa
Where does mooring fail?

How to react in Remote Area?
West Africa case study

- Status & Inventory of all mooring System in WAF,
- Define minimum shot of components to establish a correct response,
- Design a mutualized mooring failure response plan (Procurement / Storage / Intervention),
Conclusion

- Personnel and Expertise
- Track record and Presence in Remote Areas
- Controlled asset = controlled scheduled

Thank you very much for your attendance and kind attention … … we will be happy to further discuss any of your questions … see you on our booth #615

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