Technology Changes driven by increased Water Depth

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Sept 27th, 2012

Houston, TX
Where we’ve been
Where are we now
Where we need to go
How do we get there
What Technologies might we need
Where we’ve been

**Cuss 1, 1961 (Patent 1954)**
(Continental, Union, Shell & Superior)
4 steerable propellers.
operator controlled
Radar & Sonar ranging
max WD 3500m

**Shell Eureka. 1961**
Azimuthing thrusters
analogue controller & a basic Taut Wire position reference system

**Sedco 445, 1971**
Azimuthing thrusters
(lots)
analogue controller
Taut Wire and acoustic position reference system
1972, First well 1350’ wd
Brunei

**Sedco 709, 1971**
8 Azimuthing thrusters
analogue controller
Taut Wire and acoustic position reference system

Some Key Milestones
2nd Generation
- **Mid 1970s**
- Water Depth to 1000-ft
  - Displ. to 25,000 tons
- Moored - all chain
- Early DP Units arrive
- 500 ton Loadpath
- No Top drives...yet
- Manual pipe-handling
- 10k-psi BOPs typical

3rd Generation
- **Early 1980s**
- Water Depth to 3000-ft
  - Displ. to 35,000 tons
- Moored – wire/chain systems arrive
- Early DP Units arrive
- 650 ton Loadpaths
- Top drive retrofits
- Manual pipe-handling
- Few 15k-psi BOPs
- Hydraulic BOP Controls

4th Generation
- **Mid-Late 1980s**
- Water Depth to 5000-ft
- Semisubmersibles
- Moored, wire/chain
- Harsh Environments
- Displ. to 45,000 tons (a few larger)
- Mechanized Drill Floor
- 750-ton Loadpath
- Top drives common
- 7500-psi mud systems arrive
- 15k-psi BOPs prevalent, MUX arrives

5th Generation
- **Late 1990s**
- Water Depth to 10,000-ft
- Mostly Ships
- Almost all DP
- Moderate Environments
- Displ. to 100,000 tons
- Highly Mechanized Drill Floor
- 1000-ton Loadpaths
- Dual Activity and active heave dwks Introduced
- Top drives common
- 7500-psi mud systems
- 15k-psi BOPs up to 6-rams
- Hydrocarbon storage

6th Generation
- **Current Build Cycle**
- Water Depth to 12,000-ft
- Almost all Ships
- Almost all DP (+DPS2/3)
- High-reliability Power
- Moderate Environments
- Displ. to 110,000 tons
- Highly Automated Drill Floor
- 1250-ton Loadpaths
- Dual Activity
- Active Heave common
- Top drives common
- 7500-psi mud systems, (5 pumps)
- 15k-psi BOPs up to 6-rams (even 7!)
- Hydrocarbon storage
### Operating Displacements

<table>
<thead>
<tr>
<th>Drillships</th>
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<tbody>
<tr>
<td>19,750 st Peregrine I</td>
</tr>
<tr>
<td>29,252 st Deepwater Expedition</td>
</tr>
<tr>
<td>75,000 st GSF Jack Ryan</td>
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<tr>
<td>110,250 st Enhanced Enterprise class</td>
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</tbody>
</table>

<table>
<thead>
<tr>
<th></th>
<th>Water Depth (m)</th>
<th>Displacement (mt)</th>
<th>Operating VDL (mt)</th>
<th>Length (m)</th>
<th>Beam (m)</th>
<th>Usable Deck Space (m²)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Clear Leader</td>
<td>3,600</td>
<td>100,000</td>
<td>20,000</td>
<td>254</td>
<td>38</td>
<td>2,367</td>
</tr>
<tr>
<td>Expedition</td>
<td>3,000</td>
<td>24,125</td>
<td>7,000</td>
<td>171</td>
<td>28</td>
<td>485</td>
</tr>
</tbody>
</table>
Where are we now

Rig Capability Envelope

- Cajun
- Spirit
- Enhanced Enterprise Class
Where do we need to go

Rig Capability Envelope

Well Depth (MD, ft) vs. Water Depth (ft)

- Cajun
- Spirit

Enhanced Enterprise Class

Or
Maybe here

Or here

Or here

Or Back here
That depends

Known Deepwater Basins
Wells drilled since 2002 WD vs TD

Water Depth Vs Well TD

Wells Drilled since 2002 - Source GRS data
Where do we need to go

Rig Capability Envelope

- Here
- Or here
- Enhanced Enterprise Class

Water Depth (ft)

Well Depth (MD, ft)