Buoyant Tower Technology

Scalable, Self-Installing, Multi-Purpose Offshore Platform

December 2013

Bao Nguyen and Sanjai Jatar
WHO WE ARE

- 50/50 Joint Venture company
- Offers unique combination of expertise:
  - Horton Wison Deepwater – unparalleled floating platform design and engineering experience
  - GMC – extensive record of innovative engineering and project management solutions
BUOYANT TOWER DESIGN

Cell Spar Technology

- Simple fabrication
- Scalable for multiple applications

- Cell redundancy for safe operations
- Small offshore footprint
- All mild steel (AH-36 50ksi yield or eq.)
BUOYANT TOWER DESIGN

Fixed & Variable Ballast

- Provides flexibility for drilling and production operations
- Unconditionally stable
- Electronic and Manual Ballast Control
- Air-over-water for simplicity and safety
BUOYANT TOWER DESIGN

Compliant

- Resilient to seismic activity
- Resilient to wave forces
- Sea floor accelerations distributed through hull reducing topside acceleration
BUOYANT TOWER DESIGN

Suction Can Foundation

• Proven technology for in-place stability
• Ease of relocation
• Net downward force of 300MT

Main functions

- Prevent lateral movement
- Prevent vertical movement
- Prevent torsional movement
- Allow tilt motion
BUOYANT TOWER DESIGN

Simplified Installation

• Single vessel for transportation and installation
• Self-upending
• Cantilevered float-over
JACKET & BUOYANT TOWER
EARTHQUAKE RESPONSE

**Bending Moment Comparison**

- **Jacket**
  - 2000 yr Earthquake Return Period: 1.8E+09 ft-lbs
  - 200 yr Earthquake Return Period: 1.6E+09 ft-lbs

- **Buoyant Tower**
  - 2000 yr Earthquake Return Period: 1.4E+09 ft-lbs
  - 200 yr Earthquake Return Period: 1.2E+09 ft-lbs

**Topside Surge Comparison**

- **Jacket**
  - 2000 yr Earthquake Return Period: 2.0
  - 200 yr Earthquake Return Period: 1.2

- **Buoyant Tower**
  - 2000 yr Earthquake Return Period: 1.8
  - 200 yr Earthquake Return Period: 1.0

HortonGMC™
EARTHQUAKE AND WAVE DESIGN

- Not rigidly connected to the seafloor
- Tower base can move without transmitting high seismic loads
- Even in 2000 yr case the tower steel is not yielding unlike a jacket which plastically deforms (unity ratio <0.5)
- Induced accelerations nearly half compared to Spars
- Suction can is designed for specific soil and metocean conditions

---

### Minimum Bending Stress

- 50 yr
- 200 yr
- 2000 yr

### Maximum Bending Stress

- 50 yr
- 200 yr
- 2000 yr

### Table

<table>
<thead>
<tr>
<th>Storm</th>
<th>Pitch</th>
<th>Heave</th>
<th>Accelerations</th>
<th>Case</th>
</tr>
</thead>
<tbody>
<tr>
<td>Year</td>
<td>(Deg)</td>
<td>(FT)</td>
<td>Vert(g)</td>
<td>Horiz(g)</td>
</tr>
<tr>
<td>SPAR (GOM)</td>
<td>10 (Winter)</td>
<td>4.0</td>
<td>3.0</td>
<td>0.002</td>
</tr>
<tr>
<td></td>
<td>100 (Hurricane)</td>
<td>10.0</td>
<td>8.0</td>
<td>0.015</td>
</tr>
<tr>
<td>Buoyant Tower (Peru)</td>
<td>1</td>
<td>2.1</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td></td>
<td>100</td>
<td>7.21</td>
<td>0</td>
<td>0</td>
</tr>
</tbody>
</table>

---

Minimum Bending Stress

- Stress - ksi
- Elevation - ft

Maximum Bending Stress

- Stress - ksi
- Elevation - ft
BUOYANT TOWER DESIGN FLEXIBILITY

- Oil-Over-Water Storage (light oil, no wax)
- Driller Design
- Accommodation
- Variable Depth
- Integrated Topsides
Advantages

- Makes use of existing tender assist assets
- Water depth range of 50m - 250m
- Competitive with other forms of drilling such as jack-ups
ACCOMMODATION DESIGN
VARIABLE DEPTH

Advantages

• Expands range of drilling water depths
• Expands range of production water depths
• Provides added flexibility for heavy transportation configurations
INTEGRATED TOPSIDES

Advantages

• Reduces offshore installation duration
CX-15 BUOYANT TOWER – BPZ PERU

WORLD’S FIRST BUOYANT TOWER INSTALLATION

Customer: BPZ Energy
Project: CX-15
Location: Peru
Water Depth: 54 meters
Year: 2012
CX-15 – DRILLING & PRODUCTION

- **TOPSIDES:**
  - Structure (approx. 800 MT)
  - 3-levels with following deck dimensions:
    - Drilling deck (36.6m x 30.5m)
    - Production deck (36.6m x 30.5m)
    - Cellar deck (30.5m and 13.7m)
  - 24 Slots

- **FACILITIES (APPROX. 500 MT)**
  - 12,200 BOPD, 12.8MMSCFD Gas, 3500BPD water injection
  - Separation
  - Treating
  - Gas injection
  - Water injection
  - Power generation and utilities

- **PIPELINES:**
  - 8” Oil Export
  - 6” LP Gas
  - 4” HP Gas
  - 4” Water Injection
SIMULTANEOUS HULL & TOPSIDE FABRICATION
HULL LOADOUT
OFFSHORE INSTALLATION - PERU
HULL FLOAT OFF
HULL UPENDING
FIXED BALLAST INSTALLATION
TOPSIDE MATING
INSTALLED BUOYANT TOWER
INSTALLED BUOYANT TOWER
Additional Reference

Website: www.HortonGMC.net
Thank You