FPSO Mooring Connections

Subsea Europe 2011

Brian Green – 15 November 2011
FPSO Mooring Connections

- FPSO trends and mooring options
- Ball and taper subsea mooring connectors
- Ball and taper mooring
  - Turret Mooring - Jubilee Kwame Nkrumah MV21 FPSO
  - STP Mooring - Chinook – Cascade / Peregrino FPSOs
- Buoy pull-in and abandonment
- Ball and taper buoy mooring connections
FPSO Trends

- Fields
  - Further offshore
  - Adverse sea environment / weather conditions
  - Lack of infrastructure

- FPSO
  - Field hub
  - Larger, more on-board processing
  - Greater storage capacity
FPSO Mooring

- Deeper water moorings
- Mooring flexibility - FPSO needs to move off-station
- Turret Buoys: external and internal
  - disconnectable and retrievable
Ball and taper subsea mooring connectors

- 'Plug-in' Ballgrab connection
- Two load bearing components: male mandrel and receptacle
- Multi-point grip in direct proportion to load
- Self-aligning and self-energising
- Over 300 installations
Ball and taper mooring connections

- Mooring flexibility: deepwater and shallow water
- Lean Installation
- Two part connection: different times, different vessels
- Mooring line installation: surface to seabed or seabed to surface, buoy mooring
Turret Moored FPSO

Kwame Nkrumah FPSO
- 1,100m water depth, offshore Ghana
- Bow-mounted turret
- 9 Series III Ballgrab connectors (5,364kN), polyester line
- Female receptacle pre-installed on suction pile
Surface to Seabed Mooring

- Female receptacle, attached to ground chain
- Trunnion and docking porch
- Male connector lowered from surface and inserted into receptacle
Submerged Turret Production
Buoy Moored FPSO

- Chinook-Cascade FPSO
- First and deepest STP buoy mooring in GoM
- 2,500m water depth
- 11 Ballgrab connectors (6,600kN)
Seabed to Surface Mooring

- Female receptacles pre-installed on STP buoy
- Mooring lines installed with piles, held midwater
- Easier lift and tow out
Maersk Peregrino FPSO

- Shallow water, Brazil
- STP buoy, 100m water depth, 10 mooring lines
- Female receptacles pre-installed on buoy (60 degrees)
- Easier buoy lift and tow-out
Maersk Peregrino FPSO

- Spiral wire mooring line retrieved, male connector attached
- Brace fitted (30 degrees)
- ROV-activated installation aid – overcome mooring line loading
Maersk Peregrino FPSO

- ROV-assisted insertion of male connector into receptacle attached to buoy
- No diver required
- Buoy moored successfully
Buoy pull-in and abandonment

- Maersk Peregrino FPSO buoy integral Ballgrab receptacle
- Male Ballgrab lowered into receptacle
- Buoy lowered using Ballgrab during abandonment
Buoy retrieval, pull-in and abandonment

- Dynamic positioned FPSO, absence of buoy mooring lines
- Ballgrab male connector uses Doppler TV camera
- Finds and connects to buoy receptacle
Ball and Taper FPSO Mooring Connections

- Two part mooring – Lean Installation
- Greater customisation of mooring line installation to suit turret and mooring conditions
- External turret – receptacle on pile
- Internal turret – receptacle on buoy
  - Easier lift and tow out
  - Fewer, smaller vessels
  - Safer installation
- Mooring line material independent – hybrid lines
‘The innovator of engineering excellence, specializing in connection and mooring solutions’