

ABS Offshore Seminar

Nov 24 -25, 2008 at Beijing



ABS
PACIFIC DIVISION

***Column Stabilized
Drilling Units***

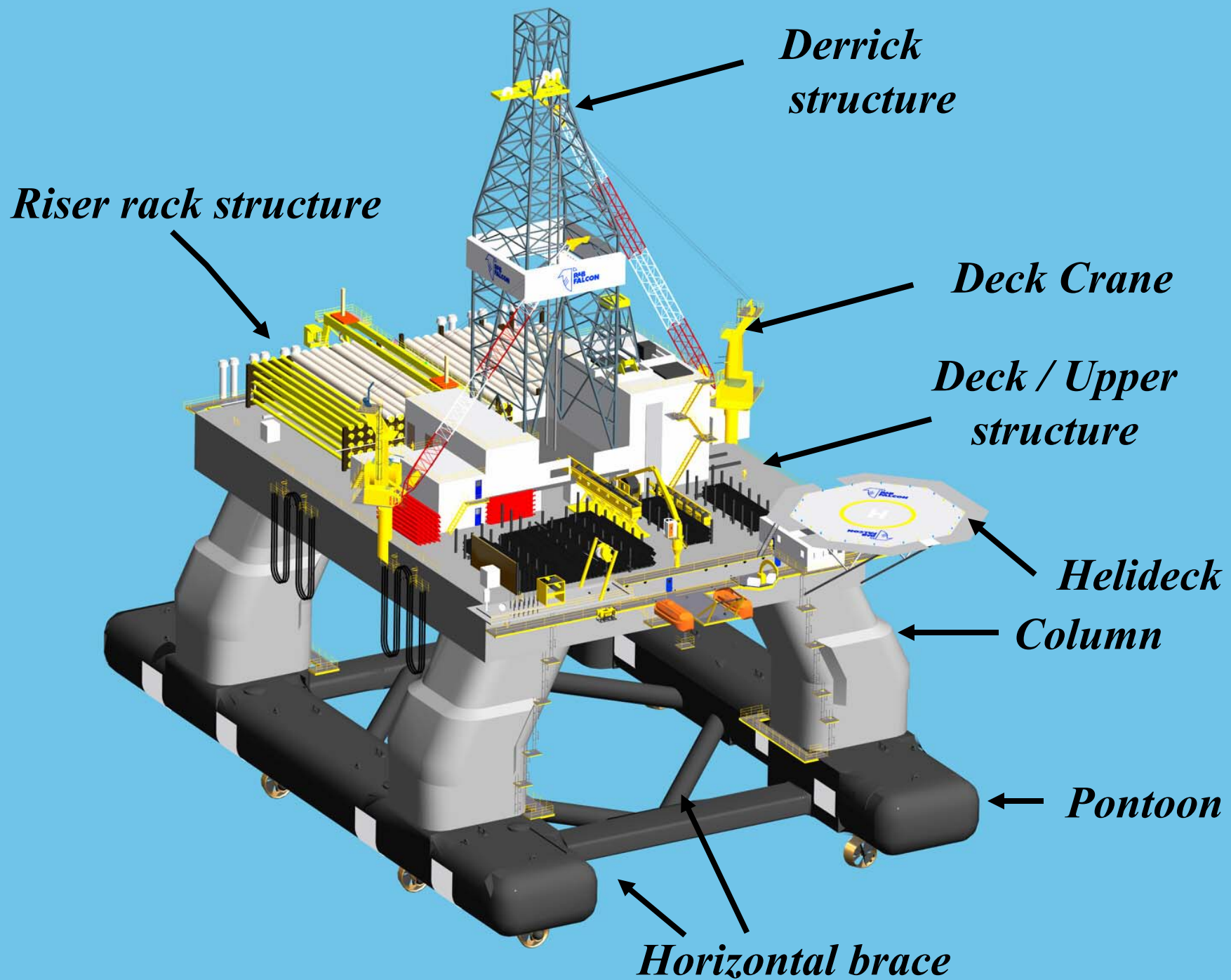


Outline

Mobile offshore drilling units (MODUs)

- *General Information*
- *Semi-Submersible or Column-Stabilized Drilling Units*







Column Stabilized Units (CSDU)

Submersible Drilling Unit:

- *Unit is operated up to 20 m water depth and supported by the seabed with a strengthened lower hull structures to resist bottom sitting reactions.*

Semi-Submersible Drilling Unit:

- *Unit is operated up to 10,000 m water depth and suitable for harsh environment with a larger deck area & operating variable deck load. Conventional mooring system, Dynamic Positioning system or combination system for station keeping.*





Column Stabilized Drilling Units

Hull Structure & Arrangements

Consists of :

➤ ***Upper Structure***

- ✓ *Typically designed for non-wave impact underneath*
- ✓ *Reasonable clearance between deck structure and wave crest*
- ✓ *The box-shaped (barge form), buoyant upper has become the prevalent design concept design for modern semis*

➤ ***Columns, Lower Hulls and Footings***

- ✓ *Main Stability columns*
- ✓ *Lower hulls or footings*
- ✓ *These may be framed or unframed shells*
- ✓ *Ring stiffeners, bulkheads or other suitable diaphragms are to be adequate to maintain shape and stiffness for all anticipated loadings.*



Semisubmersible Drilling Units

- An Introduction to Design & Construction





Outline

- ***Historical and modern Semi-Submersible***
- *Structural Design*
- *Stability*
- *Station-keeping systems / Dynamic Position*
- *Classification*
- *Semi-Submersible incidents & lessons learned*
- *Constructions*





Generation of Semi-Submersible

<i>Generation</i>	<i>Station Keeping</i>	<i>Water Depth (ft)</i>	<i>Drilling Depth (ft)</i>	<i>Hook Load (kips)</i>	<i>Remarks Average water depth</i>
<i>1 st.</i>	<i>Moored</i>	<i>< 600</i>	<i>—</i>	<i>—</i>	<i>—</i>
<i>2 nd.</i>	<i>Moored</i>	<i>1,000~ 4,000</i>	<i>~25,000</i>	<i>—</i>	<i>< 2,000</i>
<i>3 rd.</i>	<i>Moored</i>	<i>1,500~ 5,000</i>	<i>25,000~ 30,000</i>	<i>~ 1,000</i>	<i>< 4,000</i>
<i>4 th.</i>	<i>DP-1/ DP-2</i>	<i>4,500~ 8,000</i>	<i>25,000 ~ 32,500</i>	<i>~ 1,300</i>	<i>< 5,000</i>
<i>5 th.</i>	<i>DP-2/ DP-3</i>	<i>5,000 ~ 10,000</i>	<i>30,000 ~ 37,500</i>	<i>~ 1,600</i>	<i>5,000 ~ 8,000</i>
<i>6 th.</i>	<i>DP-2/ DP-3</i>	<i>8,000 ~ 10,000</i>	<i>30,000~ 40,000</i>	<i>~ 2,000</i>	<i>—</i>





The first semi-submersibles

- *Bluewater Rig No.1 (1961)*
 - *Shell design; converted from a 4-column submersible*
- *Ocean Driller (1961)*
 - *3-column, V-shaped structure, 1st purpose-built semisub*
- *Sedco 135 (1965)*
 - *Friede Goldman design*





The 2nd Generation

Design: Aker H-3, H-3.2

Built: Mid through late 1970s

Water / Drilling depths: 1,000~1500 / 25,000ft

VDL: ~3,000 s/t

Various: e.g. Nanhai II; Pride North Sea;

Many upgrades



Design: Earl & Wright Sedco 700

Built: 1970s

Water / Drilling depths: 1,000~1,500 / 25,000ft

VDL: ~3,000 s/t

Transocean: Sedco 701; Sedco 702; et al

*Some Upgraded: e.g. Sedco 707 to 6,500ft water depth,
and VDL 4,700 s/t; Transocean Marinas to 4th generation*





The 2nd Generation

Design: Odeco Ocean Victory

Built: 1973 ~ 75

Water / Drilling depths: 2,000/25,000ft

VDL: < 4,000 s/t

Diamond Offshore Ocean Baroness, et al

Upgraded to 4th ~ 5th generation 2001/2007

8,000 / 35,000ft; > 6000 s/t



Design: Forex Neptune & IFP Pentagone 85

Built: 1973 ~ 75

Water / Drilling depths: 4,000 / 25,000ft

VDL: < 3,000 s/t

Noble Drilling: Noble Lorris Bouzigard; Noble Therald Martin





The 3rd Generation

Design: F&G Enhanced Pacesetter

Built: Early to mid 1980s

Water / Drilling depths: 1,500~3,500 / 25,000ft

VDL: < 4,000 s/t

***Pride International** Pride Venezuela; Pride South Atlantic **GlobalSantaFe**: GSF Arctic series **Others**: Nanhai V, VI*



Design: Trosvik Bingo 3000

Built: Early to mid 1980s

Water / Drilling depths: 1,500~3,500 / 25 – 30,000ft

VDL: < 4,000 s/t

***Diamond Offshore** Ocean Vanguard; Ocean Patriot **Others**:*





The 3rd Generation

Design: Korkut New Era, enhanced

Built: Early 1980s

*Water / Drilling depths: 3,500~5,000 /
25,000ft*

VDL: 3,500~5,000 s/t

*Atwood Oceanic: Atwood Eagle; Atwood
Falcon; Atwood Hunter*



Design: Aker H-3, H3.2 Enhanced

Built: Mid 1970s to mid 1980s

*Water / Drilling depths: 1,500~3,500 /
25,000ft*

VDL: < 4,000 s/t

*Diamond offshore: Ocean Winner Odfjell:
Deepsea Bergen*





The 4th Generation

Design: Noble EVA-4000

Built: Early 1980s

Water / Drilling depths: 6,000~8,000 / 32,500 ft

VDL: 4,000~5,500 s/t

Noble Drilling: Noble Amos Runner; Noble Jim Thomson; Noble Paul Romano; Noble Max Smith; Noble Paul Wolff



Design: DeHoop Megathyst

Built: Early 2000s

Water / Drilling depths: 5,000 / 25,000 ft

VDL: 3,850 s/t

Pride International: Pride Brazil ; Pride Carlos Walter; Pride Portland; Pride Rio de Janeiro





The 4th Generation

Design: Friede & Goldman Trendsetter

Built: Late 1980s

Water / Drilling depths: 5,400/ 30,000 ft

VDL: 6,700 s/t

Transocean: Jack Bates



Design: GVA 4500

Built: Late 1980s

Water / Drilling depths: 4,500~5,000 / 25,000 ft

VDL: 3,857 s/t

Transocean: Transocean Richardson, Transocean Rather



Design: Maritime Engineering ME-5000

Built: 1990s

Water / Drilling depths: 6,000 / 29,500 ft

VDL: 4,300 m/t

Saipem: Scarabeo 5





The 5th Generation

Design: Friede & Goldman ExD

Built: 2005

Water / Drilling depths: 7,500 / 37,500 ft

VDL: 7,000 m/t

GlobalSantaFe: GSF Development Driller I & II



Design: SFXpress

Built: Early 2000s

Water / Drilling depths: 7,500~8500 / 35,000 ft

VDL: 6,612 s/t

Tranocean: Sedco Express, Sedco Energy, Cajun Express





The 5th Generation

Design: Reading & Bates RBS-8D and RBS-8M

Built: 2000

Water / Drilling depths: 8,000~10,000 / 30,000 ft

VDL: 8,800~10,500 s/t

Transocean: Deepwater Horizon, Deepwater Nautilus



Various converted units



*Diamond Offshore:
Ocean Baroness*

*Ocean Victory
6,500ft / 35,000ft
6,500 mt*



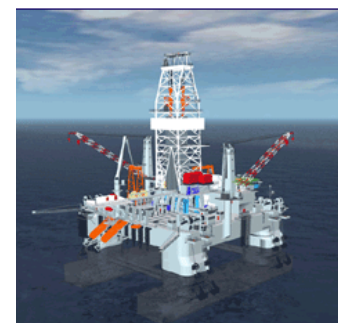
*Diamond Offshore:
Ocean Confidence*

*Aker H-3.2
7,500ft / 35,000ft
6,000 mt*

Various new Designs



*MSC/K-FELS DSS 38
Queiroz Galvao Perfuracoes
9,000 / 30,000ft
5,500 mt*



*Friede & Goldman ExD
SeaDrill
10,000/37,500ft
7000 st*





The 6th Generation



*F&G ExD
PetroMena
Jurong 2006*

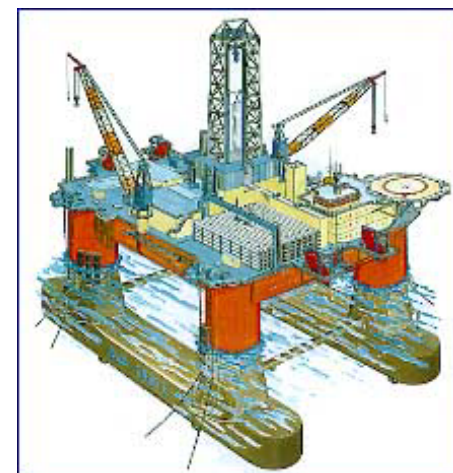
*Aker H-6e
Aker Drilling
2008*

*Aker Group
10,000 /
30,000ft
7,780 st*



*MSC/K-FELS DSS 21
Maersk Contractors
K-FELS 2008
10,000/40,000ft
7,700 st*

*GVA7500
SeaDrill
Daewoo 2009
10,000/35,000ft
7,000 mt*





Current Semi-Submersible Designs

NO.	Patten	Designer	Water Depth (ft)	Drilling Depth (ft)		
1	F & G EXD	FRIEDE & GOLDMAN	6,500		2	12
			7,500	30,000	8	
			8,000	30,000	1	
			10,000	40,000	1	
2	ENSCO 8500	ENSCO	8,500	30,000	4	4
3	GVA 7500 N	GVA Consultant AB	7,500	30,000	4	4
	GVA 4000		3,300	25,000	2	2
4	MSC DSS 21	GUSTOMSC “Marine Structure Consultants (MSC) BV”	10,000	30,000	3	3
	MSC DSS 38		7,500	25,000	1	1
	MSC DSS 51		10,000	30,000	1	1
	MSC TDS 2000		6,500	25,000	1	3
			7,500	25,000	2	
5	SCARABEO 8	SAIPEN S.P.A.	10,000	30,000	1	1
6	BINGO 9000	FRIEDE & GOLDMAN Halter	7,500	30,000	4	4
7	MOSS CS50 MK II	MOSS MARITIME	10,000	30,000	4	4
8	GM 4000	GLOBAL MARITIME	2,500	30,000	4	4
			5,000		1	1
9	AKER H 6E	AKER KVAERNER	10,000	30,000	4	4
10	SEVAN SSP	SEVAN MARINE ASA	12,500	40,000	1	1
11	FRIGSTAD D90	HARALD FRIGSTAD ENGINEERING PTE. LTD.	12,000	50,000	3	3
	YANTAI SSCV					
	ZHEN HUA	MARIC & BESTWAY U-SEMI				





Popular Semisubmersible Designs

- *F&G ExD*
 - *5 units at Jurong for Petromena and SeaDrill*
- *GVA 7500*
 - *4 units at DSME for SeaDrill, Odfjell, Petroserv*
- *MSC/K-FELS DSS 21*
 - *3 units at K-FELS for Maersk*
 - *1 DSS 38 for Querioz Galvao; 1 DSS 51 for GSF*
- *ENSCO 7500 Enhanced*
 - *3 units at K-FELS for ENSCO*
- *F&G Millennium*
 - *2 units at Yantai Raffles for Schahin Engenharia*





Column Stabilized Units (CSDU)

Established Structural Configuration



- *Multiple columns*
 - *Buoyancy; restoring moment*
 - *Tanks, storage, eqpt*
- *2 pontoons*
 - *Buoyancy; hydrodynamic damping;*
 - *Ballast, liquid, mchy spaces*
- *Vertical & horizontal tubular braces*
 - *May or may not be buoyant*
- *Single deck non-buoyant upper structure*
 - *Deep I-beams or box girders*
 - *Accommodations*
 - *Machinery, drilling eqpt*





Column Stabilized Units (CSDU)

Modern Structural Configuration



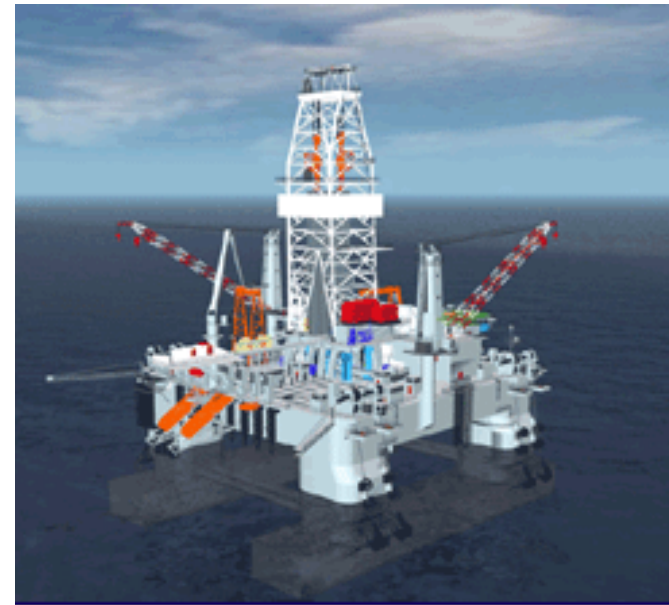
- *4 only but larger columns*
 - *Mainly to provide buoyancy & stability*
- *No vertical bracing*
 - *Reduced hydrodynamic forces*
 - *Reduced number of fatigue sensitive areas*
- *Horizontal bracing*
 - *Improve strength of deck-column joint*
- *Barge type buoyant upper hull*
 - *Provides added stability*
 - *Improves strength of deck-column joint*
 - *Provide added spaces*





Modern Semisubmersibles

- *10,000 feet water depth capability*
- *harsh environment*
- *optimized motion characteristics*
- *large operating variable deck load (VDL)*
- *large deck area*
- *conventional mooring system*
- *dynamic positioning system*





Continue to next presentation

