

ABS Offshore Seminar

Nov 24 -25, 2008 at Beijing



ABS
PACIFIC DIVISION

***Column Stabilized
Drilling Units***

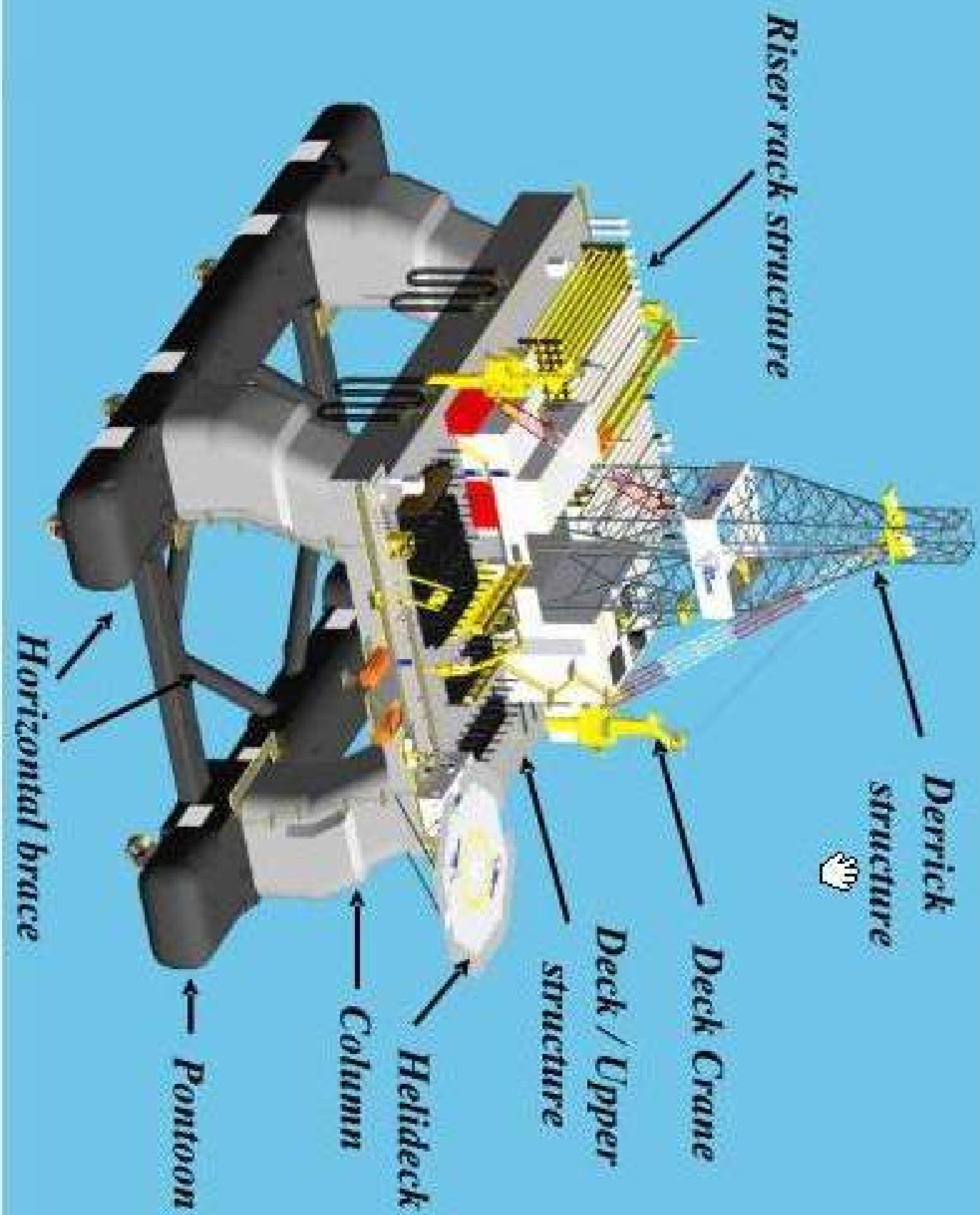


Outline

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 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

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





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 / 35,0000ft; > 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: 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



10/28/1999

Various converted units



Various new Designs

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

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



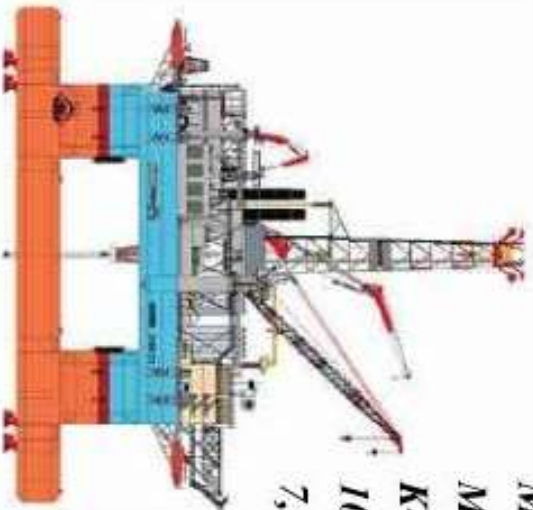


The 6th Generation



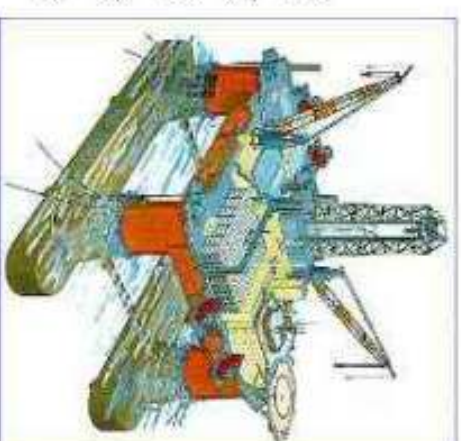
F&G ExD
PetroMena
Jurong 2006

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

GV/A7500
SeaDrill
Daewoo 2009
10,000/35,000ft
7,000 mt





Current Semi-Submersible Designs

NO.	Pattern	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 4000 MSC DSS 21 MSC DSS 38	GVA Consultant AB GUSTOMSC "Marine Structure Consultants (MSC) BV"	7,500	30,000	4	4
			3,300	25,000	2	2
			10,000	30,000	3	3
			7,500	25,000	1	1
4	MSC DSS 51 MSC TDS 2000		10,000	30,000	1	1
			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*, *Odjfell*, *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, mch'y 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 (CSU)

Modern Structural Configuration



- *Barge type buoyant upper hull*
 - ▶ Provides added stability
 - ▶ Improves strength of deck-column joint
 - ▶ Provide added spaces
- *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





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*

