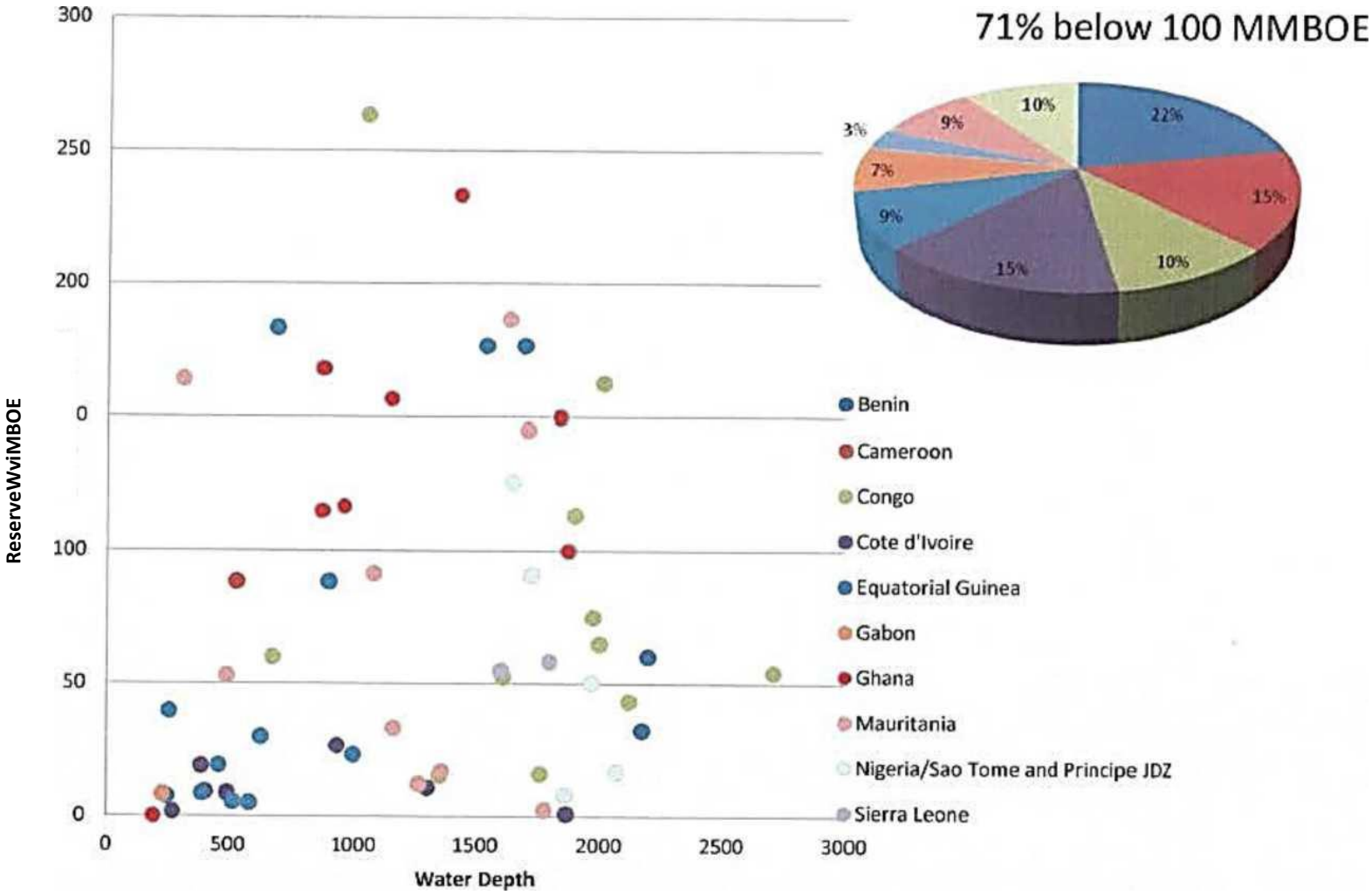
Making Deep Water Marginal Oil Fields Economical

March 2019

Topics

- West Africa Marginal Oil Fields
- Are Marginal Oil Fields Profitable?
- Production System Solution for Marginal Oil Fields
  - Self Standing Riser
  - Drilling Vessel/Production Vessel (FPSO)
  - Clustered Production Strategy
  - First Revenues Before End of 2nd Year
  - Revenues from First Well Finance Next Well, etc.

West Africa Marginal Oil Fields



Are Marginal Oil Fields Profitable?

- Conventional Cost Model - No

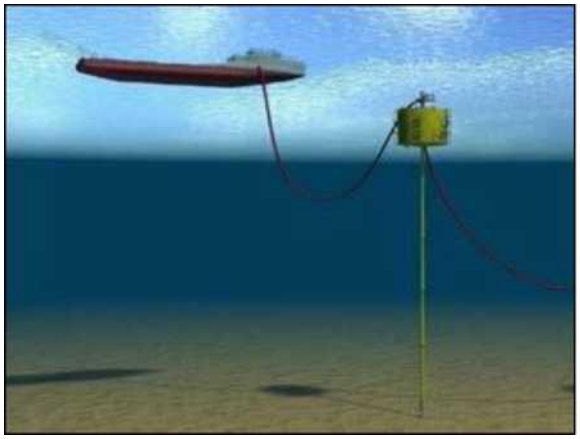
Paradigm Shift

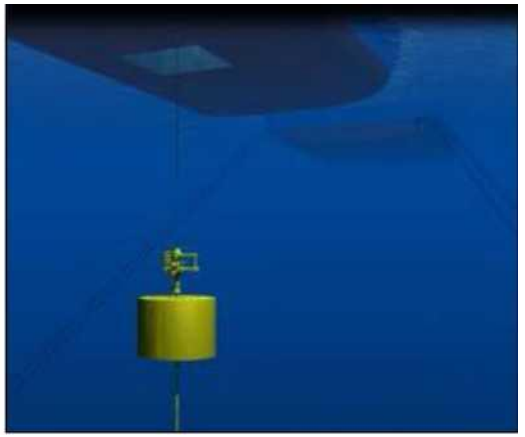
- MEPS Model - Yes
  - Self Standing Riser
  - Drilling Vessel/Production Vessel (FPSO)
  - Innovative Production Method

Production System Solution

- Drilling Vessel
- Production Vessel
- Self Standing Riser
- Cluster of Six Wells
- Staggered Drilling and Production Schedule
- Revenues from Production of First Well Finance Second Well and subsequent Wells Drilled in the Cluster

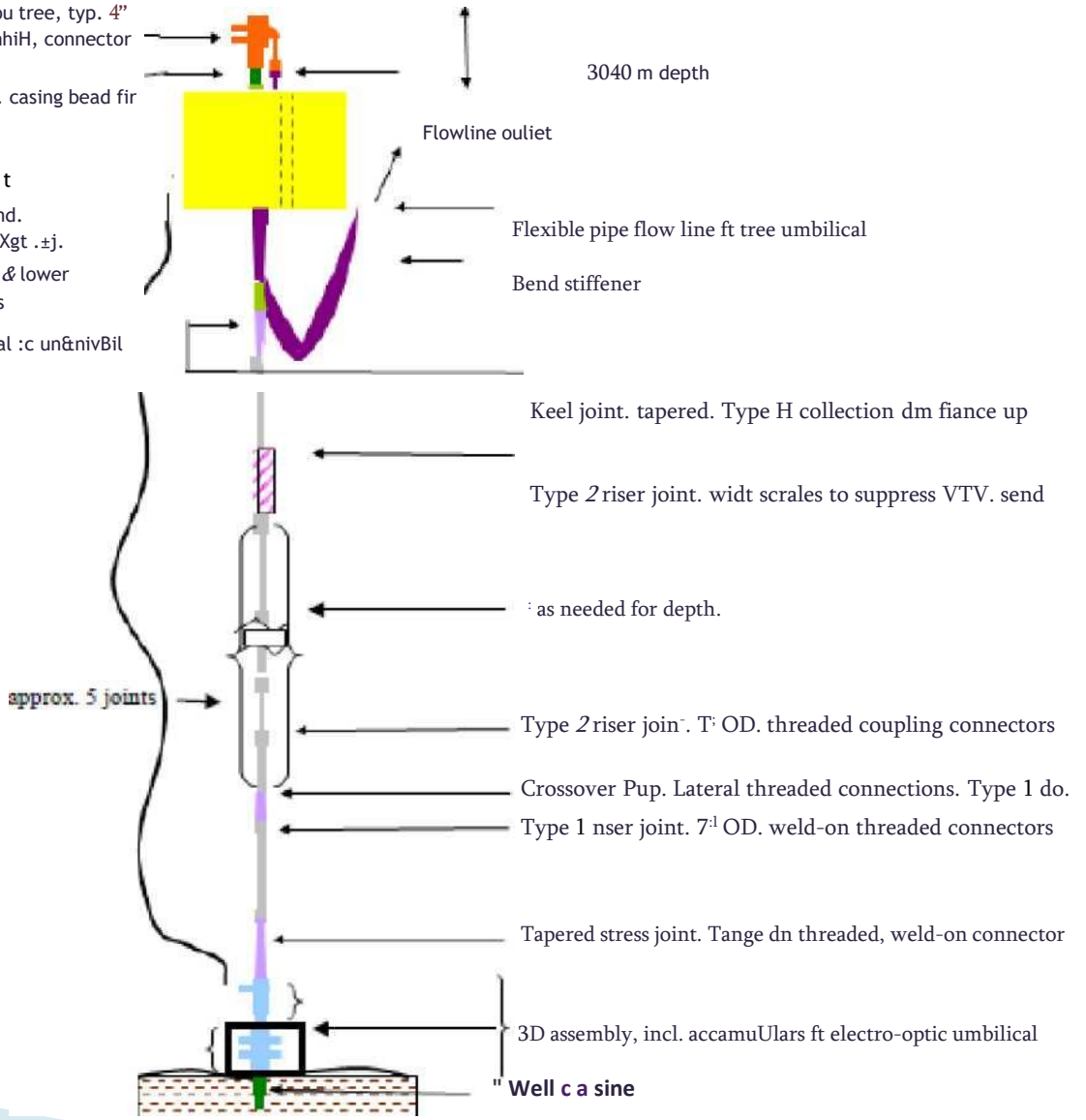
Self Standing Riser





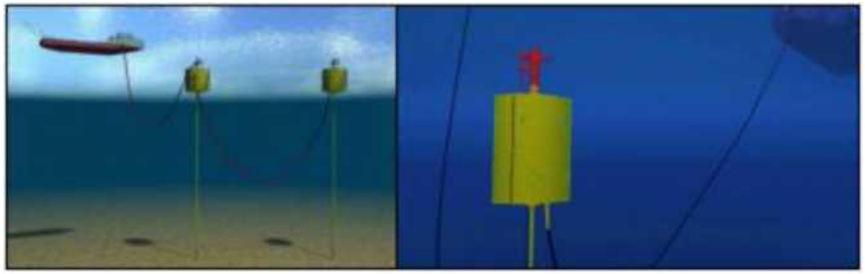
- Any new deep water system needs to:
  - Reduce drilling costs
  - Evaluate the discovery quickly and cost effectively
- Key elements driving the cost of the drilling and extended well testing is the riser and well control systems

Self Standing Riser Components



SSR Connected to Production Vessels

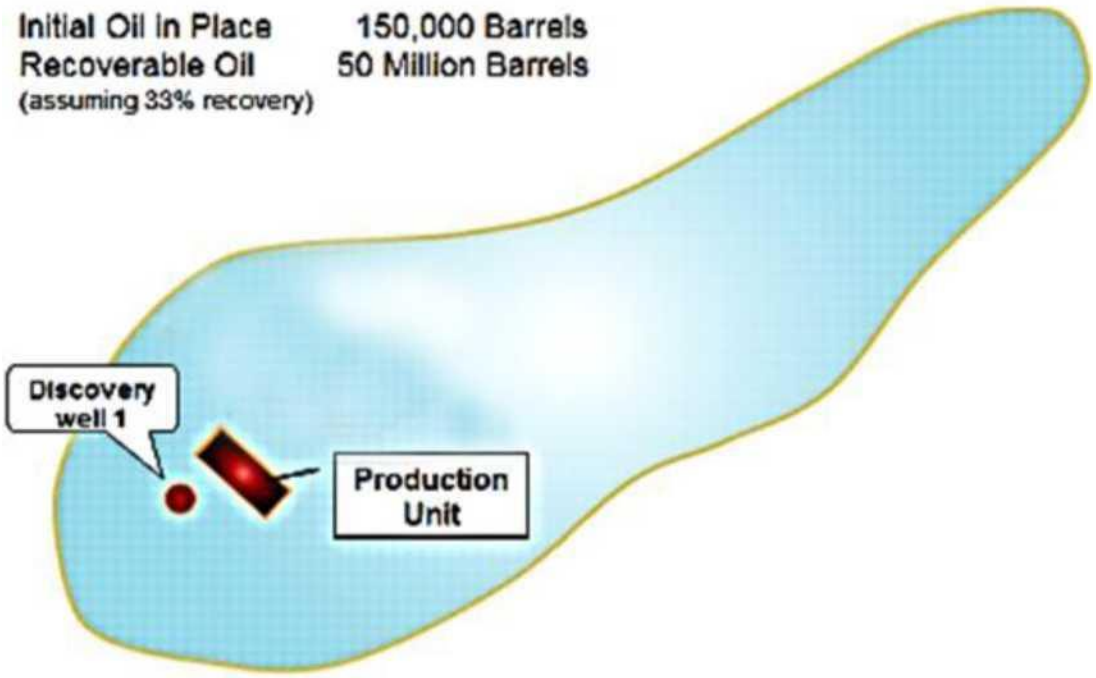
Production Tree, Buoyancy Device and Jump Line connected to Production Vessel



Typical Small Production Vessel - FPSO

Typical Small Production Vessel - FPSO

West African Deep Water Oil Field



Key Field Parameters	
Net Oil Thickness	50 ft.
Porosity	35%
Water Saturation (Sw)	20%
Permeability	500–1500 md
Original Oil in Place (OOIP)	150 million
Water Depth	3000 ft.
Depth Below Mudline	8500 ft.
Initial Reservoir Pressure	3950 PSI
Reservoir Temperature	202°F
GOR	400 SCF/Barrel
Saturation Pressure	1600 PSI
Oil Viscosity	1.2 CP

Timing of Drilling and Production

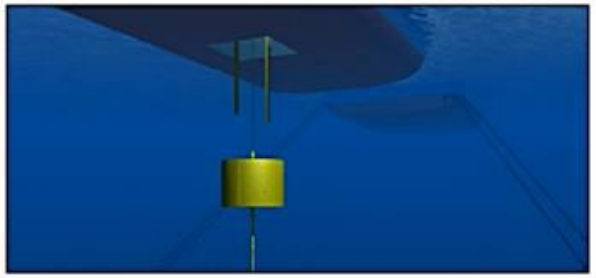
Table 2: Timing of Events for Drilling Six Wells using MEPS SSR Model with FPSO

Year 1												Year 2												Year 3											
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36
Move in Drill well #1		Complete, Test Put on Production		4000 BOPD - Well #1								4000 BOPD - Well #1												4000 BOPD - Well #1											
				Move in and drill well #2		Complete, test, put on production		4000 BOPD Well #2				4000 BOPD - Well #2												4000 BOPD - Well #2											
								Move in and drill well #3		Complete, put on Injection well		0 BOPD Injection Well #3												0 BOPD Injection Well #3											
												Drill well #4		Complete and put on Production		4000 BOPD - Well #4								4000 BOPD - Well #4											
																Drill well #5		Complete and put on Production		4000 BOPD Well #5				4000 BOPD - Well #5											
																				Move in and drill well #6		Complete, put on Injection		0 BOPD Injection Well #6											

SSR, Buoyancy Can, Wellhead, Tree

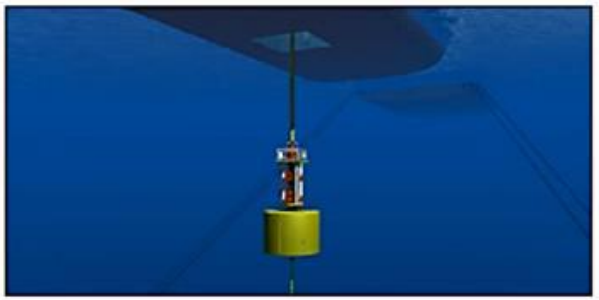
- Depicts an SSR being run by the drilling machine through the moon-pool.
- Shows the buoyancy unit and riser pipe under the drilling unit ready to connect to the well head.

SSR being run through the moon pool, buoyancy unit and riser pipe ready to connect to the well head



Riser Connected to Wellhead

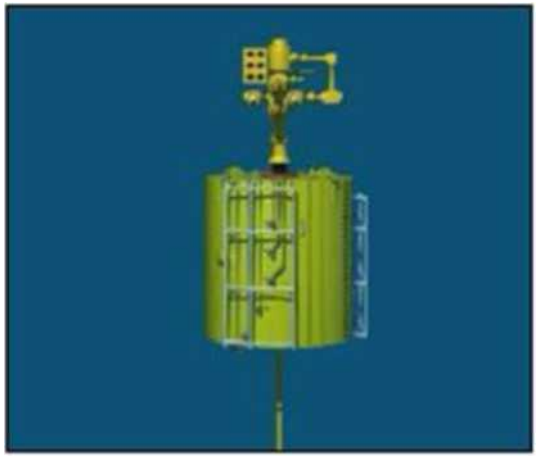
Buoyancy unit with attached BOPs and Riser



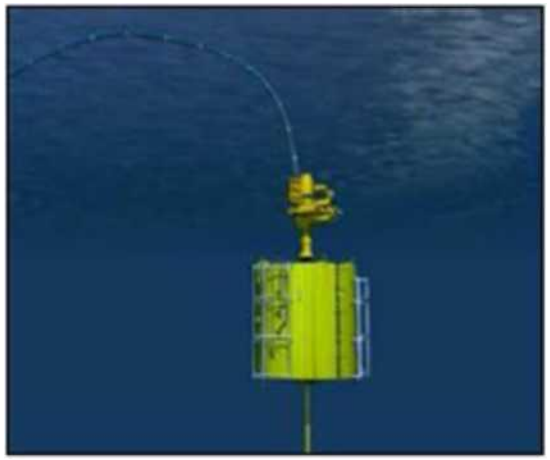
Production Tree Connected to FPSO

- Production tree added.
- A jumper (flexible production line) from the production tree to the docking station/production unit is connected to a manifold for the oil, gas, water separation module.

Production Tree Added

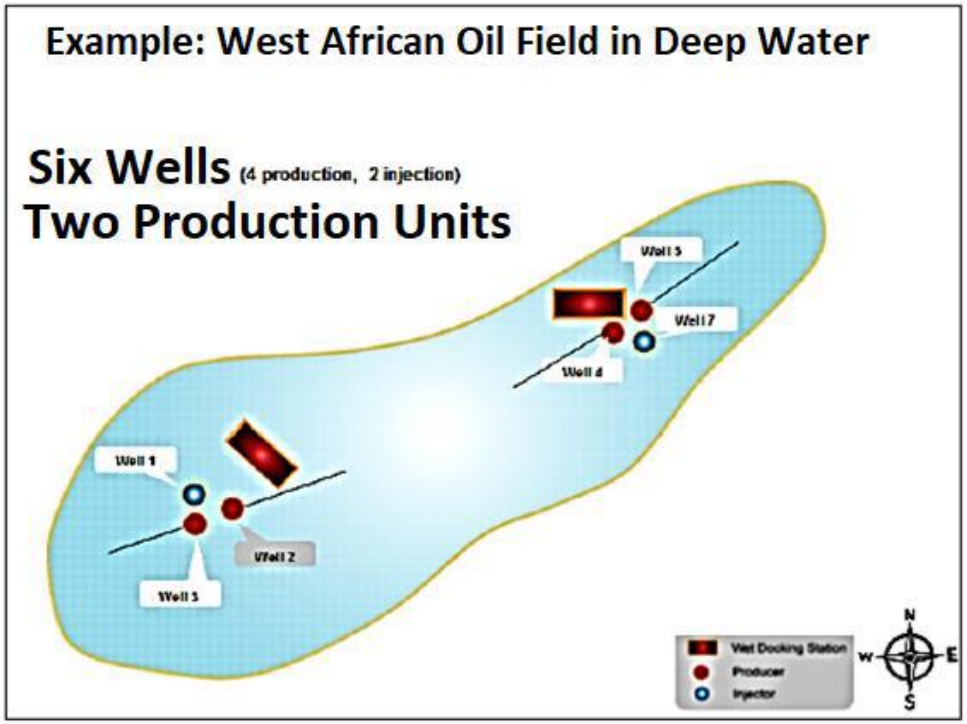


SSR Ready for Production



Production Units Six Wells

- Within 1 ½ to 2 years from the first sanctioning of the development, three wells are completed with a total production of 8,000 BOPD.



Closing Remarks

The use of the SSR for deep water drilling, completion, production, intervention and well testing is technically and economically feasible.

Owners of deep water assets deemed non-commercial using conventional deep water technologies are encouraged to recognize, that these assets can be profitable and produce an early cash flow to help finance the exploitation.