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FPSO Global Workshop

Petrobras Viewpoint on the Process of Acquiring a FPSO

Marco Maddalena

Petrobras, Brazil

Summary

- FPSOs in Campos Basin
 - PP MORAES History
 - Main Characteristics Petrobras FPSO fleet
 - Importance of FPSOs for Campos Basin Production Forecast

- Feedback
 - Conversion work
 - Operational feedback

- Conclusions



P.P. de Moraes History

- 1977 - Conversion to a FPSO with 60,000 bpd process plant
- 1979 - Tower-yoke system installed in Garoupa Field
- 1982 – CALM-yoke
- 1987 - Relocation to deep water field Albacora
- 1995 - Conversion into internal turret and installation of a new process plant
- 1997 - EPS of Barracuda and Carating field



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P.P. de Moraes History



Tower yoke

Calm-yoke





CAMPOS BASIN FPSOs

Units	Field	Capacity (bopd)	Installation	Mooring System	W.depth (m)	Vessel DWT	Status
FPSO P-34	Barracuda	60,000	July/97	Internal Turret	840	47,000	Operating
FPSO P-32	Marlim	***	August/97	Internal Turret	160	VLCC	Operating
FPSO P-31	Albacora	100,000	May/98	Internal Turret	330	VLCC	Operating
FPSO P-33	Marlim	50,000	October/98	Internal Turret	780	VLCC	Operating
FPSO P-35	Marlim	100,000	July/99	Internal Turret	850	VLCC	Operating
FPSO P-37	Marlim	150,000	August /00	Internal Turret	905	VLCC	Operating
FPSO P-38	Marlim Sul	***	May/01	Internal Turret	1,020	VLCC	Operating
FPSO-VI	Espadarte	100,000	August/00	Internal Turret	950	VLCC	Operating
FPSO-Brasil	Roncador	100,000	October/02	Internal Turret	1,290	VLCC	Construction
FPSO P-43	Barracuda	150,000	Dezember/03	Spread Mooring	790	VLCC	Construction
FPSO P-48	Caratinga	150,000	February/04	Spread Mooring	1,040	VLCC	Construction
FPSO P-50	Albacora Leste	180,000	July/04	Spread Mooring	1,225	VLCC	Bidding



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CAMPOS BASIN FPSOs



P-31

P-34



P-32



CAMPOS BASIN FPSOs

- All but P-32 have risers in free catenary configuration
- All FPSOs have a large number of risers (up to 47)
→ Large internal turrets
- All FPSOs have a large number of swivel paths
- All but P-34 designed for 20 years continuous service life



2005 Forecast

- 13 FPSO/FSOs will be in operation at Campos Basin
 - 48 offloading operations/month
 - 55% of Campos Basin oil production (45% today)

Conversion Experience

“As New” x “All New” Philosophy

- **First conversions: “As new” philosophy**
 - Real condition can only be evaluated during equipment overhaul → procurement delay → consequences to the relationship with the shipyard
 - Old equipment → spare parts issues
- **After P-37 conversion: “All new” philosophy**
 - All existing equipment and piping have to be replaced
 - Hull inspection and steel renew
 - All Units have a design life of over 20 years



Conversion Experience

Steel Renew

- No substantial corrosion during operational lifetime
- Limits for pitting dimensions

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Steel Renew

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Unit	Hull Supplier	Steel (t)
P-31	Petrobras	540
P-32	Petrobras	300
P-33	Petrobras	900
P-35 (ORE/OIL Tanker)	Petrobras	2,560
P-37	Petrobras	2,000
P-38	EPC Contractor	1,200
P-43	EPC Contractor	2,086
P-48	EPC Contractor	510

Conversion Experience

Corrosion Protection

- Aluminum metalization
 - Flare boom, risers I-tubes (access for maintenance)
 - Equipment with operational temperature over 120° C
- New paint specification
 - Solvent free, surface tolerant and abrasive or hydro blasting surface preparation
- Duplex stainless steel
 - CO₂ content

Operational Feedback

High Amplitude Ship Motion (roll resonance)

- **Swell**
 - Beam sea
- **Original loading procedure**
 - Minimum tank content after offloading
 - Tank inspection
- **Consequences**
 - Roll over 15° → process shutdown or possibility of oil out of specification
 - Difficulties on supply vessel operation
 - Difficulties on maintenance / cargo handling operation
- **Mitigation procedures**
 - Extended and larger bilge keel
 - Loading procedure adapted



Operational Feedback

Offloading

- System adopted (20")
 - Reel (P-50)
 - Chute



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Alternative system

- Emergency floating hose (10") → longer operation

Operational Feedback

- **Structural hot work**
 - Structural defects → structural details optimizing
→ composite patching
 - Piping repair / modification → flanged piping connections

- **Cargo handling**
 - Articulated boom cranes
 - Fenders in supply vessels operation area
 - Monorail along the ship
 - Bumpers for cargo lay down area



Conclusions about FPSO

- Reliable solution
- Operational flexibility