HISTORIQUE ET EVOLUTION DES PLATES-FORMES AVEC TETES DE PUITS EN SURFACE (SPAR?…) LES TENDANCES POUR LE FUTUR

Partie 1

Pierre-Armand THOMAS
TECHNIP – Division Offshore - Paris (France)

Diapositives de la présentation du mémoire
HISTORIQUE ET EVOLUTION DES PLATES-FORMES AVEC TETES DE PUIT EN SURFACE (SPAR... )
Les tendances pour le futur

Pierre-Armand Thomas
Technip

13 Juin 2006

CONTENTS

- PRESENTATION OF SPAR
- PRESENTATION OF EXTENDABLE DRAFT PLATFORM
- DEEPWATER PRODUCTS – SPECIAL STRUCTURE EQUIPMENTS
- FUTURE EVOLUTION AND OTHER ENVIRONMENTS
  - OTHER ENVIRONMENTS
  - PRESENTATION OF EDP LATEST DEVELOPMENTS
    - EDP CASE STUDY
    - DESIGN OF STRUCTURE
  - COMPARATIVE ANALYSIS OF DIFFERENT DOMAINS OF APPLICATION
  - RESEARCH & DEVELOPMENT PROGRAMME
From Classic Spar to Truss and Cell Spar

- Significant improvements in many domains:
  - Risers suspension,
  - Mooring lines,
  - VIV approach,
  - Top tension risers.

Ring section assembly at yard assembling rails
Barge Harry at the end of assembly rails

Evolution of construction model

- Dedicated investment to improve model delivery
Chevron Tahiti Spar Dimensions & Weights

Basics
- Water Depth 4,000 ft
- Production and Quarters only, all subsea wells
- Topsides design throughput 125 MBPOD
- SITWHP 12,300 psig

Spar dimensions
- Diameter 128 ft
- Draft 500 ft
- Freeboard 55 ft
- Centerwell 50x50 ft
- Hard Tank Length 216 ft

Mooring
- 13 lines; 6.2” chain, 10.2” polyester

Risers
- 4 production, 2 test, 2 water injectors; all in pull-tubes
- Oil and gas export risers w/ flex-joints

Weights
- Topside Weight 21,000 tons
- Fixed Ballast 23,700 tons
- Vertical Mooring Load 3,800 tons

Environment
- 100 yr Hurricane; Hs=39 ft Tp=12.7-15.3 sec,
  Wind=73.5 kt

Tahiti First’s
- Largest Single-Piece Spar Dry Transportation
- 360 degrees strake coverage requires portion of strakes to be installed offshore
- First spar with utility/access shaft and dedicated pump room
Holstein hard tank

LARGEST EVER BUILT

Cell Spar

RED HAWK

Both the hull and topsides were installed in March 2004. (first gas in July 2004)

THIS WAS THE FIRST APPLICATION OF A CELL SPAR
Cell Spar Installation
Upend Spar at Integration Site

Install Fixed Ballast

Cell spar safest floater
- Hull unconditionally stable
  - 28 separate buoyancy compartments
  - Center of buoyancy above center of weight
  - Simple ballast system
  - Operator cannot sink vessel
  - No down flooding points
  - Mooring line failure can not capsize vessel
- Other hulls less safe
  - Fewer compartments
  - Happier upside down
  - Complicated ballast control system

RESISTANCE TO HURRICANES TO BE TAKEN INTO ACCOUNT SERIOUSLY
Spar model for installation request

- Towing of Spar hull horizontally
- Upending at deep site > 200 m water depth
- Topsides installation by heavy crane for floatover
- Hook-up and commissioning offshore

CONTENTS

- PRESENTATION OF SPAR
- PRESENTATION OF EXTENDABLE DRAFT PLATFORM
- DEEPWATER PRODUCTS – SPECIAL STRUCTURE EQUIPMENTS
- FUTURE EVOLUTION AND OTHER ENVIRONMENTS
  - OTHER ENVIRONMENTS
  - PRESENTATION OF EDP LATEST DEVELOPMENTS
    - EDP CASE STUDY
    - DESIGN OF STRUCTURE
  - COMPARATIVE ANALYSIS OF DIFFERENT DOMAINS OF APPLICATION
  - RESEARCH & DEVELOPMENT PROGRAMME
Extendable Draft Platform (EDP)

- Extendable Draft Platform (EDP) for production drilling / workover
- Full integration onshore - minimum offshore HUC / no flotel
- Suitable for large payloads, deep water & high well counts
- Composed of:
  - Barge-type Deck
  - Topside facilities on top of deck
  - Legs (buoyant column + truss)
  - Pontoon (heave plate)
TEDP installation

- Reminder of Spar installation requirements:

- The EDP concept is offering a solution that mitigate these issues

EDP Model test/completion status

Model Test performed with GOM conditions - 1 year winter storm

Tests have proven as good motion responses as Spar
Special structure equipment

Beside the hull design, the « ancillary equipments » capture a lot of attention to provide the best service for SCR behaviour and integrity and the best handling of surface trees.
Platform-based mooring equipment

- Winching equipment
  - Rotary winches (wire)
  - Linear winches (wire)
  - Chain windlasses or capstans
  - Chain jacks or devil's claws

- Fairleads
  - Rotary-type
  - Bending shoe type

- Stoppers
  - Passive
  - Active
Examples: Pull tube hull equipment

- Kerr McGee Boomvang & Nansen
  - Pre-Installed Pull Tubes

Examples: porch – SCR interface

- Porch interface suitable for FlexJoint or Taper Stress Joint
EDP dry trees risers tensioners

- Hydro pneumatic tensioners

Hulls weight comparison

Truss Spars

- Small
- Medium
- Big Dry Trees
- Big Wet Trees
- B/Nansen
- Gunnison
- Horn Mountain
- Mad Dog
- Holstein

Tous droits de reproduction réservés – ATMA 2006
Hull weight comparison

Truss and Cell Spars

Hull Weight comparison

Truss / Cell Spars and EDP
Kikeh Spar Dimensions & Weights

Spar dimensions
- Diameter 106 ft
- Draft 430 ft
- Freeboard 35 ft
- Centerwell 55x55 ft
- Hard Tank Length 220 ft

Moorings
- 10 Lines; 142mm Chain, 108mm Spiral Strand

Risers
- 24 Prod + 1 Drilling TTR w/Riser Hydraulic Tensioners
- Tensioner Max Stroke 21 ft

Weights
- Topside Weight (w/workover) 6600 t
- Max Well System Load 4200 t (w/ 24 TTRs)
- Fixed Ballast 2900 t
- Vertical Mooring Load 2200 t

Environment
- 100 yr Typhoon; Hs=20.7ft Tp=16sec, Wind=30kt

Kikeh First’s
- First SPAR Outside GoM
  - Hull, Topsides Constructed in Malaysia
  - TOF Supervision & Know-How
- Tender Assisted Drilling
- Direct Tensioner System
- Topside Floatover installation
- Global Project Execution
  - Kuala Lumpur / Pori / Houston / Perth / Paris
Kikeh Hull Fabrication at MMHE (Malaysia)

CONTENTS

- PRESENTATION OF SPAR
- PRESENTATION OF EXTENDABLE DRAFT PLATFORM
- DEEPWATER PRODUCTS – SPECIAL STRUCTURE EQUIPMENTS
- FUTURE EVOLUTION AND OTHER ENVIRONMENTS
  - OTHER ENVIRONMENTS
  - PRESENTATION OF EDP LATEST DEVELOPMENTS
    - EDP CASE STUDY
    - DESIGN OF STRUCTURE
  - COMPARATIVE ANALYSIS OF DIFFERENT DOMAINS OF APPLICATION
  - RESEARCH & DEVELOPMENT PROGRAMME
Disconnectable Spar for Ice Regions

Bottom section disconnected from Upper Hull
CONTENTS

- PRESENTATION OF SPAR
- PRESENTATION OF EXTENDABLE DRAFT PLATFORM
- DEEPWATER PRODUCTS – SPECIAL STRUCTURE EQUIPMENTS
- FUTURE EVOLUTION AND OTHER ENVIRONMENTS
  - OTHER ENVIRONMENTS
  - PRESENTATION OF EDP LATEST DEVELOPMENTS
    - EDP CASE STUDY
    - DESIGN OF STRUCTURE
  - COMPARATIVE ANALYSIS OF DIFFERENT DOMAINS OF APPLICATION
  - RESEARCH & DEVELOPMENT PROGRAMME

Review of EDP Generation (1&2)

First Generation
1995 start developing TPG 3300

Second Generation