Mastering Floating Production, Storage & Offloading System

Design, Technology and Integrity Management of Offshore Floating Production Systems

Date: 11th June 2012 – 14th June 2012
Location: Kuala Lumpur, Malaysia

Petrosync Distinguished Instructor
Sandy Fyfe
Principal Naval Architect and Director
PAFA Consulting Engineers

TESTIMONIALS OF COMPETENCE
• Over 30 years experience in offshore engineering and naval architecture
• Previously member in the ISO Panel for production of standard on floating offshore structures
• Consulted and contributed on condition monitoring of structures for ISO 19904-1 on floating offshore structures which he lectured on for design and Structural Integrity Management of FPSO
• Worked on conceptual studies, design and offshore installation support in the UK Continental Shelf, the Persian Gulf and offshore Malaysia
• Contributing Author to “Floating Structures: A Guide for the Design and Analysis”
Masterclass Objectives

- **UNDERSTAND** the current trend of floating production systems and their design & technology
- **ENHANCE** your knowledge on key design and technology factors governing FPSO design choices
- **DETERMINE** the key design requirements based on the most recent International Standards outlining detailed FPSO design
- **ANALYZE** and **REVIEW** the functions and applications of various process systems, layouts and other major configurations onboard a FPSO
- **MASTER** key parameters in designing the Hull, Mooring, Turret, Swivels and Risers
- **APPLY** an effective approach on designing FPSO against fatigue and wave slamming occurrences
- **LEARNING** about the transition of from design to specification of a system for through-life Structural Integrity Management (SIM) and its requirements world-wide and in SE Asia
- **INCORPORATE** good Asset Integrity Management practices from the FPSO industry

Masterclass Overview

This 4 day intensive training course will cover the general technology and design factors influencing the installation, operation, construction and survival of FPSOs that any FPSO project teams need to address when overseeing an FPSO project. Participants will learn to equip themselves with a detailed understanding of FEED to Detailed design of FPSO covering major FPSO technical configurations, layouts, process systems, to the latest and future field development in floating production systems.

In addition to various safety, health and environment issues pertaining to FPSO to be covered, participants will also get to draft and implement Structural Integrity Management system and learn about current hot topics such as recent developments in FPSO applications and long term Asset Integrity Management of FPSO to maximize FPSO operation and production.

Various FPSO and other floating production system case studies will be covered throughout the course to illustrate various design concepts and FPSO configurations, while having a complete view of FPSO field developments.

Featured Case Studies

**FPSO configuration selection and design issues**

Review of the MUNIN FPSO with some of the extreme weather and fatigue design issues involved with a typical FPSO on the UK continental shelf, comparing/contrasting the associated data for metocean conditions including typhoon areas (South China Sea) and hurricanes (North Sea and other locations).

**Structural Integrity Management (SIM) System and Asset Integrity Management**

Discussion on published data from ABS Joint Industry Project (JIP) relating to experience of FPSO maintenance, which includes at least 3 FPSOs in the South China Sea with IMR experience from the North Sea and other areas. Sandy will also share his in-house experience working on North Sea projects and data relating to in-service repair from an African project.

Who Should Attend

This program is intended for:

- FPSO Project Engineers/Managers
- Offshore Installation Managers
- Subsea & Topside Engineers
- Naval Architects
- Facilities Engineers
- Process Engineers
- Production Engineers
- Marine Engineers
- Development Engineers
- Operation Engineers/Managers
- Design Engineers
- Structural Integrity Engineers/Managers

PLUS anyone who is involved in or working with FPSO projects who require knowledge on the design, technology and management of FPSO.
Review of Floating Production Facilities

- Brief history and introduction to oil and gas production using floating production facilities
- Description and coverage of entire course
- Overview of floating offshore production facilities
  - Oil & gas production – critical driving factors
  - Field development requirements and options leading to the selection of a floater
  - Main floater configurations: barge, semi-submersibles TLPs, SPARS and FPSOs
- Normal phases in a field development using a floater:
  - Front End Engineering Design (FEED)
  - Design for new-build hull or inspection
  - Design for conversion
  - Mooring arrangements
  - Interface with producing wells
  - Common fabrication and assembly options
  - Provision for in-field inspection, maintenance and repair
  - Installation, operation and removal
- Typical strengths and weaknesses of different floating options
- Special circumstances in favour of a ship-shaped FPSO
- FPSO operations in shallow water and deep water
- Effect of numbers of wells, high gas content
- Severity of weather, whether in regular seasonal hurricanes or only in rare typhoons

Metocean data, design codes and major load components for FPS

- Introduction to metocean data (ISO 19901-1 for use in ISO 19904-1)
  - Important issues for FP installation, survival, operation and supply
  - Their description and representation in design code requirements

CLASS EXERCISE - Identifying typical ranges of parameters for different areas of the South China Sea and other major world oil provinces

- Applicable design codes, standards and rules leading to functional requirement
- Issues influencing choice of floating production systems - pipelines, storage and offloading
- Main quasi-static loading and bending issues critical to FPSO design

FEED Design and Marine Effects on FPSO Projects

- FEED design - choices and options associated with FPSOs
- Examples of typical field developments employing FPSOs
- FPSO configurations – global responses and marine
  - Weight and space management – ballast, crude, fuel and storage
  - Hydrostatics and stability requirements
  - Still-water bending
- Interpretation of typical metocean report data – as used for design
  - Winds, waves, currents, tides etc – variation with height, averaging period, direction, extreme values, exceedance data etc
  - Characteristics of short-term descriptions of wind and waves, currents, typhoons, tides, storm surges, squalls and loop-currents.
  - How they are described and represented numerically in codes
  - Effects of motions on ship lay out
  - Introduction to the use of probability distributions and extreme values

Processing, utility and production facilities – topsides

- CLASS EXERCISE - Impact considerations of various factors on FPSO design: e.g. speculate on effects of Tsunami
- FPSO configurations – processing, utility and production facilities
  - Field development factors and their effects on choice of floater or FPSO
  - Oil and Gas production characteristics - their effects on equipment and layout
  - Oil, gas and produced water handling requirements
  - Flaring or otherwise
  - Power generation and utility equipment
  - Accommodation requirements and location
  - Factors affecting equipment, piping and electrical layout
  - Considerations for instrumentation and telecoms
  - Structural support for fabrication and operation
  - VOC emission, recovery and treatment
  - Effects of motions on equipment specs, layout and operations
  - Examples of typical layouts of FPSO process and utility equipment
Design of risers, turrets, moorings, offloading including response dynamics

- FPSO configurations – global responses and marine (continued)
  - Effects of wave, wind and current directionality and spread seas
  - Weathervaning or spread mooring
  - The turret - why a turret?
  - Turret options – permanent or detachable
  - Turret locations - effects on response and equipment layout
  - Mooring design with or without thruster assistance
- Modelling of hydrodynamic loading, vessel motions and structural responses
  - Response amplitude operators
  - Motion responses in short term sea states
  - Extremes motion responses
  - Combining quasi-static and dynamic loads
  - Brief discussion of non-linear and second order effects

CLASS EXERCISE - Review of example from previous day and examples of the above as applied to some typical FPSOs for participants to tackle

Design issues affecting moorings, flexible risers, umbilicals and offloading

Oil export & offloading systems and effects of metocean data and voyage on operation planning

Structural Design using ISO 19904-1

- FPSO structural design
  - Hull design requirements and specifications
  - Limit states design: ULS, SLS, ALS, FLS
  - Hull bending and its influence on topsides supporting structures
  - Structural design – beam bending
  - Cross section design

CLASS EXERCISE - Identify a list of items and functions that differentiate an FPSO from a trading tanker

- New-build FPSO, converted new-build tanker and converted old tanker
  - Pros and cons
  - Availability and cost
- Safety in design
  - HSE, planning for escape, evacuation and rescue
  - Fire and gas detection alarms
  - Design for fire and blast

Design for fire and blast

CLASS EXERCISE - Review of example from previous day and important items of fire and blast protection

DAY 4

Design for green water, slam and fatigue

- Green water, slamming and wave slam loading
  - Freeboard exceedance
  - Different types of slamming
  - Sea states that dominate green water loading and wave slam
  - Findings of SAFEFLOW JIP
  - Recent review of experience of slam damage for UK HSE

Designing for fatigue

- Detailing methods specified by ISO 19904-1 and American Bureau of Shipping (ABS)
- Review of spectral assessment approach
- Effects of crude/ballast loading
- Effects of environment loads, the loading/unloading cycle and operating practice
- Metocean input requirements
- Contributions of vessel responses and load combinations
- Appropriate global hydrodynamic and structural models
- Detailed models of fatigue stresses in components and structural details
- Miners rule
- S-N data
- Processing data for each short-term storm
- Processing data for long-term effects
- How safety factors are incorporated in fatigue design
- Identification of predominant vessel loading conditions and sea states
- Experience gathered about important details affected by fatigue

SIM systems, Asset Integrity Management, and future FPSO developments

- Structural integrity management systems:
  - ISO 19904-1 and world-wide experience
  - The design interface
  - Internal inspection: access and safety
  - References to recent experience
  - Establishing a SIM system
  - An operator’s view
  - Appropriate inspection methods
  - FPSO structural performance JIP and findings
  - Study of best practice
  - Norwegian experience
  - Risk based inspection (RBI) and UK HSE Laboratory findings
  - Relevance to ISO requirement and how it may evolve
  - Speculation about future field developments using FPSOs
    - Recent developments and potential design challenges
    - Asset Integrity Management issues
    - Latest developments in FLNG
  - Review of course and important issues relating to FPSOs as specified for different fields and different world oil provinces with emphasis on SE Asia
Sandy has over 30 years of industrial and consultation experience in offshore engineering and naval architecture. He has participated in design, analysis, procurement, project engineering and management of renewable energy projects and floating and fixed oil and gas production facilities. He previously worked on conceptual studies, conceptual design, detailed design and offshore installation support for the UK continental shelf, Persian Gulf and offshore Malaysia.

Sandy has previously organized consultation for, composed and wrote the Chapter and Annex on condition monitoring of structures for draft ISO 19904-1 on floating offshore structures which is widely used in industrial practices. He currently has a patent application pending for a particular improvement to a TLP configuration used to support renewable energy devices.

He led and contributed technically to teams designing the hull, deck and tether systems for deep water tension leg platforms. His experience also includes naval architecture and operations that are used to install large offshore structures. Throughout his career, Sandy has also developed risk and reliability-based design methods, researched issues affecting the safety of semi-submersibles and FPSOs, and contributed his extensive knowledge of weather-sensitive offshore operations to project planning, costing and risk assessment.

He has a BSc.(Hons) and MSc. in Mathematical Physics from Edinburgh University.
Sandy's Selected Past Projects in Offshore Floating Production Systems

**Saipem / Sarawak Shell Berhad - Installation of MLNG - DUA Structures**
Lead Engineer and sole Naval Architect in a team which implemented transportation and installation calculations and naval architectural design activities for installation of fixed structures and topsides using launch barges, transportation barges and cranes.

**Shell Philippines BV - Malampaya Transportation Study**
Naval Architect and Study Manager for an assessment of barge transportation and float-over installation of 6000t to 12000t deck modules for Shell Philippines Exp. BV. Weather risks to the tow were assessed for various long-distance tow routes and for their effect on the final installation operations. Durations and availability of suitable weather windows were deduced by analysis of hindcast meteorological conditions for the platform location.

**BP Bruce Project**
Developed weather alert procedure for semi-submersible Utilities Service Vessel (USV) operating to support drilling activities on a fixed platform. Naval architect/analyst contributing to detailed design of two lift-installed jackets and specification, procurement and conversion of the Utilities Service Semi-sub, moored in close proximity to both fixed structures.

**Exxon (now Exxon Mobil) - Chayvo Project**
Project Manager for field concept development studies for the Chayvo oil & gas field (Sahkalin) and Project Engineer for production definition studies of Chayvo and Arkutundagi oil field in the same area.

**ESSO Production (now Exxon Mobil) - Detailed Design of LAWIT-A**

**Conoco (now ConocoPhillips)**
Project Manager and Principal Naval Architect for Tension Leg Platform, hull and deck design study in 1000m water depth. This project involved the co-ordination, motivation and management of major inputs from naval architects, structural, mechanical engineers, outside consultants/contractors and the successful cost control of a work scope that was bid competitively.

**Amerada Hess (now Hess Corporation)**
Naval architecture design calculations for Triton FPSO, including entry and exit to drydock in Singapore for fitting a turret, addition of all top-side processing modules and sail-away, stability and hull strength design for full range of operational cargo/ballast loading combinations.

**AIOC - Western Route (Caspian to Black Sea) Pipeline**
Engineer in charge of the specification and procurement of a catenary anchor leg mooring buoy for an oil loading facility off Georgia. This work included an operational risk assessment of environmental damage from the tanker loading operations and extended to practical site support for cranage and the installation operations in the Black Sea.

**British Gas - Armada Jacket Project**
Lead Naval Architect for detailed design and installation support for a 6000t lift-installed jacket. Design responsibilities included barge transportation, jacket lift, upending and docking. Installation required participation offshore on the DB102 crane vessel.

**NIOC (National Iranian Oil Company)**
Contributed to conceptual, detail design and certification assessment activities for a range of semi-submersibles and fixed structures for a variety of field production roles.

**American Bureau of Shipping (ABS)**
- Contribution to the common tanker rules in development of methods of analysis for the study of effects of wave loading and vessel responses to fatigue design of tankers
- Developed software to combine effects of multiple stochastic load contributions to extreme load predictions - with particular reference to wave motions and springing in the hull of a trading vessel
- Prepared a review report for ABS into risk assessment for FPSO structural design

**ABB**
Developed and demonstrated a method for strength and fatigue design of PAUs mounted above the deck of the Captain FPSO, in support for a legal dispute with original designers/fabricators.

**UK Health and Safety Executive (HSE)**
- Prepared a review of current procedures and design methods for wave slam given evident structural damage to the hull of one FPSO on the UK continental shelf
- Study of fatigue design of ageing semi-submersibles
- Scoping study into effects of extreme seas and waves on operation and design of FPSOs
- Study of motions and impact energy for collisions between FPSOs and offloading shuttle tankers

**UKOOA / UK HSE**
Study of adverse weather effects on operation of fixed and floating offshore production facilities in the North Sea.

**SAFE-FLOW JIP/EU**
Major participant in SAFEFLOW JIP into design of FPSOs for green water and wave slam.

And many more studies on semi-submersibles, TLPs and FPSOs.
Course Details

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