

Floating Production System Services

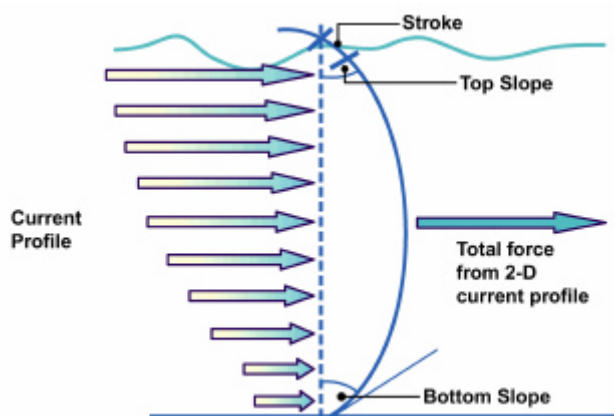
Cost benefits from metocean studies:

- feasibility assessment and selection of appropriate systems,
- appraisal of operational windows (vessel motion, FPSO shuttle tanker berthing and potential disconnection frequency), and
- estimation of component fatigue lives - helps to prevent premature and unnecessary replacement.

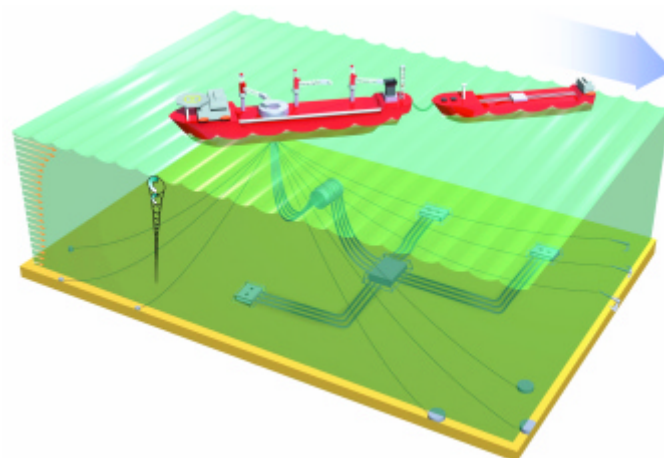
In deepwater offshore developments where conventional fixed structures may be neither cost-effective nor feasible Floating Production Systems (FPS) have a key role to play. In marginal fields they may be the only economic solution.

For any system - whether it is a Tension Leg Platform (TLP), Semi-Submersible, Spar Buoy, or Floating Production Storage and Offloading (FPSO) vessel - information on the currents, waves and winds that will affect it are required before design and installation. Especially where severe conditions are expected. During the installation, operation and decommissioning stages, real-time metocean information and forecasts remain important operational tools.

Fugro staff have a wide-ranging knowledge and understanding of the key meteorological and oceanographic processes at work in all the world's main oil and gas provinces. We have measured environmental conditions, derived criteria or forecast the weather for many of the world's FPSs. This expertise helps us as we work closely with designers and operators to understand and provide the information required, often in the short time-frames necessary for these 'fast-track' developments.



Vessel responses are critical to riser design



Wind, wave and currents: major environmental factors

Design/Selection

Feasibility appraisal, concept selection and design are just a few of the tasks needing metocean information.

The dynamical response of FPSs to complex environmental forces means that wind, wave and current loadings must be understood and quantified, both for engineering design and operational planning. For example, while most concepts align to the wind rather than the currents, if the near-surface current is strong, the vessel may align to these currents and be exposed to adverse long-period beam seas and wave slam. Limiting the likelihood of green water on deck is critical too, as is the structure's reaction to crossing seas.

The key metocean information requirements at the design stage include:

- extreme current profiles, and wave and wind conditions by month and direction;
- directional differences between currents, waves and winds to determine vessel alignment and motion;
- joint occurrence of currents, waves and winds to determine extreme environmental loadings and mooring life; and
- ambient and extreme sea temperature profiles to determine the extent of hydration and waxing.

Installation

The installation of vessel moorings and sub-sea facilities requires extensive offshore operations involving specialised vessels and underwater vehicles. Vessel selection, operational planning and execution all require detailed information about metocean conditions, including metocean statistics, real-time measurements and weather forecasts.

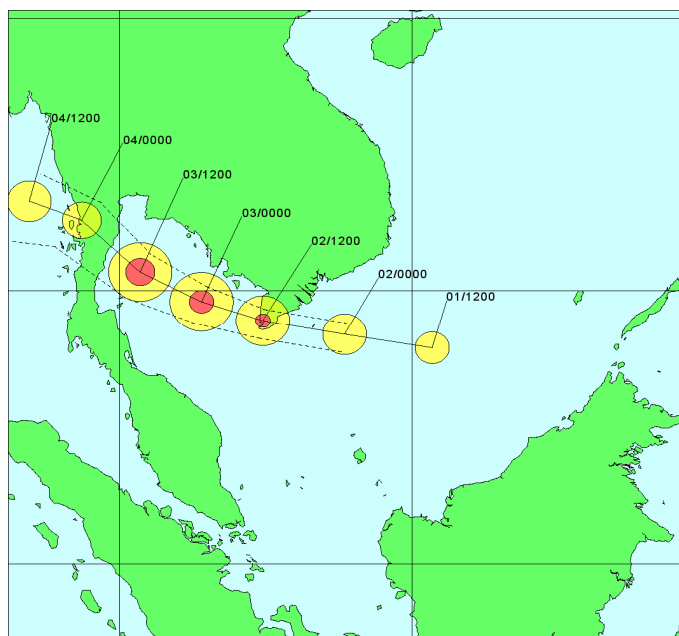
Heavy lift operations from crane barges to floating production facilities are particularly hazardous because of combined motion responses. Thresholds for such lift operations are low and require careful planning and execution to minimise downtime and optimise safety.

The key metocean information requirements at this crucial stage are:

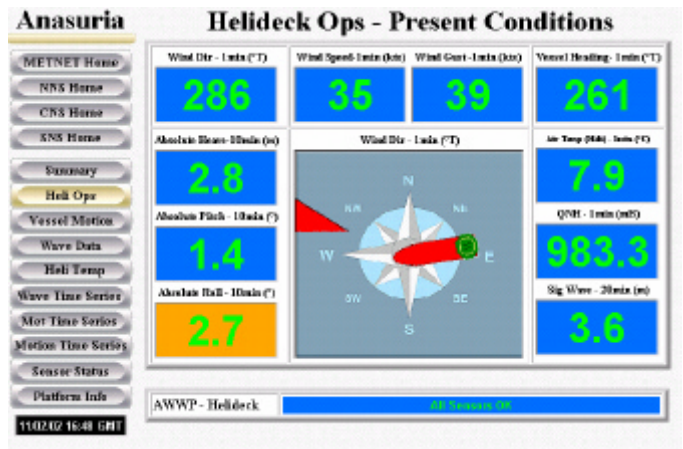
- wind, wave and current persistence analyses by month,
- operational 'window' analysis,
- real-time near-bed current measurements during sub-sea installation,
- real-time wave and current measurements during mooring installation and vessel hook-up,
- assessment of internal waves for heavy, sub-sea installations, and
- installation weather forecasts.

Operation

Operability and downtime due to adverse metocean conditions are of major importance for system viability, and real-time measurements and forecasts are essential features for successful operations. In particular,



Typhoon track forecast, South China Sea



Real-time metocean conditions

operability statistics for shuttle tanker operations must be reviewed at the feasibility stage for FPSOs with limited storage.

The key metocean information requirements are:

- real-time current and wave measurements and
- operational weather and current forecasts.

Track Record

Fugro has worked on a number of FPS developments around the world. These include:

- Agip - Morpeth (USA)
- BP - Foinaven and Schiehallion (UK), Kepodang and Terang/Sirasun (Indonesia), Marlin (USA)
- Chevron - Kuito (Angola)
- Conoco - Banff (UK), Magnolia (USA)
- Dominion - Devils Tower (USA)
- El Paso - Marco Polo (USA)
- Kerr Mcgee - Boomvang, Nansen, Gunnison (USA)
- Mariner - East Breaks (USA)
- Murphy - Medusa, Frontrunner (USA)
- Shell - Anasuria, Triton (UK)
- TFE - Girassol (Angola), Virgo (USA)
- Texaco - Frade (Brazil), Oloibiri (Nigeria), Petronius (USA)

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