OFFSHORE FLOATING AND PRODUCTION - WIND AND CURRENT LOADING

Tapping the world's offshore resources will be vital to meeting future energy needs. While resources are vast, offshore projects need to prove their value in a changing market and policy context. The correct prediction of environmental forces is critical in the design and engineering stage of offshore structures, forming a fundamental part across many design areas. Through Computational Fluid Dynamics (CFD) and wind tunnel testing, RWDI is uniquely positioned to aid our clients in enhancing the reliability of offshore platforms and mooring systems and delivering value.

Design areas affected by environmental forces

Fixed offshore structures and floating units are common for offshore exploration and production. In deep water, floating production is an obvious choice, but for more moderate depths, floating units offer undeniable advantages. A reduction in payload requirements makes floating production an attractive alternative to

fixed facilities, and they may also move from one field to another. Besides exploration and production facilities, an increasing number of vessels are engaged in installation, workover, maintenance and support work. For these units, station-keeping ability is of prime importance for their operation, with passive systems such as dynamic positioning vital to preventing drift due to waves, wind and current. Consequently, offshore units cross a range of design areas including:

- Stability
- Fatigue
- Mooring
- Dynamic positioning
- Towing resistance

Each of these areas plays a critical role in the concept, feasibility, design and engineering stages.

Environmental forces affecting offshore units

Due to their large mass, offshore units display a resonant response to low frequent excitation. Such excitation may originate from wind gusts, second order wave forces, and changes in current. For the drift of a floating offshore unit, the average components of wind, wave and current loads are of importance. Due to the interaction of these environmental forces, the design issues of a mooring system and/or subsea jacket structure can be complex:

- Line dynamics due to six degrees of freedom (in surge, sway, heave, roll, pitch and yaw)
- Low frequency motions in surge, sway and yaw
- Effects of non-collinear combinations of wind, currents and waves on the unit response

Fixed or floating offshore unit design considers a critical event, for example a 100-year return period combination of wind, current and

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waves. From a designer's point of view, there are options in the choice of unit size, design pretension, turret location, mooring pattern, line configuration and anchoring point, amongst others. The correct prediction of such critical events is key to the design of a suitable and cost-effective solution.

Improved offshore structures and mooring systems, by design

The unit size is usually dictated by the storage capacity and the topside layout as the functional requirements of an offshore project. The physical dimensions of a unit and the general arrangement of a deck and hull will in turn determine the wind, current, and wave forces and moments acting on the unit. The shape and geometry of a unit, together with its mass properties, will define the hydrostatics and motion response characteristics. Subsequently, the unit's design characteristics will determine the subsea structure and mooring system responses under the design environmental conditions. Through Computational Fluid Dynamics (CFD) and wind tunnel testing, conservatism inherent in analytical methods for calculating these quantitates is reduced. By utilising both approaches RWDI is uniquely positioned to aid our clients in enhancing the reliability of mooring and anchoring systems, and delivering value.

Why RWDI?

- **Global company with offices in the US, Canada, UK, Italy, India, Singapore, Malaysia, and Australia**
- **Five decades of CFD and wind tunnel expertise**
- **Five wind tunnels based in North America, Europe, and South-East Asia**
- **Automated wind tunnels optimised for time and efficiency, operating 24/7**
- **Large-scale wind tunnels allow larger scale models and complex vessel arrangements to be assessed**
- **We contribute to the wider community through joint industry projects and the development of design documents (e.g. SNAME offshore wind loading)**
- **Experience in developing design documentation for national oil companies and supermajors (e.g. Saudi Aramco) to serve as a basis for design on all facilities they operate**
- **Support for the global energy transition to reduce emissions and air pollutants via fuel switching**