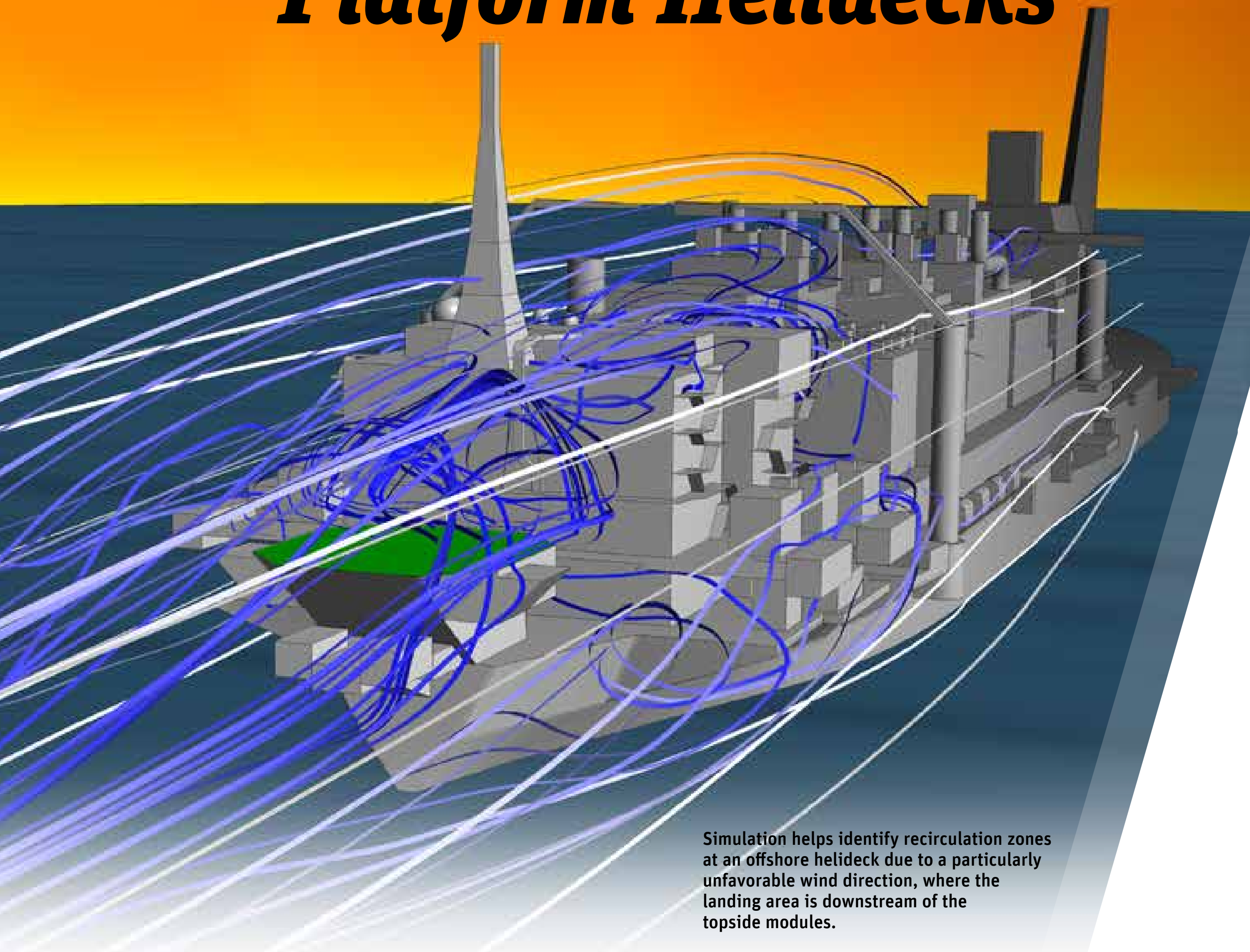
# Any Way the Wind Blows: *Optimizing Offshore Platform Helidecks*



Simulation helps identify recirculation zones at an offshore helideck due to a particularly unfavorable wind direction, where the landing area is downstream of the topside modules.

**Helicopters are the most common method of transporting personnel to offshore oil and gas installations. To ensure pilot and passenger safety, it is essential to understand how airspace conditions affect takeoff and landing on helidecks. Brazilian multinational Petrobras uses ANSYS CFD to model wind flow, turbulence and other conditions to optimize helideck design and positioning.**

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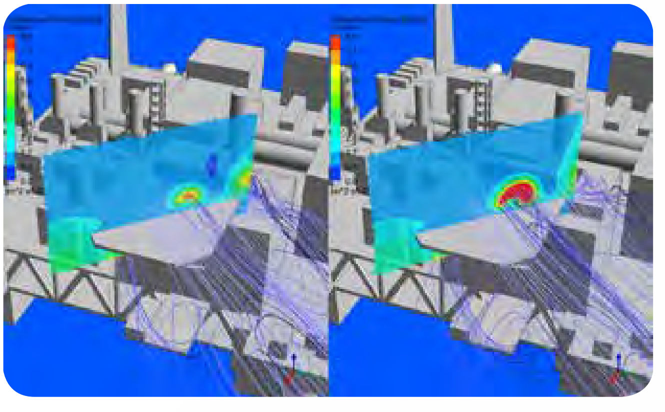
**"Using ANSYS CFD, engineers were able to define the limits of environmental and operational conditions for helicopter transportation."**

As oil and gas exploration moved offshore, the industry needed an efficient, cost-effective way to exploit, process and store product at sea. The result was the floating production storage and offloading (FPSO) unit, a ship-shaped facility that can be moored hundreds of kilometers from land in water depths up to 2,900 m.

Helicopters are considered the safest and fastest way to get FPSO crew members to work. However, local air flow conditions around FPSO helidecks can make maneuvering helicopters challenging and prevent on-time arrivals and departures.

To optimize the helideck position in new and existing FPSO installations, Brazilian multinational petroleum company Petrobras regularly simulates air velocity, temperature and gas plumes using ANSYS CFD software. Models are based on each of the company's offshore platforms, typically 150 kilometers from shore.



Before and after modeling of additional turbulence near the helideck created by topside modifications, such as new equipment

Simulation enables engineers to accomplish several goals:

- Identify where to locate helidecks on new platforms.
- Ensure greatest availability.
- Safely enlarge operational requirements for offshore units — for example, to fly when wind speeds are higher or with heavier helicopter payloads — which can ultimately reduce transportation costs.

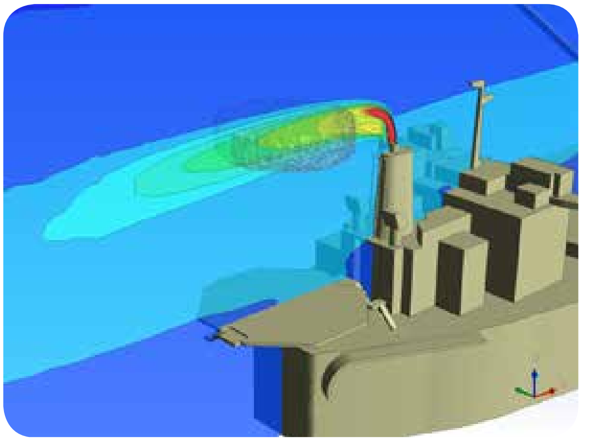
### USING SIMULATIONS TO UNDERSTAND FLIGHT CONDITIONS

It takes about an hour for a helicopter to fly the 150 kilometers from the mainland to Campos Basin, where Petrobras operates more than 50 offshore units. Considering that there are 80 flights on average per day and approximately 700,000 passengers make the trip each year, it may seem routine.

However, flight conditions, including the air flow surrounding the helidecks, can vary considerably day-to-day, complicating helicopter maneuvering and influencing platform design. With Petrobras adding new offshore installations even farther from land, engineers are going to great lengths to understand how different airspace variables affect helicopter takeoff and landing.

In accordance with the international CAP437 standard, Petrobras looks at the criteria platform designers are required to address: the effect of turbulence and of hot gas plumes on takeoff and landing operations.

It is not just gusty storms at sea that cause turbulence around offshore platforms. Topside facilities represent obstacles from an air flow perspective and, depending upon wind intensity and direction, may create local turbulence as the wind is forced to flow around, over and between them. Increasing the height of the helideck decreases exposure to turbulence but puts pilots in closer proximity to hot gas plumes from the FPSO's onboard process plant. Thermal-induced plumes from turbogeneration equipment, which can emit gas exhaust as hot as 500 C, disturb air flows and increase the ambient temperature; even a change in air temperature as small as 2 C has to be considered in terms of loss of lift, engine power drop or engine failure in a helicopter — any of which could be disastrous if critical levels are reached. This makes it challenging to pinpoint the optimal landing location and may force pilots to follow a strict approach path that can be difficult to accomplish in bad weather. Only high-quality CFD simulations can provide engineers with the velocity, turbulence and temperature fields required to analyze the helideck airspace and verify wind tunnel measurements. Although engineers could rely solely on wind tunnel experiments, simulations are less expensive and faster, especially considering the time it takes to prepare a reduced-scale model for a wind tunnel. Simulation also has an advantage over wind tunnels when managing spatial resolution and scale effects. And it is significantly easier to simulate hot gas plumes and measure temperature dissipation than it is to use a wind tunnel experiment that requires special gases to determine the relationship between gas and temperature dissipation. In addition, wind tunnel experiments cannot provide comprehensive results for elaboration of a temperature gradient matrix (TGM, as suggested by Norwegian standard NORSOK C-003) that ANSYS CFD can.



The hot gas temperature contours shown near a helideck airspace are due to exhaust gas.

**"ANSYS simulation software helps reduce expenses while ensuring safe travel — and that is priceless."**

### A QUALIFIED APPROACH TO HELIDECK DESIGN

After establishing criteria for the velocity flow field and temperature field, engineers develop a 3D geometry model of each platform and then use ANSYS Meshing to create meshes, typically with more than 5 million nodes. Mesh generation takes about an hour. Engineers simplify the representation of the FPSO platform to consider only the equipment and structures that significantly disturb the air. ANSYS CFD simulations solve for fluid flow under the most critical conditions for helicopter operations: when the wind blows from directions that either lead to turbulent flow or hit gas plumes over the helideck. The simulation strategy uses prism layers on the bottom sea surface, some detailed structures as porous media and steady-state simulations.

By comparing simulation results to wind tunnel measurements, including those derived from particle image velocimetry, engineers have found that turbulence modeling provides useful insights into turbulent flow through a very complex geometry. Despite some local differences, ANSYS CFD accurately predicts the velocity flow field and qualitatively predicts the turbulence field. As a result, Petrobras has established a new internal turbulence criterion for offshore helideck design applicable to many different platform configurations and wind orientations.

### SAVING MONEY, MITIGATING RISK

By analyzing the existing helidecks, engineers are able to define the limits of environmental and operational conditions for helicopter transportation. Specifically, ANSYS CFD enables them to:

- Quantify the impacts of airflow on offshore rig modifications and new module installations
- Modify and validate helideck operational limitations
- Optimize helideck position in new installations to minimize downtime

While the use of helicopters may vary depending on the level of offshore activities and the growth of autonomous systems, there will always be a need to transport staff safely to offshore installations. By allowing Petrobras to alter payload limitations while optimizing the location of its helidecks, ANSYS simulation software helps reduce expenses while ensuring safe travel — and that is priceless.

*Petrobras is supported by ANSYS elite channel partner ESSS.*

**Reference**

*CFD Assisted Offshore Helideck Design, presented on Convergence – ESSS Conference & ANSYS Users Meeting, South America Regional Conference, São Paulo, Brazil, May 5–7, 2015.*