EX190

Flow Near an FPSO Helideck

FLUENT simulations were recently performed to study the air flow in the vicinity of a floating production, storage, and offloading (FPSO) vessel. Operated by Kerr-McGee North Sea (U.K.) Ltd., the FPSO has a helideck at one end. Of interest in the study was the effect of wind-driven flow fields around the helideck, with the goal of identifying any potentially adverse effects from the wind on helicopter operations, as outlined in CAP437 of the U.K. Civil Aviation Authority (CAA) guidelines.

A floating production, storage, and offloading (FPSO) vessel is outfitted with several deck-mounted structures that are used for various functions. These include a pilot house and associated electronics, storage tanks, cranes, turbine exhaust outlets, and a helideck. For an FPSO used in the Leadon Development in the North Sea, the helideck is positioned at the bow of the vessel, and the exhaust outlets are at the stern. When the wind is coming from the front of the ship, there is nothing to block it at the location of the helideck. When it is directed from the stern, the hot exhaust gases from the generators could possibly affect the temperature of the air above the helideck at the bow. Since gradients in air temperature and/or velocity above the helideck could cause problems for helicopter take-offs and landings, a project was initiated to better understand the impact, if any.

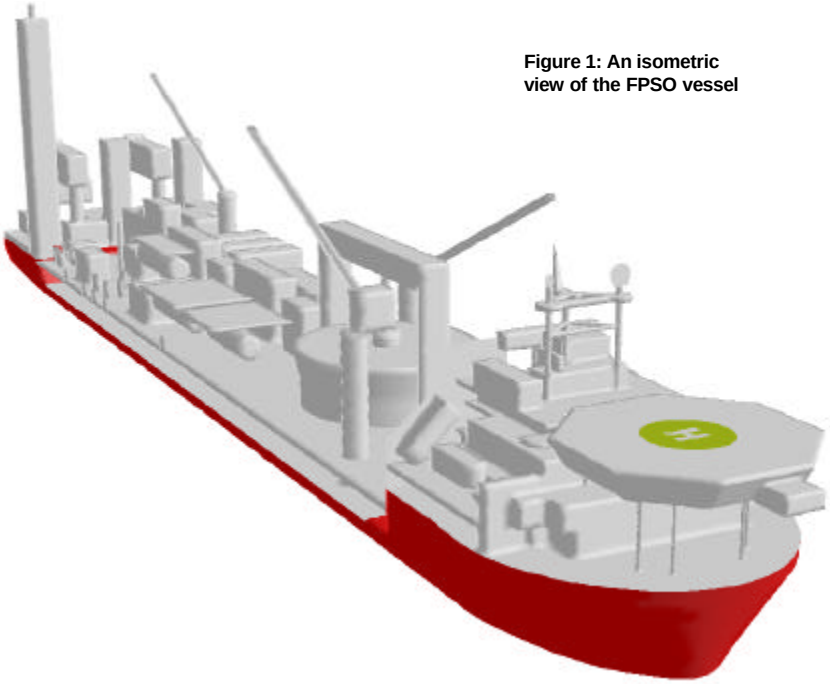

Figure 1: An isometric view of the FPSO vessel

The three main objectives of the study were to model the air flow patterns in the vicinity of the FPSO helideck, using a number of specified wind conditions; to predict the local wind speed and mean vertical components of velocity over the helideck for each of the imposed boundary (wind) conditions, and compare the results with recommendations in

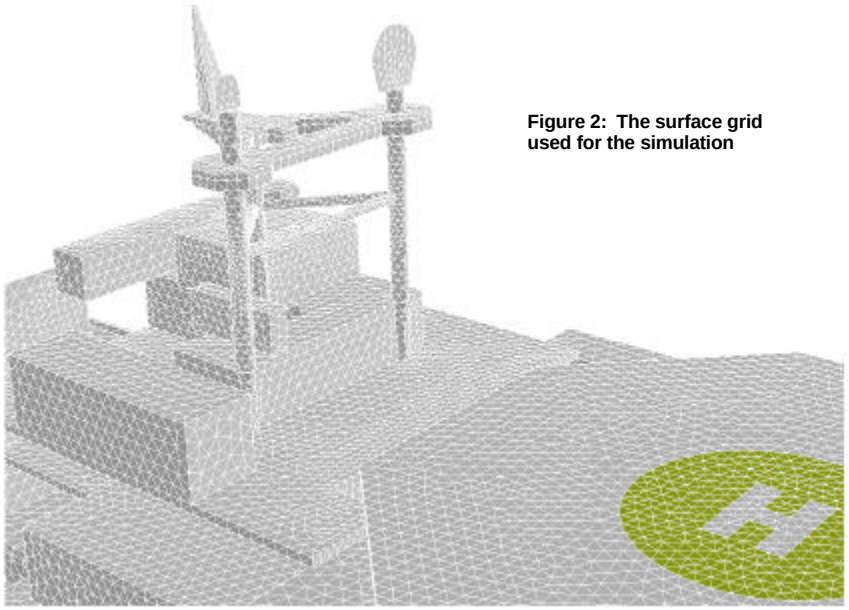

Figure 2: The surface grid used for the simulation

CAP437; and to check that hot gases emitted from the turbine exhausts do not result in temperature increases in the vicinity of the helideck in tail wind conditions.

The geometry of the FPSO is shown in Figure 1. All structures thought to significantly influence the flow field were included in the model. Lattice structures were modeled as porous media with associated resistances. One exhaust outlet of interest is behind the tall stack shown in the left of the figure. The helideck is marked with the letter "H" at the bow, on the right in the figure.

A tetrahedral mesh of approximately two million cells was used for the simulation. The surface mesh, created in GAMBIT, is shown in Figure 2.

Different wind conditions were studied during the project. One of the worst case conditions is when a head wind prevails (i.e. the wind has an angle of 0° relative to a directional vector from the bow to the stern). In Figure 3, the velocity field over the helideck is shown for this condition. Of particular interest in the wind studies is the strength of the vertical component in the region. The CAA guidelines state that for horizontal, free stream wind speeds of up to 25 m/s, mean vertical wind speeds at rotor height above the helideck should not exceed 0.9 m/s. Design changes are warranted if such wind speeds develop during normal weather conditions.

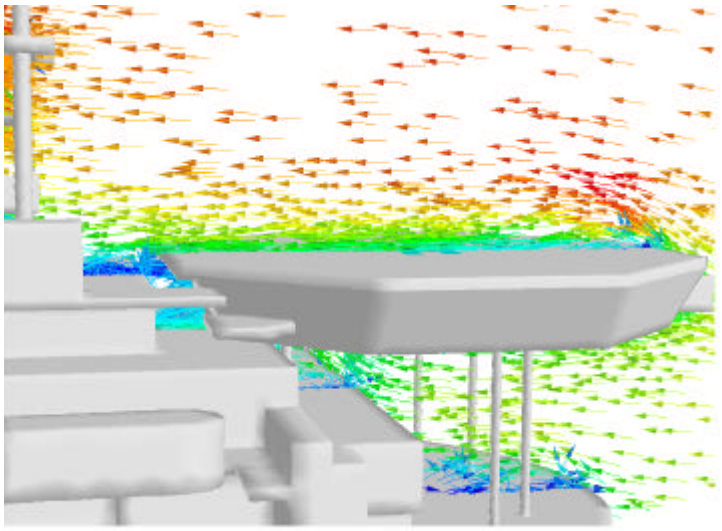

Figure 3: Velocity field near the helideck in a headwind

The worst case for elevated temperatures near the helideck occurs when tail wind conditions prevail, or when the wind direction is 180° relative to the bow-to-stern directional vector. Figure 4 shows an iso-surface on which the temperature is elevated 2°C above the ambient air temperature, a temperature rise that is due to the hot gas turbine emissions from the outlet at the rear of the vessel under tail wind conditions. The CAP 437 guidelines state that if the ambient air temperature in the flight paths or landing area of a helicopter is increased by more than 2°C, the British Helicopter Advisory Board (BHAB) should be informed. Temperature rises such as this become an operational issue and require the helicopter operator's review.

In summary, FLUENT has been used to predict the effects of free stream wind conditions on FPSO helideck operations in accordance with CAP437 guidelines, issued by the U.K. CAA. Two main issues were addressed: the wind environment, and the dispersion of turbine exhaust gases. The results demonstrated that during normal weather conditions, the wind environment around the vicinity of the helideck is satisfactory, and hot gases emitted from the turbine exhausts are not problematic with respect to helicopter operations.

Courtesy of Kerr-McGee North Sea (U.K.) Ltd.

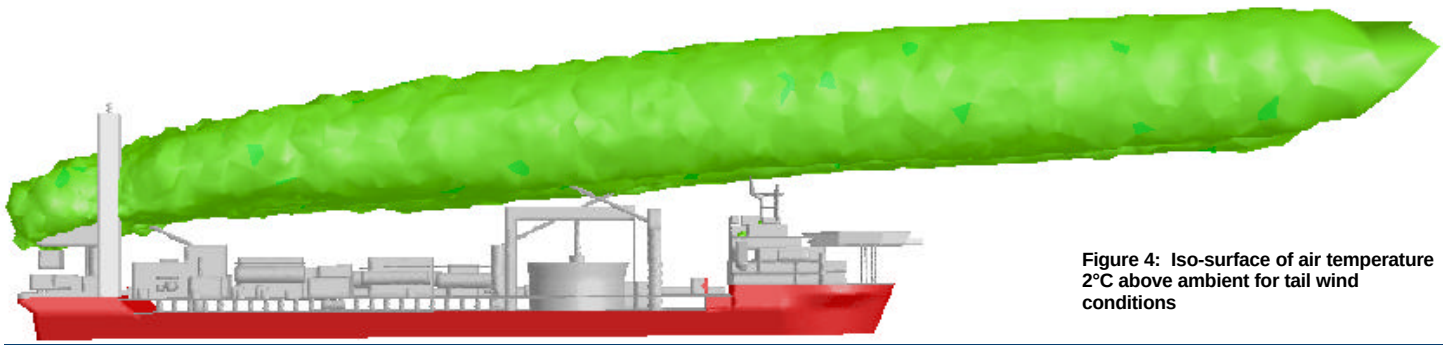

Figure 4: Iso-surface of air temperature 2°C above ambient for tail wind conditions