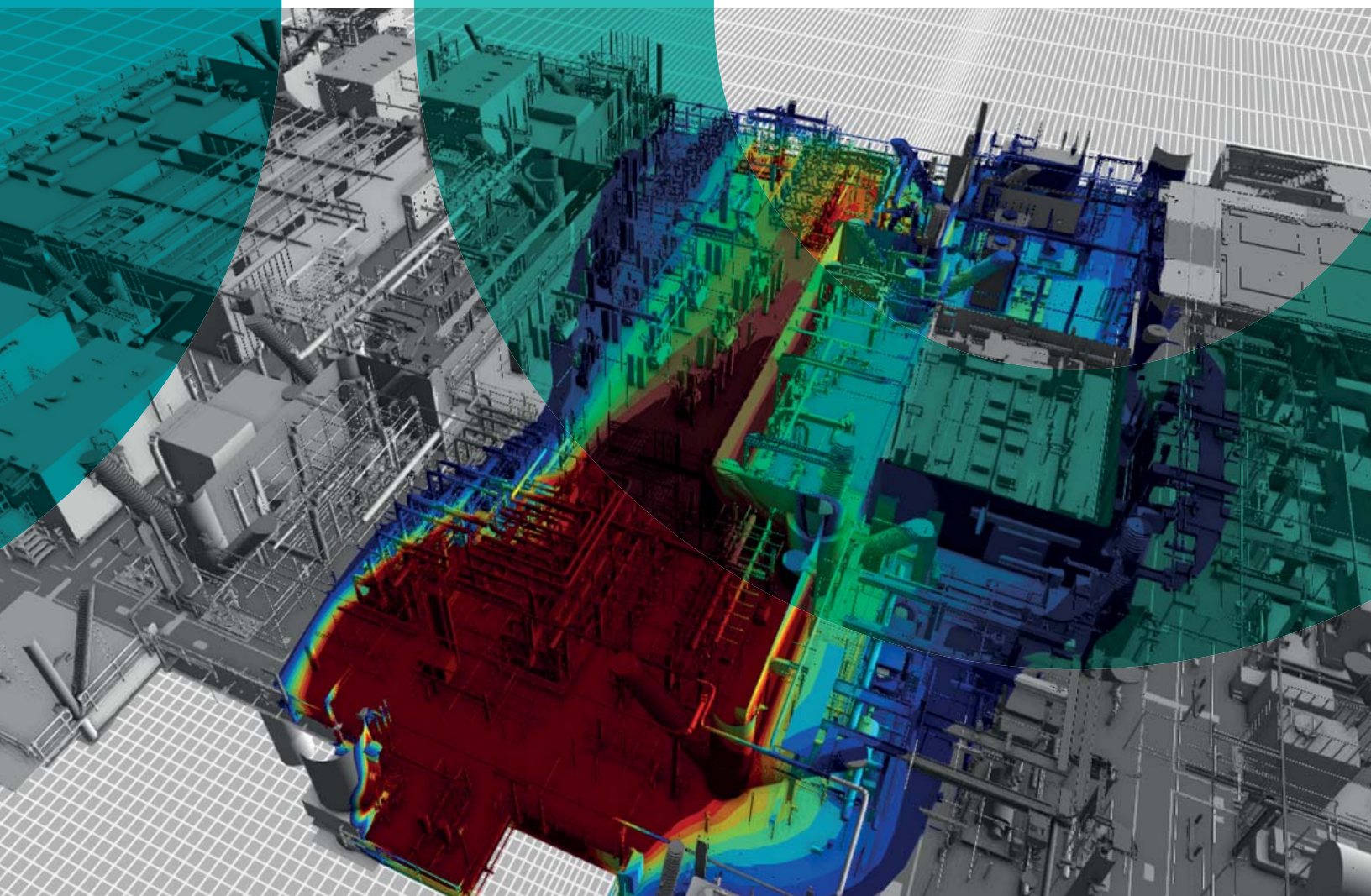
CFD Modeling for Oil and Gas Technical Safety Studies



CFD Modeling for Oil and Gas Technical Safety Studies

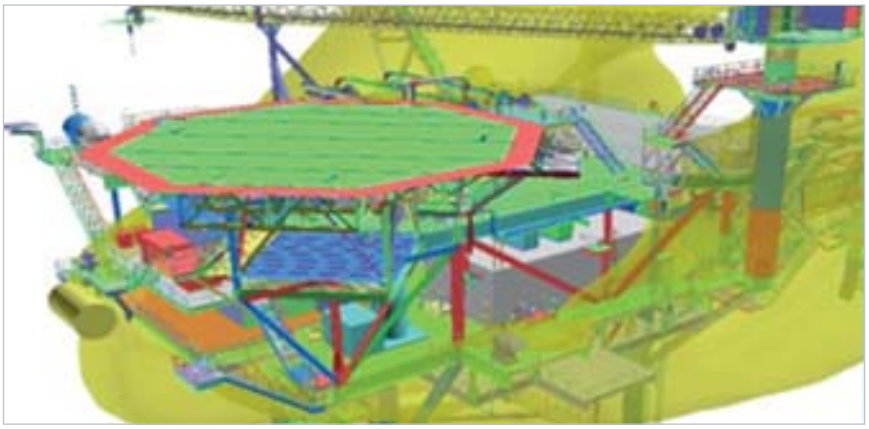
Computational Fluid Dynamics (CFD)

CFD refers to the advanced numerical modeling of the flow of fluids in simple as well as complex three-dimensional (3D) geometries. It should be noted that CFD tools are also capable of modeling heat transfer (conduction, convection and thermal radiation) associated with fires (gas jet, spray and pool) as well as explosions. CFD provides the means to analyze/visualize the various aspects of the fluid flow in order to provide a better understanding of the corresponding thermal-fluid behavior and evaluate associated structural interactions/effects. The results from the CFD simulations can serve as input to Finite Element Analysis (FEA) software that can calculate the structural response due to heat flux from fires or blast waves from explosions.

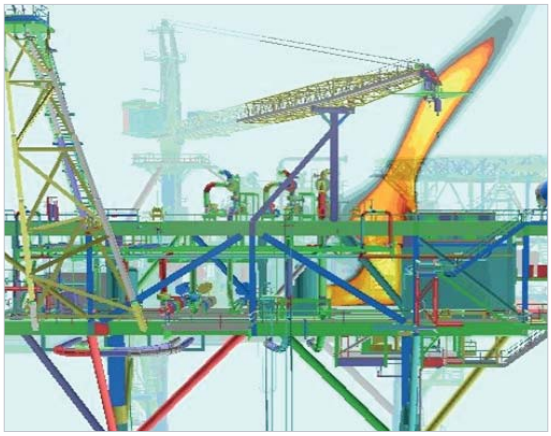
Wood's Offering

Our team has extensive knowledge in all the leading CFD software packages and have been providing solutions for a wide variety of engineering problems for over 20 years. The team members are well versed with HSE regulations and standards (UK HSE, NORSOK) and safety requirements of many major operators. We have in depth knowledge and expertise for carrying out safety related CFD studies normally conducted as part of formal safety assessment studies for oil and gas related assets.

Example of Offshore Fire



CFD Simulation of a Gas Leak and Subsequent Gas Transport



CFD

- Related Services:
  - Screening Assessment
  - Detailed Evaluation- Dispersion, Fire, Thermal Radiation, Blast
  - Quantitative Risk Assessment (QRA) – Exceedance
  - Layout Optimization
  - Toxic/ Exhaust Dispersion, Heli Deck Impact, Wind Chill, Smoke, Visibility and Ventilation Studies
  - Escape, Evacuation and Rescue Analysis (EERA)
- Example of Asset Types:
  - Onshore Refineries, Steam Assisted Gravity Drainage (SAGD) Facilities, Liquefied Natural Gas (LNG) Facilities, Mining Assets
  - Offshore Deepwater, Shallow Water Fixed and Floating
- Available Software:
  - FLACS
  - KFX™
  - STAR-CCM+®
  - ANSYS CFX
- Benefits Summary:
  - Harnessing the power of sophisticated modeling and simulation technologies to provide better information for design decisions.
  - Delivering lower cost and accurate solutions allowing clients to progress work scopes.
  - Wood offers an experienced team of technical resources available to deliver a one-stop integrated and cost effective solution globally.

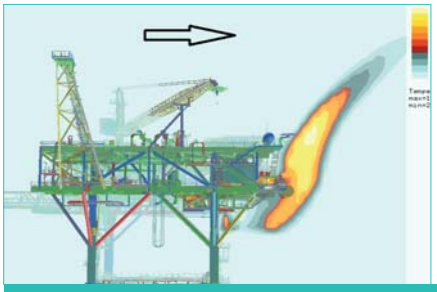
Examples of CFD-Based Safety Projects

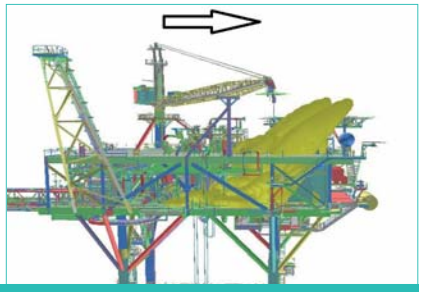
Offshore platforms are typically extremely complex 3D structures that requires a specialized tool that can handle items such as grated decks, minor pipework and equipment in a reasonable way. Modify for Porosity-based CFD tools, like FLACS and KFX™, are usually the preferred approach when addressing dispersion, fire and explosions in complex geometries. Recent CFD-based safety projects have been performed for BP (2016), Statoil (2016) and Husky (2017).

For fire studies, factors of interest typically includes CO & CO_2 concentration levels, smoke, temperature and visibility in the vicinity of the evacuation routes, living quarters and life boats. Typical results are provided on the top right hand side (BP 2016). Desired output from gas dispersion and explosion studies typically includes concentration levels of various gas species, overpressure on critical structural members and exceedance curves at critical locations. Results from the Husky (2017) study are shown on the right.

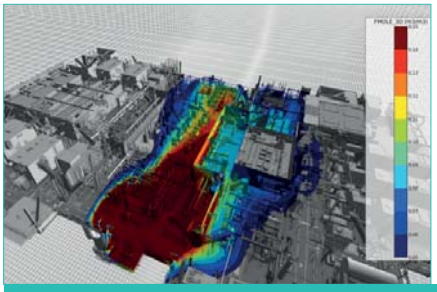
Helicopter travel to and from offshore facilities generates one of the main sources of risk for offshore workers. This is particularly the case on modern installations where other risks are relatively low. Turbulence generated by the wind and its interaction with the structures on an offshore platform and temperature fluctuation in the flight path are the two main environmental factors that determine the risk level when attempting taking off or landing on a helideck.

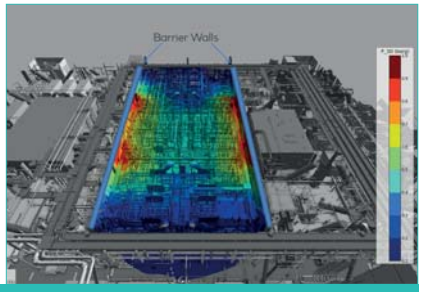
Both the NORSOK (C-004) and UK HSE (CAP 437) standard require CFD analysis when performing helideck safety studies. Both the wind speed and turbulence intensity are important when evaluating the risk level. Temperature fluctuations of more than 2°C above the helideck can result in a dangerous loss of lift for the helicopter. The release and transport of hot gases from exhaust stacks are simulated by CFD and the results can be used to generate iso-surfaces showing the extent of the volume where the temperature fluctuations exceed 2°C. Typical results for the Statoil (2016) study are provided on the bottom right hand side .



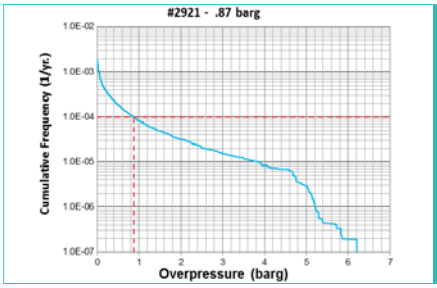


Temperature contours in a vertical plane containing the release location from a spray fire (left picture) and the 25 ppmv CO iso-surface (right picture). The arrow indicates the wind direction.

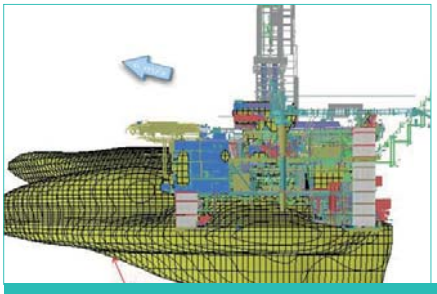


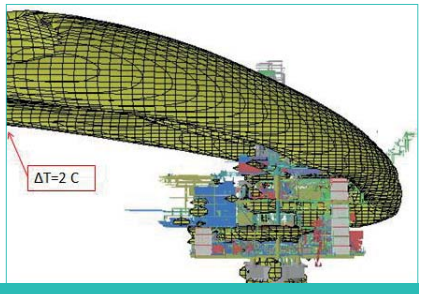


Gas concentration from a gas dispersion CFD simulation (left picture) and overpressure contours from an explosion simulation (right picture) in the vicinity of the barrier walls (Husky 2017).



Exceedance curve at on of the barrier walls for the Husky study.





The 2°C (above ambient temperature) iso-surface for two different wind directions.

Wood is a global leader in the delivery of project, engineering and technical services to energy and industrial markets. We operate in more than 60 countries, employing around 55,000 people, with revenues of around $10 billion. We provide performance-driven solutions throughout the asset life-cycle, from concept to decommissioning across a broad range of industrial markets including the upstream, midstream and downstream oil & gas, chemicals, environment and infrastructure, power & process, clean energy, mining and general industrial sectors. We strive to be the best technical services company to work with, work for and invest in.

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