

Risks to offshore installations in Europe due to natural hazards

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Natural hazards, such as storms, earthquakes, or lightning are a major threat to industry. In particular, chemical plants, storage facilities, pipelines, and offshore oil and gas facilities are vulnerable to natural events which can cause hazardous materials releases and thereby endanger workers, the population and the environment. These technological accidents are commonly referred to as Natech accidents. Recent events have increased concerns about safety in the offshore oil and gas sector, and the need for improving knowledge on the matter has become evident.

With those premises, we analyzed accidents, near misses and accident precursors at offshore facilities in Europe caused by natural events using both a statistical and a qualitative approach. For this purpose, we screened the World Offshore Accident Database (WOAD) to identify all incidents that featured natural events as causes or aggravating factors. A dataset of 1,085 global Natech events was built for the statistical analysis. Among those, a subset composed of 303 European records was selected.

The results of the analysis showed that offshore Natech events in Europe are frequent; they resulted, however, in low consequences. The main threat to offshore facilities resulted from bad weather, such as strong winds and heavy seas. Storms can put intense loads on the structural parts of offshore installations, eventually exceeding design resistance specifications. Several incidents triggered by lightning strikes and earthquakes were also recorded.

Substantial differences in terms of vulnerability, damage modality and consequences emerged between fixed and floating offshore structures. The main damage mode for floating structures was the failure of station keeping systems due to the rupture of mooring or anchors, mainly caused by adverse meteorological conditions. Most of the incidents at fixed offshore structures in Europe involved falling loads for both metal jacket and concrete base platforms due to storms. In contrast, in other parts of the world, and in particular in the Gulf of Mexico, tropical storms are likely to trigger severe direct damage to structures, resulting in platform capsizing, sinking or grounding.

The in-depth analysis of the incident records also showed that the natural event was often just the triggering cause of the accident, which was frequently accompanied by contributing factors (e.g. corrosion, fatigue, wrong procedures, etc.). Under these circumstances, not only extreme storms, but also storms with moderate intensity can trigger incidents. Due to the high density of offshore structures and the unique environmental conditions promoting fatigue and corrosion, the North Sea is the area with the highest number of incidents recorded in Europe, as well as the area with the highest number of incidents at semi-submersible units in the world.

About 4% of all reported global Natech events at offshore infrastructures involved casualties, and 2.6% for the European incident subset. Hazardous materials releases were documented for 21 events in Europe, resulting in fires and hydrocarbon spills polluting the sea. Furthermore, a surprisingly high number of severe events occurred during towing which highlights the impact of natural hazards on the safety of offshore transfer operations.