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Study on impacts of natural hazards to offshore oil and gas structures in European waters

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Objectives



- ✓ Statistical analysis of past events triggered by natural hazards;
- ✓ Investigation of the underlying causes and event dynamics;
- ✓ Relation between incidents, structure type, geographic location and natural hazard;
- ✓ Lessons learned to prevent future losses;
- ✓ Support to risk assessment by informing scenario building for prevention and preparedness

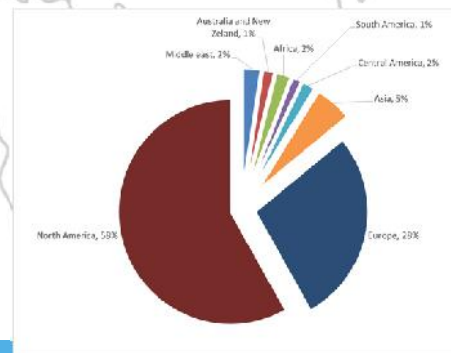
Dataset creation



The Worldwide Offshore Accident Database (WOAD) is an offshore accident and incident database operated by DNV-GL.

A dataset of 1085 events globally was built for a statistical analysis of incidents with an environmental trigger.

A subset of 307 events was defined for the assessment of incidents occurred in European waters



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3

The European dataset



Natural Hazard	World	Europe
<i>Bad weather</i>	546	283
<i>Lightning</i>	17	13
<i>Earthquake</i>	5	3
<i>Hurricane</i>	513	7
<i>Freeze</i>	4	1
TOT	1085	307

Europe North Sea
267

Europe West
21

Europe South
13

Europe Arctic
4

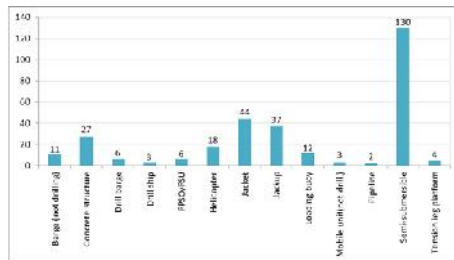
East Europe
2



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Facility typologies



The most frequently damaged units are: semi-submersibles, jackets, jackups and concrete structures

Jacket structure

Jackup

Concrete structure

Semi-submersible

In 77 cases, production was ongoing (on 78 production units)

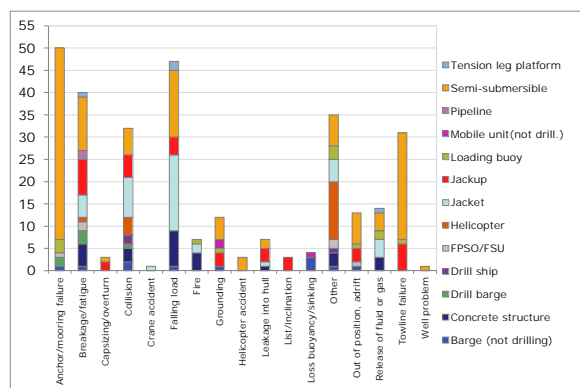
In 81 cases, drilling was ongoing (on 146 rigs)

In 56 cases, transport operations were ongoing



5

Main Events



- "Stationkeeping" is the main issue for semi-sub ("anchor failure", "grounding", "out of position")
- "Falling load" and "collision" are major problems for both fixed and for mobile units
- "Breakage or fatigue" is the direct damage dealt to any type of structure
- "Towline failure" is the main hazard during transport operation of semi-subs and jackups

6

Fixed structures



- Platforms built on concrete supports are more resistant than those mounted on metal jackets
- Falling load is the most frequent outcome; workers injured and dead
- Direct damage reported at connection bridges between different platforms, gratings and at flare stacks
- The majority of fires occurred at fixed structures (all lightning strikes)



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Floating structures



- Semi-submersible units are those featuring the highest number of records
- Main damage mode: failure of station keeping systems (moorings or anchors)
- Failures are contributed to by corrosion and fatigue phenomena
- Only a few release events occurred
- Failure of towline in heavy weather; the platform, the tug or both were damaged

The majority of accidents at semi-submersible units occurred in the North Sea



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Transport and towing



- 56 incidents occurred during transport operations, damaging semi-subs, jackups and other MODUs
- Damage modes: deck flooding, capsizing and sinking
- Breakage: collapse of derricks and cranes, bending or buckling of jackup legs

UK, 2016 – Transocean Rig



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Releases and fires



- Fragmented data only are available for LOCs in Europe and only 21 releases have been reported.
- Substances released are: hydrocarbons, fuels, lubricants, others
- 16 fire events (10 fires due to lightning)
- Worldwide, a total of 202 loss-of-containment (LOC) events were recorded

Gasoil spilling from a damaged jack-up rig



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307 offshore incidents from natural causes in European waters:

- **Frequent but low consequences**
- **Main problem: bad weather**; also cases of lightning and earthquakes
- **Damage/failure modes:**
 - Floating infrastructure: loss of station keeping (mooring/anchors) due to high winds and rough seas
 - Fixed infrastructures: falling loads due to storms
- **Strong contributing factor fatigue and corrosion**
 - North Sea: highest number of incidents in Europe; highest number of incidents at semi-submersible units in the world
- **High number of incidents during towing**
 - Impact of natural hazards on safety of transfer operations

- Some storms have exceeded any expectation in terms of intensity. Met-ocean criteria need to be adapted to factor in climate change
- Station-keeping systems are vulnerable to recurrent bad weather (typical of the North Sea), freeze and water salinity, which promotes fatigue and corrosion and reduces the operative life of components
- For towing operations of mobile units, an additional vulnerability to natural-hazard impacts was identified, in particular during heavy weather
- The consequences of natural-hazard impacts at offshore infrastructures are costly in terms of human health, environmental pollution and economy

Thank you for your attention!



RAPID-N tool for rapid Natech risk assessment and mapping:
rapidn.jrc.ec.europa.eu



eNATECH database for Natech accidents
enatech.jrc.ec.europa.eu



Questions?