NEW ZEALAND OIL & GAS

WELL HEAD CONTROL/ BLOW-OUT PREVENTION

You asked us for information on well head control and blow-out prevention

This note provides a high-level summary of the measures in place to prevent a well blowing out. More information on how government agencies manage offshore drilling in New Zealand, including reviewing and approving designs and operational requirements, is available online: https://www.nzpam.govt.nz/assets/Uploads/our-industry/factsheets/deep-sea-drilling.pdf

WHAT MEASURES ARE IN PLACE TO PREVENT A WELL BLOWING OUT?

There are multiple mechanical (physical), system and process control measures in place in well design, all designed to prevent accidents.

The primary focus of the design process is to ensure that positive pressure is maintained at the bottom of the well (to prevent any abnormal pressures from entering the well).

When a well is begun, steel casing tube is pushed into the sea floor to a depth of about 100 metres. For Barque conductor casing string is likely to be around 76cm wide. A smaller casing tube is then drilled down inside the first casing, to a depth of about 600 metres. The hole is only about 50 centimetres wide at this point.

Concrete is then pumped to the bottom to backfill the gap between the rock wall and the outside of the steel tube to lock it in place, providing strength and stability. After the cement has hardened, the bottom of the well is drilled out, and the process continues.

Once the second casing string is installed, a blow-out preventer is lowered onto the well opening, to effectively seal the well. The blow-out preventer allows water, mud and cuttings to be recovered from the bottom of the well. It uses huge and immensely strong valves to contain excessive pressure within the well, facilitating a constant, controlled release of oil and gas to the surface.

Prior to drilling, plans for the individual well are subject to internal, external and regulatory review and approval, including certification from an independent well examiner.

WHAT IS A BLOW-OUT?

A blow-out is a failure with serious consequences for the environment and safety. In a blow-out, downhole pressure overcomes the weight of drilling fluid and rises to the surface out of control. Just as plane accidents are tragic disasters for the aviation industry (and more common than blow-outs), both industries use lessons from past mistakes to develop techniques and processes that help to avoid repeats.

In New Zealand there have never been any offshore well blow-outs. However there have been several oil spills of varying volumes. The largest spill to date was 23 tonnes of oil from the Umuroa floating production, storage and offloading vessel on the offshore Tui Field in 2007.

HOW ARE BLOW-OUT RISKS MANAGED AT AN OPERATIONAL LEVEL?

Blow-outs are rare events. They can occur when multiple failures of mitigation controls occur, each of which is an unlikely event itself.

Preventing an oil spill and maintaining or recovering well control is the responsibility of the operator.

In the unlikely event of a blow-out occurring during drilling, drilling mud acts as a first line of defence. Drilling mud is a complex thick fluid consisting of water, clay and additives continuously pumped down the well while it is being drilled. This fluid has been designed for each section of the well and the expected conditions of that section.

The weight of the drilling mud can counteract underground pressures, which can be responsible for causing blow-outs. In addition to the mud, the casing strings and the cement used to hold them in place are part of the secondary mechanical barriers.

The well's blow-out preventer is the next barrier. The blow-out preventer is a hydraulically operated system of valves and other ram devices that sits on top of the well head on the seafloor. Valves can be closed to counteract an uncontrolled rise of oil or gas from the reservoir. The blow-out preventor is capable of sealing off the well or re-routing fluids and gas into containment systems. Multiple redundancies are present in the physical design and operation.

In the highly unlikely scenario of those systems failing, leading to a complete loss of well control by an operator, several different responses would be considered. At all times, safety of personnel is paramount.

One intervention technique could be the drilling a relief well. A relief well intersects the original well. Drilling mud, followed by cement, would be pumped down at pressure to stop the flow of oil from the reservoir. The same ship or rig can be used to drill a relief well, if it isn't damaged and there is no risk to workers.

Another option could be to use a capping stack to contain the oil in the well. A capping stack weighs over 80 tonnes and is designed to fit over a blown-out well, allowing the operator to gradually shut in oil flow with hydraulic rams. Capping stacks are only suitable in certain scenarios and are a temporary containment measure to stop oil flow while a relief well is drilled.

Capping stacks are located at various strategic locations around the world, including Singapore – which is the closest location containing a capping stack to New Zealand. Specialist support vessels would also be needed to help fit the cap.

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WHAT ABOUT THE BP MACONDO (DEEPWATER HORIZON), GULF OF MEXICO SPILL – WHAT'S TO STOP THAT HAPPENING AGAIN?

The Deepwater Horizon incident in the Gulf of Mexico in 2010 was the world's largest oil spill resulting from drilling a well and resulted in significantly increased oversight of offshore oil installations in the United States, and globally. Eleven workers died and close to five million barrels of petroleum were spilt into the Gulf before the well was closed and sealed.

The cause of the accident was ultimately ruled as the result of a failure of multiple processes and emergency functions. Both regulators and industry learnt a great deal from it. Many of the large international operators adopted improved processes as a result of what was learned.

New Zealand was a participant in an international forum on offshore containment following the Deepwater Horizon accident. The forum set best practice for exploration and production, including containment and management of oil spill incidents. The New Zealand Government has made changes to regulatory processes and environmental protection.

READ MORE

www.energymix.co.nz/our-process/offshore-drilling/

www.nzpam.govt.nz/assets/Uploads/our-industry/factsheets/deep-sea-drilling.pdf

Well Examination & Operation:

worksafe.govt.nz/dmsdocument/23-petroleum-well-operations-and-well-examination-schemes

www.pepanz.com/dmsdocument/11

Macondo-specific:

National Commission report to the President
www.nrt.org/sites/2/files/GPO-OILCOMMISSION.pdf

BP's assessment of events
www.bp.com/content/dam/bp/pdf/sustainability/issue-reports/Deepwater_Horizon_Accident_Investigation_Report.pdf

CHANGES TO REGULATORY PROCESSES AND ENVIRONMENTAL PROTECTION INCLUDE:

- Changes to the Crown Minerals Act 1991 to strengthen regulatory agencies' coordination.
- The establishment of the High Hazards Unit, part of Worksafe, to oversee health and safety practices within the oil and gas industry.
- The establishment of the Exclusive Economic Zone and Continental Shelf (Environmental Effects) Act 2012 (the EEZ Act). Prior to this many of the environmental effects of activities in the EEZ were not regulated.
- Stricter rules apply to offshore operators' spill preparedness and response capability. These changes have significantly increased the range of preventative measures operators must take and further reduces the likelihood, and severity, – already very small – of a well blow-out. They also ensure that only the most responsible companies can explore for oil and gas.

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