AWESOME stories

What Caused the Deepwater Horizon Explosion?

Deepwater Horizon burns on April 21, 2010—the day after catastrophic explosions occurred aboard the offshore oil platform. The next day, the rig would sustain another explosion, causing it to sink in the Gulf of Mexico. AP Photo used here as fair use for educational purposes. Click on the image for a better view.

Why did the offshore drilling rig, *Deepwater Horizon*, explode on April 20, 2010? It all started when the rig was ready to move on, leaving behind the oil well which its crew had drilled.

That well, known as the Macondo Well, would be capped until it was time for another crew, working on another vessel, to extract the oil from the hydrocarbon reservoir into which the Macondo well was tapped. The hydrocarbon reservoir, of oil and natural gas, was located miles below the surface of the Gulf of Mexico.

What was the *Deepwater Horizon* leaving behind? According to the "Report to the President," prepared by the National Commission on the BP Deepwater Horizon Spill and Offshore Drilling:

> *The Deepwater Horizon was drilling the Macondo well under 5,000 feet of Gulf water, and then over 13,000 feet under the sea floor to the hydrocarbon reservoir below...The deepwater environment is cold, dark, distant and under high pressures—and the oil and gas reservoirs, when found, exist at even higher pressures (thousands of pounds per square inch), compounding the risks if a well gets out of control.*

The two-and-a-half-mile well, designed by BP, had a nickname ... "the well from hell." One of its designers, Brian Morel, told his colleagues (in an email):

> *...this has been [a] nightmare well which has everyone all over the place.* (See Report to the President, page 18 of the PDF version.)

Morel was aboard *Deepwater Horizon* on the morning of April 20, 2010. He was watching a team from Halliburton cementing the Macondo Well. That cementing process was needed so the well would remain temporarily capped until it was time for another crew to harvest the oil from the hydrocarbon reservoir.

It seemed that everything with the cementing procedures had gone well. People were so happy with the process that BP decided the team from another company—Schlumberger—did not have to conduct a cement evaluation. That decision would save BP time and a $128,000 Schlumberger fee. (See Page 20 of the "Report to the President.")

That decision was a mistake.

In fact, the whole disaster at *Deepwater Horizon* began with a "well-integrity failure," according to BP's investigation report (at page 9), which was caused by a "bad cement job."

The cement job, which seemed so good to the people involved, had actually failed to seal the well. When the cement failed to seal the well, the crew lost control of the fluid pressure in the well.

A "blowout preventer" is supposed to automatically seal a well when things go wrong. If, for example, the crew cannot control the fluid pressure in the well—which can happen even when the well is far less than 2½ miles deep—they are at risk of a blowout. To prevent the loss of control, resulting in a blowout, the blowout preventer automatically seals the well.

Deepwater Horizon's blowout preventer did not engage.

When a blowout preventer fails to do its job, hydrocarbons are able to fly up the well at enormous speeds. When those hydrocarbons—such as methane gas—fly up the well, and reach the drilling rig, they will find an ignition source if the rig's Emergency Disconnect System (EDS) isn't activated. If hydrocarbons find an ignition source, an explosion will occur.

No one activated *Deepwater Horizon's* Emergency Disconnect System before the first explosion occurred on the rig.

No one activated the general alarm on the rig until after the first explosion.

The “Report to the President” notes that:

> *The explosive loss of the Macondo well could have been prevented.*

In its report of 8 September 2010, BP identified eight main failures which caused *Deepwater Horizon’s* explosion. We can breakdown BP’s analysis of the eight main failures—identified at pages 10-11 of its report—as follows:

Cement Problem

The cement did not create a seal, at the bottom of the borehole, which allowed gas and oil to start leaking into the pipeline. The pipeline extended all the way to the surface of the Gulf.

Valve Failure #1

Two mechanical valves, designed to prevent the flow of gas and oil up the pipeline to the surface of the Gulf, failed. When the valves failed, gas and oil could move up the pipe to the surface.

Misinterpreted Pressure Test

When the crew conducted their pressure tests, to make sure the well was actually sealed, they misinterpreted the rest results. They believed the well was under control when it actually wasn’t.

An Actual Leak Was Not Identified As a Leak

If gas and oil are flowing to the surface, because of a leak, crew members can usually detect that movement because there will be unexpected pressure increases in the well. Fifty minutes before *Deepwater Horizon’s* first explosion, there was such an increase. No one interpreted it as a leak.

Valve Failure #2

Around eight minutes before disaster struck the rig, the crew saw gas and mud pouring onto the rig floor. Crew members immediately tried to close a valve in the Blowout Preventer (positioned on the Gulf floor, right above the top of the well borehole). The valve did not work properly.

An Overwhelmed Separator

The crew could have diverted the gas and mud away from *Deepwater Horizon* and into the Gulf, via pipes over the side of the rig. Instead, they directed the flowing gas and mud to a separator device, aboard the rig, which was designed to separate much smaller amounts of gas from a mud flow. When the separator device (sometimes called a “gas buster”) became overwhelmed, due to the large amounts of flow, flammable gas began to engulf the rig.

No Gas Alarms

Deepwater had a gas-detection system to sound alarms and trigger the cut-off of ventilation fans. Closing-down ventilation prevents gas aboard the rig from reaching ignition sources (like *Deepwater’s* engines). The system was in manual mode.

Lack of Working Battery for the Blowout Preventer

Although the explosion destroyed control lines which the crew needed to close the blowout preventer’s safety valves, the device itself has two separate safety systems. Those separate systems are designed to shut the valves, automatically, when the blowout preventer loses contact with the surface. Both automatic systems failed. One had a defective switch; the other had a bad battery. As a result, the blowout preventer could not close.

In addition to the disaster on the rig—causing the deaths of 11 crew members—the explosions caused a disaster in the Gulf of Mexico. The leak, at the well head, occurred on April 20, 2010. The well could not be capped until the 15th of July, three months later, and it wasn’t permanently sealed until the 19th of September, 2010.

Credits:

Image of *Deepwater Horizon* burning, on 21 April 2010, online via the AP. Image used here as fair use for educational purposes.

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