Blowout

What caused the* Deepwater Horizon *disaster?

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The sun had just set over the Gulf of Mexico on April 20 last year when a fireball suddenly lit the sky about 66 kilometers (41 miles) off the shore of Louisiana. A massive explosion had ignited the oil drilling rig *Deepwater Horizon.* Eleven workers were killed in the explosion. The survivors fled by lifeboat or leapt into the gulf six stories below.

The inferno blazed out of control for two days before the rig sank. Then the bad news got worse. On the seafloor, a mile underwater, oil was gushing from the broken top of the well. The spill surged into the record books as the biggest environmental disaster in U.S. history.

What went wrong exactly? And how can similar disasters be kept from happening again?

DEEP DRILL

Vast reservoirs of oil and natural gas lie beneath the Gulf of Mexico. To reach them, oil companies use huge, floating drilling rigs.

To drill a well, workers on a rig connect an open pipe called a riser to the seafloor. Then a second pipe with drill bit attached to the end is lowered into the riser. The drill bit bores a hole thousands of feet deep. The borehole is lined with a steel casing to keep it from collapsing. Beneath the *Deepwater Horizon*, the completed well had reached its final depth—4,052 meters (13,294 feet below the seafloor—in early April.

RISKY BUSINESS

With thousands of feet of rock and sediment above it, a deep reservoir of oil and natural gas is under enormous pressure. Punching a hole into it is like poking a hole in a balloon. Sometimes, the pressure forces oil and gas to explode up the well. That explosion is called a *blowout.* It's an oil companies worst nightmare.

To prevent blowouts during the drilling process, oil companies employ several strategies. Heavy drilling fluid called "mud" circulates inside the riser and casing, pushing down on the oil and gas. The gap between the casing and the surrounding reservoir rock is also sealed with concrete.

The brawniest safeguards are *blowout preventers* (BOPS). A BOP is a stack of valves installed at the seafloor, where the riser meets the well. If the well blows, the BOP can choke it shut. BOPs have devices called *shear rams* than can cut and seal the casing and drill pipe in n extreme emergency.

WORST-CASE SCENARIO

When the drilling was completed in April, workers began replacing the heavy mud with lighter seawater, unaware that the concrete seal in the well had failed. The seawater couldn't hold back the natural gas. Gas blasted through the seal, up the well, and into the riser—and the BOP failed to activate. "The fact that all the controls and barriers failed is shocking," says Stefan Mrozewski, an engineer at Columbia University in New York.

Natural gas overwhelmed the *Deepwater Horizon,* and sparks in the rig ignited it. The rig exploded and sank; then the riser snapped. The charred hulk of the *Deepwater Horizon* sank to the seafloor. Oil began pouring from the broken well into the Gulf of Mexico.

To stop the gusher, BP, the oil company that owned the well, tried one thing after another. Wells had leaked before, but never nearly a mile underwater. A British oceanographer told reporters that working that deep was as "easy" as working on the moon.

BP lowered a four-story dome over the well to capture the oil and funnel it to a ship. In the cold water, however, frozen crystals of methane clogged the system. BP also began drilling a second well to help control the runaway well. Finally, in July, it capped the well with a special BOP. Heavy mud was forced feeo into the well to keep any more oil from moving upward. By September, the well, sealed with concrete, was officially dead.

HARD LESSONS

The *Deepwater Horizon* accident taught some hard lessons. It wasn't just equipment that failed. Human error played a role, too. "It appears to have been a perfect storm of design, execution, and equipment failures," says Mrozewski.

There's no doubt that the accident is going to change the way things are done, says Greg McCormack, a University of Texas scientist who trains oil and gas workers. For one thing, BOP design has not kept up with increasingly deep drilling. That, McCormack told *Current Science*, will change. For example, shear rams may be spaced differently inside a BOP. And backup BOPs will be ready at drilling sites.

Machinery won't get the only makeovers. Concrete seals will be better designed and more carefully tested. The government most likely will monitor drilling rigs more closely. Worker training will improve, as will communication and decision making on the rigs.

What about quitting deepwater drilling altogether? Not an option, says Mrozewski. "There's too much oil there, and Americans want it. "As a society we've proved unwilling—if not unable—to wean ourselves off oil and gas," he said.