Unusual Decisions Set Stage for BP Disaster

Drilling "mud," perhaps mixed with oil, spewed from BP's crippled well Wednesday, the company said, after workers began trying to plug it. CEO Tony Hayward said success wouldn't be clear until Thursday.

DEEP TROUBLE

BY BEN CASSELLMAN
AND RUSSELL GOLD

It was a difficult drill from the start.

API Well No. 60-817-44169 threw up many challenges to its principal owner, BP PLC, swallowing expensive drilling fluid and burping out dangerous gas. Those woes put the Gulf of Mexico project over budget and behind schedule by April 20, the day the well erupted, destroying the Deepwater Horizon rig and killing 11 men.

Government investigators have yet to announce conclusions about what went wrong that day. The final step in the causation chain, industry engineers have said in interviews, was most likely the failure of a crucial seal at the top of the well or a cement plug at the bottom.

But neither scenario explains the whole story. A Wall Street Journal investigation provides the most complete account so far of the fateful decisions that preceded the blast. BP made choices over the course of the project that rendered this well more vulnerable to the blowout, which unleashed a spew of crude oil that engineers are struggling to staunch.

BP, for instance, cut short a procedure involving drilling fluid that is designed to detect gas in the well and remove it before it becomes a problem, according to documents belonging to BP and to the drilling rig's owner and operator, Transocean Ltd.

BP also skipped a quality test of the cement around the pipe—another buffer against gas—despite what BP now says were signs of problems with the cement job and despite a warning from cement contractor Halliburton Co.

Once gas was rising, the design and procedures BP had chosen for the well likely gave it no chance against this perilous gas an easier path up and out, say well-control experts. There was little keeping the gas from rushing up to the surface after workers, pushing to finish the job, removed a critical safeguard, the heavy drilling fluid known as "mud." BP has admitted a possible "fundamental mistake" in concluding that it was safe to proceed with mud removal, according to a memo from two Congressmen released Tuesday night.

Finally, a BP manager overseeing final well tests apparently had scant experience in deep-water drilling. He told investigators he was on the rig to "learn about deep water," according to notes of an interview with him seen by The Journal.

Some of these decisions were approved by the U.S. Interior Department's Minerals Manage-

ment Service, which has come under fire for what President Obama has called its "cozy relationship" with the oil industry. But in at least one case, the decision made apparently diverged from a plan MMS approved. MMS declined to comment.

Some of BP's choices allowed it to minimize costly delays. "We were behind schedule already," said Tyrone Benton, a technician who operated underwater robots and worked for a subcontractor. He said that on the day before the accident, a Monday, managers "hoped we'd be finished by that Friday... But it seemed like they were pushing to finish it before Friday."

He added: "They were doing too many jobs at one time." Mr. Benton is suing BP and Transocean, claiming physical injury and mental anguish.

BP acknowledges the well was running over budget but says it didn't cut corners. "Safe and reliable operations remain a priority regardless of how much a well is behind schedule or over budget," spokesman Andrew Gowers wrote in an email.

Some workers agree safety was paramount for both BP and Transocean. "Safety was their No. 1 concern. Protecting the environment was their No. 1 concern," said Darin Rupinski, a Transocean employee whose job was to help keep the rig in place.

BP was drilling to tap an oil reservoir it had identified called Macondo, the same name as the cursed town in Gabriel Garcia Marquez's novel "One Hundred Years of Solitude." As on many past projects, BP hired a drilling rig from Transocean, the largest deep-water driller. Workers from Transocean and other contractors did most of the work, under the supervision of BP employees on the rig and in Houston.

BP started working on the well in October, using a different rig. After three weeks natural gas got into the well, called a "kick." That's not uncommon. But two weeks later a hurricane damaged the rig and it had to be towed to port for repairs.

BP started again in January, then this time with Transocean's Deepwater Horizon, a workhorse rig that had worked for BP for years. BP filed a new drilling permit with federal regulators.

According to a company document seen by the Journal, BP approved spending $96.3 million
Recipe for Disaster?

Investigators are still trying to figure out exactly what caused the Deepwater Horizon to blow up on April 20. But based on what is known, experts have worked out the most likely scenario. This diagram of the well's lining is vastly foreshortened to emphasize the well's layers.

1. Oil and gas
2. Gas
3. Workers pumped cement to seal off the sides of the well. But they didn't flush out the mud-filled gas first. Instead, the cement pushed any gas further up the well.
4. BP didn't test the cement to see if it was sound.
5. Oil and gas also might have gotten into the inside of the casing through a cement plug at the bottom.
6. Any gas rising up the side of the well would have expanded, pushing against both the inner pipe within the well and a seal at the top.
7. Due to the design of the well, the gas had a straight shot to the top of the well.
8. Gas got into the inside of the pipe, either by pushing through a seal at the top, or through the cement on the bottom, or else by collapsing the pipe.
9. A final cement plug would have stopped gas from reaching the surface, but workers didn't set a plug before removing heavy drilling fluid.
10. With gas in the well, heavy drilling fluid was the only thing keeping it out of the surface.

On April 20, workers began removing the drilling fluid and replacing it with seawater, allowing gas to shoot to the surface, where it caught fire.

and about 78 days on the well. The target time was much less—about 51 days. By April 20, the well was in its 80th day, owing to delays such as one that had begun on March 8.

That day, workers discovered that gas was seeping into the well, according to drilling reports from the rig reviewed by the Journal. Workers lowered a measuring device to determine what was happening, but when they tried to pull it back up, it wouldn't budge. Engineers eventually told them to plug the last 2,000 feet of the then-13,000-foot hole with cement and continue the well by drilling off in a different direction.

The episode took days to resolve, according to drilling reports, not counting backtracking and re-drilling. Each extra day cost BP about $1 million in rig lease and contractor fees.

Other problems arose. The rock was so brittle drilling mud cracked it open and escaped. One person familiar with the matter estimates BP lost at least $15 million worth of the fluid.

Still, by mid-April, the well seemed a qualified success. BP was convinced it had found a lot of oil. Until engineers in Houston could make plans to start pumping it out, the workers on the nearly complete well, in a standard practice, would plug it and temporarily abandon it.

One of the final tasks was to cement in place the steel pipe that ran into the oil reservoir. The cement would fill the space between the outside of the pipe and the rock, preventing any gas from flowing up the sides.

Halliburton, the cementing contractor, advised BP to install numerous devices to make sure the pipe was centered in the well before pumping cement, according to Halliburton documents, provided to congressional investigators and seen by the Journal. Otherwise, the cement might develop small channels that gas could squeeze through.

In an April 18 report to BP, Halliburton warned that if BP didn't use more centering devices, the well would likely have "a SEVERE gas flow problem." Still, BP decided to install fewer of the devices than Halliburton recommended—six instead of 21.

BP said it's still investigating how cementing was done. Halliburton said that it followed BP's instructions, and that while some "were not consistent with industry best practices," they were "within acceptable industry standards."

The cement job was especially important on this well because of a BP design choice that some petroleum engineers call unusual. BP ran a single long pipe, made up of sections screwed together, all the way from the sea floor to the oil reservoir.
Companies often use two pipes, one inside another, sealed together, with the smaller one sticking into the oil reservoir. With this system, if gas tries to get up the outside of the pipe, it has to leak through not just cement but also the seal connecting the pipes. So the more typical design provides an extra level of protection, but also requires another, long, expensive step of pipe.

"I couldn't understand why they would run a long string," meaning a single pipe, said David Pursell, a petroleum engineer and manager-director of Tudor Pickering, Holt & Co., an energy-focused investment bank. Oil major Royal Dutch Shell PLC, in a letter to the MMS, said it "generally does not" use a single pipe.

BP's Mr. Gowers said the well design wasn't unusual, BP engineers "evaluate various factors" to determine what design to use for each well, he said.

Despite the well design and the importance of the cement, daily drilling reports show that BP didn't run a critical, but time-consuming, procedure that might have allowed the company to detect and remove gas building up in the well.

Before doing a cement job on a well, common industry practice is to circulate the drilling mud through the well, bringing the mud at the bottom all the way up to the drilling rig.

This procedure, known as "bottoms up," lets workers check the mud to see if it is absorbing gas leaking in. If so, they can clean the gas out of the mud before putting it back down into the well to maintain the pressure. The American Petroleum Institute says it is "common cementing best practice" to circulate the mud at least once.

Circulating all the mud in a well of 18,360 feet, as this one was, takes six to 12 hours, says people who've run the procedure. But mud circulation on this well was done for just 30 minutes on April 19, drilling logs say, not nearly long enough to bring mud to the surface.

This decision could have left gas at the bottom of the well. When workers poured in cement to seal the sides, that gas would have been pushed up the outside of the well. Expanding as it rose, it would have reached the top, where it either would have pushed against a massive seal on the ocean floor or might have gone even higher and reached the bottom of the pipe connecting the well to the drilling rig.

BP's Mr. Gowers said the amount of time spent circulating mud was "one of many parameters considered when designing a successful cement job." He said BP's investigation is ongoing.

Three offshore engineers the Journal asked to review the drilling reports all pointed to the failure to circulate the mud completely as a serious mistake.

Robert MacKenzie, a former oil-industry cementing engineer now at FBR Capital Markets, said, "If you have any worries about gas, if you have any worries about getting a good cement job, you should definitely do it."

BP also didn't run tests to check on the last of the cement after it was pumped into the well, despite the importance of cement to this well design and despite Halliburton's warning that the cement might not seal properly. Workers from Schlumberger Ltd. were aboard and available to do such tests, but on the morning of April 20, about 12 hours before the blowout, BP told Schlumberger workers that their work was done, according to Schlumberger. They caught a helicopter back to shore at 11 a.m.

BP told the Journal Tuesday that the tests weren't run because they were needed only if there were signs of trouble in the cement job, and the work seemed to go smoothly. But the same day, BP officials told congressional investigators there were signs before the disaster that the cement might have been contaminated and that some cementing equipment didn't work properly, according to a memo from two Congressmen.

The mood aboard the rig on April 20 was upbeat. The work was nearly done, and workers were eager to put the troublesome well behind them.

Some saw indications that managers wanted to wrap up quickly. Kevin Senegal, a subcontractor employee who cleaned tanks, said he was told to be ready to clean two tanks on a coming shift instead of the usual one. "To me it looked like they were trying to rush everything," he said.

A disagreement broke out on the rig on April 20 over the procedures to be followed. At 11 a.m., workers for the half-dozen contractors working on the rig gathered for a meeting. Douglas Brown, Transocean's chief mechanic on the rig, testified Wednesday at a hearing in Louisiana that a top BP official had a "skirmish" with top Transocean officials.

The Transocean workers, including offshore installation manager Jimmy Wayne Harrell, disagreed with a decision by BP's top man about how to remove drilling mud and replace it with lighter seawater. Mr. Brown said he heard Mr. Harrell say, "I guess that is what we have those pinchers for," referring to a part of the blowout preventer that would shut off the well in case of an emergency.

BP won the argument, said Mr. Brown, who is a plaintiff in a suit against BP and Transocean. Mr. Harrell declined Journal requests for comment.

A little after 5 p.m., to check the well's integrity and whether gas was seeping in, rig workers did what is called a "negative pressure test." It was supervised by a BP well-site leader, Robert Kaluza. His experience was largely in land drilling, and he told investigators the rig was on the rig to "learn about deep water," according to Coast Guard notes of an interview with him. BP declined to comment on his experience.

A lawyer for Mr. Kaluza said he "did no wrong on the Deepwater Horizon."

The test initially strayed from the procedure spelled out in BP's permit, approved by the MMS, according to the Coast Guard interview with Mr. Kaluza. When the first test results indicated something might be leaking, workers repeated the test, this time following the permitted procedure. The second time, pressure rose sharply, with witnesses saying that the well continued to flow and spurted, according to notes gathered by BP's investigators that were reviewed by the Journal. BP denies violating its MMS permit.

Well-control experts say it's clear gas was leaking into the well, most likely through the
seal at the top but possibly through the bottom or even through a collapsed pipe.

Earlier this month, BP lawyers told Congress the test results were “inconclusive” or “not satisfactory.” On Tuesday, according to the Congressmen’s memo, BP said it saw signs of “a very large abnormality.”

Just two things then stood between the rig and an explosive mixture of gas and oil. One was the heavy drilling mud. The other was the blowout preventer near the sea floor. But the BOP had various problems, among them some leaking hydraulics.

By 8 p.m., BP was satisfied with the test and had enough confidence to proceed. It was this that may have been “a fundamental mistake,” a BP official told congressional staffers Tuesday, according to the memo from two members of Congress.

Following BP’s instruction, Transocean workers turned to replacing the mud with seawater, according to Coast Guard interviews with Mr. Kahwa and Donald Vidrine, the top BP official on the rig. Removing the mud keeps it from polluting the sea but also means there’s less weight to hold down any gas.

BP’s plans for the well, approved by the MMS on April 16, called for workers to remove the mud before performing two procedures designed to make sure gas couldn’t get into the well.

The first called for installing a giant spring to lock the seal at the top of the well in place after removal of the mud. There’s no evidence in rig-activity logs the spring was ever installed. If gas was coming up the sides of the well, pushing against the seal, this spring would have helped prevent leakage.

Second, BP opted to remove the mud before placing a final cement plug inside the well.

In documents presented to Congress, BP has hypothesized that gas could have gotten into the inside of the pipe through a failure of the cement at the bottom of the well. BP was planning to set a second, backup cement plug in the well before declaring its work done.

But workers began removing mud before setting this plug, leaving little to prevent any gas inside the pipe from rising to the rig. That plan was approved by the MMS on April 16, according to the memo reviewed by the Journal.

A spokeswoman for the Interior Department, of which the MMS is a part, said it was “looking at everything, from what happened on the rig that night and the equipment that was being used to the safety testing and backup procedures.”

About 9:45, the seawater and remaining mud began to head back up the pipe. Witnesses say they saw mud shooting out of the derrick like water from a firehose. A worker on the rig floor made a frantic call to BP’s Mr. Vidrine, who had gone to his office, according to his interview with the Coast Guard.

Transocean workers raced to tame the well. Nothing worked. This was no ordinary gas kick. It was far more ferocious.

Workers rushed to hit the emergency button to activate the blowout preventer’s clamps and detach the rig from the well, according to witness accounts. They were too late. Gas flowing out found an ignition source, and an explosion rocked the rig.

Well No. 60-817-44169 was beyond control and on its way to becoming infamous.

—Vanessa O’Connell, Jeffrey Ball, Douglas A. Blackmon, Ana Campoy, Miguel Bustillo and Jennifer Levitz contributed to this article.
THE GULF OIL SPILL

There Was 'Nobody in Charge'

After the Blast, Horizon Was Hobbled by a Complex Chain of Command; a 23-Year-Old Steps In to Radio a Mayday

DEEP TROUBLE

In the minutes after a cascade of gas explosions crippled the Deepwater Horizon on April 20, confusion reigned on the drilling platform. Flames were spreading rapidly, power was out, and terrified workers were leaping into the dark, oil-coated sea. Capt. Curt Kutchta, the vessel's commander, huddled on the bridge with about 10 other managers and crew members.

By Douglas A. Blackmon, Vanessa O'Connell, Alexandra Berzon And Ana Campoy

Andrea Fleytas, a 23-year-old worker who helped operate the rig's sophisticated navigation machinery, suddenly noticed a glaring oversight: No one had issued a distress signal to the outside world, she recalls in an interview. Ms. Fleytas grabbed the radio and began calling over a signal monitored by the Coast Guard and other vessels.

"Mayday, Mayday. This is Deepwater Horizon. We have an uncontrollable fire."

When Capt. Kutchta realized what she had done, he reprimanded her, she says.

"I didn't give you authority to do that," he said, according to Ms. Fleytas, who says she responded: "I'm sorry."

An examination by The Wall Street Journal of what happened aboard the Deepwater Horizon just before and after the explosions suggests the rig was unprepared for the kind of disaster that struck and was overwhelmed when it occurred. The events on the bridge raise questions about whether the rig's leaders were prepared for handling such a fast-moving emergency and for evacuating the rig—and, more broadly, whether the U.S. has sufficient safety rules for such complex drilling operations in very deep water.

The chain of command broke down at times during the crisis, according to many crew members. They report that there was disarray on the bridge and panic in the lifeboat area, where some people jumped overboard and others called for boats to be launched only partially filled.

The vessel's written safety procedures appear to have made it difficult to respond swiftly to a disaster that escalated at the speed of the events on April 20. For example, the guidelines require that a rig worker attempting to contain a gas emergency had to call two senior rig officials before deciding what to do. One of them was in the shower during the critical minutes, according to several crew members.

The written procedures required multiple people to jointly make decisions about how to respond to "dangerous" levels of gas—a term that wasn't precisely defined—and some members of the crew were unclear about who had authority to initiate an emergency shutdown of the well.

This account of what happened aboard the rig at the time of the explosions, which killed 11, is based on interviews with survivors, their written accounts, testimony to the Coast Guard and internal documents of rig operator Transocean Ltd. and well owner BP P.L.C.

In written responses to the Journal, Transocean said that the time between the first sign of trouble and the catastrophic explosion was too short for the crew to have done anything to effectively prevent or minimize the disaster. The company also said the rig's chain of command was in place and "did not hinder response time or activity."

At a Coast Guard hearing on Thursday, Jimmy Wayne Harrell, the top Transocean executive on the rig, acknowledged under questioning that a split chain of command on the platform could lead to "confusion" but it didn't hinder emergency response. At the same hearing, Capt. Kutchta said that communications had not been a problem.

BP declined to comment on anything that happened April 20.

In the minutes before the Deepwater Horizon exploded, almost no one on board realized that serious trouble was brewing, other than a few men on the drilling floor—the uppermost of three levels on the massive structure.

The sea was as still as glass. A cool wind blew faintly from the north. Capt. Kutchta was hosting two BP executives on board for a ceremony honoring the rig for seven years without a serious accident.

Nearly 20 men, many of them close friends, were operating the drilling apparatus, which already had bored through more than 13,000 feet of rock about 5,000 feet deep in the Gulf of Mexico. No alarms had sounded that day signaling gas on the platform.

At about 9:47 p.m., workers all over the rig heard a sudden hiss of methane gas. Methane is often present in the ground in and near reservoirs of crude oil, and managing the threat is a regular part of drilling.

Within two minutes, pressure caused by gas in the well pipe had spiked dramatically, drilling records indicate. A torrent of methane gas struck the rig. Power failed throughout the vessel. "Everything started jumping up and down and rocking us," said Kevin Senegal, 45, a tank cleaner, in an interview.

Out on the water, 40 feet away, a 250-foot supply ship called the Damom B. Bankston was tethered to the rig by a hose. That ship's captain said in an interview that he saw drilling "mud," which is used as a counterweight to gas in the well, flowing out of the drilling derrick like a "volcano." He radioed the bridge of the Deepwater Horizon. He was told there was "trouble with the well" and the Bankston should move 150 meters back. Then the channel went silent.

Micah Sandell, a 40-year-old with a wife and three children, watched with alarm from the
rig's gantry crane, a massive device that moved across the main deck on a track. He radioed his crew to move away from the derrick.

Down on the deck, Heber Morales, 33, a former Marine from Texas, turned to the worker beside him. “Oh, man. That’s not good,” he said. The two moved away from the derrick.

Up in the crane, Mr. Sandell saw another worker on the deck, assistant driller Donald Clark, a 48-year-old former soybean farmer from Newellton, La., bolt for a set of stairs leading for the area where workers were fighting to control the well.

Ms. Fleytas, one of only three female workers in the 126-member crew, was on the bridge monitoring the rig’s exact location and stability. Briefly, all the equipment went black, then a backup battery kicked on. She and her coworkers checked their monitors, which indicated no engines or thrusters were operational. Multiple gas alarms were sounding. One of the six huge engines that kept the floating platform stable was revving wildly.

No methane had been detected on the Deepwater Horizon before the massive gas jolt. So no “Level I” gas emergency—according to Transocean safety regulations, when “dangerous” levels of gas are detected in the well—had been declared, according to crew members. That meant the crew had gotten no general alert to prepare for trouble and no order to shut down anything that might ignite the gas.

The rig’s regulations state that in the event of such an emergency, the two top managers—on April 20 they were BP’s senior person on the rig, Donald Vidrine, and Transocean’s installation manager, Mr. Harrell—were to go to the drilling floor and evaluate the situation jointly. But once the gas hit, neither was able to get to the area.

Transocean says the rig’s chain of command and safety standards were followed and worked effectively under the circumstances. Mr. Harrell didn’t return phone calls. BP said Mr. Vidrine was unavailable to comment.

When the pressure in the well spiked suddenly, the drilling crew had limited options and little time to act. Jason Anderson, a 35-year-old “toolpusher” who was supervising the crew on the oil platform’s drilling floor, tried to divert gas away from the rig by closing the “bag,” a thick membrane that surrounds a key part of the drill mechanism. That didn’t work.

Four emergency calls were made from the rig floor to senior crew members in the moments before the blast, according to a BP document reviewed by the Journal. One went to Mr. Vidrine, according to notes about a statement he gave the Coast Guard that were reviewed by the Journal. The rig worker, who isn’t identified in the notes, told him the drilling crew was

Above, smoke from the burning Deepwater Horizon on April 21, the day after it caught fire, seen from high above the Gulf of Mexico;
“getting mud back,” a sign that gas was flooding into the well. At that point, Mr. Vidrine rushed for the drilling floor, but already “mud was everywhere,” he told the Coast Guard.

At about 9:50 p.m., Stephen Curtis, the 40-year-old assistant driller working with Mr. Anderson, called the rig’s senior toolpusher, Randy Ezell, who was in his sleeping quarters, according to a statement given by Mr. Ezell to the Coast Guard.

Mr. Curtis said that methane was surging into the well and workers were on the verge of losing control.

Two rig workers who later discussed the matter with Mr. Ezell said he was told that Mr. Anderson was going to trigger the blowout preventer, a 450-ton device designed to slice the drill pipe at the ocean floor and seal the well in less than a minute. If triggered in time, it might have been enough to prevent the explosions, or at least limit the scale of the disaster, say some drilling experts. Mr. Ezell prepared to go to the drilling floor, according to his statement.

Seconds later, the methane ignited, possibly triggered by the revving engine. That set off an explosion that blew away critical sections of the Deepwater Horizon, sheared off at least one engine, set large parts of the rig on fire and allowed oil to begin spewing into the sea.

Mr. Curtis, an ex-military man who enjoyed turkey hunting, and Mr. Anderson, a father of two who was planning to leave the Deepwater Horizon for good at the end of his 21-day rotation, almost certainly were killed instantly, according to other workers.

So was veteran driller Dewey Revette, 48, from State Line, Miss. Six men working nearby also died. They included 22-year-old Shane Rossho and Karl Kleppinger, Jr., 38, from Natchez, Miss., and Mr. Clark, the assistant driller who had rushed to the stairs to help out.

Dale Burkeen, a 37-year-old Mississippian who operated the rig’s tall starboard crane, had been trying to get out of harm’s way when the blast hit. It blew him off a catwalk, other workers say, and he fell more than 50 feet to the deck, where he died.

A series of detonations followed. The motor room was wrecked. Steel doors were blown off their hinges. The well on one door flew off and struck a worker. Crew members were hurried across rooms, leaving many with broken bones, gashes and serious burns.

When he heard the first explosion, toolpusher Wyman Wheeler, who was scheduled to go home the next day, was in his bunk. He got up to investigate. The second blast blew the door off his quarters, breaking his shoulder and right leg in five places, according to family members. Other workers scooped him up and carried him toward the lifeboat deck on a stretcher.

The explosions knocked gantry-crane operator Mr. Sandell out of his seat and across the cab. As he fled down a spiral staircase to the deck, another explosion sent him into the air. He fell more than 10 feet, then got up to run. “Around me all over the deck, I couldn’t see anything but fire,” he said in an interview. “There was no smoke, only flames.” He ran for the lifeboat deck.

From the bridge, Chief Mate David Young ran outside to investigate and to suit up for firefighting. After he encountered only one other crew member in gear, he returned to the bridge.
The Final Moments | A surge of natural gas exploded on the 32,000-ton Deepwater Horizon drilling platform on April 20, killing 11 of the 126 crew members aboard.

Derrick
A shaft of flame shot through the 250-foot derrick and engulfed surrounding areas.

Starboard Crane
1 DEAD
The explosion blew Dale Burgeen from a catwalk. He fell to his death.

Engine Room
The explosion wrecked the engine room, and at least one of rig's eight motors was shoved off.

Lifeboats 3 and 4
Flames and debris cut off access to the aft lifeboats.

Living Quarters/Offices
The explosion blew in the door of Wynn Wheeler's quarters, leaving him with broken bones.

The Victims
Indicates where they are believed to have died

Jason Anderson
Age: 37
Job: Tool pusher
Bay City, Texas

Aaron Dale Burgeen
Age: 37
Job: Crane operator
Neshoba County, Miss.

Stephen Ray Curtis
Age: 40
Job: Assistant driller
Georgetown, La.

Gordon Jones
Age: 28
Job: Mud engineer
Baton Rouge, La.

Roy Wyatt Kemp
Age: 27
Job: Derrick hand
Jennette, La.

Keith Blair Manuel
Age: 50
Job: Mud engineer
Gonzales, La.

Dewey Revette
Age: 46
Job: Driller
Staunton, Miss.

Shane Rosabe
Age: 22
Job: Floor hand
Flemish County, Miss.

Adam Walse
Age: 24
Job: Floor hand
Yorktown, Texas

Help Pad
Bridge
Two victims BP investigators were locating the bridge when the explosion hit. Capt. Curt Kochta and crew members attempted to restart engines and restore power. Andrew Fladas sent a marine signal.

Pit Room
Below deck
6 DEAD
The initial blast killed six men in the mud pit, where drill materials were handled, and a nearby shaker room.

Gantry Crane
Mirch Sneed escaped after ordering his crew to move away from the derrick.

Rig Floor
4 DEAD
Jason Anderson and two crew members frantically tried to stop the natural gas before the rig blew.

Lifeboats 1 and 2
Crew argued over whether to leave on the forward lifeboats, which could hold about 75 people each.

Water illustrations are based on the accounts of several survivors and may not reflect facts. Art: The Wall Street Journal, Illustrations by Alberto Ernesto/Inkspace; the Wall Street Journal.
Crew members say no significant firefighting efforts were undertaken. "We had no fire pumps. There was nothing to do but abandon ship," said Capt. Kuchta, in testimony at a Coast Guard inquiry on Thursday.

As workers poured out of their quarters, many found their routes to open decks blocked. Ceiling tiles and insulation were blown everywhere. In some areas, fire-suppression systems were discharging carbon dioxide. Stairways were gone.

According to many workers, most crew members didn't get clear direction from the bridge about what to do for several minutes. Finally, the public-address system began to blare: "Fire. Fire. Fire. Fire on the rig floor. This is not a drill."

Many crew members couldn't reach their designated assembly areas. Scores scrambled instead toward the only two accessible lifeboats, which hung by cables 75 feet above the water on one side of the rig. Each enclosed and motorized boat could hold about 75 passengers.

"The scene was very chaotic," said worker Carlos Ramos in an interview. "People were in a state of panic." Flames were shooting out of the well hole to a height of 250 feet or more. Debris was falling. One crane boom on the rig melted from the heat and folded over.

Injured workers were scattered around the deck. Others were yelling that the rig was going to blow up. "There was no chain of command. Nobody in charge," Mr. Ramos said.

"People were just coming out of nowhere and just trying to get on the lifeboats," said Darin Rupinski, one of the operators of the rig's positioning system, in an interview. "One guy was actually hanging off the railing.... People were saying that we needed to get out of there."

At one point, a Transocean executive was standing partly in the lifeboat, helping injured workers off the rig and telling Mr. Rupinski not to lower the boat yet. Rig workers piling in were shouting for him to get the boat down.

"There had to be at least 50 people in the boat, yelling, screaming at you to lower the boat," Mr. Rupinski recalled. "And you have a person inside saying, 'We have to wait.'"

Terrified workers began jumping directly into the sea—a 75-foot leap into the darkness. Mr. Rupinski radioed the bridge that workers were going overboard.

A Transocean spokesman said the company hasn't yet been able to determine exactly what happened in the lifeboat loading area.

Capt. Kuchta and about 10 other executives and crew members, including Ms. Fleytas, were gathered on the bridge, which was not yet threatened by fire. When word reached the bridge that workers were jumping, Ms. Fleytas's supervisor issued a "man overboard" call.

The Bankston, now positioned hundreds of feet from the burning rig, picked up the call. Officers on that vessel had seen what appeared to be shiny objects—the reflective life vests on rig workers—tumbling from the platform into the water. The Bankston put a small boat into the water and began a rescue operation.

Messrs. Vidrine and Harrell, the two highest ranking executives, appeared on the bridge. Mr. Vidrine later told the Coast Guard that a panel on the bridge showed that the drilling crew, all of whom were dead by then, had already closed the "hatch," the thick rubber membrane around a section of the well.

But the emergency disconnect, which would sever the drilling pipe and shut down the well, had not been successfully triggered. Some crew members on the bridge said the disconnect needed to be hit, and a higher-ranking manager said to do so, according to an account given to the Coast Guard. Then another crew member said the cutoff couldn't be hit without permission from Mr. Harrell, who then gave the OK.

At 9:56 p.m., the button finally was pushed, with no apparent effect, according to an internal BP document.

Mr. Young, the chief mate who had left the bridge to survey the fire, told Capt. Kuchta that the fire was "uncontrollable," and that everyone needed to abandon the rig immediately, according to two workers on the bridge.

Under Transocean safety regulations, the decision to evacuate was to be made by Capt. Kuchta and Mr. Harrell.

Capt. Kuchta didn't immediately issue the order, even though at least one lifeboat had already pushed away, according to several people on the bridge.

At the Coast Guard hearing Thursday, several crew members said they weren't certain who issued the abandon ship order or whether one was ever given.

Capt. Kuchta didn't return calls seeking comment, but in his testimony said it was obvious to all by that time that the crew should evacuate.

Alarmed at the situation, Ms. Fleytas recalled in the interview, she turned on the public-address system and said: "We are abandoning the rig."

Capt. Kuchta told everyone who remained on the bridge to head for the lifeboats, according to one person who was there.

One boat was long gone. When they reached the boarding area, the second was motorizing away, according to several witnesses. Ten people were left on the rig, including Mr. Wheeler, the injured toolpusher, who was lying on a gurney.

The deck pulsed with heat. The air was thick with smoke, and the surface of the water beneath the rig—covered with oil and gas—was burning. Crew members attached a 25-foot life raft to a winch, swung it over a railing and inflated it. Mr. Wheeler was lifted in and several others climbed in with him.

As the raft began descending, Ms. Fleytas jumped in. The remaining people on the rig, including Capt. Kuchta, leapt into the Gulf.

Once the life raft reached the ocean, it didn't move, even as fire spread across the water. Some hanging on to its sides thought the heat of the rig was creating a draft sucking the craft back in. Terrified, Ms. Fleytas rolled out of the raft into the oil-drenched water.

"All I saw was smoke and fire," she recalled. "I swam away from the rig for my life."
Minutes later, the rescue boat from the Bankston plucked Ms. Fleytas and several others from the water. The crew of the small boat saw that a line attached to the life raft was still connected to the burning rig.

"Cut the line," yelled one Bankston crew member. Another passed over a knife, the raft was cut free, and the last survivors were towed away from the fire. All told, the Bankston rescued 115, including 16 who were seriously injured. A Transocean spokesman says that the fact that so many survived "is a testament to the leadership, training, and heroic actions" of crew members.

The crew of the Deepwater Horizon watched from the deck of the Bankston as the drilling platform burned through the night. More than 24 hours later, it sank in 5,000 feet of water.

Ben Casselman, Russell Gold, Jennifer Levitz, Miguel Bustillo and Jeffrey Ball contributed to this article.
On Doomed Rig’s Last Day, A Divisive Change of Plan

By RUSSELL GOLD
AND BEN CASSELMAN

On April 20 at 10:43 a.m., a young BP PLC engineer sent a 173-word email to colleagues aboard the Deepwater Horizon drilling rig. The email spelled out a recent change to a key safety test that sparked confusion and debate aboard the rig.

Less than 12 hours later, the rig was engulfed in flames so hot they melted steel. Eleven workers were dead.

The worst offshore oil spill in U.S. history had begun.

The Deepwater Horizon blowout has become one of the most scrutinized maritime disasters ever. Congressional investigators and outside experts have identified a series of decisions in the weeks beforehand that made the blowout more likely.

But a central uncertainty remained: Why didn’t the crew recognize the warning signs in the final hours and bring the well under control while there was still time to prevent a lethal eruption?

The Wall Street Journal has reviewed BP internal documents along with hours of public testimony before a joint Coast Guard and Interior Department panel. The Journal also interviewed dozens of witnesses to the disaster. What emerges is a startling picture of the last day of the Deepwater Horizon—a day filled with disruption and disagreement.

Many workers on the rig didn’t find out until the morning of April 20 about the change in a pressure test that would help determine the well’s safety. BP wanted to remove an unusually large amount of the thick drilling fluid called mud from the well and then run the test. It was unorthodox and left crew members confused.

The oil industry employs extraordinary cutting-edge technologies. BP uses some of the world’s fastest computers to locate oil reservoirs. Underwater robots tinker with wells beneath a mile of water.

But the truth about the modern oil industry is that it often relies on the judgment and instinct of men—and they are overwhelmingly men.

Wells must be listened to, they say. On April 20, a small group of men aboard the Deepwater Horizon listened to the nearly complete well and didn’t understand what it was telling them.

Key managers were out of the loop for parts of that day.

On Tuesday, Mr. Morel declined to testify before a federal panel, citing his rights under the Fifth Amendment.

Before the Deepwater Horizon crew could leave for another job, there was a final step: The well needed to be tested to make sure the cement and steel locked together, preventing any gas from leaking in and causing a fire or explosion.

If the well passed, giant cement plugs—as long as a football field—would be inserted. The well then could be temporarily abandoned until BP was ready to tap its oil and gas.

Despite its importance, this “negative” test—how to do it, how to interpret it—was basically left to the discretion of rig workers. And different rigs have different procedures.

Normally, workers on the rig remove about 300 feet of mud below the blowout preventer and replace it with seawater. Mud holds down any gas that leaks into the well. So companies usually test a well fully to make sure it is sealed against any influx of gas before removing too much of the mud.

But BP engineers in Houston, including Mr. Morel and his colleague Mark Haflé, had decided to set the cement plug much deeper than usual and remove 10 times as much mud as is normal before running the test. It was unusual, but BP says it changed the procedure in order to avoid damage to a key seal.

Ronald Sepulvado, the top BP
managers who were on shore that day with his phone switched off, was asked under oath by the Interior Department-Coast Guard panel in July if he had ever run a negative test where so much mud had been removed.

“No, ma’am,” replied Mr. Sepulveda. Had he ever heard of BP doing so anywhere? “No, ma’am.”

BP had asked federal regulators for permission to use a deeper plug on April 16, and received approval after only 20 minutes. But Transocean workers and contractors aboard the rig later said they weren’t informed of the change until the morning of April 20.

The decisions to pull out so much mud perplexed Robert Kaluza, BP’s day-shift manager on April 20. “Don’t know why—maybe trying to save time,” he later told BP internal investigators, according to notes from that conversation reviewed by the Journal. “At the end of the well sometimes they think about speeding up.”

Mr. Kaluza has declined to testify before either Congress or the federal panel, citing the Fifth Amendment. BP has denied cutting corners to save time and money. BP said the notes are only investigators’ interpretation of Mr. Kaluza’s comments.

Jimmy Wayne Harrell also found the directive unorthodox. A 54-year-old from small-town Mississippi, Mr. Harrell had worked for Transocean almost his entire adult life. He was the most senior of the 79 Transocean workers aboard the rig that day.

At a daily 11 a.m. meeting in the rig’s cinema room, Mr. Kaluza told everyone about BP’s plan. Mr. Harrell protested.

“All these plans kept changing,” Mr. Harrell later testified.

Mr. Harrell and Mr. Kaluza argued about the negative test, according to one witness. “This is how it’s going to be,” Mr. Kaluza said, according to sworn testimony from one witness, and Mr. Harrell “reluctantly agreed.”

In sworn testimony, Mr. Harrell denied arguing with Mr. Kaluza. He said he just wanted to make sure that a negative test was performed and that Mr. Kaluza agreed. But his lawyer, Pat Fanning, said that Mr. Harrell also told Mr. Kaluza he didn’t want to remove so much mud before running the negative test
and was overruled. Mr. Kaluza couldn’t be reached for comment for this story.

“It was BP’s well, they were paying for it. BP gave the marching orders,” Mr. Fanning said.

Not long after the meeting, a helicopter carrying a group of executives—two each from BP and Transocean—landed on the rig for a tour.

Mr. Harrell said he spent almost the entire rest of the day either showing them around or in his office.

By 5 p.m., Transocean workers had removed much of the mud and started the pressure test, according to a timeline of events prepared by BP.

It didn’t go well. Pressure built up unexpectedly, and no one was sure why. Workers in the rig’s central “drilling shack,” a type of control room, struggled to interpret the readings. In walked Mr. Harrell with the visiting VIPs.

Mr. Harrell stayed behind as the tour moved on, but he didn’t think the problem was serious. He ordered another worker to tighten down a valve at the top of the blowout preventer—the device that is supposed to pinch off the well in the event of disaster—that prevented mud above from leaking down.

This seemed to resolve the problem. Mr. Harrell testified that he was satisfied with the test results and went back to the visiting executives.

It was the last time there is any record of Mr. Harrell, the rig’s most experienced leader, setting foot on the drill floor.

His lawyer says he wasn’t distracted by the visiting executives and that the crew could have asked for his help at any time, but never did.

Mr. Harrell’s second-in-command, Randy Ezell, stuck around the drill shack for a few more minutes, but soon he also left to return to the visiting executives. He later testified to the joint Interior Department and Coast Guard panel that if it hadn’t been for the tour, he would have stayed longer to deal with the situation.

With Mr. Harrell gone, the argument continued. Wyman Wheeler wasn’t convinced everything was all right. Mr. Wheeler was the dayshift toolpusher, the man who supervised the drilling crew for 12 hours each day.

“Wyman was convinced something wasn’t right,” Christopher Pleasant, another Transocean worker, later recalled in testimony. Mr. Wheeler couldn’t be reached for comment.

But Mr. Wheeler’s shift wrapped up at 6 p.m. on April 20. His replacement, Jason Anderson, came on duty and had his own interpretation of the test, according to Mr. Pleasant.

Mr. Anderson, 35, had worked on the rig since it left the shipyard in 2001.

A burly former high school lineman, Mr. Anderson had earned the respect of his fellow rig workers, and now he assured them that the pressure readings weren’t unusual.

Mr. Kaluza decided to check with Donald Vidrine, an experienced BP manager who was due to relieve Mr. Kaluza at 6 p.m.

The two BP men conferred for an hour, with Mr. Vidrine peppering Mr. Kaluza with questions.

Mr. Vidrine wasn’t satisfied. “I wanted to do another test,” he said, according to the notes of BP’s internal investigation seen by the Journal.

Workers performed the test again, but this time the results were even more perplexing. One smaller tube that led up from the well showed no pressure, a sign that the well was stable. But gauges on the main pipe did show pressure, according to BP’s preliminary investigation.

The two pipes were connected and should have had the same pressure. It wasn’t clear what was going on in the well.

One possibility, put forward by engineers who have studied the events subsequently, is that the smaller pipe was clogged, interfering with pressure readings.

Finally, about 7:50 p.m., Mr. Vidrine made a decision, according to Mr. Pleasant. He turned to Mr. Kaluza, his colleague, and told him to call BP engineers in Houston and tell them he was satisfied with the test, Mr. Pleasant said.

Mr. Vidrine, through his attorney, declined to comment.

Over the next two hours, there were other signs the well was slipping out of control. For one, more fluid was flowing out of the well than was being pumped in, according to electronic data reviewed by investigators after the explosion.

But none of the Transocean workers monitoring the well caught these signs. Investigators from the federal panel have said Transocean workers may have struggled to monitor the well because they were performing other work at the same time.

Around 9 p.m., the meeting of the executives wrapped up. A few of them went up to the bridge, including Pat O’Brien, BP’s recently appointed vice president of drilling in the Gulf of Mexico.

The rig’s captain showed
them a training simulator—a video game that allowed the crew to practice keeping the giant Deepwater Horizon in position during severe weather.

Mr. O'Bryan, 49, had earned a Ph.D. at Louisiana State University decades earlier on how to measure gas escaping into a well. Now, gas was escaping in, unchecked, and Mr. O'Bryan was on the bridge—standing around the simulator with the rig's captain.

Mr. Ezell, the second-in-command, was lying in bed, watching television with the lights out, when his phone rang, he testified before the panel in May. He glanced at his clock. It was 9:50 p.m.

"We have a situation," said Steve Curtis, an assistant driller, on the other end of the phone, according to Mr. Ezell. "Randy, we need your help." Mr. Ezell got up, put on his clothes and went to get his hard hat as alarms rang. Before he could reach it, the first of two massive explosions ripped through the rig.

In the following few minutes, Messrs. Anderson and Curtis were killed. Mr. Wheeler was badly injured. The blowout preventer failed to pinch off the well. And most of the other men who made the crucial decisions of April 20 were fleeing for their lives.