

Executive Summary

Transocean was contracted by BP Exploration & Production Inc. (BP) to provide the *Deepwater Horizon* rig and personnel to drill the Macondo well on Mississippi Canyon Block 252. Drilling started on Feb. 11, 2010, and was completed on April 9, 2010.

On April 20, 2010, the blowout of the Macondo well resulted in explosions and an uncontrollable fire onboard the *Deepwater Horizon*. Eleven people lost their lives, 17 were seriously injured, and 115 of the 126 onboard evacuated. The *Deepwater Horizon* sank 36 hours later, and the Macondo well discharged hydrocarbons into the Gulf of Mexico for nearly three months before it was contained.

Following the incident, Transocean commissioned an internal investigation team comprised of experts from relevant technical fields and specialists in accident investigation to gather, review, and analyze the facts and information surrounding the incident to determine its causes.

The investigation team began its work in the days immediately following the incident. Through an extensive investigation, the team interviewed witnesses, reviewed available information regarding well design and execution, examined well monitoring data that had been transmitted in real-time from the rig to BP and which had been available to BP's operating partners and Halliburton, consulted industry and technical experts, and evaluated available physical evidence and third-party testing reports.

The loss of evidence with the rig and the unavailability of certain witnesses limited the investigation and analysis in some areas. The team used its cumulative years of experience but did not speculate in the absence of evidence. This report does not represent the legal position of Transocean, nor does it attempt to assign legal responsibility or fault.

This report focuses on the following critical questions:

- How did reservoir fluids reach the rig floor?
 - How and why did reservoir fluids enter the well?
 - What actions did the drill crew take?
- Why did the blowout preventer (BOP) not stop the flow of reservoir fluids?
- How did reservoir fluids ignite?
 - What occurred after the reservoir fluids reached the rig?
 - How did personnel onboard evacuate the rig?

This report is the culmination of the investigation. These conclusions are the result of the investigation team's analysis of information available to date. The investigation team is aware of investigations conducted by other companies and is aware of, but did not review, additional testimony that is being developed in multi-district litigation proceedings.

The data relied upon by the investigation team is identified in footnotes, endnotes, and the appendices to this report.

Overview of Findings

The Macondo incident was the result of a succession of interrelated well design, construction, and temporary abandonment decisions that compromised the integrity of the well and compounded the risk of its failure. The decisions, many made by the operator, BP, in the two weeks leading up to the incident, were driven by BP's knowledge that the geological window for safe drilling was becoming increasingly narrow. Specifically, BP was concerned that downhole pressure — whether exerted by heavy drilling mud used to maintain well control or by pumping cement to seal the well — would exceed the fracture gradient and result in losses to the formation. While these and other contributing factors were complex, the Transocean investigation team traced them to four overarching issues:

Risk Management and Communication

BP was responsible for developing detailed plans as to where and how the Macondo well was to be drilled, cased, cemented, and completed, and for obtaining approval of those plans from the Minerals Management Service (MMS). It retained full authority over drilling operations, casing and cementing, and temporary abandonment procedures, including approval of all work to be performed by contractors and subcontractors. Evidence indicates that BP failed to properly assess, manage, and communicate risk. For example, BP did not properly communicate to the drill crew the lack of testing on the cement or the uncertainty surrounding critical tests and procedures used to confirm the integrity of the barriers intended to inhibit the flow of hydrocarbons. It is the view of the investigation team that on April 20, 2010, the actions of the drill crew reflected its understanding that the well had been properly cemented and successfully tested.

Well Design and Construction

The precipitating cause of the Macondo incident was the failure of the downhole cement to isolate the reservoir, which allowed hydrocarbons to enter the wellbore.

BP's original well plan called for use of a long-string production casing. While drilling the Macondo well, BP experienced both lost circulation events and kicks and stopped short of its planned total depth because of an increasingly narrow margin between the pore pressure and fracture gradients. In the context of these delicate conditions, cementing a long-string casing further increased the risk of exceeding the fracture gradient. Rather than adjusting the production casing design, BP adopted a technically complex nitrogen foam cement program. The resulting cement program was of minimal quantity, left little margin for error, and was not tested adequately before or after the cementing operation. Further, the integrity of the cement may have been compromised by contamination, instability, and an inadequate number of devices used to center the casing in the wellbore.

Risk Assessment and Process Safety

Based on the evidence, the investigation team determined that during various operations at Macondo, BP failed to properly require or confirm critical cement tests or conduct adequate risk assessments.

Halliburton and BP did not adequately test the cement slurry and program despite the inherent complexity, difficulties, and risks associated with the design and implementation of the program and some test data showing that the cement would not be stable.

BP also failed to assess the risk of the temporary abandonment procedure used at Macondo. BP generated at least five different temporary abandonment plans for the Macondo well between April 12, 2010, and April 20, 2010. After this series of last-minute alterations, BP proceeded with a temporary abandonment plan that created risk and did not have the required approval by the MMS. Most significantly, the final plan called for a substantial and unnecessary displacement of drilling mud, thus underbalancing the well before setting a second surface cement plug and conducting a negative pressure test.

It does not appear that BP used risk assessment procedures or prepared Management of Change documents for these decisions, or otherwise addressed these risks and the potential adverse effects on personnel and process safety.

Operations

The results of the critical negative pressure test were misinterpreted. The negative pressure test was inadequately set up because of displacement calculation errors, a lack of adequate fluid volume monitoring, and a lack of management of change discipline when the well monitoring arrangement was switched during the test. It is now apparent that the negative pressure test results should not have been approved, but no one involved in the negative pressure test recognized the errors. BP approved the negative pressure test results and decided to move forward with temporary abandonment.

The well became underbalanced during the final displacement, and hydrocarbons began entering the wellbore through the faulty cement barrier and a float collar that likely failed to convert. None of the individuals monitoring the well, including the Transocean drill crew, initially detected the influx.

With the benefit of hindsight and a thorough analysis of the data available to the investigation team, several indications of an influx during final displacement operations can be identified. Given the death of the members of the drill crew, and the loss of the rig and its monitoring systems, it is not known which information the drill crew was monitoring or why the drill crew did not detect a pressure anomaly until approximately 9:30 p.m. on April 20, 2010. At 9:30 p.m.,^A the drill crew acted to evaluate an anomaly. Upon detecting an influx of hydrocarbons by use of the trip tank, the drill crew undertook well-control activities that were consistent with its training including the activation of various components of the BOP. By the time actions were taken, hydrocarbons had risen above the BOP and into the riser, resulting in a massive release of gas and other fluids that overwhelmed the mud-gas separator system and released high levels of gas around the aft deck of the rig. The resulting ignition of this gas cloud was inevitable.

Forensic evidence from independent post-incident testing by Det Norske Veritas (DNV) and evaluation by the Transocean investigation team confirm that the *Deepwater Horizon* BOP was properly maintained and did operate as designed. However, it was overcome by conditions created by the extreme dynamic flow, the force of which pushed the drill pipe upward, washed or eroded the drill pipe and other rubber and metal elements, and forced the drill pipe to bow within the BOP. This prevented the BOP from completely shearing the drill pipe and sealing the well.

In the explosions and fire, the general alarm was activated, and appropriate emergency actions were taken by the *Deepwater Horizon* marine crew. The 115 personnel who survived the initial blast mustered and evacuated the rig to the offshore supply vessel *Damon B. Bankston*. Mild weather conditions and the presence of the *Bankston* at the location aided in the survival of all individuals who evacuated.

Structure of Report

The report is structured as follows:

Chapter 1 provides an overview of the Macondo prospect, the *Deepwater Horizon* drilling rig, well operations through mid-April 2010, and the companies involved.

Chapter 2 sets forth a chronological summary of the incident, highlighting the critical technical, logistical, and operational issues at Macondo.

Chapter 3 details the technical analysis and findings of the investigation team.

Chapter 4 is a summary of the overall findings by the investigation team surrounding the questions outlined above and the possible causes of the incident.

The information in this report and its appendices is available on the Transocean website at www.deepwater.com.

^A All references to time are displayed as Central Daily Time (CDT).