National Academy of Engineering
and
National Research Council
Interim Report
on

Causes of the *Deepwater Horizon* Oil Rig Blowout

Presentation by

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Study Origin and Task

Origin

- Request from U.S. Department of Interior Secretary Salazar

Study Task:

- Examine probable causes of the *Deepwater Horizon* incident in order to identify measures for preventing similar harm in the future.
- Prepare an interim letter report … to inform other formal investigation of the incident.
- Prepare a final report by June 2011 that presents the committee's overall findings regarding the causes … and recommended approaches for the future.

Committee Roster

- Donald Winter (chair) University of Michigan, Ann Arbor
- Paul Bommer, University of Texas, Austin
- Chryssostomos Chryssostomidis, MIT
- David Daniel, University of Texas, Dallas
- Thomas Eccles, US Navy
- Edmund Giambastiani, Jr., US Navy (retired)
- David Hofmann, University of North Carolina, Chapel Hill
- Roger McCarthy, McCarthy Engineering
- Najmedin Meshkati, University of Southern California
- Keith Millheim, Strategic Worldwide LLC
- Elisabeth Pate-Cornell, Stanford University
- Robert Sawyer, University of California, Berkeley
- Jocelyn Scott, DuPont
- Arnold Stancell, Georgia Institute of Technology
- Mark Zoback, Stanford University

Context

- May not be possible to definitively establish specific failure mechanism and hydrocarbon pathway leading to blowout
  - Loss of 11 witnesses
  - Sinking of rig along with records,
  - Difficulty in conducting forensics at depth of the Macondo well.
- Committee has developed a good understanding of key factors and decisions that may have contributed to the blowout of the well

Decision to Proceed to Temporary Abandonment

- The Macondo well blowout was precipitated by the decision to proceed to temporary abandonment despite negative pressure test indications that the cement job failed to provide an effective barrier to hydrocarbon flow.

Decision to Proceed was Compounded by Impact of:

- Delays in recognizing the flow of hydrocarbons into the well and riser.
- Failure to take timely and aggressive well-control actions.
- Failures or limitations of actuated BOP that inhibited its effectiveness in controlling the well.

Implications of Decisions to Proceed

- Suggests an insufficient consideration of risk and a lack of operating discipline.

- Raises questions about the adequacy of operating knowledge on the part of key personnel.

- Reduces available margins of safety that account for complexities of hydrocarbon reservoirs and well geology

Multiple Decisions Potentially Contributed to the Blowout, Including:

- Changing key supervisory personnel on the rig just prior to abandonment procedures.
- Cementing multiple zones in the well in a *single* operational step, despite markedly different fluid pressures.
- Selecting a long-string production casing instead of a cement liner over the uncased section of the well.
- Deciding that only six centralizers would be needed, even though modeling results suggested the need for more.
- Limiting bottoms-up circulation of drilling mud prior to cementing.
- Not running a bond log to assess cement integrity.
- Not incorporating a float shoe at the bottom of the casing.
- Removing drilling mud from the well without installing the lockdown sleeve on the production casing.

Drilling and Abandonment Operations

- Available evidence points to insufficient checks and balances for decisions involving:
  - Schedule to complete well abandonment procedures, and
  - Considerations for well safety.

Management and Regulatory Oversight

- None of these questionable decisions was identified or corrected by
  - Operating management of BP or their contractors, or
  - Oversight of MMS or other regulators.

Cementing Process

- Aspects of cement process could have had a material impact on well integrity:
  - Type and volume of cement used
  - Adequacy of the time provided for the cement to cure

Well Control Actions

- BOP did not control—or recapture control of—the well after hydrocarbons were flowing into the well.

- Emergency disconnect system and automatic sequencers failed to operate.

Alarms and Safety Systems of the *Deepwater Horizon*

- Given the large quantity of gas released onto the rig, ignition was most likely.
- However, reports of failed alarms and safety systems on the rig warrant consideration.

Management of Risk, Uncertainties, and Dangers

- Observations of various failures indicate:
  - Lack of a suitable approach for anticipating and managing the inherent risks, uncertainties, and dangers associated with deepwater drilling operations, and
  - Broader failure to learn from previous near misses

A Systems Approach

- There is an apparent lack of a systems approach to:
  - Integrate many factors potentially affecting well safety,
  - Monitor the overall margins of safety, and
  - Assess various decisions from perspectives of well integrity and safety.