

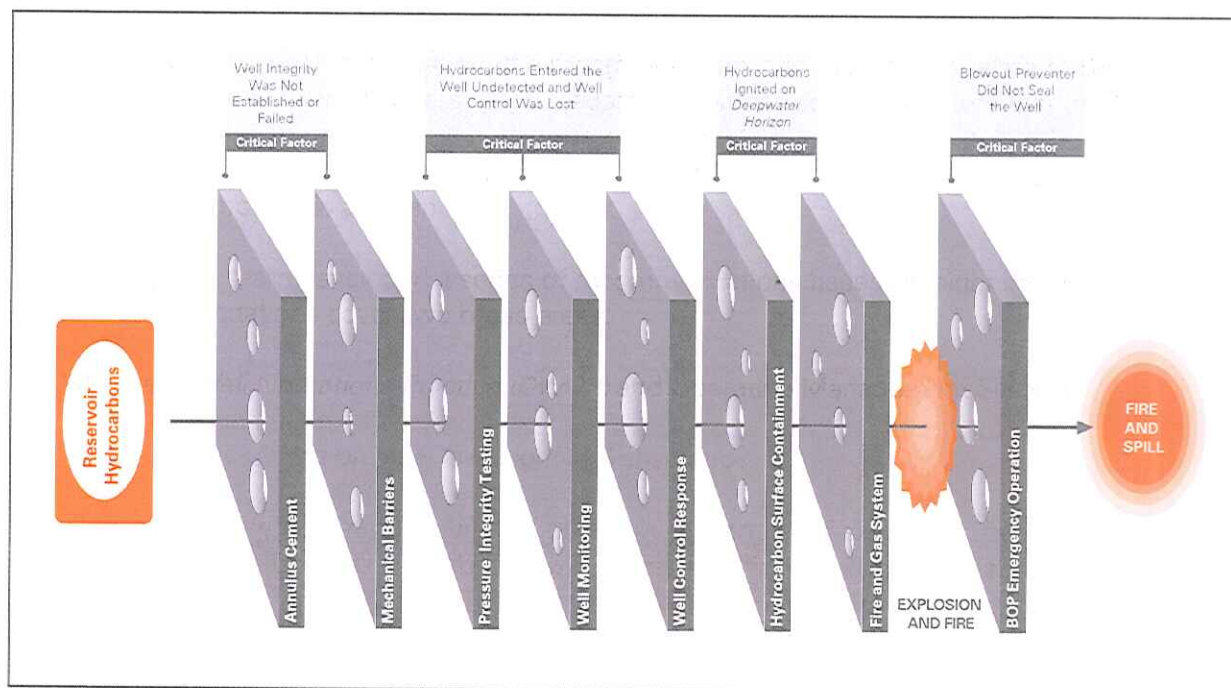
# Section 6. Investigation Recommendations

As this was a BP internal investigation, the recommendations in this section relate to BP, its contractors and its service providers. Some recommendations concern matters that the team viewed as inconclusive with respect to causing or contributing to the accident. It should not be inferred that by making such recommendations, the team viewed those matters as causal or contributing factors in this accident.

The investigation team developed a series of recommendations based on eight key findings. These recommendations cover two broad areas:

- *Drilling and Well Operations Practice (DWOP)* and Operating Management System (OMS) implementation.
- Contractor and service provider oversight and assurance.

The purpose of these recommendations is to enable prevention of similar accidents occurring in the future by strengthening the defensive physical or operational barriers needed to eliminate or mitigate hazards. (Refer to Figure 1.) The recommendations are intended to provide a basis for the consideration of actions that can be implemented by both BP and by the contractor community that provides critical services and products to BP's exploration and production operations.



Adapted from James Reason (Hampshire: Ashgate Publishing Limited, 1997).

**Figure 1.** Barriers Breached and the Relationships of Barriers to the Critical Factors.

Others in the industry may benefit from consideration of these recommendations as well. Full implementation of the recommendations would involve a long-term commitment and a prioritized action plan with due dates and accountabilities for each element of the plan, with each of the actions tracked to completion. Some of the recommendations are dependent on the cooperation of entities outside BP.

## DWOP and OMS Implementation

### 1 Procedures and Engineering Technical Practices

1.1 Update and clarify current practices to ensure that a clear and comprehensive set of cementing guidelines and associated *Engineering Technical Practices (ETPs)* are available as controlled standards. The practices should include, as a minimum:

- Clearly defined mandatory practices.
- Recommended practices and operational guidance.
- Definitions of critical cement jobs.
- Description of the technical authority's (TA's) role in oversight and decision making.

1.2 Review and update *ETP GP 10-10 Well Control*, clarifying requirements for subsea blowout preventer (BOP) configuration:

- Establish minimum requirements for ram types, numbers and capability.
- Establish minimum requirements for emergency well control activation systems.
- Conduct a gap assessment of the BP-operated and BP-contracted rig fleet and put corrective actions in place to assure conformance.

1.3 Update the relevant technical practices to incorporate the following design requirements:

- *BPA-D-003 Tubular Design Manual*: Consider load conditions for negative-pressure tests in the casing design assessment for subsea wells.
- *DWOP*: Standardize the installation of the locking mechanism of the casing hanger seal assembly to the high-pressure housing for subsea wellheads.

1.4 Review and update *ETP GP 10-45 Working with Pressure* to include negative-pressure testing; this practice should provide as a minimum:

- The purpose of the test.
- A definition of the barriers to be tested.
- Identification and evaluation of the consequences of failure.
- A contingency plan of action in the event that failures occur.
- A requirement for detailed procedures which should include as an example:
  - The configuration of test lines and correct valve positions.
  - All operational steps and decision points.
  - A description of the roles and accountabilities for the personnel involved.
  - Clearly defined success/failure criteria for the test.
  - Authorization instructions if results are outside the defined success criteria.
- Assurance that contractor procedures are consistent with *ETP GP 10-45*.

- 1.5 Clarify and strengthen standards for well control and well integrity incident reporting and investigation. Ensure that all incidents are rigorously investigated and that close out of corrective actions are completed effectively.
- 1.6 Propose to the American Petroleum Institute the development of a recommended practice for design and testing of foam cement slurries in high-pressure, high-temperature applications.
- 1.7 Review and assess the consistency, rigor and effectiveness of the current risk management and management of change (MOC) processes practiced by Drilling and Completions (D&C) by:
  - Implementing an action plan to address areas that should be strengthened to conform with OMS expectations.
  - Defining minimum requirements of D&C functional teams to deliver consistent and effective application of MOC and risk mitigation from planning through execution.
  - Assessing high-consequence drilling activities as a priority, starting with the Gulf of Mexico Exploration and Appraisal drilling team.

## 2 Capability and Competency

- 2.1 Reassess and strengthen the current TA's role in the areas of cementing and zonal isolation. Ensure adequate TA coverage to support all the D&C global operations. As a minimum, a TA should:
  - Review and approve all critical zonal isolation engineering plans and procedures.
  - Provide assurance of contractors for all services related to zonal isolation engineering and technical services, including engineering competency, service quality and adherence to relevant standards.
- 2.2 Enhance D&C competency programs to deepen the capabilities of personnel in key operational and leadership positions and augment existing knowledge and proficiency in managing deepwater drilling and wells operations by:
  - Defining the key roles to be included in the enhanced competency programs.
  - Defining critical leadership and technical competencies.
  - Creating a 'Deepwater Drilling Leadership Development Program.' The program would build proficiency and deepen capabilities through advanced training and the practical application of skills.
  - Developing a certification process to assure and maintain proficiency. Conduct periodic assessments of competency that include testing of knowledge and demonstrations of the practical application of skills.

- 2.3 Develop an advanced deepwater well control training program that supplements current industry and regulatory training. Training outcomes would be the development of greater response capability and a deeper understanding of the unique well control conditions that exist in deepwater drilling. This program should:
- Embed lessons learned from *Deepwater Horizon* accident.
  - Require mandatory attendance and successful completion of the program for all BP and drilling contractor staff who are directly involved in deepwater operations, specifically supervisory and engineering staff, both onshore and offshore.
  - Where appropriate, seek opportunities to engage the broader drilling industry to widen and share learning.
- 2.4 Establish BP's in-house expertise in the areas of subsea BOPs and BOP control systems through the creation of a central expert team, including a defined segment engineering technical authority (SETA) role to provide independent assurance of the integrity of drilling contractors' BOPs and BOP control systems. A formalized set of authorities and accountabilities for the SETA role should be defined.
- 2.5 Request that the International Association of Drilling Contractors review and consider the need to develop a program for formal subsea engineering certification of personnel who are responsible for the maintenance and modification of deepwater BOPs and control systems.

### 3 Audit and Verification

- 3.1 Strengthen BP's rig audit process to improve the closure and verification of audit findings and actions across BP-owned and BP-contracted drilling rigs.

### 4 Process Safety Performance Management

- 4.1 Establish D&C leading and lagging indicators for well integrity, well control and rig safety critical equipment, to include but not be limited to:
- Dispensations from *DWOP*.
  - Loss of containment (e.g., activation of BOP in response to a well control incident).
  - Overdue scheduled critical maintenance on BOP systems.
- 4.2 Require drilling contractors to implement an auditable integrity monitoring system to continuously assess and improve the integrity performance of well control equipment against a set of established leading and lagging indicators.

# Contractor and Service Provider Oversight and Assurance

## 5 Cementing Services Assurance

5.1 Conduct an immediate review of the quality of the services provided by all cementing service providers. Confirm that adequate oversight and controls are in place within the service provider's organization and BP regarding:

- Compliance with applicable service provider, BP and industry standards.
- Competency of engineering and supervisory personnel.
- Effective identification, communication and mitigation of risk associated with providers' services.

## 6 Well Control Practices

6.1 Assess and confirm that essential well control and well monitoring practices, such as well monitoring and shut-in procedures, are clearly defined and rigorously applied on all BP-owned and BP-contracted offshore rigs (consider extending to selected onshore rigs such as those for high-pressure, high-temperature, extended reach drilling [ERD] and sour service applications). These practices should be:

- Defined and codified as BP minimum standards for demonstrated practice and proficiency.
- Formally bridged into contractor rig site well control policies and procedures, with a self-verification and reporting process.
- Reinforced by regular audit by BP well site leaders.

## 7 Rig Process Safety

7.1 Require hazard and operability (HAZOP) reviews of the surface gas and drilling fluid systems for all BP-owned and BP-contracted drilling rigs. Include a HAZOP review as an explicit check for rig acceptance and rig audit. Phase 1 should address offshore rigs. Phase 2 should address selected onshore rigs such as those for high-pressure, high-temperature, ERD and sour services applications.

7.2 Include in the HAZOP reviews a study of all surface system hydrocarbon vents, reviewing suitability of location and design.

## 8 BOP Design and Assurance

- 8.1** Establish minimum levels of redundancy and reliability for BP's BOP systems.  
Require drilling contractors to implement an auditable risk management process to ensure that their BOP systems are operated above these minimum levels.
- 8.2** Strengthen BP's minimum requirements for drilling contractors' BOP testing, including emergency systems. Require drilling contractors to:
- Demonstrate that their testing protocols meet or exceed BP's minimum requirements.
  - Perform self-audits and report conformance with their own protocols.
- 8.3** Strengthen BP's minimum requirements for drilling contractors' BOP maintenance management systems. Require drilling contractors to:
- Demonstrate that their maintenance management systems meet or exceed BP's minimum requirements.
  - Perform self-audits and report results to confirm conformance with their own management systems.
- 8.4** Define BP's minimum requirements for drilling contractors' MOCs for subsea BOPs. Require drilling contractors to:
- Demonstrate that their MOC systems meet or exceed BP's minimum requirements.
  - Perform self-audits and report results to confirm conformance with their own MOC processes.
- 8.5** Develop a clear plan for ROV intervention (independent of the rig-based ROV) as part of the emergency BOP operations in each of BP's operating regions, including all emergency options for shearing pipe and sealing the wellbore.
- 8.6** Require drilling contractors to implement a qualification process to verify that shearing performance capability of BSRs is compatible with the inherent variations in wall thickness, material strength and toughness of the rig drill pipe inventory.
- 8.7** Include testing and verification of conformance with *Recommendations 8.1 through 8.6* in the rig audit process.

Although the investigation team has taken a broad approach to making recommendations within the intent of its *Terms of Reference*, the team believes that as the findings in this report are considered and discussed, they may give rise to broader systemic responses or recommendations associated with possible broader industry issues. These issues might include industry working practices; training and competency assessment; and interfaces among operators, drilling contractors and service providers.