RULE 26 REPORT ON BP's DEEPWATER HORIZON MACONDO BLOWOUT

RE: OIL SPILL by the OIL RIG
"DEEPWATER HORIZON"
GULF OF MEXICO
APRIL 20, 2010

EXPERT OPINIONS
BASIS OF OPINIONS
ANALYSIS & DISCUSSION

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At the behest of

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and
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UNITED STATES DISTRICT COURT
EASTERN DISTRICT OF LOUISIANA

THE HONORABLE JUDGE BARBIER
MAG. JUDGE SHUSHAN

By order of
The Judicial Panel on Multi District Litigation

August 26, 2011

Executive Summary

On March 8, 2010, just over a month before the Macondo blowout, the well sustained a severe gas kick that in every way resembled the April 20th kick that killed 11 people. A member of BP's Tiger Team (responsible for pore pressure analysis) sent an email to a BP geologist that would prove to be a harbinger:

> Everyone was aware of the gas but we decided to drill ahead to stay as close to the prog[ram]-casing points as possible. The "prize" was to skip the contingency liner. After deciding to drill ahead, we encountered the losses. We were aware of the upper limit of the ECD ["Equivalent Circulating Density"] and exceeded it because we didn't believe the MWD ["Measurement Whilst Drilling"] LOT ["Leak Off Test"] values. I'm not sure it was a lack of communication or awareness as much as a **"we can get away with this" attitude** - after all, the surface LOT provided an additional 0.5 ppg of window. The ECD had already exceeded the closure and propagation values having been exceeded for a long time before we encountered the losses. Given that the MWD LOT value wasn't trusted because it was lower than the surface value, **I don't think this is going to be a learned lesson**.... I'm sorry to push back on the lessons learned. I know you've got to get something out there to make it look like we won't do this again. But without obvious indicators **and with the real push to make hole and skip the contingency liner, I don't see us really learning. The best bet is to hedge the "most likely" to have some centroid built in to the plan initially**.[1]

This communication highlights numerous problems: it identifies that risks were being taken in an effort to obtain the prize of a faster, cheaper drilling method; it makes clear that risks were not being assessed despite knowing they existed; it admits that key drilling indicators were being ignored in an effort to achieve the goal of quickly finishing the well; it admits that the attitude of "getting away with it" was placed above the known harm; and it concedes that lessons were not going to be learned from this event.

These were all Process Safety and System Risk Management failings that had also resulted in previous major BP accidents.

[1] Exh. 1136, BP-HZN-2179MDL00025882 (emphasis added).

INTRODUCTION

BP Management's systemic Process Safety and Risk Management failings caused the Macondo blowout. BP Management refused to identify the risk, refused to manage the risk, refused to establish operating guidelines commensurate with the dangerousness of deepwater exploration drilling, and refused to ensure that critical safety equipment was functional to industry standards.

BP Management knew that drilling the Macondo well was a highly risky and dangerous venture that demanded taking a cautious and conservative approach to meet its objectives and obligations. However, at each major decision point, BP Management chose the cheaper and riskier path. BP's drilling operations violated industry accepted Process Safety and Risk Management standards and even its own Group Defined standards and practices. BP knowingly took unnecessary risks and committed the very same failures that resulted in major incidents at BP's Texas City, Grangemouth, Scotland, and Prudhoe Bay facilities.

A. Professor Robert G. Bea and Dr. William E. Gale, Jr.

Professor Bea and Dr. Gale are experts in the engineering field of Process Safety Management and Risk Assessment and Management. This Report is their expert opinion as to the cause of the Macondo blowout.

Professor Bea has over 58 years of professional engineering experience with over 50 years of experience in the oil and gas industry.[2] Dr. Bea is a Professor Emeritus at the University of California at Berkeley in the field of Civil and Environmental Engineering and is a co-founder of the Center for Catastrophic Risk Management. Dr. Bea has authored, contributed to, and delivered over 500 articles, books, and reports on issues related to risk and risk management. From 1982 to 2005, Dr. Bea was periodically retained by BP as a consultant to provide advice and recommendations on issues related to safety systems, human error, and risk assessment for deepwater platforms, offshore drilling, pipelines, oil tankers, and refineries.

Dr. Gale has over 40 years of professional experience in project engineering, design, and construction.[3] Dr. Gale is an engineering specialist in all aspects of loss prevention, hazard and failure analysis, risk management and safety, including risk assessment Process Safety management, facility safety, and major risk incident investigations involving explosions, releases of hazardous materials, and fires. Dr. Gale earned a Ph.D. from the University of California Berkeley in an interdisciplinary program for Fire Safety Engineering Science as well as a

[2] Professor Bea's full Curriculum Vitae is attached as Appendix "A".

[3] Dr. Gale's full Curriculum Vitae is attached as Appendix "B".

Masters degree in Civil Engineering with an emphasis on Material Science, Marine Construction, and Fire Safety Engineering.

B. Process Safety and Risk Management.

Process Safety and Risk Management is an internationally accepted multi-disciplinary field of engineering and project management that focuses on the development of procedures and processes to protect Engineered Systems and assets, including people and the environment, from failures and undue exposure to the risk of injuries and damages which are well known and expected to occur when left to last minute reactions under emergency circumstances.

Process Safety and Risk Management forms the basis of a Safety Management System, which includes the standard of care and regulatory requirements for oil and gas drilling around the world. This industry recognizes and incorporates the philosophy, principles, ethics, and tools of these engineering disciplines for controlling risks. The particulars may vary depending on the circumstances, yet there are accepted rules used throughout – risk must be identified, analyzed, and mitigated by continuous application and maintenance of *layers of protection* known as protective barriers.

The preceding email concerning the March 8 kick clearly demonstrates that BP knew that it was taking risks that were not being assessed, knew that the risks were being intentionally ignored to finish the well as fast as profitably possible, and knew that it would not learn any lessons from it. The following email, written just 3 days before the deadly Macondo blowout from the BP Well Team Leader to the BP Operations Manager, confirms it:

> David,
>
> [O]ver the past four days there has been so many last minute changes to the operation that the WSL's have finally come to their wits end. The quote is "flying by the seat of our pants." . . . Everybody wants to do the right thing, but, this huge level of paranoia from engineering leadership is driving chaos. This operation is not Thunderhorse. Brian [Morel] has called me numerous times trying to make sense of all the insanity . . . This morning Brian called me and asked my advice about exploring opportunities both inside and outside of the company.

What is my authority? With the separation of engineering and operations, I do not know what I can and can't do. The operation is not going to succeed if we continue in this manner.[4]

BP Management refused to implement and maintain appropriate and sufficient protective barriers during the execution of its often-changed well plan for Macondo.[5] BP Management refused to fully consider the very real consequences of making ad hoc decisions in its rush to complete and temporarily abandon the well. The risks BP Management took were excessive or otherwise deliberately ignored despite an abundance of leading Process Safety indicators that ought to have signaled a need for greater awareness of simple, industry recognized, fundamental protections. Had BP implemented rudimentary, known protective barriers, the Macondo disaster could have been prevented.

OPINION NO. 1:

BP Management Knowingly Ignored Process Safety and Risk Management for Deepwater Exploration Wells Drilled by Contractor Owned Mobile Offshore Drilling Units in the Gulf of Mexico.

Risk identification and assessment is the foundation of Process Safety and Risk Management. The purpose of risk identification and assessment is to "identify, evaluate, and where unacceptable, reduce the likelihood and/or minimize the consequence of uncontrolled releases and other safety or environmental incidents."[6] Risk assessment and identification should employ disciplined, systematic, verifiable approaches.[7] BP Management disregarded

[4] Exh. 96, pp. 2 (emphasis added), BP-HZN-BLY-00097030.

[5] *See also* Deposition of BP Drilling Engineer Robert Bodek, pp. 205 ("I had a concern that, close to casing point where we're -- our drilling margin is diminishing and we're looking for casing point, I had a concern that we were drilling too fast. That's documented, yes."); *3/16/10 Email from Bodek to Paul Johnston* ("In retrospect, after compiling the above list of observations from various individuals, it seems that the accelerated rate of penetration and the resulting onslaught of drilling indicators exceeded the ability of all team members to effectively recognize, properly communicate, and decisively act upon available data."), BP-HZN-2179MDL00006076; 3/12/10 Email from Stuart Lacy to Jonathan Bellow ("Drilling like a bat out of hell in these pore pressure narrow-window wells is perhaps not wise . . . ."), BP-HZN-217900010256.

[6] Recommended Practice for Development of a Safety and Environmental Management Program for Offshore Operations and Facilities, API Recommended Practice 75 (3d May 2004).

[7] Guidelines for Chemical Process Quantitative Risk Analysis, Center for Chemical Process Safety (1989); Guidelines for Preventing Human Error in Process Safety, Center for Chemical Process Safety (1994).

general conditions and specific warning signs that called for an appropriate mechanism to properly assess risk.

1.1 BP Management refused to identify and assess Process Safety risk for contractor-owned MODUs in the Gulf of Mexico.

Before the Macondo blowout, BP Management knew that an uncontrolled, deepwater blowout was one of its highest risks within the organization. Nonetheless, BP Management refused to assess risk in the following ways:

- Refusing to conduct a Major Accident Risk analysis of the Macondo Well System.
- Refusing to require its contractor Transocean to conduct a Major Accident Risk analysis of the Macondo Well System.
- Refusing to timely implement BP Operating Management Systems and Group Defined Practices in the Gulf of Mexico Drilling and Completions organization for the majority (69%) of its Gulf of Mexico deepwater drilling operations.
- Refusing to provide a Bridging Document and auditing system to monitor and ensure Transocean was following BP's Process Safety minimum Group standards and practices.
- Refusing to require Transocean to follow BP’s Operating Management System.

BP Management’s knowledge about the Process Safety risk of drilling operations was quite specific. In 2001, BP Management hired Professor Bea and colleague Professor Karlene Roberts as consultants. Professors Bea and Roberts made presentations in London to then CEO Lord John Browne’s Executive Committee as well as BP U.S. Business Unit Leaders. At the meetings, BP Management expressed three specific problems. First, BP management expressed concerns about “clashes of corporate cultures” in their U.S. based operations. The U.S. companies BP acquired through corporate mergers (Arco, Amoco, Vastar) had very different operating organizations, cultures, procedures and processes than those of BP's U.K. based operations.[8]

Second, BP Management expressed to Professors Bea and Roberts that it had experienced a “loss of core competencies,” meaning that it no longer retained a “sufficient stock” of experienced engineering and operating personnel at its U.S. assets. Included in this concern was BP Management’s decision to eliminate their U.S. based research and development program.

[8] *See also* Stanley Reed & Alison Fitzgerald, *In Too Deep*, at 126.

Third, BP Management expressed to Professors Bea and Roberts that it had downsized and outsourced so much that BP organizations were showing signs of "brittle tendencies," meaning BP Management was not able to function properly when they encountered serious organizational challenges.

BP Management knew all three of these problems were caused by its decision to cut costs, its decision to downsize, and its decision to focus on production to the detriment of responsible management and adequate protection system safety. BP Management also knew that it had created Process Safety dangers. BP Management knew this because Professors Bea and Roberts told them. Professor Bea told BP Management three times that it was headed for disaster.

1.2 The decision to disregard accepted standards and protocols for risk identification and assessment started at the very top of BP Management.

Upper-level management plays a central role in Process Safety and Risk Assessment. Management establishes and provides "goals," "performance measures," and "resources" for Process Safety and Risk Management processes and procedures.[9] One of the most important performance measures is adequate recognition of the costs and benefits of developing and maintaining effective Process Safety and Risk Management processes and procedures.

These knowing violations of Process Safety and Risk Assessment and Management were made by the following BP management level representatives:

- BP Board of Directors, which was ultimately responsible for the organization's risk management and internal control systems.
- BP's Chief Executive, who is required by the Board to operate with a comprehensive system of controls and internal audits to manage risks.
- BP's Group Operations Risk Committee, which includes the Chief Executive and other Executive Management, and is responsible for incident analysis, learning, and response along with oversight and development of BP's Operating Management System.
- BP's Safety, Ethics, and Environment Assurance Committee, which is a Board subcommittee, and is responsible for assuring that the processes adopted by the Chief Executive and Executive Management for Process Safety and Risk Management are appropriate in design and implementation.

[9] A.P.I., R.P.-75.

BP Management knew before the blowout that it was a Process Safety violation to not have Senior Management involved in the assessment and management of risk. In 2003, BP Management retained Professor Bea to advise it on how to improve its Process Safety Systems for deepwater exploration and production in the Gulf of Mexico. Professor Bea delivered a power-point presentation to BP Management in which he advised them that they needed to ensure that Senior Management be involved in the process to see the big picture. Professor Bea also advised BP Management to adopt the principle of Command and Control Elements – to avoid a catastrophe in its Gulf of Mexico Deepwater operations, BP Management needed to implement migrating decision making whereby the person with the most experience is making the decision as well as formal rules and procedures which clearly define a decisional hierarchy.

One year after the Macondo blowout, BP Management is acknowledging that it had not properly assessed or managed risk in the Gulf of Mexico. On the one year anniversary of the Deepwater Horizon disaster, BP's Group Chief Executive and CEO, Bob Dudley, introduced a video presentation, "A year of change," in which Mark Bly, BP's newly appointed Executive Vice President of Safety & Operational Risk and who led BP's internal investigation, explained that the company is now "driving to have risk assessment, risk awareness, risk management deeply embedded in how we think about operations and what we do." [10] And as Bob Dudley made clear, "it's the sensitivity to thinking about risk differently. It's about how we incentivise (sic) people, it's about how we get people to think about the long term as well as the short term. We need to look and reward people for characteristics such as building teams, to build complex projects; with sense of managing the risks very well. And I believe that safety always leads to good operational and financial success."

1.3 BP Management decisions were driven by cost considerations over Process Safety concerns.

In order to properly manage risk, Process Safety and Risk Management must be commensurate with the level of risk assessed. When cost is elevated above Process Safety and Risk Management, as happened with the Macondo well, risk will become mismanaged, safety barriers fail, and catastrophic failures predictably result. BP Management emphasized cost over Process Safety in the following manner:

- Emphasizing a "forward agenda" that focused on "slashing management layers" and embedding an "every dollar counts" culture in the organization. BP Management refused to conduct a risk assessment of impacts this forward agenda would have on Process Safety and Risk Management performance.[11]

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[10] *BP-A year of change*, April 20, 2011; ref. http://www.youtube.com/watch?v=xc1u5-h1LBU.

[11] Moreover, the talent drain ("*bleeding*") from the cost-cutting and removal of numerous positions directly affected GoM D&C engineering at the time Macondo was being drilled with the loss of some of their best engineers. Deposition of David Sims, pp. 409-411.

- Including "safety" spending in its operating budgets while at the same time planning to cut its operating budget (i.e. cash costs) by 20% from 2008 to 2010. This was a critical time in which BP Management claimed to have been implementing its Operating Management System. BP Management refused to conduct a risk assessment of its cost cutting mandates and did not provide adequate and robust processes and procedures to prevent cost cutting from impacting Process Safety and Risk Management performance.

- Incentivizing cost cutting through its Variable Pay Program, which tied bonuses to reductions in Non-Productive Time but did not include effective, measurable Process Safety and Risk Management performance measures.

BP Management drove the business phrase "every dollar counts" into every facet of its organization – from Performance Assessments of Upper Management to rig workers, in emails, strategy sessions, press releases, and operations documents.[12] When Process Safety and Risk Management are not provided the same consideration, the message to management and workers alike is that money drives risk management.[13]

BP Management tracked 'threats and opportunities" at the Macondo well only in terms of project costs − to identify what could cost them more money, and opportunities to save money. BP Management was managing risk solely in terms of financial impact and costs during the well planning process and had no system in place to evaluate process safety hazards or otherwise

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[12] Examples of management and rig worker Performance Assessments in which "every dollar counts" appears as a criteria include the following: Ian Little's 2009 Assessment, Exh. 7063, BP-HZN-2179MDL01797934; Earl Lee's 2009 Assessment, Exh. 2667, BP-HZN-2179MDL01802532; Murry Sepulvado's 2009 Assessment, Exh. 1984, BP-HZN-2179MDL01308980; and John Guide's 2009 Assessment, Exh. 6294, BP-HZN-2179MDL00346653. Other examples of categories include the following: Tony Hayward Press Release, (April 16, 2009), Exh. 6016, p.5; BP Strategy Presentation from London (March 3, 2009), BP-HZN-CEC028404-598; 2009 D&C Team Building, Exh. 2544, p.3, BP-HZN-2179MDL01497550; GoM SPU – Operating Plan – OMS Handbook, Exh. 866, p.5, BP-HZN-2179MDL00333155; GoM Overview for Doug Suttles (April 13, 2010), Exh. 7062, BP-HZN-2179MDL00344298; 2009 Performance Fest Pre-Read (April 2009), Exh.2288, p.4, BP-HZN-CEC026501-519, BP-HZN-2179MDL01437553.

[13] This BP Management focus contributed to the decision to not have well control experts or specialists on the Macondo project or on the Deepwater Horizon rig in and around the time of the blowout, even though the well had experienced severe kicks well control problems in the weeks and days immediately preceding April 20, 2010. Deposition of David Sims, pp. 160, EXH. 1127; Deposition of James Cowie, pp. 70, 78.

assess risky decisions during the well execution process, including decisions about cementing, float shoe conversion, and zonal isolation.[14]

BP Management knew before the blowout that it was a Process Safety and Risk Management violation to incentivize cost cutting and production time but not incentivize Process Safety. In his 2005 lecture and presentation to BP Management, Professor Bea delivered a power-point presentation to BP Management in which he advised that a Reward System must include a Process Safety component or else BP Management and BP offshore drilling will develop riskier operational behavior in an effort to achieve the reward of greater production and profitability.

By April 20th, the Macondo well was significantly behind schedule and over budget. At the time of the blowout, the cost of this well was approximately $150 million[15] – 160 percent over the original Appropriation for Expenditure (AFE) of $96 million.[16] Because of continuing severe difficulties with drilling the Macondo well, BP had to return to its partners three times to authorize supplemental expenditures.[17] The cost of this well put the Macondo prospect in the bottom 10 percentile of comparable BP projects.[18] The Non Productive Time (NPT) for the Macondo well was estimated to be 48 percent.[19] This placed the well in the bottom 10 percentile of comparable wells.[20]

In addition, the Macondo well project schedule was approximately 150 percent over the original time forecast in the well drilling plan.[21] This schedule delay had important ramifications for other projects planned for the Deepwater Horizon after it completed temporary abandonment of the Macondo well.[22] Based on BP individual and corporate performance incentive metrics, the

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[14] *See* Deposition of Kal Jassal, pp. 256-259. *See also* Deposition of John Guide, pp. 196-200; Deposition of David Sims, pp. 647-648.

[15] Deposition of Xuemei Liu, pp. 45, 24-25.

[16] Exh. 2370.

[17] MBI Hearings Exhibit, AFE Summary for the Macondo Well, October 7, 2010. See also BP-HZN-MBI 19552, 192558, and 192559.

[18] BP-HZN-BLY 47298.

[19] BP-HZN-MBI 128953.

[20] BP-HZN-BLY 47298.

[21] BP-HZN-MBI 125958.

[22] Deposition of Brett Cocales, pp. 21-36.

BP Macondo drilling team was under significant pressure to wrap up this "well from hell" as quickly and cheaply as possible.

1.4 BP Management refused to monitor Process Safety and Risk Management Performance on contractor-owned MODUs in the Gulf of Mexico.

Process Safety and Risk Management requires that risks within an operation be continuously monitored, assess, reassessed, and managed. BP management knowingly disregarded this precept in the following manner:

- Using primarily "lagging" indicators to monitor Process Safety and Risk Management performance. Lagging indicators alone are not an effective way of measuring Process Safety and Risk Management performance. Lagging indicators only trigger reporting requirements once a Process Safety accident has occurred.

- Refusing to incorporate robust leading indicators in its Process Safety and Risk Management reviews. Leading indicators trigger reporting requirements before a Process Safety accident occurs and are critical to identifying deteriorating Process Safety and Risk Management performance.

- Applying a one size fits all approach to its Process Safety and Risk Management reviews. BP Management refused to include key performance indicators for deepwater, exploration drilling – kicks, lost circulation events, and overdue inspections and maintenance of BOPs – in these reviews.

- Focusing on personal safety measures such as workforce fatalities, days away from work, and injury frequency.

BP Management knew before the blowout that it was a Process Safety and Risk Management violation to not monitor drilling safety performance. In his 2003 presentation to BP Management, Professor Bea advised BP on how to improve its Process Safety Systems for deepwater exploration and production in the Gulf of Mexico by following the Process Safety and Risk Management principle of Process Auditing – the establishment of a system for ongoing checks designed to catch expected as well as unexpected safety problems.

BP Management recognized the major gaps it had in development of Process Safety:

> As we have started to more deeply investigate process safety incidents, it's become apparent that process safety major hazards and risks are not fully understood by engineering or line operating personnel. Insufficient awareness is leading to missed signals that precede incidents, and response after incidents: both of which

> increase the potential for, and severity of, process safety incidents.[23]

Instead, BP used their risk register solely during its well planning process and not during execution of the plan, i.e., not during drilling and construction of the well. The was no ever-green risk management process in place for Macondo to monitor and mitigate emerging risks, such as the decisions on how to cement and abandon the well.[24]

1.5 BP Management violated industry standards by refusing to implement industry appropriate policies, practices, and procedures for the auditing of contractor owned MODUs.

Audits of Safety and Environmental Management Program Elements are a key component to establishing protective interactive barriers to prevent catastrophic failures. BP Management violated industry standards for creating an industry appropriate audit system in the following manner:

- Refusing to conduct safety and operational audits on contractor-owned mobile offshore drilling rigs (MODUs) in the Gulf of Mexico.
- Refusing to ensure that identified problems on audits were properly and promptly closed out.
- Refusing to audit the Macondo drilling team to confirm compliance with BP policies and procedures.

BP Management knew before the blowout that it was a Process Safety violation to not implement an industry standard auditing systems. In his 2003 presentation to BP Management, Professor Bea advised BP Management to include the Process Safety principle of Auditing to capture expected and unexpected safety problems, including the testing of safety critical equipment and follow-ups on problems revealed in prior audits.

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[23] Exh. 2919, p. 7, BP-HZN-2179MDL01109082. *See also* Exh. 2514, BP-HZN-2179MDL01556393

[24] *See, e.g.*, Deposition of David Sims, pp. 646-647; Deposition of John Guide, pp. 196-198.

OPINION NO. 2

BP Management Disregarded Process Safety at Macondo In the Same Manner as It Did at Grangemouth, Texas City, and Prudhoe Bay.

A key component in Process Safety and Risk Management is the ability to learn from previous accidents. Although this is known as a "reactive barrier," it provides proactive benefits in that it can provide information to prevent future accidents. BP Management refused to learn crucial lessons from the 2000 Grangemouth Refinery incident, the 2005 Texas City Refinery incident, and the 2006 Prudhoe Bay pipeline incident.

2.1 As in Macondo, BP Management refused to correct the known systemic causes from the previous incidents.

In the Grangemouth, Texas City, and Prudhoe Bay incidents, BP Management refused to assess risk in the following manner:

- Conducting inadequate, rare risk identifications and assessments of critical safety equipment and operations.
- Conducting vague, ineffectual, and unhelpful risk identification or mitigation when the rare audit was performed.[25]
- Discouraging line managers and operating personnel from assessing risk.
- Refusing to take corrective action even after finding that BP Management suffered from poor hazard/risk identification skills.
- Refusing to take corrective action even after finding that BP Management exercised a poor understanding of Process Safety.

2.2 As in Macondo, BP Management did not provide guidance, training, or incentive for Process Safety in the Grangemouth, Texas City, and Prudhoe Bay incidents.

Management is ultimately responsible for Process Safety and Risk Management within an organization.[26] In particular, "[m]anagement provides leadership in establishing goals and

[25] *See* Deposition of Kal Jassal, pp. 45-46, 50, 122-126, 132, 163-164, 169-170, 221-222, 230, 245, 256-257, 263-264, 280, 284, and 288.

[26] A.P.I., R.P. 75.

performance measures, demands accountability for implementation, and provides necessary resources for carrying out an effective program."[27]

BP accepted the following findings of Management failings from government and internal investigations:

- BP Management focused disproportionately on profits and cost-cutting goals to the exclusion of Process Safety and thereby provided gross imbalances between Production and Protection.
- BP Management refused to provide its line managers and operating personnel with the necessary resources to effectively manage Process Safety risks.
- BP Management unofficially sacrificed Health, Safety, and Environment concerns in favor of cost cutting.
- BP Management de-scoped and deferred Process Safety important projects due to budget pressures.
- BP Management consistently elevated cost above Process Safety.
- BP Management focused on personal safety, excluding Process Safety metrics when discussing safety.
- BP Management refused to create a site governance structure to provide overview and assurance that Process Safety issues were being handled appropriately.
- BP Management refused to incorporate a holistic early warning system for Process Safety exposure.
- BP Management's safety measures primarily focused on lagging indicators, not leading indicators.
- BP Management refused to intervene in clearly deteriorating situations.
- BP Management refused to create an adequate communication protocol that would allow immediate Process Safety concerns to ascend vertically.
- BP Management refused to provide appropriate oversight of major accident prevention programs.
- BP Management's organizational structure, frequent reorganizations, and personnel shuffling created unclear accountabilities.

[27] *Id.*

- BP Management created new roles and responsibilities that had not been formally reviewed against the old roles and responsibilities.

- BP Management fostered an entrepreneurial risk-taking culture.

2.3 As in Macondo, BP Management refused to engage in an industry acceptable audit of its operations in the Grangemouth, Texas City, and Prudhoe Bay incidents.

Audits are an important part of Process Safety and Risk Management. The purpose of an audit is to determine whether Process Safety and Risk Management processes and procedures have been "properly implemented and maintained and to provide information on the results of the audit to management."[28] BP accepted the following findings related to audit failings from government and internal investigations:

- BP Management refused to create a structured and comprehensive audit program to provide assurance for its Process Safety risks.

- BP Management decided, rather than proactively identifying risk, it would initiate a self-verification model where business units were responsible for implementing corrective actions.

- Audit close-out items were not diligently pursued, properly performed, and completed in a timely manner.

- Audit close-out items commonly resulted in a chronic backlog due to inadequate close-out protocol and follow through.

2.4 As in Macondo, BP Management refused to properly maintain safety critical equipment at its Grangemouth, Texas City, and Prudhoe Bay facilities.

Process Safety and Risk Management should "require that procedures are in place and implemented so that critical equipment for any facility is designed, fabricated, installed, tested, inspected, monitored, and maintained in a manner consistent with appropriate service requirements, manufacturer's recommendations, or industry standards."[29] BP accepted the following findings of critical equipment failings from government and internal investigations:

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[28] A.P.I., R.P. 75.

[29] *Id.*

- Allowing a chronic maintenance backlog of critical equipment to accumulate without a written plan of action.

- Incorporating a "run to failure" protocol of safety.

- Incorporating a maintenance program that does not sufficiently address wear and breakage on system.

2.5 As in Macondo, BP Management has persistently refused to learn lessons from previous significant events at the individual facility or from similar earlier incidents at Grangemouth, Texas City, and Prudhoe Bay.

A critical part of Process Safety is accident investigations and lessons learned. Process Safety and Risk Management processes and procedures should require "investigation of all incidents with serious safety or environmental consequences."[30] "The intent of the investigation should be to learn from the incident and help prevent similar incidents."[31] BP accepted the following findings from government and internal investigations:

- At Grangemouth, BP Management failed to incorporate major chemical accident reports and take note of on-site loss of containment incidents.

- At Texas City, BP Management refused to learn from eight previous serious releases of flammable material at the facility.

- At Texas City, BP Management refused to learn from the Grangemouth disaster and its own Report which identified numerous failings: (1) inadequate audit systems; (2) poor root cause analysis of incidents; (3) lack of leadership and accountability among BP Management; (4) insufficient awareness of Process Safety; (5) inadequate performance measurement; (6) a safety program focused on personal safety, not Process Safety; and (7) a refusal to complete corrective actions.

- At Prudhoe Bay, BP Management committed the same Process Safety failings as it had before in Grangemouth and Texas City.

Since the 2005 Texas City explosion, four additional deaths have occurred, OSHA imposed $87,430,000 in proposed penalties, and OSHA identified 439 new willful violations. In Alaska, in November 2009, BP spilled over 45,000 gallons of oil.

[30] *Id.*

[31] *Id.*

2.6 As in Grangemouth, Texas City, and Prudhoe Bay, BP Management intentionally refuses to learn from the Macondo blowout.

A key concept of process management is to identify root causes from previous incidents to avoid repeating them. However, BP Management has deliberately refused to investigate management level Process Safety root or systemic causes of the Macondo blowout, in violation of industry standard practices as well as its own internal guidelines. This refusal demonstrates a high-level conscious decision to place litigation risk above the risk to human lives, property, and environment. Without the willingness to even investigate Process Safety causes comes the unmistakable decision not to learn from them. Without learning from past safety Process Safety deficiencies, BP Management is destined to repeat them.

OPINION NO. 3.

BP Management's Process Safety Failures Caused The Macondo Blowout.

As happens when Senior Management refuses to identify and manage risk, the consequences are realized on a very specific level. The personnel and management overseeing the Macondo well furthered the policies, practices, and procedures for risk identification and management promulgated by BP Management. In this way, BP's policies, practices, and procedures caused the Macondo blowout.

3.1 The BP Macondo Team refused to manage risk in much the same way as BP Management.

The BP Macondo Team attempted to manage risk pursuant to BP Management's policies and practices. As a result, they made decisions which failed to identify and assess risks that were in direct consequence to BP Management's practices. These decisions include the following:

- Relying upon a BP Manual ("Beyond the Best Common Process") to manage risks which pre-dated the Texas City accident and was described by BP as a "fragmented fot-for-purpose" risk management approach with "no uniform way to manage, aggregate, track or report risks."
- Relying upon a BP Manual ("Beyond the Best Common Process") to manage risks and which defined risk strictly in an economic sense relating to the "delivery" of the well and its "net present value."
- Utilizing a "Risk Register" that disregarded the health, safety, and environmental impacts of the risk, instead identifying the business risks of "cost" and "scheduling."

- Utilizing a "Risk Register" that was developed long before the Macondo well was spudded, that was based on unvalidated "inputs" and that was never updated after the well was spudded.

- Refusing to provide Process Safety and Risk Management engineering support in connection with risk prevention at the Macondo well.

- Refusing to continuously update and assess risk as it develops throughout the well life-cycle.

- Refusing to create guidelines for when a decision would be subject to a formal risk assessment.

- Ignoring the lessons learned from the March 8, 2010 well kick.

- Refusing to remediate Process Safety major hazards acknowledged in 2008.

Many of these problems occurred because of BP Management's last minute changes without assessing risk, without measuring the consequences, and without following industry recognized Process Safety and Risk Management processes and procedures.

In 2003, Professor Bea presented BP Management with a Report that it commissioned titled "Managing Rapidly Developing Crises: Real-Time Prevention of System Accidents." In the Report, Professor Bea advised BP Management that the best means to avoid a catastrophe in real time was to develop systems for identifying, assessing, and managing risk. Professor Bea informed BP Management that crises develop and go undetected when it increases risk taking, when it looks at emerging problems as only having a single cause, when it fails to establish clearly defined duties and responsibilities of management and crew, and when the physical systems are inadequate support for crisis management or accomplishing the task. BP Management refused to implement Professor Bea's advice.

3.2 BP Management's knowing failures of policy and practice resulted in key well drilling decisions in the face of predictable, yet unaddressed, hazards.

Policies and procedures are important barriers to Process Safety accidents.[32] In particular, policies and procedures are "the way that up-to-date technical information gets built into day-to-day operations."[33] Management must insist that policies and procedures be created and followed.[34] The knowing failures of the BP Macondo Team include the following:

- Not having a detailed procedure for conducting the critically important negative pressure tests, interpreting the results from the tests, and taking appropriate corrective action.
- Misreading the two negative pressure tests.
- Deviating from the planned and recommended number of centralizers.
- Not waiting a sufficient time for the cement to gain sufficient strength.
- Not waiting for laboratory test results for the cement slurry formulation that was actually used downhole.
- Refusing to run a cement bond log.
- Using spacer made from surplus lost circulation materials.
- Displacing riser before setting cement plug.
- Performing simultaneous operations during displacement.
- Refusing to circulate full bottoms up prior to cement job.
- Using long string casing instead of liner.
- Refusing to install additional physical barriers during temporary abandonment.
- Refusing to have a written procedure for conducting or specifying acceptance criteria for negative pressure tests.

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[32] Deposition of Samuel Defranco, p. 57.

[33] *Id.* at pp. 56-59.

[34] Deposition of Samuel Defranco, pp. 24-25.

- Refusing to wait sufficient time for the primary barrier at the bottom of the well, i.e., the cement, to cure and reach adequate strength before proceeding with a positive pressure test.

- Converting the lower ram on the BOP to a test ram.

- Not placing a mud pill in the rat hole heavier than the tail cement prior to running casing.

BP Management knew before the blowout that it was committing Process Safety and Risk Management violations in its deepwater exploration and production in the Gulf of Mexico. In a 2003 report commissioned by BP titled "Human and Organizational Factors in Design and Operation of Deepwater Structures," Professor Bea advised BP Management that it should include in its Gulf of Mexico deepwater operations Process Auditing, Reward System, Quality Degradation, Perception of Risk, and Command and Control Elements. BP choose to ignore the need for validated, effective, and continuous Proactive, Reactive, and Interactive processes in risk assessment and management of its high risk operations and systems.

3.3 BP Management's refusal to implement consistent, formal risk assessment processes for deepwater exploration drilling for contractor owned MODUs caused the Macondo Blowout.

Process Safety and Risk Management is first and foremost about identifying and assessing risk. Before risk can be managed, it must be identified and properly assessed. BP Management's refusal to implement consistent, formal risk assessment processes for deepwater, exploration drilling from contractor owned MODUs resulted in the BP Macondo Team committing the following Process Safety and Risk Management violations:

- Refusing to identify the collective risk of key decisions -- decisions were made in isolation without multi-level or collaborative benefits.

- Ostensibly delegating risk management responsibilities to Transocean, although retaining key decision-making authority such as the well completion plan and the cement protocol.

- Refusing to include Transocean in risk management such as the decision to conduct simultaneous operations during the displacement of the riser.

3.4 The BP Macondo Team chose time and money over Process Safety.

Just as BP Management elevated cost decisions over Process Safety concerns, the BP Macondo drilling team committed the same systemic mistakes. The BP Macondo drilling team made the following cost saving decisions at the expense of Process Safety and Risk Management:

- Encouraging employees to achieve the "technical limit" for drilling time.
- Rewarding fast drilling through the annual bonus plan which was measured by, among other things, delivering a 10% improvement to non-productive time, improve rig productivity by 7%, and deliver each well drilled within authority for expenditure estimates of time and cost.
- Refusing to include measurable Process Safety indicators in the performance contracts.
- Rewarding its contractors with bonuses based on fast drilling.
- Fostering a "we can get away with it attitude" - actions motivated by "greed and fear without conscience."[35]
- Ignoring the drilling data indicators – refusing to heed lessons learned.[36]

This type of behavior resulted in increased risk in direct proportion to the amount of time and money saved. Examples of key Macondo well decisions that increased risk but saved time and money are as follows:

- Refusing to use the originally planned number of centralizers.
- Refusing to wait for a foam stability test.
- Refusing to confirm the proper conversion of float equipment.
- Refusing to wait for the cement to fully cure, even assuming that it ever would.
- Deciding to place sole reliance on the float equipment and shoetrack cement to isolate the bottom of the production casing.
- Refusing to run a cement bond log.
- Deciding to use an untried experimental spacer concoction made from left over lost circulation materials.
- Displacing riser before setting cement plug.
- Displacing the well to over 8,000 feet below the drill deck.

[35] Exh. 4235, BP-HZN-2179MDL02406768.

[36] Exh. 1136, BP-HZN-2179MDL00025882.

- Refusing to install additional physical barriers during temporary abandonment.

- Refusing to circulate a full bottoms up prior to the cement job.

- Refusing to properly monitor mud pit volumes and flow out meter during displacement of drill mud with sea water during temporary abandonment.

- Using a long string casing instead of liner.

BP and its Macondo drilling team were under significant pressure to complete the well. At the time of the blowout, the Macondo well was nearly $60 million dollars over budget and 45 days past schedule. The Deepwater Horizon was scheduled to go to the Nile and Kaskida wells immediately following Macondo. If it took too long, BP was in danger of losing the Kaskida lease.

3.5 The refusal to implement Process Safety and Risk Management created ineffective barriers to prevent a catastrophic failure.

Initiating proactive, reactive, and interactive barriers is an industry accepted methodology for managing risk. BP Management is responsible for creating policies, practices, and procedures to create these barriers and ensure they are properly maintained. BP Management refused to enact or enforce industry accepted barriers. BP Management's own structure itself was a cause of the Macondo blowout in the following manner:

- Terminating the BP executive (Kevin Lacy) who was attempting to reform risk management in the Gulf of Mexico at the end of 2009.

- Transferring Harry Thierens, who was assisting Mr. Lacy in reforming risk assessment, out of the organization.

- Terminating Curtis Jackson and his position as Health, Safety, and Environmental director.

- Removing BP's full-time Health, Safety, and Environmental Field representative who was assigned to Deepwater Horizon and depending solely on the contractor's safety man, despite Transocean's objections.

- Refusing to identify any single member of the wells team as responsible for Process Safety and Risk Management.

- Separating engineering and operations such that they reported to separate managers, causing confusion and uncertainty as to who was responsible for what decision.

- Altering the reporting structure within the Gulf of Mexico Drilling and Completion leadership team during the 2009 reorganization.
- Refusing to appropriately steward and manage the 2009 re-organization.
- Replacing a senior well site leader, Ronald Sepulvado, with a less experienced well site leader, Robert Kaluza, at a critical stage of the completion and abandonment process.

BP Management knew before the blowout that it did not have adequate safety barriers in place in its deepwater exploration and production in the Gulf of Mexico. Professor Bea delivered speeches, power-point presentations, and papers to BP Management in 2001 and 2003 which advised the development of a system to include these barriers. BP Management failed to listen.

3.6 BP Management refused to create and follow written policies and procedures for safety critical activities.

Many of the operational decisions at the Macondo well were poorly planned and delivered to the rig at the last minute. Examples of BP Management's failure to create and follow written guidelines include the following:

- Refusing to create a written protocol for the negative pressure test.
- Allowing the cementing of the production casing on the well to begin before receiving the results of the foam stability test until after the blowout.

BP Management knew before the blowout that it was committing Process Safety and Risk Management violations in its deepwater exploration and production in the Gulf of Mexico. In his 2003 Report to BP, Professor Bea advised BP Management that it needed formal rules and procedures that would ensure a definite hierarchy and migrating decision making to ensure that the person with the most experience makes the decision.

3.7 The BP Macondo Team violated clear policies and procedures that were either internal BP written guidelines or established industry guidelines.

BP Management's practice of making Process Safety decisions based predominately on cost resulted in violations of the following practices:

- Drilling and Well Operations Practice requirement of two confirmed barriers capable of sustaining flow to the surface in violation of BP DWOP 21.1.1.

- Drilling and Well Operations Practice requirement of a well control bridging document, in violation of DWOP 15.2.17.

- Engineering Technical Practice requirement that temporary abandonment process be risk assessed.

- Drilling and Well Operations Practice requirement that kicks and lost circulation events be entered into BP's traction computer database.

3.8 Like BP Management's refusal to conduct comprehensive risk audits of Gulf of Mexico MODUs, the BP Macondo team did not conduct industry standard audits of the Macondo well.

An industry acceptable audit includes identification of the risk, assessment of operating procedures, and inspection of safety critical equipment. For an audit to function as designed, any problems that are identified must be closed out in such a manner to ensure remediation of any problems. BP disregarded both aspects of an industry acceptable audit for the Macondo well in the following manner:

- Refusing to conduct a Group Safety and Operations audit.

- Refusing to conduct a well control policies and procedures audit of Transocean.

- Refusing to audit BP Macondo team members to ensure that they were following BP written policies.

- Refusing to timely close out action items for safety critical equipment.

- Refusing to timely close out the 2009 audit action of recertifying the BOP.

- Refusing to audit the risk assessment of converting the bottom ram of the BOP into a test ram.

- Refusing to ensure that the Macondo well employs the Best Available and Safest Technology pursuant to MMS regulation 33 C.F.R. 250.107.

- Refusing to ensure that the drill pipe on the Macondo well was capable of being sheared pursuant to MMS regulation 33 C.F.R. 250.416.

3.9 Due to BP Management's refusal to have written, clearly defined operating protocols concerning risk assessment of evolving drilling operations, the BP Macondo drill team refused to identify and learn from prior drilling events.

Had the BP Macondo team identified and learned from these risk creating events, and implemented effective layers of protection, the Macondo blowout would not have occurred. These failures center upon the 10 well control issues – one of the more important being the March 8, 2010 kick resulting in the drill pipe getting stuck, having to be severed, and a bypass well being drilled.

CONCLUSION

The root cause of the Macondo blowout was not the decisions and mistakes made by the Macondo drilling team during the days and hours leading up to the blowout. Rather, at its root, the Macondo blowout was the result of failures and decisions made by BP Management during the weeks, months, and years preceding the blowout.

The Macondo blowout resulted from a knowing refusal to follow Process Safety Management and Risk Assessment & Management systems, standards, codes, and practices to prevent, control and mitigate major accidents and failures involving the release of hazardous materials, such as flammable liquids and gases.

Table of Contents

Section 1. Introduction to Process Safety and Risk Management

1.1 Introduction.

The universal goal of Process Safety and Risk Management is to anticipate, prevent, control, and mitigate major accidents and failures involving the release of hazardous materials, such as flammable liquids and gases.[1] The foundational knowledge-base for Process Safety and Risk Management grew out of, *inter alia*, the lessons-learned from past catastrophic failures and work performed by loss prevention engineers and professional organizations such as the American Institute of Chemical Engineers (AIChE)[2] and its Loss Prevention Engineering Symposia, the first of which was held in 1967. Initially, Process Safety and Risk Management practices, codes, and regulations were driven by several catastrophic accidents that occurred during the 1970s (e.g., the Flixborough (1974)[3,] and Severso (1976)[4] disasters).

Since the mid-1980s, Process Safety and Risk Management has continued to develop and mature in recognition and importance[5] following a number of major accidents occurring

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[1] Deposition of Tony Hayward, p. 145; *Management of Process Hazards*, API Recommended Practice 750 (January, 1990), American Petroleum Institute; *Process Safety Management*, U.S. Department of Labor Occupational Safety and Health Administration OSHA 3132, 2000 (Reprinted); http://www.osha.gov/Publications/osha3132.pdf; API RP-75; *International Safety Management Code (ISM Code)*, International Maritime Organization, ref. http://www.imo.org/OurWork/HumanElement/SafetyManagement/Documents/ISMCode_4March2010_.pdf; Robert Bea, "Human & Organizational Factors in Design and Operation of Deepwater Structures," Report to BP, Houston, TX (2003); Robert Bea and Karlene Roberts, "Managing Rapidly Developing Crisis: Real Time Prevention of System Accidents," Report to BP, Houston, TX (2003).

[2] *See, e.g.*, American Institute of Chemical Engineers Global Congress on Process Safety; http://www.aiche.org/Conferences/Specialty/GCPS.aspx.

[3] Flixborough Explosion (NyproUK) *Accident Summary*, June 1, 1974, U.K., Health and Safety Executive.

[4] Seveso Disaster, *Learning from Accidents*, Kletz, T., 3rd edition, Gulf Professional Publishing, 2001.

[5] For example, in Louisiana, its Loss Prevention Program is administered by the Office of Risk Management. *State of Louisiana Loss Prevention Policy Statement*, Governor Bobby Jindal, Sept. 28, 2008, http://doa.louisiana.gov/orm/pdf/LP_policy_statement.pdf.

throughout a variety of industries, including commercial and military aviation, nuclear power, chemical processing and transport, oil refining,[6] and oil and gas exploration and production.[7]

1.2 Basic principles of Process Safety and risk management.

Process Safety and Risk Management is a multi-disciplinary field of engineering and social sciences (e.g., project management, human and organizational behavior) that focuses on the development of procedures and processes to protect Engineered Systems from undue exposure to injury and harm (failures).

1.2.1 Risk identification and assessment.

Process Safety and Risk Management begins with the identification and assessment of risks within an Engineered System. An Engineered System can be characterized as consisting of six major interconnected, interdependent, and interactive components:

- **Operating teams**: people that have direct contacts with the design, construction, operation, maintenance, and decommissioning of the system;
- **Organizations**: groups that influence how the operating personnel conduct their operations and provide the resources for the conduct of these operations;
- **Procedures**: formal and informal, written and unwritten practices that are followed in performing operations;
- **Hardware**: structures and equipment on which and with which the operations are performed;
- **Environments**: external, internal, and social; and
- **Interfaces** among the foregoing.

In-depth studies of past catastrophic failures have demonstrated such failures involve malfunctions developed in and by all six components.[8] This is a unique characteristic of

[6] *See, e.g.,* U.S. Chemical Safety Board's video, "Anatomy of Disaster," March 21, 2008, concerning the BP Texas City Refinery Disaster and its causes: http://www.csb.gov/videoroom/detail.aspx?vid=16&F=0&CID=1&pg=1&F_All=y.

[7] *See, e.g.,* http://www.osha.gov/SLTC/oilgaswelldrilling/indExh.html; http://www.osha.gov/SLTC/etools/oilandgas/indExh.html.

Engineered System failures. Another unique characteristic is that the components that consistently make the largest contributions (typically more than 80 percent) to causation of system failures are the "people-based human" components involving Operating Teams, Organizations, and their Interfaces. Studies show that the leading malfunctions involved in human components are those associated with organizational and operating team cultures, communications, and violations (intentional departures from required practices).

Once potential hazards and threats to the acceptable performance of an Engineered System have been identified, they must be properly assessed. The assessment of a risk associated with a given system has two basic components: (1) determination of the likelihood of an adverse event occurring (characterizing performance of the system); and (2) the potential adverse consequences associated with event.

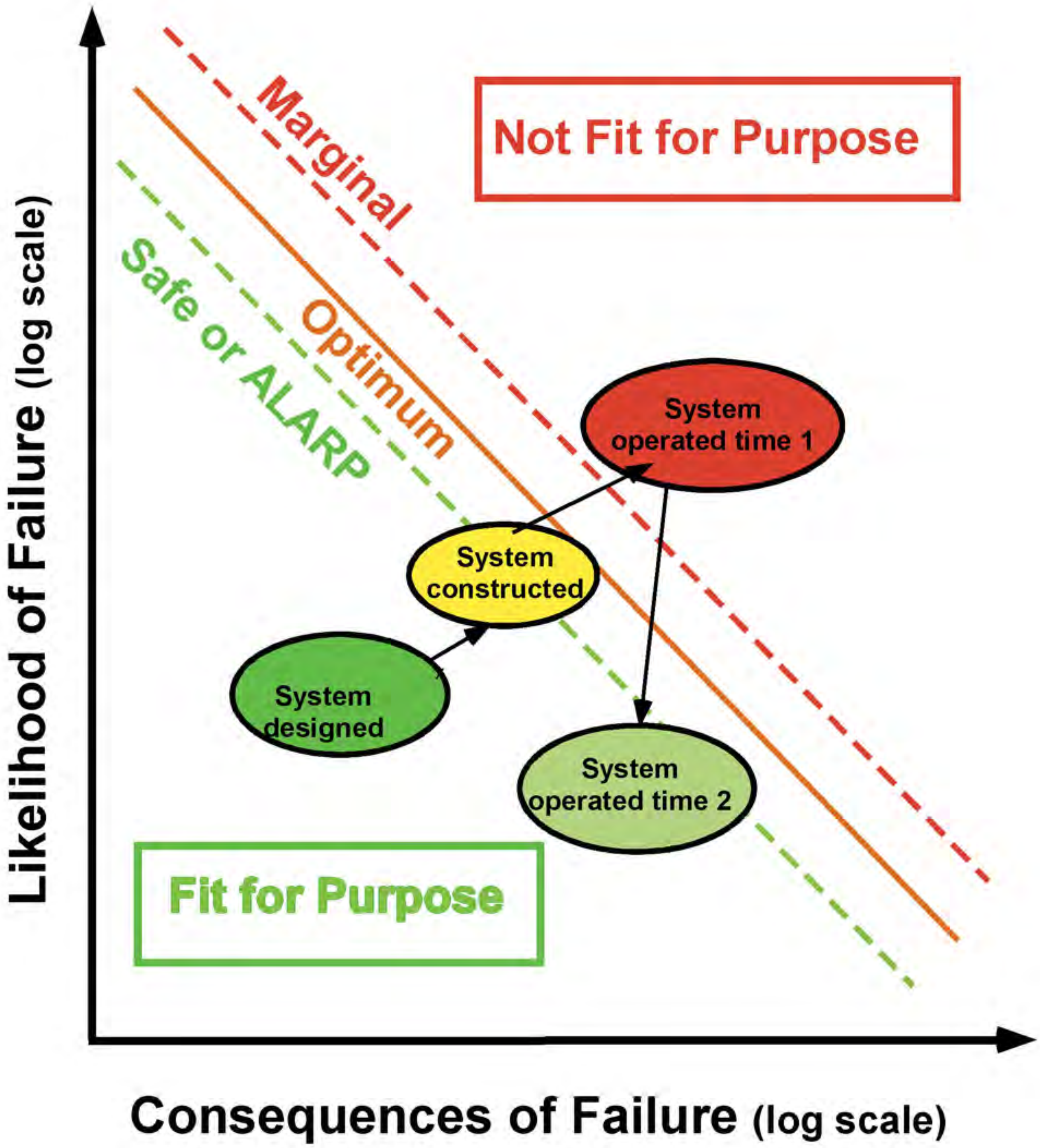
There are varying techniques for determining the likelihoods and consequences of an adverse event. The primary techniques for evaluation include:

- **Qualitative** (Non-numeric, subjective, generally consisting of a high, medium, low-type assessment);
- **Quantitative** (numerical, objective, mathematical measurement of risk as in a *Quantified Risk Assessment* or QRA); and
- **Mixed** (combination of qualitative and quantitative).

Additionally, it should be understood that the risks associated with an event, are conditional and dynamic – changing based upon "environmental" conditions and engineering/operating decisions and actions. Engineering and operating decisions can greatly increase the accumulative risk-level of an Engineered System, particularly if the linkage between subsequent decisions and prior decisions is not made, i.e., if decisions are reached independently or "siloed" without full consideration of their overall potential impact on the performance and reliability of the system.

[8] Robert Bea, "Human & Organizational Factors in Design and Operation of Deepwater Structures," Report to BP, Houston, TX (2003).

Figure 1: Risk Management Goal (ALARP-As Low as Reasonably Practicable)



A key part of Risk Management is determination of what constitutes an acceptable or desirable risk (Figure1).[9] This determination is intended to answer the key question: “How Safe Is Safe Enough?” The answer to this question defines in quantitative terms the primary goal of Process Safety and Risk Management during the life-cycle of an Engineered System: to manage, engineer, construct, operate, and maintain the system so it has acceptable and desirable performance, service, and reliability, i.e., safety characteristics. Determination of what combinations of likelihoods and consequences of failure are acceptable ideally is a process involving close collaboration of industry and government (legislative, judicial, regulatory).[10]

As shown in Figure 1, if a system “evolves” or “migrates” into the “Not Fit For Purpose” risk region, timely and effective management, engineering, and operations processes must be implemented to reduce the likelihoods of failure (e.g., reduce system demands, increase capacities and robustness, decrease uncertainties) and consequences of failure (e.g. risk mitigations to reduce the impact of failure such as increasing thermal impact resistance, planning emergency management and response contingencies, personnel training and drills, and so forth) so that the system is operated in the “Fit for Purpose” risk region. A system is deemed “safe” only when it is operated in the “Fit for Purpose” risk region.

1.2.2 Barriers.

After a risk is identified and assessed, Process Safety and Risk Management requires that appropriate barriers (Figure 2) be developed and maintained to prevent, control, and mitigate the risks from having negative impacts on the desirable performance of an Engineered System. Barriers must be developed and implemented on a continuous basis during the life-cycle of the system including concept development, design, construction, operations, maintenance, and decommissioning.

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[9]Robert Bea, *Reliability Based Design Criteria for Coastal and Ocean Structures*, The Institution of Engineers, Australia, Barton ACT (1990).

[10] Risk Assessment can be thought of as defining the degree of peril or the possible harm that might occur. It is the statistical probability or quantitative estimate of the frequency and severity of injury or loss. The judgment of *acceptable level of risk* is the dispositive discriminator for safety. When something is judged to be safe, it does not mean it is risk-free. Impartial judgment of the acceptable level of risk; however, is subject to both *cognitive bias* (a pattern of deviation in judgment that occurs in particular situations that is frequently based upon heuristics, or rules of thumb, which people may employ out of habit or evolutionary necessity based on past experience, i.e., “*it always worked before…*”) and *expectation bias* (the tendency to believe, look for, and collect evidence and data that agrees with and supports expectations for a desired outcome, and to disbelieve, discard, or downgrade the corresponding importance of evidence or data that appears to conflict with those expectations, i.e., *the subjective risk-reward expectation bias based on the potential value of the reward to be gained by taking the risk being assessed*).

Barriers can be organized into three general categories: (1) Proactive; (2) Reactive; and (3) Interactive. Each of these barriers employ three basic strategies: (1) reduce the likelihood of undesirable events, (2) reduce the consequences of undesirable events, and (3) increase the proper detection and correction of undesirable events. The role of these barriers in preventing, controlling, and mitigating the risk of a major accident is illustrated in Figure 2. The barrier holes are created by active activities, such as unsafe acts, and by latent activities, such as undetected or otherwise embedded defects. Active holes are developed by operators at the sharp end of the Engineered System, that is, when the system is actually operating. Latent conditions are embedded in the system by organizations along the blunt end of the system, e.g., during the system design or construction. These conditions may be present for many years before they combine with the local active failures to allow hazards to penetrate the barriers.

Figure 2: Barriers and Escalation Controls

The size and alignment of the holes in the barriers are determined in large measure by the balance maintained by the involved organization between production and protection. Multiple barriers are effective only when there are no other factors at work to help defeat the barriers. When insufficient resources are devoted to protection, the increased hazards associated with increased production act to enable the Engineered System to fail. If the imbalance is very high (high production, low protection), catastrophes resulting from multiple failures develop. The organization's safety culture has major effects on maintenance of appropriate balances between production and protection, and consequently, on the effectiveness of barriers to prevent failures.

1.2.2.1 Proactive barriers.

Proactive barriers are based on attempts to analyze the Engineered System before it fails (unacceptable performance) in an attempt to identify how it could fail in the future. These barriers depend critically on "predictability" of the threats to acceptable performance of a system – and on implementation of means and measures to control and manage those threats. Measures can be developed and put in place to prevent the failure or failures that have been anticipated. One of the important types of Proactive barriers are those providing "robustness" (damage and defect tolerance) and "resilience" (ability to rapidly recover from severe disturbances). Proactive barriers include the following: (1) safety and environmental information; (2) hazard analysis; (3) operating procedures; (4) safe work practices; (5) training; and (6) pre-start up review.[11]

1.2.2.2 Reactive barriers.

Development of Reactive barriers is based on analysis of the failure or near failures (incidents, near-misses) of an Engineered System. An attempt is made to understand the reasons (the hows and whys) for the failure or near-failure, and then to put measures in place to prevent future failures of the system. The Reactive barriers are also directed to mitigate the consequences associated with the failure of a system. Reactive barriers include the following: (1) emergency – crisis response and control; (2) investigation of accidents; (3) implementation of lessons learned into revised Proactive Barriers; and (4) documentation and record keeping – monitoring and tracking so-called leading and lagging indicators or metrics that provide feedback to the operator.[12]

This attention to accidents, near-misses and at risk behavior is clearly warranted. Studies have indicated that generally there are about 100 to 1000 hazardous acts or events instances of at risk behavior and 10 to 100 near-misses for every accident. At risk behavior and near-misses can give early warnings (leading indicators) of potential degradation in the safety of the Engineered System. The at risk behaviors and near-misses, if well understood and communicated, provide important clues as to how the operators are able to rescue the system, returning it to a safe state, and to potential degradation in the inherent safety characteristics of the system. Responses to accidents, near misses, and at risk behavior can reveal much more about maintaining adequate quality and reliability than responses associated with successes.

Figure 3: Safety Pyramid

Well-developed guidelines have been established for investigating accidents and performing audits or assessments associated with near-misses and accidents. These guidelines indicate that the attitudes and beliefs of the involved organization are critical in developing successful reactive processes, particularly doing away with "blame and shame" cultures and practices. It is further observed that many if not most incident and accident investigations focus on "technical causes" including

[11] American Petroleum Institute, *Recommended Practice 75: Development of a Safety and Environmental Program for Offshore Operations and Facilities*, Section 1.2.1, (3d 2004).

[12] Process Safety Performance Indicators for the Refining and Petrochemical Industries, ANSI/API Recommended Practice RP-754, First Edition, April 2010, pp. 2, Figure 1, "Swiss Cheese Model".

equipment and hardware and excluding "human-ware." Human–system failures are often treated in a cursory manner and from a safety engineering behavioral-perspective that has a focus on outcomes of errors (e.g. inattention, lack of motivation) and statistical data (e.g., lost-time accidents).[13]

1.2.2.3 Interactive Barriers.

Interactive Barriers are perhaps the most important because of the limitations present in Proactive and Reactive Barriers. Interactive Barriers involve "real-time" Risk Management processes that are intended to provide defenses for "unpredictable" and often "unimaginable" things that threaten the acceptable performance of an Engineered System. Interactive barriers include: (1) Management of Change (MOC); (2) Quality Assurance (Proactive) and Control (QA/QC); (3) Crisis Management (detection, analysis, and correction), and (4) audits of safety and environmental management program elements and "evergreen" risk management.[14]

When dangers or hazards build up in an Engineered System, it is necessary to actively intervene with the system to return it to an acceptable quality and reliability state. This Interactive Barrier approach is based on the contention that many aspects that influence or determine the failure of a system in the future are fundamentally unpredictable and unknowable. These are the incredible, unbelievable, complex sequences of events and developments that unravel a system until it fails. Process Safety and Risk Management processes and procedures should be able to assess and manage these evolving disintegrations.

Engineers can have important influences on the abilities of people to rescue an Engineered System and on the abilities of the system to be rescued by providing adequate measures to support and protect the operating personnel and the system components that are essential to their operations. Quality assurance and quality control (QA/QC) is an example of the real-time approach. QA is done before the activity, but QC is conducted during the activity. The objective of the QC is to be sure that what was intended is actually being carried out.

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[13] *See, e.g., The Report Of The BP U.S. Refineries Independent Safety Review Panel* ("The Baker Panel Report") (January 2007), http://www.bp.com/liveassets/bp_internet/globalbp/globalbp_uk_english/SP/STAGING/local_assets/assets/pdfs/Baker_panel_report.pdf.

[14] A.P.I. R.P. 754.

Two fundamental approaches to improving Interactive Barriers are: 1) providing people support, and 2) providing system support.[15] People support strategies include such things as selecting personnel well suited to address challenges to acceptable performance, and then training them so they possess the required skills and knowledge. Re-training is important to maintain skills and achieve vigilance. The cognitive skills developed for interactive approach degrade rapidly if they are not maintained and used.

Interactive teams should be developed that have the requisite variety to recognize and manage the challenges to quality and reliability and have developed teamwork processes so the necessary awareness, skills, and knowledge are mobilized when they are needed. Auditing, training, and re-training are needed to help maintain and hone skills, improve knowledge, and maintain readiness. Interactive teams need to be trained in problem "divide and conquer" strategies that preserve situational awareness through organization of strategic and tactical commands and utilization of "expert task performance" (specialists) teams. Interactive teams need to be provided with practical and adaptable strategies and plans that can serve as useful "templates" in helping manage each unique crisis. These templates help reduce the amount and intensity of cognitive processing that is required to manage the challenges to quality and reliability.

Improved Engineered System support includes factors such as improved maintenance of the necessary critical equipment and procedures so they are workable and available as developments unfold. Data and communications are needed to provide and maintain accurate, relevant, and timely information in "chunks" that can be recognized, evaluated, and managed. Adequate "safe haven" measures need to be provided to allow interactive teams to recognize and manage the challenges without major concerns for their well-being. Hardware and structure needs to be provided to slow the escalation of the hazards, and re-stabilize the system.

1.2.3 Implementation of Barriers.

1.2.3.1 Barrier Design

The effectiveness of barriers is frequently described in a six-level "Hierarchy of Risk Control." In descending order of effectiveness, they are:

- **Eliminate the risk:** this of course in the most desirable and effective course of action but rarely achievable. It embraces the concept of "inherently safer design" by seeking to eliminate the hazard or reduce the amount of that which poses the

[15] Robert Bea and Karlene Roberts, "Managing Rapidly Developing Crisis: Real Time Prevention of System Accidents," Report to BP, Houston, TX (2003).

hazard (hazardous material) that could be involved (released) during a process incident involving loss of containment.

- **Substitution:** this course of action involves replacing the material or process with a less hazardous one. For example, the use of a non-flammable inert gas in place of fuel gas for process instrumentation control and activation.

- **Isolate the Hazard:** using either remoteness or physical barriers to separate a hazard and people within the workplace.[16]

- **Engineering Controls:** the application of systems and equipment designed to control the risk and protect workers, such as fire and gas detection systems, process instrumentation to detect high levels and pressures, and interactive safety devices such as "dead-man" switches that require manual operator intervention that generate an engineered *permissive signal* to allow a potentially hazardous act to proceed under safe conditions, such as in the absence of electrical power (e.g., a kill-switch to shut down an operating piece of machinery).

- **Administrative Controls:** institute policies, procedures, and practices aimed at regulating the behavior of operators to ensure that the methods and means employed during plant operations, start-ups, shutdowns, maintenance and inspection, and testing are performed safely and in accordance with all applicable regulatory requirements and company practices. This barrier depends on the diligence, judgment, training, and acumen of operating personnel and management, and has shown to be the least effect of the preceding barrier types.

- **Personal Protective Equipment:** in most cases this is viewed as a "last line of defense" to protect a worker if the above measures have failed or are otherwise ineffective. It may be used in combination with all of the above risk control measures to directly protect works from the hazards that may occur in the workplace which otherwise cannot be eliminated or have managed to penetrate holes in the established protective barriers.

[16] For example, following the Baker Report, the American Petroleum Institute re-issued RP-752, *Management of Hazards Associated with Location of Process Plant Permanent Buildings,* to incorporate Lessons Learned from BP's Texas City Refinery Explosion regarding the location of temporary buildings and trials in refineries. This practice uses a "Consequence-Based" approach that takes into consideration the impact of explosions, fires, and toxic releases based on "maximum credible events" for each building and type of hazard considered. *See also Andrew Hopkins, Failure to Learn: The BP Texas City Refinery Disaster* (2008).

1.2.3.2 Effectiveness of the "5 C's"

Studies of organizations that have been successful and unsuccessful in Process Safety and Risk Management have shown that "5 Cs" are needed to enable success:[17]

- **Cognizance**: clear and continuous recognition of the threats and hazards that confront a system's ability to realize acceptable performance and reliability.
- **Capabilities**: organizations that have the shared knowledge, rules, and skills to address all of the components that comprise a system during its life-cycle with particular emphasis on the "human" and "organizational" aspects.
- **Commitment**: top-down and bottom-up unwavering devotion of management, leadership, and follower-ship (teamwork) to a continuous program of improvement in the performance and reliability of the system.
- **Culture**: shared beliefs, attitudes, values, and feelings that bring into balance pressures of system productivity and protection thereby enabling realization of acceptable performance and reliability during the life of the system.
- **Counting**: effective financial and social incentives (positive and negative) and metrics to encourage development and maintenance of adequate system performance and reliability.

One of the most important issues that must be addressed in Process Safety and Risk Management is "Counting" – explicit up-front analysis of the "costs and benefits" associated with implementation of Process Safety and Risk Management processes and procedures. Development and maintenance of effective Process Safety and Risk Management processes and procedures costs substantial amounts of money and other important resources. Yet, if the Process Safety and Risk Management processes and procedures are effective, there are no (or vastly reduced numbers of) major Engineered System failures. This develops a natural tension between "production" (i.e., measured growth and profitability that are sensitive to costs) and "protection" (resources invested to prevent failures – that do not happen – and that are very difficult to "measure" – until they happen). If this tension is not properly addressed, then experience has clearly demonstrated organizations can expect to develop undesirable balances between system production (readily measured) and protection (not readily measured) with the

[17] Robert Bea, "Human & Organizational Factors in Design and Operation of Deepwater Structures," Report to BP, Houston, TX (2003).

attendant undesirable major system failures. Logical and apparently justifiable work to achieve cost efficiencies - "make every dollar count" – can and will lead to unrecognized degradations in the system's protective barriers – particularly if risk assessments are based on unverified overly optimistic "beliefs" (wishful thinking) and the assessments of the benefits are based on "hard cold cash." Such trade-offs represent trading something "for sure" – saving money – for something that is "not likely" – a catastrophic system failure. Cost-benefit analysis and financial accounting processes have been developed, validated, and applied to help organizations properly address the financial tensions between production and protection – to demonstrate that safety is good business.[18]

1.3 Process Safety and risk management in deepwater, exploration drilling.

Major accidents, including blowouts, have occurred in the oil and gas exploration industry. In 1979 an uncontrolled blowout occurred during the drilling of Pemex's well, Ixtoc I, off the coast of Mexico releasing more than 140,000,000 gallons of oil into Gulf of Mexico.[19] Oil flowed into the Bay of Campeche for over nine months before the well could be plugged resulting in the world's worst oil spill from a well blowout until it was eclipsed by the Macondo blowout. Less than 10 years later, in 1988, an explosion aboard the Piper Alpha production platform in the North Sea killed 167 people.[20] That same year, an uncontrolled blowout occurred on a well that ARCO was drilling in the North Sea (before BP had acquired ARCO). The blowout preventer did not prevent the blowout, because the lower rams could not shut-in the well to stop the flow.[21] More recently, in August 2009, an uncontrolled blowout occurred during

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[18]Robert Bea, "Human & Organizational Factors in the Safety of Offshore Structures," Risk and Reliability in Marine Technology, Balkema Publishers (1998); "Design for Reliability: Human and Organizational Factors," Handbook of Offshore Engineering (2005).

[19] *Ixtoc Oil Spill Assessment Final Report Executive Summary*, Prepared for Bureau of Land Management Contract No. AA851-CTO-71, ERCO/Energy Resources Company, Cambridge, MA, March 19, 1982. http://home.versatel.nl/the_sims/rig/ixtoc1.htm; http://invertebrates.si.edu/mms/reports/IXTOC_exec.pdf; http://home.versatel.nl/the_sims/rig/ixtoc1.htm.

[20] *Building Process Safety Culture, Tools to Enhance Process Safety Performance*, Center for Chemical Process Safety, American Institute of Chemical Engineers, 2005, Piper Alpha Case History.

[21] The Ocean Odyssey was one of the most advanced semi-subs of its day and was designed to work on high pressure-high temperature (HPHT) deepwater wells as was the Deepwater Horizon. Its blowout and sinking is similar to the Macondo disaster in several ways. Due to a loss-of-well-control event (i.e., lost circulation) on the morning of September 22, 1988, ARCO representatives chose to pull out of the hole to try and regain circulation reportedly against the judgment of others on board. The drill bit was tripped out to 13200 feet, at which point the ARCO reps. decided to stop and circulate. A rapid rise in casing pressure was seen, with

drilling operations on the Montara Wellhead Platform off the coast of Australia. Oil poured into the waters around Australia for 74 days.

All of the preceding offshore well blowouts, are attributable to failures in Process Safety and Risk Management. Moreover, all but one of these incidents occurred in far less challenging environments than those encountered in deepwater exploration drilling. Deepwater exploration drilling is universally considered to be one of societies' most technologically challenging engineering and operating environments and endeavors. The technological challenges related to deepwater exploration drilling have routinely been compared to the challenges associated with space exploration. Chief among the engineering and operational challenges of deepwater exploration drilling are the complexity of the systems and hazardous conditions that demand the utmost attention to detail and situational awareness.

Given these technological and engineering challenges, robust damage and defect tolerant Process Safety and Risk Management processes and procedures are particularly critical for preventing major accidents in deepwater exploration drilling. The consequence of an uncontrolled deepwater blowout, as most recently demonstrated by the Macondo blowout, can be catastrophic.

In deepwater exploration drilling, Process Safety and Risk Management must assess, identify, and mitigate potential event consequences and their likelihood, such as an uncontrolled deepwater well blowout. This includes understanding the limitations of being able to effectively mitigate major risks imposed by technology and environmental constraints and the high degree of uncertainty associated with wildcat exploration. Simply said, the execution of effective Process Safety and Risk Management is crucial to ensuring that deepwater exploration drilling can be safely conducted and for detecting and responding to incipient problems before they escalate into major events. Effective execution of Process Safety and Risk Management, in turn,

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substantial mud returns and the presence of gas vapor at the rotary table. With the bit at 13200 feet, the circulating pressure was not great enough to prevent a gas influx into the well and the well began to flow. The well was not shut in completely with the BOP's lower rams and an explosion occurred. Subsequently, catastrophic choke hose failure caused by the uncontrolled flow of erosive fluids through the choke hose led to the release of large quantities of gas and caused fires both on the rig and on the surface of the sea beneath the rig. Eight of the crew were force to jump overboard after lifeboats had already been launched; however one remaining crew member perished. According to the Odyssey investigation report (as summarized by Versatel), the ARCO representatives had not followed safe and correct drilling practices in the management of the well, which included failing to correctly identify shut-in drillpipe pressure, failing to correctly calculate the circulation time of the gas kick and failing to shut in the well once the well began flowing uncontrollably. For some years after this incident, the UK Department of Energy banned drilling in areas with anticipated reservoir pressures in excess of 10,000 psi. Based in part on information from: http://home.versatel.nl/the_sims/rig/o-odyssey.htm.

can only be done with effectual managing leadership and a strong organizational ***safety culture*** as explained in the CCPS's review of Piper Alpha's case history.[22]

In deepwater exploration drilling, the owner and/or operator is responsible for Process Safety and Risk Management throughout the lifecycle of the well. Industry standards for Process Safety and Risk Management in deepwater exploration drilling are a combination of general industry practices, applicable within all industries that have the potential to cause a major accident, industry standards and practices specific to the oil and gas industry, and codes and regulations developed and established by regulatory agencies.

With respect to general industry practices, the Center for Chemical Process Safety and the American and Petroleum Institute have developed a number of general standards and practices that address the fundamentals of Process Safety and Risk Management, including, but not limited to:[23]

- Center for Chemical Process Safety, Guidelines for Risk Based Process Safety (2007);
- Center for Chemical Process Safety, Essential Elements for a Sound Safety Culture (2005);
- Center for Chemical Process Safety, Guidelines for Preventing Human Error in Process Safety (1994);
- Center for Chemical Process Safety, Guidelines for Chemical Process Quantitative Risk Analysis (1989);
- Center for Chemical Process Safety, Guidelines for Hazard Evaluation Procedures (3d 2008);
- Center for Chemical Process Safety, Guidelines for Implementing Process Safety Management Systems (1994);
- Center for Chemical Process Safety, Guidelines for Investigating Chemical Process Incidents (1992);

[22] *Process Safety Culture, Tools to Enhance Process Safety Performance*, CCPS, 2005; also see BP-HZN-2179MDL01808592 RE Oct. 1, 2009 Email from Lacy (BP's VP of D&C, GoM SPU) to Thierens, et al.

[23] *See, e.g.*, Ref. BP GRP 3.1-0001, Selection of Hazard Evaluation and Risk Assessment Techniques (July 7, 2008), BP Group Recommended Practice, BP-HZN-2179MDL01334603.

- Center for Chemical Process Safety, Technical Management of Chemical Process Safety (1989); and

- Center for Chemical Process Safety, Guidelines for Hazard Evaluation Procedures (1985).

There are also a number of industry standards that have been developed by various industry organizations that are specific to Process Safety and Risk Management in the oil and gas exploration industry, including, but not limited to:

- American Petroleum Institute, Recommended Practice 75: Development of a Safety and Environmental Program for Offshore Operations and Facilities (2004).

- American Petroleum Institute, Recommended Practice 754: Process Safety Indicators for the Refining and Petrochemical Industries;

- Energy Institute, High Pressure/High Temperature Well Planning (2009);

- United Kingdom Offshore Operators Association, Guidelines on a Framework for a Risk Related Decision Support (1999).

The following governmental regulatory agencies have established standards specifically applicable to Process Safety and Risk Management in the oil and gas exploration and production industry:

- United States Minerals Management Service/Bureau of Energy Management Regulation and Enforcement: Code of Federal Regulations 30 CFR Part 250 Lessee Oil and Gas and Sulphur Operations on the Outer Continental Shelf (2009);

- United States Coast Guard:[24] 33 CFR Subchapter N, Outer Continental Shelf Activities, Parts 140-147 and 46 CFR, Shipping;

[24] *See Memorandum of Agreement (MOA) between the Minerals Management Service - U.S. Department Of The Interior and the U.S. Coast Guard - U.S. Department Of Homeland Security*, MMS/USCG MOA: OCS-04, "Floating Offshore Facilities", (Feb. 28, 2008), http://www.uscg.mil/hq/cg5/cg522/cg5222/docs/mou/FLOATING_OFFSHORE_FACILITIES.pdf.

- International Maritime Organization (IMO);[25] International Safety Management Code (ISM Code, 2010);
- Canadian Department of Justice and the Canadian Standards Association: Canada Oil and Gas Installations Regulations – Canada Oil and Gas Operations Act, SOR/96-118, and Canada Oil and Gas Drilling and Production Regulations (SOR/2009-315);
- Norwegian Petroleum Safety Authority: Regulations Relating to Health, Safety, and the Environment in the Petroleum Activities and at Certain Onshore Facilities (The Framework Regulations) (2010);
- Health and Safety Executive-United Kingdom: Offshore Installations (Safety Case) Regulations 2005.

[25] IMO, the International Maritime Organization, is the United Nations specialized agency with responsibility for the safety and security of shipping and the prevention of marine pollution by ships, including Mobil Offshore Drilling Units (MODUs) and drill ships. The United Nations Convention on the Law of the Sea (UNCLOS) creates both an obligation and provides a structure for regulation of offshore activities, which are being pursued by several United Nations organizations. The UNCLOS, which entered into force on November 16, 1994, is a widely accepted treaty, having been accepted by 138 nations (states party) as of October 1, 2002. The convention provides an overall framework for environmental governance of offshore and, to some extent, onshore oil and gas exploration and production operations. States must adopt laws and regulations addressing pollution from vessels that are entitled to fly their flag (i.e., flag states) that are at least as effective as generally accepted international rules and standards. Industry trade organizations have also developed a framework of standards, recommended practices and other guidelines for environmental protection. The principal organizations for the oil and gas industries are the International Organization for Standardization (ISO), the International Association of Oil and Gas Producers (OGP), the International Association of Drilling Contractors (IADC) and the American Petroleum Institute (API). These organizations represent their membership before government and governmental organizations. Spackman, Alan, *Environmental Standards for Offshore Drilling,* International Association of Drilling Contractors (IADC); *Exploration & Production: The Oil & Gas Review* (2003).

In 2001, 2003, and 2005, Professor Bea delivered speeches, power point presentations, and articles discussing these very same principles to BP Management. This consulting work focused on Process Safety generally and BP Management's deepwater drilling practices in the Gulf of Mexico. Professor Bea presented two reports to BP Management: "Human and Organizational Factors in Design and Operation of Deepwater Structures"; "Managing Rapidly Developing Crises: Real-Time Prevention of System Accidents".[26] BP Management knew the principles of Process Safety. Professor Bea told them.

[26] Professor Bea also presented BP Management with another Report it commissioned in 2000 called "Risk Based Life-Cycle Engineering of Pipeline Systems: Human and Organizational Factors."

Section 2. Process Safety and Risk Management Failures at Macondo

2.1 Introduction

The Macondo blowout was a preventable disaster. Moreover, the root cause of the Macondo blowout was not the decisions and mistakes made by the Macondo drilling team during the days and hours leading up to the blowout. Rather, at its root, the Macondo blowout was the result of decisions made by BP Management during the weeks, months, and years preceding the blowout.

BP Management ignored and disregarded Process Safety and Risk Management for deepwater, exploration wells drilled by contractor owned Mobile Offshore Drilling Units (MODUs). Instead, BP Management emphasized cost-cutting ("cost efficiencies"), personal safety, and simply maintaining its "license to operate."

At Macondo, the consequences of BP Management's decisions were predictable. Risks were misunderstood or not identified, policies and procedures were not created and followed, suitable, safety-critical equipment was not maintained, and audits were not conducted or closed out. Identified "gaps" in BP's GoM Operating Management System (OMS) that had been ranked at the highest risk level of importance were numerous. The result, inevitably, was the Macondo blowout.

2.2 BP Management disregarded Process Safety and Risk Management for deepwater exploration wells drilled by contractor-owned MODUs in the Gulf of Mexico.

BP Management plays an integral part in actively managing risks within the organization and has the ultimate discretionary power and decision making authority on how risks are managed and for setting the acceptable level or risk.

Figure 4: BP Group Risk Management Organizational Structure

BP PLC's Board of Directors is ultimately responsible for the organization's risk management and internal control systems.[27] This responsibility is discharged through the Chief Executive, who is required by the Board to operate with a comprehensive system of controls and internal audits to identify and manage risks that are germane to BP's business interests.[28]

The Board discharges its oversight responsibilities through, the Safety, Ethics, and Environment Assurance Committee (SEEAC). The SEEAC ensures that the "processes adopted by BP's Executive Management Team to identify and mitigate significant non-financial risks, including monitoring Process Safety management . . . are appropriate in design and effective implementation."[29] The SEEAC is a sub-committee of the Board of Directors and is comprised solely of non-executive directors.[30] However, SEEAC meetings are regularly attended by various other BP executives, including the Chief Executive, Head of Safety and Operational Risks, and the General Auditor.[31]

Below the Chief Executive, at the Executive Management level, risk is managed by the Group Operations Risk Committee ("GORC").[32] The GORC includes the most senior of all BP leadership. For example, as of April 2010, The GORC included, among other people, BP's Chief Executive, Tony Hayward, Chief Executive of Exploration and Production, Andy Inglis, and Head of Safety and Operational Risks, Mark Bly.[33] The GORC's responsibilities include (1)

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[27] Deposition of Hayward, pp. 164; Deposition of Grounds, pp. 215, 225; Deposition of Castell, pp. 428-429, 431-434; Exh. 2514, BP-HZN-2179MDL01556392; Deposition of Baxter, pp. 181-182, 223-224; Exh. 7179, BP-HZN-2179ML00333155 (BP-HZN-2179MDL00333192); Deposition of Sprague, pp. 483, 489-490; Exh. 785, BP-HZN-2179MDL00650169.

[28] *Id.*

[29] SEEAC Role and Structure (www.bp.com).

[30] *Id.*

[31] *Id.*

[32] BP Sustainability Report 2007. *See also* Deposition of Hayward, pp. 199-200.

[33] *See, e.g.* Group Operations Risk Committee Minutes (Feb. 2010), Exh. 3850, p. 1, BP-HZN-2179MDL02212519.

incident analysis, learning and response; (2) monitoring performance indicators; (3) reviewing delivery of the Six-Point Plan; (4) oversight of development and implementation of OMS; and (5) Oversight of HSE and Operations capability development.[34]

2.2.1 BP Management disregarded the risk of an uncontrolled, deepwater MODU blowout in the Gulf of Mexico.

BP uses a "Group Reporting Line" to identify who is specifically responsible for managing risk within the organization.[35] The Group Reporting Line is a function of the severity level of risk (i.e., the likelihood and consequences of an adverse event – system failure) and is defined by BP's Major Accident Risk ("MAR") Group Practice.[36] Risks above the Group Reporting Line, as defined by the MAR Group Practice, are managed by Senior BP Management.[37] Lower level risks are managed by local operating units.[38]

Figure 5: BP Group Reporting Line

[34] Steve Flynn, *Leading from the Top*, p. 6 (April 28, 2008), Exh. 6002, www.hse.gov.uk/leadership/bpsteveflynn.ppt.

[35] Exh. 1734, pp. 15-17, BP-HZN-2179MDL00407937; Deposition of Kal Jassal, pp. 54-55, 84-85, 347-348.

[36] *Id.*

[37] Deposition of Grounds, pp. 45-47; Exh. 1734, p. 11 (The benefits of the MAR process are . . . [t]he highest risks receive Group level attention . . . ."), BP-HZN-2179MDL00407937.

[38] Deposition of Grounds, pp. 46-47.

As discussed in Section 1, risks above the "Group Reporting Line" are deemed to be in the "Not Fit for Purpose" category – an "unacceptable" or "intolerable" region of risk (Figure 1).[39] Systems whose risks have been determined to be in this region are expeditiously managed[40] so they are in the "Fit for Purpose" category.[41] BP Management's interpretation of the Group Reporting Line is much less definitive and demanding in terms of Process Safety and Risk Management: "*The Group reporting line does not define an acceptable/tolerable level of risk but rather a level of risk that is sufficiently high to warrant Group attention and approval.*"[42] However, prior to the Macondo blowout, even such an ill-defined acceptable level risk was never established by BP Management for the MODUs it was using to drill most of its deepwater, exploration wells in the Gulf of Mexico. [redacted]

Prior to the Macondo blowout, BP Management had identified an uncontrolled, deepwater blowout as one of the highest risks within the organization and the highest risk in the Gulf of Mexico SPU.[44] However, rather than prudently manage that risk BP Management ignored it.[45] Significantly, BP Management did not require contractor-owned MODUs to be incorporated into BP's MAR reviews.[46] This decision was of particular importance to BP's

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[39] "Legal framework considerations in the development of risk acceptance criteria," D.N. D. Hartford, J. of Structural Safety, 31 (2000) 118-223. *Assessing compliance with the law in individual cases and the use of good practice*, Health and Safety Executive website, http://www.hse.gov.uk/risk/theory/alarp2.htm; "Risk Assessment and Management: Challenges of the Macondo Well Blowout Disaster," Robert G. Bea, Deepwater Horizon Study Group Working Paper, January 2011, pp. 21-24.

[40] Proactive, Interactive, and Reactive methods applied to reduce the likelihood and consequences of system failure – or the system removed from service.

[41] *Assessing compliance with the law in individual cases and the use of good practice*, ref: http://www.hse.gov.uk/risk/theory/alarp2.htm.

[42] Major Accident Risk (MAR) Process, BP Group Engineering Technical Practices, GP 48-50, June 2008, BP-HZN-2179MDL00407947.

[43] [redacted]

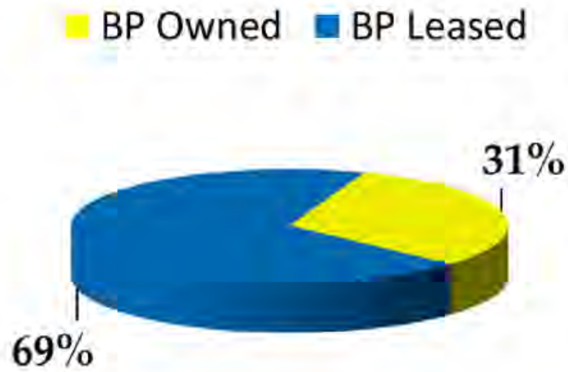
[44] Deposition of Hayward, p. 196.

[45] There does not appear to be any reference to an uncontrolled, deepwater blowout in any of the Board, SEEAC, or GORC minutes prior to April 20, 2010.

[46] Deposition of John Baxter, p. 198; Deposition of Ellis Armstrong, pp. 160 (noting that GORC sets the timetable for MAR reviews). As required by BP Group Defined Engineering Technical Practice GP 48-50, "Major Accident Risk Process," (June 5, 2008), and as approved by BP

deepwater, exploration drilling operations in the Gulf of Mexico. Between October 2004 and April 2010, BP drilled approximately 176 deepwater, exploration wells in the Gulf of Mexico with identifiable rigs.[47] Sixty-nine percent, i.e., more than two-thirds of BP's GoM deepwater wells were drilled by contractor-owned MODUs.[48]

Figure 6: Exploration Wells (Identifiable Rigs)



Thus, the decision not to include MODUs in MAR reviews assured BP Management that it would never be "responsible" for managing drilling Engineered System risks stemming from BP's deepwater, exploration drilling operations in the Gulf of Mexico.[49] BP Management decided that those risks, no matter how high, how unacceptable, or not fit for purpose, would be managed by local organizations. The decision also saved BP Management the time and expense associated with an effort that reportedly would have taken 18 months for each MODU.[50]

Although BP Management decided that the risk of an uncontrolled, deepwater blowout would be managed locally, BP Management made decisions that undermined the ability of the GoM D&C organization to manage the risk of an uncontrolled deepwater blowout.

Management Vice President of Safety and Operations *for implementation across BP Management* (BP-HZN-2179MDL00407937). "The MAR process is a high level quantified risk assessment with a consistent *approach for all BP operations that have the potential to give rise to a major accident*….Inherent in the MAR approach is the principle of continuous risk reduction for risks to people and to the environment. BP Operation leaders are accountable for risk reduction plans in their operation." (BP-HZN-2179MDL00407938) (emphasis added). "BP Management SPA (single point accountability) [for] MAR shall be responsible for 1) ownership of the technical aspects of the MAR process; 2) development of the onshore and offshore MAR Calculators; 3) assignment of the Group reporting line to BP Operations; 4) resolution of issues over scope and applicability of the MAR process, 5) review of MAR reports; and 6) endorsement of MAR study leader competency." (BP-HZN-2179MDL00407948-7949).

[47] *See* Summary of BP Deepwater Drilling Activity in GoM, attached as Appendix "C".

[48] *Id.*

[49] Deposition of Hayward, pp. 132-34; 161-62.

[50] Deposition of John Mogford, pp. 99.

For example, BP Management did not require the GoM D&C organization to be an early adopter of OMS. BP Management controlled the schedule in which OMS was implemented.[51] Moreover, BP Management claimed that OMS was to be implemented on a "risk and resource" basis.[52] However, at the time of the Macondo blowout, while 80% of BP's other operations had implemented OMS, OMS still had not been fully implemented in the GoM D&C organization.[53] Moreover, within the GoM D&C organization, the focus was on implementing OMS on BP owned assets, not MODU's.[54] As a result, at the time of the blowout, the BP's onshore well team was managing risk in much the same as it had prior to the Texas City accident.[55]

Additionally, BP Management delegated responsibility for managing operational risks (i.e., well control) to the MODU contractor.[56] BP, however, retained authority to decide how wells would be designed, how aggressively the wells would be drilled, what changes were to be made during the course of drilling, how to complete and abandon the well, and what the acceptable level of risks for the well would be. All of these BP decisions produced conflicts in authority, responsibility, and management that greatly affected the level of real-time risk on the drill floor (i.e., Process Safety decisions that were effectively beyond the control of its contractor).

And it is clear that even though BP did not own the MODU, Deepwater Horizon, the Macondo well was a BP asset,[57] and BP "owned" the associated risks entailed in drilling it.[58] In short, BP called the shots but refused to accept responsibility for managing the risks and their

[51] Deposition of Ellis Armstrong, pp. 164-65; Deposition of Tony Hayward, pp. 149-150.

[52] Deposition of William Castell, pp. 48-49; Exh. 6247, pp. 2, BP-HZN-2179MDL02004462..

[53] Deposition of Tony Hayward, pp. 155-56; Exh. 6023, pp. 5-6, http://www.bp.com/liveassets/bp_internet/globalbp/STAGINGglobal_Assets/e_s_assets/e_s_assets_2009/downloads_pdfs/safety.pdf.

[54] Exh. 1736, pp. 1-2, BP-HZN-BLY00204248.

[55] Deposition of Patrick O'Bryan, 146-47, 152-53.

[56] Deposition of John Baxter, pp. 74-75, 91-92; Deposition of Patrick O'Bryan, pp. 168; Deposition of Tony Hayward, pp. 132-140, 853, Exh. 6020, BP-HZN-2179MDL00306832.

[57] Testimony of David Sims, BP Drilling and Completions (D&C) Operations Manager, pp. 141, 144, USCG/BOEM Marine Board Of Investigation Into The Marine Casualty, Explosion, Fire, Pollution, And Sinking of Mobile Offshore Drilling Unit Deepwater Horizon, with Loss of Life in the Gulf of Mexico, (August. 26, 2010), http://www.c-spanvideo.org/program/295196-102.

[58] BP's senior drilling engineer, Mark Hafle was the designated "Risk Owner," Exh. 1741, BP-HZN-2179MDL00412928.

potential consequences – risks stemming from their own asset. BP did not develop the Macando well as a coherent, well managed Engineered System but rather as an incoherent, poorly managed collection of "pieces and parts" that promoted propagation and accumulation of Process Safety risks.

Likewise, MODU contractors (and BP employees on contractor owned rigs) were not required to follow OMS or any of BP's predecessor safety management systems.[59] Consequently, MODUs like the Deepwater Horizon were "opted" out of BP's Process Safety and Risk Management processes and procedures the same way as BP's Texas City refinery was "opted" out of BP's post-Grangemouth Process Safety/Integrity Management standard.[60] Both BP and Contractor HSE representatives were focused on occupational (behavioral) safety – not Process Safety on MODUs, just as was the problem in Texas City and Grangemouth.[61]

2.2.2 BP Management emphasized cost over Process Safety.

When Tony Hayward took over as CEO of BP in 2007, he described BP's financial performance as "appalling."[62] Hayward laid out a "*Forward Agenda*" that included "slashing management layers" and "redeploying and removing" staff.[63] As part of his Forward Agenda, Hayward emphasized that BP needed to do a better job of "reducing our overhead" and "managing our third-party spending."[64] Hayward described his forward agenda "as big as anything [BP] has achieved in the last 20 years."[65] According to Hayward, the "mantra" at BP going forward would be "every dollar counts, every seat counts."[66] Hayward embedded a company culture based on cost-cutting, increasing production, and risk-taking rather than

[59] Deposition of John Baxter.

[60] *U.S. Chemical Safety and Hazard Investigation Board Investigation Report: Refinery Explosion and Fire*, Report No. 2005-04-I-TX (March 2007), pp. 150.

[61] Deposition of Curtis Jackson, pp. 19-22, pp. 50-51, 80-82; Deposition of Troy Hadaway, pp. 66-67.

[62] Deposition of Tony Hayward, p. 103.

[63] *Id.* at pp. 108.

[64] *Id.* at pp. 109-110.

[65] *Id.* at 110.

[66] BP Press Release (Feb. 3, 2009).

fostering a safety-based culture. In fact, as stated in the Gulf of Mexico SPU Operating Plan OMS Handbook, a key BP strategy is to foster an "every $ counts culture."[67]

Hayward outlined new plans to slash management from eleven to seven layers, for redeploying some staff and removing others in order to kick start an oil group that he believed had become *overcautious*, despite the fatal Texas City refinery fire and other major accidents in the U.S. In September of 2007 after taking over as CEO, he told Houston GoM SPU management that the company share price performance compared with that of its peers was now at its lowest ebb since 1992. He went on to complain that "assurance is killing us," noting that "too many people were engaged in decision-making leading to excessive cautiousness."[68]

Hayward's cost cutting dictates and leadership tone trickled-down through the organization. For BP Management, total cash costs[69] were reduced by $4 billion from 2008 to 2009, with plans for approximately $1.4 billion in additional reductions in 2010.[70] All told, Hayward's plan was to reduce cash costs by nearly 20% between 2008 and 2010.

2.2.3 BP Management did not monitor drilling Process Safety performance.

As noted above, BP Management is responsible for monitoring safety performance indicators for the organization, including Process Safety indicators.[71] To that end, BP created the HSE & Operations Integrity Report ("Orange Book").[72] The Orange Book is regularly provided to BP Management to track safety performance of the company's highest risks.[73]

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[67] Gulf of Mexico SPU Operating Plan OMS Handbook, EXH. 860, BP-HZN-2179MDL00333159.

[68] Deposition of Tony Hayward, pp. 108-109; EXH. 6014.

[69] BP defines cash costs as "a subset of production and manufacturing expenses plus distribution and administration expenses. They represent the substantial majority of the expenses in these line items but exclude associated non-operating items, and certain costs that are variable, primarily with volumes (such as freight costs). They are the principal operating and overhead costs that management considers to be most directly under their control . . . ." *See* bp.com. The definition is also found on BP's quarterly and full year results.

[70] Exh. 6017, pp. 3.

[71] Deposition of Ellis Armstrong, pp. 84-85.

[72] *Id.* at p. 86.

[73] *Id.* at 88-89, 152-53, 161-62.

The Orange Book tracks personal safety measures such as workforce fatalities, days away from work case frequency, and recordable injury frequency.[74] It also tracks Process Safety indicators, such as fires and explosions, loss of primary containment, flammable gas releases, oil spills, and overdue plant inspections and tests.[75] However, these "indicators" are flawed in a number of key ways.

Significantly, the indicators do not have sufficient specificity to provide meaningful information on drilling Process Safety performance. The indicators are a "one size fits all approach." As such, BP's Cherry Point, Washington refinery uses the same indicators as a BP operated rig drilling in the deepwater off Azerbaijan. Mindful development of relevant Process Safety indicators requires time and thought and must be validated and tailored to specific operations. For example, key "leading" Process Safety indicators for a deepwater drilling operation would include dispensations from standard practices and procedures, frequency and severity of well control events, such as gas kicks, loss of circulation fluids,[76] hydrocarbon leaks, and overdue inspections and maintenance of BOPs. In drilling offshore Norway, operators (including BP) are required by the Petroleum Safety Authority to participate in a long-term Risk Level Project (RNNP) that provides validated "leading and lagging" safety indicators.[77]

Additionally, with the exception of overdue plant inspections and tests, all of BP Management's Process Safety indicators are lagging indicators. Lagging indicators simply show when a desired safety outcome has failed or not been achieved. Leading indicators, however, measure indications that an undesirable outcome is possible. Leading indicators measure the subtle signals indicating that a Process Safety incident may occur. In the context of deepwater drilling, major well events (kicks, lost circulation), overdue BOP inspections and audits for compliance with policies and procedures would be examples of effective leading indicators, as BP had identified in their OMS Gap analysis.[78]

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[74] Exh. 3864, p. G2, BP-HZN-CEC083197.

[75] *Id.*

[76] The Macondo well was plagued with numerous and severe well control events. During its drilling approximately 15,926 bbls. (668,892 gallons) of drilling mud was lost in a series of lost-circulation events. Ref. Exh. 1035, BP-HZN-2179MDL00452101.

[77] Jon Espen Skogdalen, Ingrid B. Utrne, Jan Erik Vinnem, "Looking Back and Forward: Could Safety Indicators Have Given Early Warnings About the Deepwater Horizon Accident?" Deepwater Horizon Study Group Working Paper, Jan. 2011.

[78] EXH. 6025, BP-HZN-2179MDL00650168

2.2.4 BP Management did not audit deepwater, exploration drilling from MODUs in the Gulf of Mexico.

BP Management was responsible for directing Safety and Operational Integrity Audits of BP operations.[79] The purpose of these audits was to ensure that problems were identified and timely closed out.[80] Operations are audited on a 3-year cycle,[81] with the intent of identifying shortcomings in the operations compared to BP's internal standards and regulations, and then develop due dates for those action items to be closed out.[82] The due dates for closing out action items are included in the Orange Book and tracked by BP Management.[83]

The General Auditor for the Safety and Operational Integrity Audits reported to BP Management.[84] Moreover, BP Management controlled the schedule of what operations would and would not be audited.[85] Prior to the Macondo blowout, BP performed Safety and Operational Integrity audits on BP owned drilling rigs in the Gulf of Mexico.[86] However, BP Management decided that contractor-owned MODUs like the Deepwater Horizon would not be audited.[87] In effect, BP Management decided to disown the major accident risks associated with nearly 70% of BP's deepwater, exploration wells in the Gulf of Mexico.

2.3. BP Management knew it failed to assess and manage risk for its Gulf of Mexico deepwater drilling operations even before the Macondo blowout.

BP Management's knowledge about the Process Safety risk of drilling operations was quite specific. In 2001, BP Management hired Professor Bea as a consultant. Professor Bea made a presentation in London to then CEO John Brown's Executive Committee as well as BP U.S. Business Unit Leaders. At the meeting, BP Management expressed three specific problems.

[79] Deposition of John Baxter, pp. 226-27.

[80] *Id.* at 227.

[81] Deposition of James Wetherbee, p. 26; Deposition of Ellis Armstrong, pp. 174-76.

[82] Deposition of James Wetherbee, p. 26.

[83] *Id.* at 26-27.

[84] Deposition of John Baxter, p. 228.

[85] Deposition of Ellis Armstrong, p. 173.

[86] Deposition of Kal Jassal, pp. 174-75.

[87] Deposition of John Baxter, pp. 235-36; Deposition of Kal Jassal, pp. 173-74.

First, BP Management expressed problems they were having with the leadership of the U.S. companies (Amoco, Arco, and Vastar) that it had recently acquired. BP Management was experiencing communication difficulties and problems with decision making – represented by BP as a "clash of corporate cultures".

Second, BP Management expressed to Professor Bea that it had experienced a "loss of core competencies," meaning that it no longer retained a "sufficient stock" of experienced engineering and operating personnel at its U.S. assets. Included in this concern was BP Management's decision to eliminate the program for testing and obtaining advanced technology.

Third, BP Management expressed to Professor Bea that it had downsized and outsourced so much that BP was showing signs of "brittle tendencies," meaning that BP Management was not able to function properly when it encountered a serious organizational challenge.

BP Management knew all three of these problems were caused by its decision to cut costs, its decision to down size, and its decision to focus on production to the detriment of responsible management. BP Management also knew that these decisions created Process Safety dangers. BP Management knew this because Professor Bea told them. Professor Bea told BP Management three times that it was headed for disaster.

In 2005, BP Management again retained Professor Bea as a consultant for deepwater drilling in the Gulf of Mexico. Professor Bea explained to BP Management the need to understand the risk in order to develop Process Safety. Professor Bea explained to BP Management that first it must know whether the risk exists and, if so, the extent to which the risk is acknowledged and appropriately mitigated and/or minimized. To achieve this end, Professor Bea explained, proactive, reactive, and interactive barriers must be achieved and constantly maintained.[88] And that it must be done in the Gulf of Mexico.

[88] The 2001 and 2005 series of lectures presented to and commissioned by BP Management resulted in numerous power point presentations. They are as follows: (1) "Organizational Factors" (2005); (2) "Implementation" (2005); (3) "Implementation of High Reliability Organizations (HRO) Developments in BP/Amoco Operations" (2001); (4) "What is an HRO?"; (5) "Measuring High Reliability Organizations (HRO) Developments in Operations with QMAS (Quality Management Assessment Systems)"; (6) "Importance of HRO Developments in BP Operations GVP Discussion Details"; (7) "Operational Excellence – High Reliability Organization"; (8) "Operations Excellence Cross-Stream Collaboration Model" (BP-London) (2001); and (9) "How do Organizations Become an HRO?".

Section 3. BP's Process Safety and Risk Management Culture

3.1 Introduction.

During the ten years preceding the Macondo blowout, BP had three major accidents at its oil and gas handling facilities. These accidents exposed common organizational and systemic flaws in BP's Process Safety and Risk Management stemming from a poor safety (protection) culture that placed profits before prudence. The organizational and systemic causes of these major accidents are virtually identical to the systemic and organizational causes of the Macondo blowout. As a result, these major accidents shed light on why the Macondo blowout occurred and add context to the management decisions that caused the Macondo blowout.

3.1.1 Grangemouth, Scotland Refinery, Texas City Refinery, and Prudhoe Bay Pipeline.

Grangemouth, Scotland Refinery (2000). From May 29th to June 10th three sequential accidents occurred at BP's Grangemouth Complex (UK). The power distribution failed (May 29th); the medium pressure (MP) steam main ruptured (June 7th); and the Fluidized Catalytic Cracker Unit (FCCU) caught fire (June 10th). Each incident had the potential to cause fatal injury and environmental impact, although no serious injury occurred, and there was only short term impact on the environment.[89]

As a result of the three incidents, BP pled guilty to two criminal charges and was fined £1,000,000.[90] Prior to this, BP had pled guilty to charges under the U.K. Health and Safety at Work Act and was fined £500,000 for a "devastating explosion" on March 22, 1987 that killed one contract worker during the start-up of their Hydrocracker Unit.[91] This powerful explosion fragmented a pressure vessel, igniting fires and sending one piece of flying debris weighing approximately 3 tons more than 1100 meters (3600 ft.). Damage to the complex was reportedly $78,500,000 (1987) [+ $158,000,000 (2011)].[92,93]

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[89] Major Incident Investigation Report: BP Grangemouth, Scotland (Aug. 18, 2003), pp. 4.

[90] *Id.*

[91] *Id.* at 95.

[92] Marsh & McLennan Protection Consultants (M&M PC), Large Property Damage Losses in the Hydrocarbon-Chemical Industries, pp. 11 (1993).

Texas City Refinery (2005). On March 23, 2005, BP's Texas City refinery suffered one of the worst industrial disasters in recent U.S. history, again during a unit start-up.[94] Explosions and fires killed 15 people and injured another 180 workers. The accident occurred during the start-up of an isomerization (ISOM) unit when a 164 foot high raffinate splitter tower was overfilled. Pressure relief devices opened, resulting in a highly flammable hot liquid-geyser that was discharged to the atmosphere from an atmospheric vent that was not connected to the refinery's flare system.[95] The release of flammables led to an explosion and fire. All of the fatalities occurred in or near office trailers located too close to the blowdown drum.[96]

In 2009, as a result of the Texas City explosion, BP pled guilty to felony violations of the Clean Air Act, was fined $50,000,000, and was placed on three years of probation.[97] Over a 30 year period spanning BP and AMOCO ownership of the refinery, 23 workers were killed in the refinery in addition to the 15 who lost their life on March 23rd.[98] Just a few months before, on September 2, 2004, two pipe fitters were killed and a third badly burned while performing maintenance and repair work. Since March 23, 2005, several more workers have been killed in various accidents.[99]

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[93] Dollar Loss Value in 2011 is based on an inflation rate of 101.3% from March 1987 to June 2011. See http://inflationdata.com/inflation/Inflation_Calculators/Inflation_Calculator.asp#calcresults

[94] U.S. Chemical Safety and Hazard Investigation Board, Investigation Report: Refinery Explosion and Fire, Report No. 2005-04-I-TX (March 2007), Exh. 6012, p. 17.

[95] *Id.* at 17, 22, and pp. 114-121. The raffinate splitter tower is a distillation column that takes raffinate, a non-aromatic predominately straight-chained hydrocarbon mixture, and separates it into light and heavy components, i.e., distills and separates components such as pentane and hexane for gasoline blending. The hot liquid raffinate that discharged from the atmospheric vent rapidly vaporized forming both a ground-level liquid pool and a large flammable vapor cloud that became ignited by a nearby vehicle with its diesel engine running. During the 15 years prior to the March 2005 incident, a number of proposals were made to remove blowdown stacks that vent directly to the atmosphere at the Texas City refinery, but none were implemented, primarily due to cost considerations.

[96] Exh. 6012, pp. 17.

[97] *United States v. BP Products N. Am. Inc.*, Crim. H-07-434, 2008WL 501321 (S.D. TExh. 2/21/08); EXH. 6006, pp. 1-3.

[98] U.S. Chemical Safety Board News Release, "U.S. Chemical Safety Board Concludes "Organizational and Safety Deficiencies at All Levels of the BP Corporation" Caused March 2005 Texas City Disaster That Killed 15, Injured 180," March 20, 2007.

[99] In July 2006, a contract worker was crushed to death against the basket of an aerial lift while doing work prompted by the 2005 blast. In June 2007, a contract worker was electrocuted while

Prudhoe Bay Pipeline (2006). In March 2006, a year after the Texas City explosion, a leak was discovered in a BP Prudhoe Bay crude oil pipeline on Alaska's North Slope.[100] This resulted in a spill of over 200,000 gallons of crude oil.[101] As a result of the spill, in 2007, BP pled guilty to criminal violations of the Clean Water Act, was ordered to pay $20,000,000.00 in fines and restitution, and was placed on three years of probation.[102]

Collectively, the above major accidents resulted in nearly 20 deaths,[103] hundreds of injuries,[104] the release of hundreds of thousands of gallons of gas and oil into the environment, and billions of dollars in fines, restitution, injury settlements, property damage, and probation.[105]

Each of these major accidents was the subject of extensive investigations by BP, government regulators, and independent panels. Each of the investigations into these major accidents reached the same conclusion: BP's Process Safety and Risk Management is fundamentally flawed and incapable of preventing major accidents.[106]

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working on a lighting circuit in one of the units. In January 2008, the top blew off a water filter, killing a BP supervisor. In October 2008, a contract worker was killed after being struck by the bucket of a backhoe. Ref. *Blast at BP Texas Refinery in 2005 Foreshadowed Gulf Disaster*, Ryan Knutson, ProPublica, July 2, 2010; http://www.propublica.org/article/blast-at-bp-texas-refinery-in-05-foreshadowed-gulf-disaster.

[100] Alaska Department of Environmental Conservation: Situation Report, EXH. 869, pp. 1.

[101] *Id.*

[102] Exh. 6008, pp. 1-5.

[103] *Id.*

[104] U.S. Chemical Safety and Hazard Investigation Board Investigation Report: Refinery Explosion and Fire, Report No. 2005-04-I-TX (March 2007), Exh. 6012, pp. 17.

[105] In addition to the fines listed above, BP also set up a $2.1 billion fund to compensate over 4,000 affected by the Texas City refinery explosion. See BP to Pay Record Fine for Refinery, New York Times, Aug. 12, 2010 available at http://www.nytimes.com/2010/08/13/business/13bp.html.

[106] For the Grangemouth incident, the investigations discussed herein include: Major Incident Investigation Report: BP Grangemouth, Scotland (Aug. 18, 2003), pp. 69; Broadribb, Michael, Lessons from Grangemouth: A Case History (2004), Exh. 6011. For Texas City Refinery incident, the investigations discussed herein include: U.S. Chemical Safety and Hazard Investigation Board, Investigation Report: Refinery Explosion and Fire, Report No. 2005-04-I-

3.2 BP Management disregarded Process Safety and Risk Management at Grangemouth, Texas City, and Prudhoe Bay.

Management is ultimately responsible for Process Safety and Risk Management within an organization.[107] In particular, "[m]anagement provides leadership in establishing goals and performance measures, demands accountability for implementation, and provides necessary resources for carrying out an effective program."[108]

The investigations into the Grangemouth, Texas City, and Prudhoe Bay accidents laid the blame for each of the accidents at the feet of BP Management.[109] Each of the investigations concluded that BP Management incentivized and emphasized the wrong things (i.e., production over protection) and did not adequately oversee and manage the Process Safety risks within the organization. In short, the investigations concluded that BP Management ignored Process Safety and Risk Management.

3.2.1 BP Management emphasized and incentivized a culture that placed profits over safety.

Upper-level management plays a central role in Process Safety and Risk Management. Management establishes and provides "goals," "performance measures," and "resources" for Process Safety and Risk Management processes and procedures.[110] As discussed previously, one of the most important performance measures is adequate recognition of the costs and benefits of developing and maintaining effective Process Safety and Risk Management processes and procedures.

TX (Mar. 2007), Exh. 6012, pp. 17; The Report of the BP U.S. Refineries Independent Safety Review Panel (Jan. 2007); The Report of the BP U.S. Refineries Independent Safety Review Panel (Jan. 2007); *BP Texas City Site Report of Findings*, Texas City's Protection Performance, Behaviors, Culture, Management, and Leadership, Jan. 21, 2005, ref. BPISOM00122318 . For the Prudhoe Bay Pipeline incident, the investigations discussed herein include Booz-Allen Management Systems Review: BP America Inc. Final Report (March 2007), Exh. 6013.

[107] API Recommended Practice 75, p. 25. *See also* Deposition of Jassal pp. 123.

[108] *Id.* at 26.

[109] As used herein, BP Management refers to the senior managers and leadership within BP, including the Board of Directors, Chief Executive, and Executive Management team.

[110] API RP-75.

Each of the investigations concluded that BP Management focused disproportionately on profits and cost-cutting goals and, thus, refused to provide its line managers, engineers, and operating personnel with the necessary resources to effectively manage Process Safety risks:

MANAGEMENT FOCUS ON PROFITS AND COST-CUTTING		
2000 GRANGEMOUTH	**2005 TEXAS CITY**	**2006 PRUDHOE BAY**
"The tendency was to place relatively high emphasis on short-term benefits of cost and speed and to be readier to make compromises over longer-term issues like plant reliability." (UK HSE) "There was too short a focus on short term cost reduction . . . and not enough focus on longer-term investment for the future. HSE was unofficially sacrificed to cost reductions, and cost pressures inhibited staff from asking the right questions; eventually staff stopped asking . . . The safety culture tolerated this state of affairs, and did not 'walk the talk.'" (BP)	"Cost-cutting, failure to invest and production pressures from BP Group executive managers impaired Process Safety performance at Texas City." (CSB) "Good Process Safety performance requires adequate resources, including funding . . . . BP has [not] always ensured that the resources required for strong Process Safety performance at its U.S. refineries were identified and provided . . . The Texas City refinery illustrates this point. From 1992 to the 1998 merger with BP, Amoco consistently and significantly cut costs in the Texas City refinery." (Baker) " Although leadership stated "safety first", this was not evidenced or believed by many of the workforce." (BP)	BPXA had a deeply ingrained cost management ethic as a result of long periods of low oil prices, constrained budgets, and multiple cost/headcount reduction initiatives. CIC made important project and activity tradeoff decisions to meet its budget targets. Budget pressure eventually led to de-scoping some projects and deferring others. For example, the plan to run a smart pig in the OTL was dropped in 2004 and 2005.

Similarly, each investigation concluded that, when emphasizing safety goals, BP Management did not emphasize Process Safety measures, choosing instead to focus on more easily measurable safety parameters such as personal safety:[111]

[111] Personal safety hazards, on the other hand, affect individuals but have little to do with the processing activity of the plant. Typically they give rise to incidents such as falls, trips, crushing incidents, electrocutions and vehicle accidents. *See* Andrew Hopkins, Working Paper 53: Thinking about Process Safety Indicators (May 2007), pp. 3.

MANAGEMENT FOCUS ON PERSONAL SAFETY OVER PROCESS SAFETY		
2000 GRANGEMOUTH	**2005 TEXAS CITY**	**2006 PRUDHOE BAY**
"There was a more optimistic perception of safety performance than might be borne out by comparison with different performance indicators. This was due to real and commendable success in managing personal injury rates down to a very low level*, **together with a failure to adequately distinguish these successes from Process Safety management**.*" (UK HSE) "With no formal structure or specific focus on Process Safety, many of the components of Process Safety management (PSM) were not formalized at Grangemouth. There was no site governance structure to provide overview and assurance that Process Safety issues were being handled appropriately. ***Process Safety needed to be elevated to the same level as personal safety.***" (BP)	"BP incorporated the Refining and Marketing GHSER performance targets in performance contracts with business units and personal contracts with Group and business unit leadership. The performance contracts were used to evaluate personnel and impacted managers' compensation. The contracts consisted of weighted metrics for categories such as financial performance, plant reliability, and safety. The largest percentage of the weighting was in financial outcome and cost reduction. The safety metrics included fatalities, days away from work case rate, recordable injuries, and vehicle accidents; ***Process Safety metrics were not included.***" (CSB) "The safety measures were primarily focused on lagging indicators for personal or occupational safety, such as Days Away From Work Cases (DAFWC – lost time) and Recordable Injury frequency (RIf). ***There was no obvious priority or management focus on KPIs for Process Safety.***" (BP)	"***2006 ALT Performance Contracts included metrics for recordable injury frequency (RIF) as the only explicit target for risk management.*** Other metrics had implicit risk elements, such as operating efficiency and production, but the only metric specifically linked to integrity risk was the integrity spend (Gross Opex) target for the GPB Field Manager. There were a few integrity-related milestones, but these related to the implementation of the IM standard."

3.2.2 BP Management did not oversee and monitor Process Safety risks.

Leadership is critical to Process Safety and Risk Management.[112] This includes the oversight and monitoring of Process Safety risks within an organization. In particular, management must "appoint specific representatives who will be responsible for establishing, implementing and maintaining" Process Safety and Risk Management processes and

[112] API Recommended Practice 75.

procedures.[113] Likewise, management must develop an "organizational structure that define[s] responsibilities, authorities, and lines of communication required to implement the [Process Safety and Risk] management program."[114] The investigations into the Grangemouth, Texas City, and Prudhoe Bay incidents all concluded that BP Management failed as leaders and did not provide adequate oversight and monitoring of Process Safety risks within the organization.

For instance, in the Grangemouth, Texas City, and Prudhoe Bay incidents BP Management's lack of oversight and refusal to intervene in clearly deteriorating situations was cited as a critical factor in each incident:

LACK OF OVERSIGHT BY MANAGEMENT		
2000 GRANGEMOUTH	**2005 TEXAS CITY**	**2006 PRUDHOE BAY**
"BP and Complex Management did not detect and intervene early enough on deteriorating performance" (UK HSE)	"Warning signs of a possible disaster were present for several years, but company officials did not intervene effectively to prevent it." (CSB) "BP's executive management either did not receive refinery-specific information that suggested Process Safety deficiencies at some of the U.S. refineries or did not effectively respond to the information that they did receive." (Baker)	"Risk related vertical and horizontal communications do not elevate critical risk data to senior leadership and, in some cases, preclude the efficient exchange of information related to corrosion."

In addition to poor oversight, each investigation concluded that BP's organizational structure, frequent reorganizations, and personnel shuffling created unclear accountabilities. Resulting in situations where no one truly "owned" the Process Safety and Risk Management System:

113 *Id.*

114 *Id.*

ORGANIZATIONAL STRUCTURE, REORGANIZATION, AND PERSONNEL SHUFFLING		
2000 GRANGEMOUTH	**2005 TEXAS CITY**	**2006 PRUDHOE BAY**
"Significant organizational and personnel changes had occurred at the management, superintendent, supervisor, and operator/technician levels over a number of years. However, new roles and responsibilities had not been formally reviewed against the old roles and responsibilities. In the absence of comprehensive mapping of tasks, certain former tasks were missed and were no longer anyone's formal responsibility." (BP)	"After the BP South Houston complex was formed, a series of leadership changes occurred . . . The impact of these ineffectively managed organizational changes on Process Safety was summed up by the Telos study consultants: 'We have never seen an organization with such a history of leadership changes over such short period of time. Even if the rapid turnover of senior leadership were the norm elsewhere in the BP system, it seems to have a particularly strong effect at Texas City. Between the BP/Amoco mergers, then the BP turnover coupled with the difficulties of governance of an integrated site… there has been little organizational stability. This makes the management of protection very difficult.'" (CSB)	"BPXA senior management tenure averaged roughly three years. This lack of continuity contributed to perceptions of disconnection between the Alaska Leadership Team and BPXA operating management and staff." "There was no single owner of the OTL as a system. Accountability for them was divided geographically among the six GPB area managers."

3.3 BP Management's disregard for Process Safety and Risk Management resulted in predictable and preventable Process Safety incidents at Grangemouth, Texas City, and Prudhoe Bay.

Process Safety and Risk Management is "top down," meaning that the tone set by management cascades through an organization. When an organization's top level management refuses to provide effective Process Safety and Risk Management focus and leadership, the Engineered Systems within the organization fail in predictable ways. Risks are not properly identified and assessed, barriers fail or are not put in place, and, inevitably, Process Safety incidents occur.

In the cases of Grangemouth, Texas City, and Prudhoe Bay, BP Management's refusal to focus on and provide leadership in Process Safety and Risk Management resulted in expected and common Process Safety failures. Risks were poorly identified and barriers failed in expected ways, with tragic consequences. The degree of commonality between these failures, which involved different operations separated by thousands of miles, is indicative of the systemic and organizational flaws in BP's Process Safety and Risk Management culture.

3.3.1 BP's Grangemouth, Texas City, and Prudhoe Bay facilities ignored Process Safety risks.

Risk identification and assessment is the foundation of Process Safety and Risk management. The purpose of risk identification and assessment is to "identify, evaluate, and where unacceptable, reduce the likelihood and/or minimize the consequence of uncontrolled releases and other safety or environmental incidents."[115] Risk assessment and identification should employ disciplined, systematic, verifiable approaches.[116]

The line managers, engineers, and operating personnel involved in BP's Grangemouth, Texas City, and Prudhoe Bay operations were plagued by an inability to see and assess risk. In many cases risk identifications and assessments on critical equipment and operations were never done. When done, the risk identifications and assessments were often ineffectual. The blindness of line managers, engineers, and operating personnel to major risks was cited as a key factor in each of the investigations into the Grangemouth, Texas City, and Prudhoe Bay accidents:

BLINDNESS TO RISK		
2000 GRANGEMOUTH	**2005 TEXAS CITY**	**2006 PRUDHOE BAY**
"Process Safety review used elsewhere in BP for major accident hazard installations review (to analyse installation condition and ensure prevention of major incidents) was not used and no effective equivalent procedure was in place"	"Risk assessment was 'often incomplete,' that business units did not understand or address major hazards, and that competency in risk and hazard assessment was poor." (CSB) "The fourth cultural issue is the inability to see risks and, hence, toleration of a high level of risk. This is largely due to poor hazard/risk identification skills throughout management and the workforce, exacerbated by a poor understanding of Process Safety." (BP)	"There was no formal, holistic risk assessment process for pipeline integrity. BPXA relied on inspection results and the experience and expertise within CIC to assess and manage corrosion risk." "None of the risk assessment and risk management processes or tools in use at BPXA for pipelines explicitly addressed root cause ex ante. Root causes were well evaluated as part of the incident analyses ex post."

[115] *Id.*

[116] Guidelines for Chemical Process Quantitative Risk Analysis, Center for Chemical Process Safety (1989); Guidelines for Preventing Human Error in Process Safety, Center for Chemical Process Safety (1994).

3.3.2 BP's oil and gas handling facilities did not have effective Process Safety barriers.

As noted previously, barriers play a critical role in preventing and mitigating Process Safety accidents. Barriers can take many forms. A barrier may consist of a piece of equipment, a policy or procedure, training, audits, emergency response, or lessons learned from prior accidents. The single most important thing in realization of effective barriers are knowledgeable, experienced, and properly motivated and resourced people and organizations.

3.3.2.1 BP did not perform effective audits at Grangemouth, Texas City, and Prudhoe Bay.

Audits are an important part of Process Safety and Risk Management. The purpose of an audit is to determine whether Process Safety and Risk Management processes and procedures have been "properly implemented and maintained and to provide information on the results of the audit to management."[117] Among other things, audits determine whether equipment and operations are in line with an organization's expectations, policies, and procedures. To be effective, audits must be "closed loop," meaning there "should [be] a system to determine and document the appropriate response to the findings and assure satisfactory resolution.[118] Grangemouth, Texas City, and Prudhoe Bay were all plagued by ineffective and non-existent audits:

[117] API Recommended Practice 75.

[118] API Recommended Practice 75.

FAILED AUDITS		
2000 GRANGEMOUTH	**2005 TEXAS CITY**	**2006 PRUDHOE BAY**
"Grangemouth did not have a structured and comprehensive audit program to provide assurance around its key HSE risks." (UK HSE) "Over the years a number of maintenance and reliability reviews, task forces and studies had been conducted, but many of the recommendations had not been implemented. There was a maintenance backlog and mechanical integrity testing was not prioritized to ensure that safety critical equipment received timely preventative maintenance." (BP)	"The Panel's technical reviews found that during the past few years all five refineries had significant numbers of action items that were not completed within a reasonable period of time, as well as backlogs of overdue action items—some as long as many months or years overdue. The Panel considers BP's tolerance of repeat findings and the chronic failure to correct deficiencies identified by audits, incident investigations, and hazard assessments as a serious systemic deficiency." (Baker)	"Remediation of audit and assessment findings (internal, EMS, HSE) relied on a self-verification model where business was responsible for implementing corrective actions. In addition, the consequences for not complying with processes and practices were not clear. The absence of third-party verification and sanction led to long delays in implementation, administrative documentation of close-out even through remedial actions were not actually taken, or simple non-compliance."

3.3.2.2 BP's oil and gas handling facilities did not create, follow, and update safety critical procedures.

BP's ineffective audits of its oil and gas handling facilities had ripple effects throughout its organization, resulting in common themes and failures in the Grangemouth, Texas City, and Prudhoe Bay accidents. Chief among these failures was a lack of understanding of the importance of policies and procedures. Policies and procedures are important barriers to Process Safety accidents.[119] In particular, policies and procedures are "the way that up-to-date technical information gets built into day-to-day operations."[120] Management must insist that policies and procedures be created and followed.[121] The simplest and easiest way to accomplish this is through effective audits. However, at Grangemouth, Texas City, and Prudhoe Bay, in the absence of effective audits, policies and procedures for safety critical operations either did not exist, were not updated, or were not followed:

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[119] Deposition of Samuel Defranco, p. 57.

[120] *Id.* at pp. 56-59.

[121] Deposition of Samuel Defranco, pp. 24-25.

FAILED POLICIES AND PROCEDURES		
2000 GRANGEMOUTH	**2005 TEXAS CITY**	**2006 PRUDHOE BAY**
"Insufficient management attention and resources was given to maintaining and improving technical standards for process operations and enforcing adherence to standards, codes of practice, good engineering practice, company procedures and the HSE guidance" "The three incidents would not have occurred if BP's high standards and policies and procedures been followed consistently . . . ." (UK HSE)	Texas City management did not emphasize the importance of following procedures as evidenced by its lack of enforcement of the MOC policy, its acceptance of procedural deviations during past startups, and its failure to ensure that the procedures remained up-to-date and accurate. "Outdated and ineffective procedures did not address recurring operational problems during startup, leading operators to believe that procedures could be altered or did not have to be followed during the startup process." (CSB)	"CIC's corrosion management strategy was developed in the late 1990s, and had not been substantially reviewed or revised until now, despite specific direction in a 2004 internal technical audit to do so." "The emergency shut-in procedures lack clarity and enforcement."

3.3.2.3 BP did not maintain suitable, safety critical equipment.

BP's ineffective audit system, combined with cost cuts by management, also undermined the quality assurance and mechanical integrity of safety critical equipment at BP's Grangemouth, Texas City, and Prudhoe Bay facilities. A Process Safety and Risk Management system should "require that procedures are in place and implemented so that critical equipment for any facility is designed, fabricated, installed, tested, inspected, monitored, and maintained in a manner consistent with appropriate service requirements, manufacturer's recommendations, or industry standards."[122] With no "closed loop" audit system and inadequate funding, integrity problems identified in safety critical equipment at Grangemouth, Texas City, and Prudhoe Bay were not timely repaired or corrected:

[122] API Recommended Practice 75.

INTEGRITY MANAGEMENT FAILURES		
2000 GRANGEMOUTH	**2005 TEXAS CITY**	**2006 PRUDHOE BAY**
"Over the years a number of maintenance and reliability reviews, task forces and studies had been conducted, but many of the recommendations had not been implemented. There was a maintenance backlog and mechanical integrity testing was not prioritized to ensure that safety critical equipment received timely preventative maintenance." (BP)	"Deficiencies in BP's mechanical integrity program resulted in the "run to failure" of process equipment at Texas City." (CSB) Several instruments in the ISOM raffinate splitter section failed, likely due to inadequate maintenance and testing, contributing to the incident. (CSB)	"Pipe integrity root causes . . . inadequate maintenance pigging planning." "Maintenance program does not sufficiently address wear and breakage on system." "Pig launchers, receivers, and slug catchers are inoperable or do not exist."

3.3.2.4 BP did not learn from prior incidents and near misses.

Process Safety and Risk Management must be "evergreen," meaning that Engineered Systems must constantly be reviewed, assessed, and updated. A critical part of this process is accident investigations and lessons learned. Process Safety and Risk Management processes and procedures should require "investigation of all incidents with serious safety or environmental consequences."[123] "The intent of the investigation should be to learn from the incident and help prevent similar incidents."[124] Management "should implement a system whereby conclusions of investigations are distributed to similar facilities and/or appropriate personnel within their organization."[125] When performed effectively, investigations and lessons learned act as a barrier to future Process Safety accidents.

The Grangemouth, Texas City, and Prudhoe Bay incidents all revealed fundamental failures in BP's investigation of and learnings from prior incidents and near misses. Importantly, learnings from major industry incidents were not disseminated throughout the organization. Further, near misses and other incidents were not properly investigated and lessons learned were not incorporated.

[123] *Id.*

[124] *Id.*

[125] *Id.*

For example, during its investigation of the Grangemouth incidents, the United Kingdom's Health & Safety Executive noted that:

> Learnings from major chemical industry accident reports (Texaco and Associated Octel) were not adequately actioned. On-site loss of containment incidents of relevance to the FCCU incident were not properly analyzed and actioned.[126]

The Chemical Safety Board made similar findings during its investigation of the Texas City explosion, emphasizing that:

> In the years prior to the incident, eight serious releases of flammable material from the ISOM blowdown stack had occurred, and most ISOM startups experienced high liquid levels in the splitter tower. Neither Amoco nor BP investigated these events.[127]

However, following the Texas City explosion, the most pejorative statements regarding BP's inability to learn from prior accidents were directed at BP's refusal to learn from the Grangemouth incidents. For example, the Chemical Safety Board stated:

> BP Group did not systematically review its refinery operations and corporate governance worldwide to implement needed changes identified in the Health and Safety Executive report and in its own Task Force report, even though the Group Chief Executive told staff in October 2000 edition of BP's in-house magazine that BP would learn lessons from Grangemouth and other incidents. The CSB found that a number of managers, including executive leadership, had little awareness or understanding of the lessons from Grangemouth. Moreover, BP Group leadership did not ensure that necessary changes were made to BP's approach to safety. They did not effectively address the need for greater focus on PSM, including measuring PSM performance, nor did they resolve problems associated with BP's decentralized approach to safety.[128]

The Baker Panel echoed the concerns of the Chemical Safety Board, emphasizing that the similarities between the Texas City and Grangemouth incidents were disturbing:

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[126] Major Incident Investigation Report: BP Grangemouth, Scotland (Aug. 18, 2003), pp. 65.

[127] U.S. Chemical Safety and Hazard Investigation Board Investigation Report: Refinery Explosion and Fire, Report No. 2005-04-I-TX (March 2007), Exh. 6012, pp. 25.

[128] *Id.* at 145-46.

> "In addition, the Panel observes that many of the Process Safety deficiencies it identified during its review are not new to BP. Many of these same deficiencies were identifiable to BP based upon lessons from previous Process Safety incidents, including three major process incidents that occurred at BP's petrochemical complex in Grangemouth, Scotland in 2000 . . . The Panel considers the similarities between the "lessons" from Grangemouth and the Texas City incident to be striking . . . Although the incidents occurred five years apart at different sites in different countries, many of the underlying deficiencies identified after the incidents appear to be the same . . . ."[129]

Moreover, the Baker Panel roundly criticized BP's investigation practices, noting that BP refused to ensure that "management" or systemic causes of accidents were consistently investigated:

> The Panel is concerned, however, that BP's investigations may miss systemic causes by considering only causes in a direct, linear chain of causation . . . The Panel's review . . . raises questions regarding the adequacy and thoroughness of BP investigations into incidents and near misses, especially as BP's investigations relate to root cause analysis and the identification of multiple causes . . . In the situation in which true root causes are not identified, proposed corrective action likely will address immediate or superficial causes, but not the true root cause. In such cases, corrective action may be ineffective to prevent future incidents arising from the same root causes.[130]

3.4 BP Management has not changed BP's Process Safety and Risk Management culture.

BP Management's responses to the Grangemouth, Texas City, and Prudhoe Bay incidents were similar in nature and result. After each incident, BP Management promised to fundamentally change the way BP operated in order to prevent similar incidents. However, following these promises BP Management continued to make decisions that fundamentally undermined BP's ability to change its Process Safety and Risk Management culture.

For instance, following the Grangemouth accidents, BP's then CEO, Lord John Browne, publicly promised that BP would learn the lessons of Grangemouth and would do whatever it

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[129] The Report of the BP U.S. Refineries Independent Safety Review Panel (Jan. 2007), pp. 183-84.

[130] *Id.* at 198.

takes to prevent similar accidents from happening again.[131] One of the centerpieces of BP's response to the Grangemouth incident was BP's development of a group wide "standard" for Process Safety and Integrity Management in May 2001.[132] However, BP allowed the Texas City refinery to "opt out" of the new standard.[133] Thus, one of the critical "changes" that BP made following Grangemouth was *never incorporated* into BP's operations at Texas City.

Likewise, following the Texas City and Prudhoe Bay incidents, BP again promised to do whatever it took to prevent similar accidents from occurring again.[134,135] Publicly, BP's CEO, Lord John Browne, described Texas City explosion as a "watershed"[136] event in BP's history and "the worst tragedy in the recent history of BP."[137] Moreover, Browne said the responsibility for changing BP rested with him and his successor, Tony Hayward:

> If I have one thing which I hope you will all hear today, it is this: *BP gets it, and I get it, too.* This has happened on my watch, as Chief Executive I have responsibility to learn from what has occurred. I recognise the need for improvement, and *that my successor, Tony Hayward, and I need to take a lead in putting that right by championing Process Safety as the foundation of BP's operations.*[138]

After taking over as CEO, Hayward agreed with Browne's comments, noting that Texas City had been "transforming" for the company and a "catalyst" for "deep-rooted" change.[139]

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[131] Deposition of Tony Hayward, pp. 63.

[132] Major Incident Investigation Report: BP Grangemouth, Scotland (Aug. 18, 2003), pp. 69.

[133] U.S. Chemical Safety and Hazard Investigation Board Investigation Report: Refinery Explosion and Fire, Report No. 2005-04-I-TX (March 2007), pp. 150.

[134] Alaskan Oil Pipeline Leak Raises Environmental Concerns, PBS Newshour (Aug. 8 2006).

[135] BP to Appoint Independent Panel to Review U.S. Refinery Safety, BP Press Release (Aug. 17, 2005).

[136] Statements by John Browne, Baker Panel Conference Call (Jan. 16, 2007).

[137] BP to Appoint Independent Panel to Review U.S. Refinery Safety, BP Press Release (Aug. 17, 2005).

[138] Statements by John Browne, Baker Panel Conference Call, Jan. 16, 2007, (emphasis added).

[139] An audience with . . . Tony Hayward, The BP Magazine, Issue 1 2008.

Publicly, other BP executives reiterated Browne and Hayward's statements. In 2006, John Mogford,[140] BP's head of safety, commented that:

> BP has learned many lessons from its investigations into the explosion which killed 15 workers and injured scores more. Its findings, plus investigations into recent leaks in Alaska's Prudhoe Bay pipeline, have led to a frank and thorough examination of BP's global approach to safety, operations, environmental management and technical integrity, and to the start of a long journey of transformation. *The destination? A place where a tragedy such as Texas City will never happen again.*[141]

Mogford also acknowledged the importance of changing BP's Process Safety and Risk Management culture, noting that if BP did not get better BP was going to *have another "Texas City" every 10-15 years.*[142]

BP's response to the organizational and systemic issues borne out by the Texas City and Prudhoe Bay accidents included two phases. Phase One was BP's "Six Point Plan," which was to be followed by Phase Two, a more comprehensive operating management system ("OMS").

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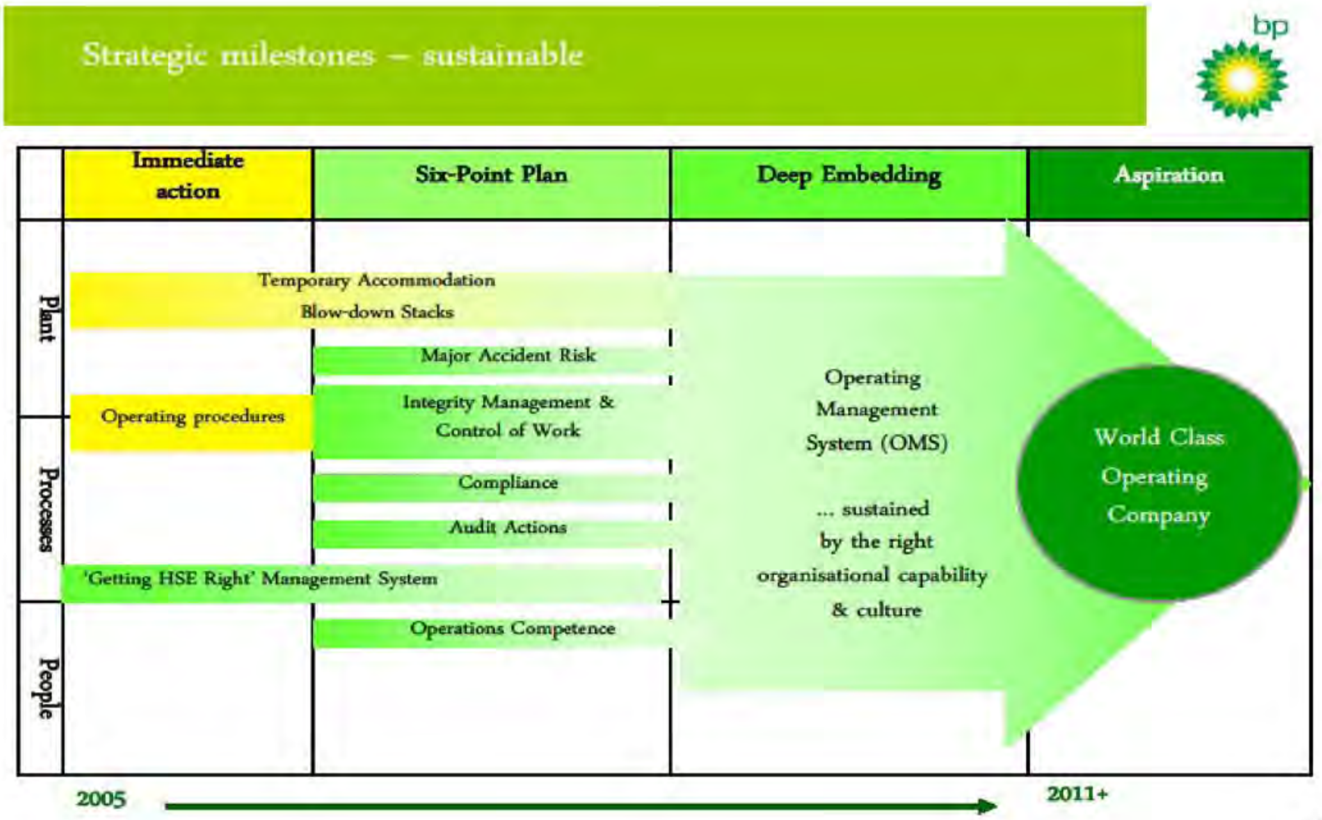
[140] Mogford was replaced by Mark Bly in June 2009. Deposition of John Mogford, pp. 64, 71.

[141] Interview with John Mogford, The BP Magazine, Issue 3 2006 (emphasis added).

[142] Safety: The Number One Priority, The BP Magazine, Issue 3 2006.

Figure 7: Excerpts from BP PowerPoint Presentation



The "Six Point Plan" was not limited to BP's Texas City operations. Instead, BP emphasized that "*[e]very part of our business is fully implementing the six-point plan . . . .*"[143] In a 2006 article published in The BP Magazine, Ellis Armstrong, an executive in BP's Exploration and Production Strategic Performance Unite ("SPU"), emphasized that BP's upstream operations were actively incorporating the lessons learned from Texas City in its operations:

> "Texas City had a big impact on us . . . One of the first things we did was realize that it could happen to us. We immediately analysed high potential incidents in E&P and realised we had experienced a number of near misses that could have

[143] Safety: The Number One Priority, The BP Magazine, Issue 3, 2006.

> had a similar consequence to Texas City. As a result, we have fundamentally changed our approach to safety and operations, and that change is ongoing."[144]

As noted above, BP's "Six Point Plan" was folded into its larger management system, OMS.[145] As with BP's "Six Point Plan," OMS was not limited to BP's Texas City operations, but was to be implemented "across BP worldwide."[146] Tony Hayward described OMS as follows:

> The operating management system (OMS) is fundamental to delivering safe and reliable operating activities in BP. It is the foundation for a responsible and high performing BP where our goals are simply stated: no accidents, no harm to people and no damage to the environment.[147]

Since the Prudhoe Bay and Texas City incidents, BP's performance is not indicative of an organization that has changed its Process Safety and Risk Management culture.

On the North Slope of Alaska, BP has continued to experience leaks and oil spills. For example, in November 2009, BP had an oil spill at its Lisburne Production Center, resulting in approximately 45,822 gallons of oil leaking into the environment.[148] Additionally, in July 2011, BP had a second spill at its Lisburne Production Center, this time resulting in 4,200 gallons of oil and other materials leaking into the environment.[149]

Most indicative of BP Management's refusal to change BP's Process Safety and Risk Management culture are the continued failures, fines, and problems occurring at BP's Texas City refinery. Since the 2005 Texas City explosion, four additional deaths have occurred at the facility.[150]

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[144] Safety: The Number One Priority, The BP Magazine, Issue 3 2006.

[145] Deposition of Mark Bly, p. 240.

[146] Structured for Success, The BP Magazine, Issue 3 2009.

[147] Exh.6257, pp. 2, BP-HZN-2179MDL00333196.

[148] Letter from John Minge to Senator Lisa Mukowski, pp. 1, BP-HZN-2179MDL02349045.

[149] Methanol Spill Reported at BP Alaska Oil Field, Associated Press (July 18, 2011), *http://finance.yahoo.com/news/Methanol-spill-reported-at-BP-apf-3575308898.html?x=0*.

[150] OSHA Fact Sheet, Exh. 6028, pp. 1.

Additionally, in October 2009, following an inspection of BP's Texas City refinery, OSHA announced $87,430,000 in proposed penalties to BP arising from the company's "failure to correct potential hazards faced by employees."[151] The inspection revealed 270 instances where BP had failed to fix problems it had agreed to correct as part of a settlement agreement with OSHA following the Texas City explosion.[152] Further, the inspection revealed 439 new "willful" violations resulting from BP's failure to follow accepted, industry standards.[153] Under OSHA guidelines, a "willful" violation occurs when "an employer has knowledge of a violation and demonstrates an *intentional disregard* for the requirements of the Occupational Safety and Health (OSH) Act . . . or shows *plain indifference* to employee safety and health."[154]

From June 2007 to February 2010, OSHA inspections at other U.S. BP refineries found similar problems. All told, including the Texas City inspections, OSHA cited BP for a total of 829 willful violations of OSHA standards.[155] During this time period, BP accounted for 97% of the flagrant violations found within the industry.[156] Jordan Arab, the Deputy Assistant Secretary of Labor for Occupational Safety and Health, summed up the post-Texas City, post-"Six Point Plan," post-OMS BP as follows: "*The only thing you can conclude is that BP has a serious, systemic safety problem*."[157]

151 OSHA News Release, Exh. 870, pp. 1.

152 OSHA News Release, Exh. 870, pp. 1.

153 *Id.*

154 *Id.* (emphasis added).

155 Renegade Refiner: OSHA says BP has "systemic safety problem", iWatch News, Exh. 6027, pp. 1.

156 *Id.*

157 *Id.*

Section 4. BP Management's Knowing Disregard of Process Safety and Risk Management on Gulf of Mexico MODUs caused the Macondo blowout.

4.1 Introduction.

In 2003, Professor Bea presented BP Management with a Report that it commission called "Managing Rapidly Developing Crises: Real-Time Prevention of System Accidents." In the Report, Professor Bea advised BP Management that the best means to avoid a catastrophe in real time was to develop systems for identifying, assessing, and managing risk. Professor Bea informed BP Management that crises develop and go undetected when it increases risk taking, when it looks at emerging problems as only having a single cause, when it fails to establish clearly defined duties and responsibilities of management and crew, and when the physical systems are inadequate support for crisis management or fail to accomplish the task. BP Management refused to implement Professor Bea's advice.

BP Management's decisions to repeatedly ignore the major accident risks associated with contractor owned MODUs had significant consequences for risk management within the Macondo drilling team. The Macondo drilling team essentially operated "off the grid."[158] The Macondo drilling team did not have a comprehensive approach to Process Safety and Risk Management.[159] There were no Safety and Operations audits to ensure compliance with good Process Safety and Risk Management processes and procedures. Moreover, there was no management oversight to prevent BP Management's cost cutting mandates from undermining the ability of the Macondo drilling team to prevent a major accident.

The Macondo drilling team (and BP as a whole) did not possess a functional Process Safety and Risk Management culture. Their Engineered System was not propelled toward the goal of maximum safety in all of its manifestations but rather was geared toward a trip-and-fall compliance mentality rather than being focused on the big-picture. The Macondo drilling team "forgot to be afraid." The system was not reflective of one having well-informed, reporting, or a just culture. The system showed little evidence of possessing a rapid learning culture that had the willingness and competence to draw the right conclusions from the system's safety signals.

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[158] Deposition of Cheryl Grounds, p. 88, 18-20. Exhibit 1736, BP-HZN-BLY00204248.

[159] Deposition of Kal Jassal, p. 50, 111, 124-27; Deposition of John Baxter, p. 175, Exhibit 7172, BP-HZN-BLY00151043.

In short, the Macondo blowout was an organizational accident whose roots were deeply embedded in gross imbalances between the Engineered System's provisions for production and those for protection.

4.2 The Macondo drilling team was blind to major Process Safety risks.

BP Management's decisions to delay implementation of OMS in its GoM D&C organization, focus implementation of OMS on BP owned assets, and not require contractor owned MODUs to follow OMS resulted in a Macondo drilling team that was blind to major Process Safety risks. As a result, the Macondo drilling team[160] failed to identify and/or was not informed of many critical hazards. When hazards were identified, the likelihoods and consequences of the hazards were underestimated or compartmentalized. In short, the Macondo drilling team never fully appreciated the astonishingly high risks they were taking in drilling the Macondo well.

The Macondo drilling team was not preoccupied with failure; they were preoccupied with success and lost their ability to manage risk. The Macondo drilling team was not reluctant to simplify interpretations such as those associated with results from the critical negative pressure tests. The team lost situational awareness, did not make proper sense of the situations, and did not act thoughtfully. The team was brittle rather than robust. Proper selection, training, and support systems for the team were not present. Effective damage and defect tolerance in the drilling team and in the Engineered System they created was defeated by the team itself.

For example, the BP onshore well team leader, John Guide, considered the Macondo well as a regular "run of the mill" well with the same safety and risks concerns as any other well, even after all of the kicks and loss circulation problems experienced during its drilling.[161] Moreover, he felt that once a well plan had been agreed on, there was no reason to reassess risk unless something was changed.[162] However, when it came to safety-critical decisions, such as zonal isolation and cementing decisions, Guide's position was that assessing the associated risks did not come under his purview – it was not his responsibility on the operations side – he left it up to engineering to decide if a risk assessment should be performed, i.e., *it's not my job*.[163,]

160 "Macondo well team" refers to BP, Transocean, and other contractors that were working on the Macondo well.

161 Deposition of John Guide, pp. 177.

162 Deposition of John Guide, pp. 197.

163 Deposition of John Guide, pp. 200.

Guide and his boss, David Sims, the D&C Wells Operations Manager, were not effectively communicating. Guide told Sims that he did not know his responsibilities or his level of authority, and perceived that well site engineering team members were causing "*paranoia*" and "*chaos*". The wells team leader felt that his team was "flying by the seat of their pants" and he foretold that the Macondo operation was not going to succeed if they continued in this manner.[164] But Sims did not take Guide seriously and brushed off his remarks before leaving for vacation. Sims and Guide had been at odds over several disagreements, and both Sims and Guide were frustrated.[165] Sims thought Guide was mad at him and Guide thought Sims was going to fire him. At one point, Sims told Guide that "we cannot fight about every decision" and that he (Sims) would hand the well over to him (Guide) "and then you will be able to do whatever you want."[166]

The risk identification and assessment processes used by the Macondo drilling team were deeply flawed and deficient. At the time of the Macondo blowout, BP's onshore well team was using BP's manual, Beyond the Best Common Process ("BtB CP"), to manage risk.[167] The BtB CP manual pre-dated the Texas City accident,[168] and is described by BP as a "fragmented fit-for-purpose" risk management approach with "no uniform way to manage, aggregate, track, or report risks" which results in a "lack of consistency across the teams . . ."[169]

BP's description of the BtB CP manual, while accurate, does not address other fundamental flaws with the BtB CP risk management process, including how risk is defined. The BtB CP manual defines risk (i.e. the likelihood and consequences of an adverse event) strictly in an economic sense, namely the effect the risk may have on the "delivery" and "net present value" of a well.[170] Explicit evaluations of health, safety, and environmental impacts are excluded from

[164] Deposition of David Sims, pp. 162, 166-167; Exh. 1694, BP-HZN-BLY00069434; Exh. 1144, BP-HZN-BLY00120105.

[165] Deposition of David Sims, pp. 141-142, 150, 164-167, 172-173, et seq.

[166] Exh. 1126, BP-HZN-2179MDL00286815.

[167] Deposition of Pat O'Bryan, pp. 147-48, 152-53.

[168] *Id.* at 63-64.

[169] Deposition of Harry Thierens, pp. 124; Exh. 6086, pp. 7, BP-HZN-2179MDL01793819.

[170] Exh. 2681, pp. 54, 59, BP-HZN-2179MDL00333308.

the analysis. Effective Process Safety and Risk Management requires uniformity and consideration of the full suite of consequences from an event.[171]

The BtB CP manual is reflective of an organization that is blind to major Process Safety risks and does not fully appreciate the implications. This "blindness" to major Process Safety risks was well documented by BP. In December 2008, BP concluded that within its Gulf of Mexico SPU:

> "[P]rocess safety major hazards and risks are not fully understood by engineering or line operating personnel. Insufficient awareness is leading to missed signals that precede incidents and response after incidents; both of which increases the potential for, and severity of, Process Safety related incidents."[172]

By January 2010, little had changed: BP concluded that its GoM SPU remained blind to major Process Safety system risks.[173] An internal "gap" assessment by the Gulf of Mexico SPU identified critical gaps in the organization's creation and following of policies and procedures, people and competence, accountabilities, risk assessment and management, regulatory compliance, integrity management, and Process Safety management.

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[171] BP's OMS defines risk as "[a] measure of loss/harm to people, the environment, compliance status, Group reputation, assets or business . . ." *See* Exh. 765, pp. 22. As such, it requires that the full suite of consequences be considered when assessing a hazard. *Id.*

[172] Exh. 866, pp. 38, BP-HZN-2179MDL00333155.

[173] Deposition of Kevin Lacy, pp. 90-91, 147-51; Exh. 2919, pp. 7, BP-HZN-2179MDL01109076.

Figure 8: Excerpts from Gulf of Mexico Gap Assessment

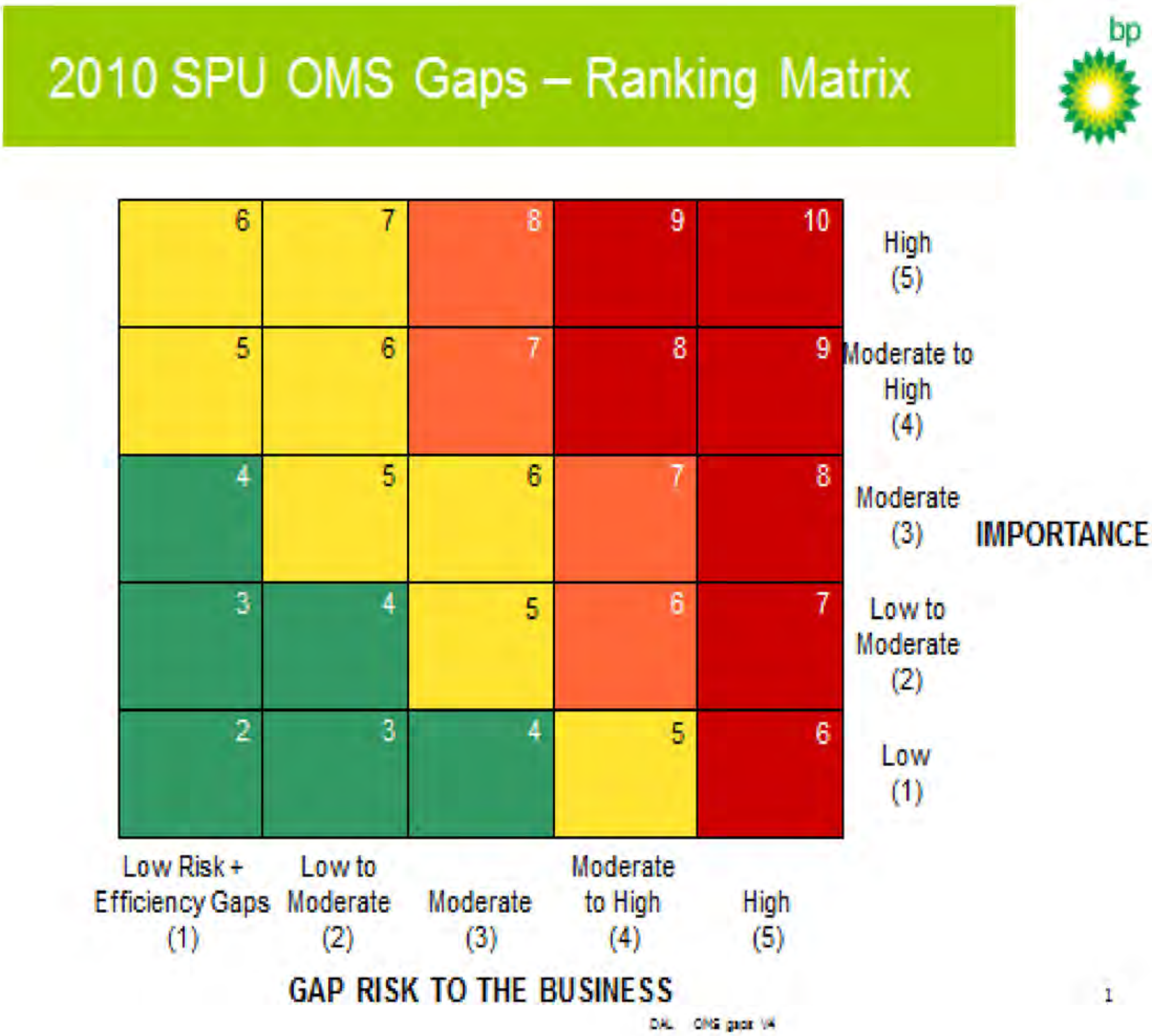
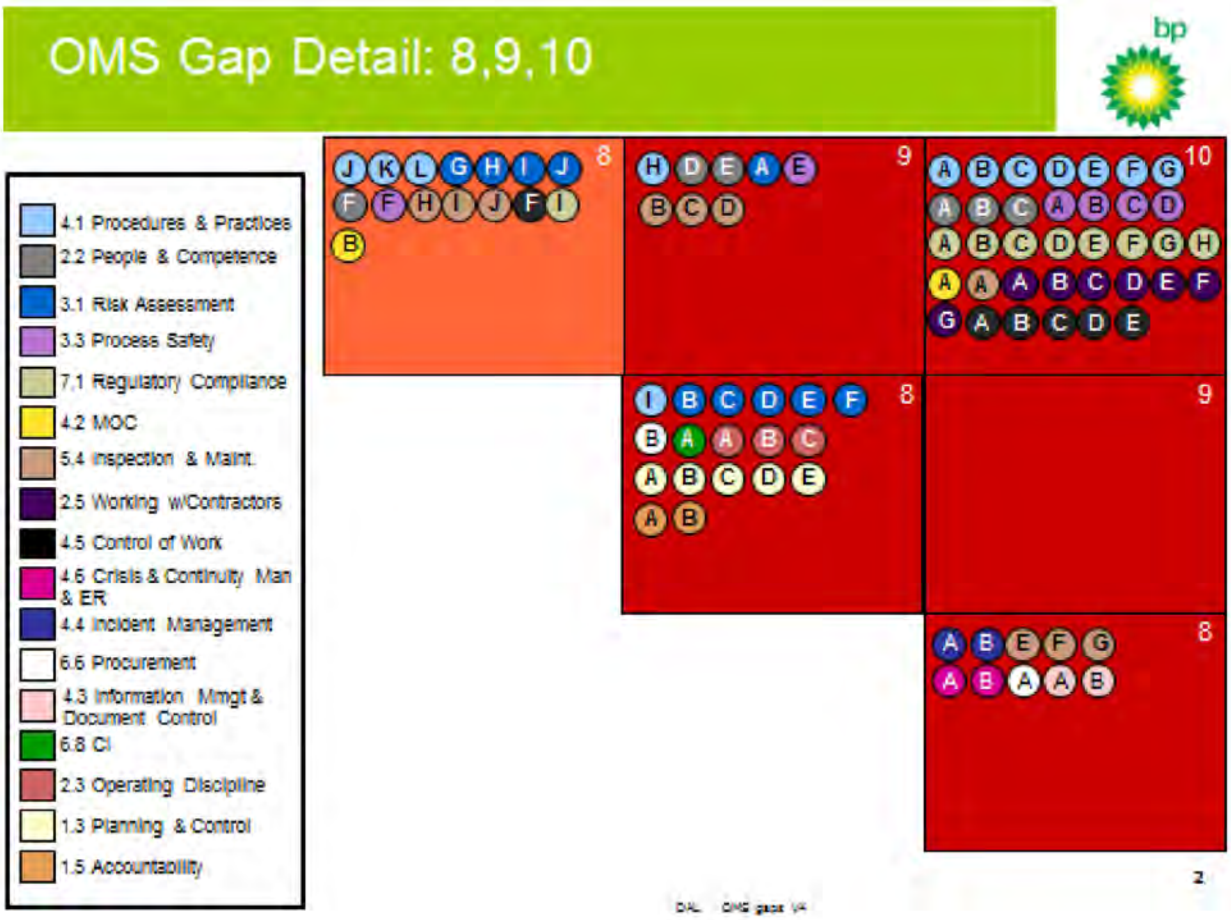


Figure 9: Excerpts from Gulf of Mexico Gap Assessment



These vitally important gaps, i.e., holes in protective barriers and recognized Process Safety leading indicators, were ignored and never closed out,[174] as were numerous lagging indicators, including repeated kicks and lost circulation events during drilling, which foretold the bigger problems on the Deepwater Horizon. BP management *still didn't get it*.

[174] American Petroleum Institute Recommended Practice RP-754, *Process Safety Performance Indicators*... (April 2010). *Developing Process Safety Indicators*, HSG254, UK Health and Safety Executive (2006); Vinnem, J., Risk Indicators For Major Hazards on Offshore Installations. *Safety Science*, 2010. 48(6): 770-787.

This blindness to major Process Safety risks explains many of the Process Safety and Risk Management failures at the Macondo well. When each of the primary decisions and subsequent actions leading up to the Macondo blowout were developed, risk assessments, when conducted, found no significant likelihoods or consequences associated with failure. No one person or group was keeping tabs on the accumulation of risks that accompanied the individual decisions and subsequent actions or inactions. Apparently, the Macondo drilling team concluded that there were no significant challenges to safety. Realistic, rigorous Process Safety and Risk Management processes and procedures were not performed. The result was a serious compromise of Process Safety.

Judgments of the likelihoods and consequences of failures (e.g., blowout) were based on unsubstantiated feelings. The participants had no major formal training or qualifications in risk assessment and management of complex systems. Experience has adequately demonstrated that a few hours of training with a risk matrix (plot of likelihoods versus consequences) does not qualify people to perform risk assessments of complex systems. The power of this extensive branch of technology is critically dependent on the knowledge, qualifications, training, experience, and motivations of the people who use it. Gut feelings, like tacit knowledge, do matter, but they too need to be substantiated by appropriate Process Safety and Risk Management processes and procedures.

For example, Mark Hafle, as the senior drilling engineer for the Macondo well team, was charged with creating a risk register for the Macondo well, as required by the BtB CP manual, and was assigned as the "risk owner."[175] Although Hafle identified many of the ultimate technical failures at Macondo as "risks" on the register, he did not consider the health, safety, and environmental impacts of those risks as part of the risk register.[176] Instead, consistent with the requirements of the BtB CP manual, he simply listed "cost" or "schedule" as the potential impact of the risks.

[175] Deposition of Cheryl Grounds, pp. 108-12; Exh. 1741, pp. 2-3, BP-HZN-2179MDL00412928.

[176] *Id.*

Figure 10: Risk Register Excerpts

	Risk Register for Project:	Macondo	Last Updated:	20-Jun-09			
General			Pre-Response		Post-Response		
R/O no.	Risk/Opportunity Name	Event Description / Impact	Impact Type	Manageability	Impact Type	Impact Level	Prob.
1	Well Control	Potential well control problem: risk of losing the wellbore in an uncontrolled situation	Cost	**High**	Cost	**Medium**	**Moderate**
8	Lost Circulation	Lost circulation identified in the offsets. Risk to time and cost.	Cost	**Medium**			
18	BOP Issue	Potential for the BOP stack to cause NPT on the well.	Schedule	**Medium**	Schedule	**High**	**Low**
19	Zonal Isolation	Risk of a good cement job on the 9-7/8" Production String	Cost	**High**			

The Macondo well risk register was completed by Mark Hafle before the drilling operations were initiated – during June 2009. Even though the Macondo well (as an Engineered System) changed dramatically during the project (e.g. reorganization), the risk register was never completed before April 20, 2010. There was no risk register that contained a well control action plan owner, status, and due date.[177]

Mark Hafle and other BP engineers and personnel involved with the Macondo well were not provided with adequate training and support in assessing the Process Safety risks associated with the Macondo well. Process Safety risk assessment and management requires

[177] Deposition of Kal Jassal, pp. 111-112.

knowledgeable and experience qualified "risk champions." In other words, Process Safety and Risk Management requires someone who is trained in how to assess major Process Safety risks. BP used Process Safety engineers in this capacity on BP owned assets.[178] However, D&C GoM engineers like Mark Hafle, who were assigned to operations being performed by contractor-owned MODUs, were not provided with similar support.[179]

The BtB CP manual states that the risk register is a "continuous loop by which risks are captured and worked throughout the well life-cycle."[180] However, at the local GoM D&C level, the Macondo risk register was not required or expected to be continually updated and re-assessed the throughout the life of the well.[181,182] Moreover, no monitoring or auditing was being performed at the Group level. This "check the box" mentality reflects an organization that does not understand Process Safety and Risk Management.[183]

The absence of a continual, cohesive system risk management process within Macondo drilling team adversely impacted the decisions made during the drilling. Once a well reached the drilling stage, whether a decision was subjected to a formal risk assessment – formal Management of Change (MOC) process - was largely left to the discretion of the well team. During the drilling of the Macondo well, BP onshore personnel made a number of critical

178 Deposition of Cheryl Grounds, pp. 85-98.

179 *Id.*

180 Exh. 2681, pp. 54, BP-HZN-2179MDL00333308.

181 Deposition of Ian Little, pp. 141-43; Deposition of David Sims, pp. 647-48.

182 Apparently, even within BP, there was confusion as to whether the risk register needed to be updated throughout the life of the well. Greg Walz claimed that it did. Deposition of Greg Walz, pp. 721-22.

183 A similar culture was prevalent at the Texas City refinery, where the Chemical Safety Board noted "Texas City was at a "high risk" for the "check the box" mentality. This included going through the motions of checking boxes and inattention to the risk after the check-off." U.S. Chemical Safety and Hazard Investigation Board Investigation Report: Refinery Explosion and Fire, Report No. 2005-04-I-TX (March 2007), Exh. 6012, pp. 174. Hopkins, Failure to Learn: The BP Texas City Refinery Disaster.

decisions that increased the risk of the well. However, those decisions were not formally risk assessed and the Well Team Leader (WTL) didn't think it was his or his team's job.[184]

Key Decisions at Macondo		
Decision	**Increased Risk?**	**Formal Risk Assessment?**
Not using the correct number of centralizers	Yes	No
Not waiting for foam stability test results	Yes	No
Not running cement bond log	Yes	No
Using spacer made of lost circulation materials	Yes	No
Displacing riser before setting cement plug	Yes	No
Not installing additional physical barriers during temporary abandonment	Yes	No
Not circulating bottoms up prior to cement job	Yes	No
Performing simultaneous operations during displacement	Yes	No

Because safety-critical decisions were not being subjected to formal risk assessment and management processes, these decisions, often made on an ad hoc basis, were not methodically analyzed to identify the associated risks incurred and to ensure that the risk mitigation barriers that are needed to prevent, diminish, and control those risks were understood.

Moreover, the absence of a formal risk assessment process permitted the Macondo drilling team to "compartmentalize" or "silo" many of their decisions. Decisions were made in isolation. Individual decisions were viewed as only adding incremental risk to the Macondo well. The collective risk generated by these decisions was never considered.

BP Management's decision to delegate operational risk management to MODU owners (Transocean) also had significant impacts on how risk was perceived by the Macondo drilling team. BP's onshore well team refused to communicate key risks of the operation to Transocean.

[184] Deposition of John Guide, pp. 197-200.

For example, the cement job for the Macondo well was much riskier than typically encountered by BP or Transocean. However, BP refused to emphasize this fact to Transocean.

Additionally, Transocean was blind to major Process Safety system risks in much the same as BP's onshore well team. In particular, a 2010 study by Lloyd's register reached the following conclusions about Transocean: (1) "the work force was not always aware of the hazards they were exposed to . . .;" (2) "THINK Plans did not always identify relevant major hazards . . . ;" (3) "The risks posed by identified hazards were not fully understood, and the subsequent control measures were not always appropriate; (4) "Emerging hazards during task execution, and hazards with a changing risk level were not always detected or fully appreciated;" and (5) "'They don't know what they don't know.'"[185]

Further, Transocean was not included in many of the decisions made by BP's onshore well team that increased the risk of failures at the Macondo well. According to BP, Transocean nonetheless was expected to manage the risks of those decisions. In many cases, Transocean managed those risks poorly. For example, there is no evidence that Transocean performed a formal risk assessment prior to conducting simultaneous operations during the displacement of the riser. Likewise, there is no evidence that the BP well site leaders on the Deepwater Horizon insisted that such a risk assessment be done. Additionally, Transocean personnel on the rig refused to maintain proper situational awareness and missed key indicators that control of the Macondo well was being lost and the well was blowing out.

4.3 The Macondo drilling team favored cost over Process Safety.

Within BP's Gulf of Mexico SPU, Hayward's Forward Agenda, created "tremendous" and "incredible" cost reduction pressures (incentives).[186] In particular, from 2008 into 2009, there were concerns that as oil prices fell, BP's Gulf of Mexico operations would no longer be viable.[187] As a result, the Gulf of Mexico SPU championed Hayward's "every dollar counts, every seat counts" philosophy. The Gulf of Mexico SPU emphasized that "time is money" and "every minute matters."[188] Employees were encouraged to achieve the "technical limit" for

[185] Exh. 929, pp. 8-9, TRN-HCEC-00090493.

[186] Deposition of Kevin Lacy, pp. 184, 795-799.

[187] *Id.* at 184.

[188] Deposition of Tony Hayward, pp. 123, Exh. 6018, pp. 5, BP-HZN-2179MDL00633307.

drilling time.[189] Fast drilling was encouraged even though it was recognized by the Macondo well team that important information was being lost and well control signals missed.[190]

From a financial perspective, the organization was successful. From 2008-2009, the Gulf of Mexico SPU shed $243 million in costs.[191] Moreover, during the same time period, the GoM increased production by 55%.

Figure 11: Gulf of Mexico Cash Costs

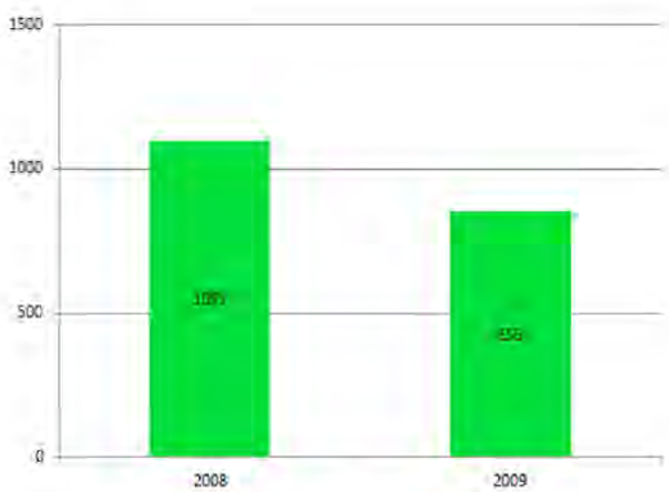
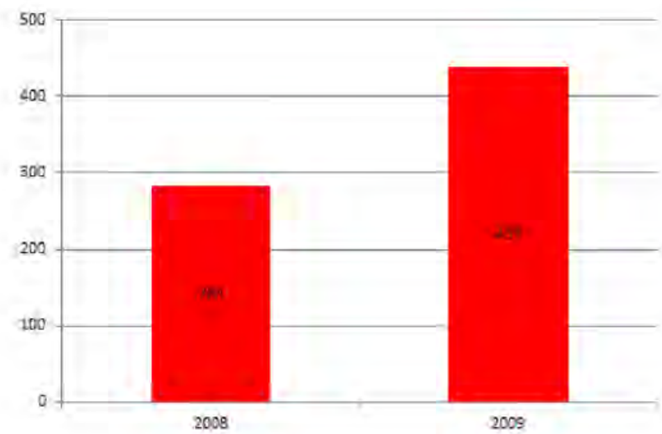


Figure 12: Gulf of Mexico Production



Similarly, the GoM D&C organization cut between $250 and $300 million in costs between 2008 and 2009, with the goal of further reducing costs in 2010.[192]

This cost cutting (cost efficiency) drive affected how safety spending was prioritized. Within BP's Exploration & Production Segment, capital expenditures on Safety and Operational Integrity were only 4% of the planned total capital expenditures in 2010.[193] For the Gulf of

[189] Exh. 2681, pp. 133, BP-HZN-2179MDL00333308.

[190] Deposition of Robert Bodek, pp 222, 223.

[191] A summary of relevant BP's financial metrics is provided in Appendix "D."

[192] Deposition of Kevin Lacy, pp. 774-775.

[193] BP-HZN-2179MDL00980469.

Mexico SPU, capital expenditure on Safety and Operational Integrity were only planned to account for 0.8% of total capital expenditures.[194]

Figure 13: Exploration & Production 2010 Planned Capital Expenditures

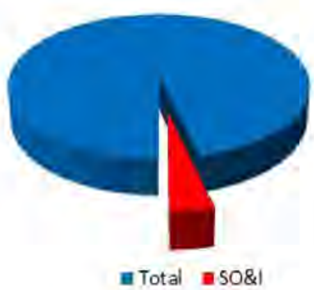
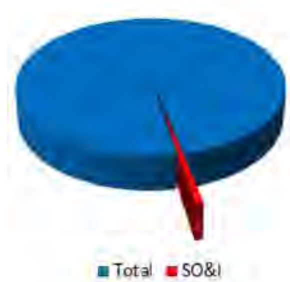


Figure 14: Gulf of Mexico 2010 Planned Capital Expenditures



As a percentage of total capital expenditures, the Gulf of Mexico SPU planned to spend less on Safety and Operational Integrity than all but one other SPU in the Exploration & Production Segment.[195]

BP Management incentivized cost cutting through its Variable Pay Program ("VPP").[196] The VPP is a bonus program. Bonuses are tied to performance contracts, which outline goals for each employee.[197] Safety is a component of an employee's *performance contract*, but only counts as a small factor and is primarily tied to personal safety rather than Process Safety.[198] Other metrics, such as "cost efficiency" are considered as the remaining factors of the

[194] *Id.*

[195] BP-HZN-2179MDL00980469

[196] Deposition of James Dupree, pp. 346; Deposition of Ian Little, pp. 210.

[197] Deposition of Erik Cunningham, pp. 112-13.

[198] BP-HZN-2179MDL01844732.

program.[199] For BP employees, VPP bonuses can equal nearly one-half of their base salary.[200] Moreover, this arrangement tends to act as a disincentive for employees to report incidents involving minor injuries and near misses – key Process Safety indicators – in order to enhance bonus payouts.

For the BP well team, a key component of their performance contracts was measurable drilling performance. BP Group management provided significant incentives to improve "capital efficiency" and to reduce Non Productive Time (NPT).[201] For example, to meet their performance contracts, the BP members of the Macondo drilling team had to, among other things: (1) deliver a 10% improvement in overall NPT;[202] (2) improve rig productivity by 7%,[203] and (3) deliver each well drilled within AFE estimates of time and cost.[204] The "belief" was that these drives for capital "efficiency" would not have, and did not have, any effects on "safety."[205]

This incentive to "drill cheap and fast" had significant rewards for employees in BP's GoM D&C organization. In 2009, Jonathan Sprague, a drilling engineer in the GoM D&C organization, received a [redacted] bonus in addition to his [redacted] salary. In 2010, he received a [redacted] bonus in addition to his [redacted] salary.[206]

As with all BP performance contracts, the performance contracts for BP members of the Macondo drilling team also had a safety component. This "safety" component accounted for only 25% of an employee's total evaluation.[207] Moreover, the safety component primarily dealt with personal safety, not drilling Process Safety. For example, John Guide's performance

[199] Deposition of Ian Little, pp. 215; Deposition of Kevin Lacy, pp. 791-93; Deposition of David Rainey, pp. 28; Deposition of Cindi Skelton, pp. 128-29; Deposition of Doug Suttles, pp. 72-75, 499.

[200] March 28, 2011 Letter from Hariklia Karis to Stephen Herman and James Roy.

[201] Deposition of Ellis Armstrong, pp.446-452; Exh. 3880, BP-HZN-2179MDL01767997.

[202] Exh. 1671, pp. 1, BP-HZN-2179MDL00655655.

[203] *Id.*

[204] Exh. 2667, pp. 1, BP-HZN-2179MDL01802532.

[205] *Id.* at 452, 2-12.

[206] Deposition of Sprague, pp. 32, 40, 439-440.

[207] BP-HZN-2179MDL01844732.

contract listed "recordable injuries" as the primary metric by which his safety performance was measured.[208] Similarly, the safety metrics for the well site leaders at Macondo included things such as safety observations and conversations (i.e., safety meetings).[209] Measurable drilling Process Safety indicators were not included in the Macondo drilling team's performance contracts.[210] As a result, the Macondo drilling team was not incentivized to prevent low frequency, high consequence accidents (i.e., major accidents).

BP also provided bonuses to its contractors for drilling fast.[211] The bonus could only be obtained if a well was drilled within the number of days designated by BP.[212] The bonuses also had safety components. However, as with BP's performance contracts, the safety components were tied to personal safety metrics and not drilling Process Safety.[213] The bonus program did not measure or reward the prevention of low probability, high consequence accidents.

The Macondo drilling team was clearly cognizant of time and cost pressures. The BP onshore well team meticulously tracked and recorded the time and cost for each task performed at Macondo.[214] Additionally, members of the BP onshore well team routinely documented and tracked instances where they believed they had personally saved BP money.[215]

This emphasis on time and money created an inappropriate balance between "production" and "protection." The Macondo drilling team's blindness to major risk, coupled with their "every dollar counts" mentality, led to a number of decisions that saved time and money but increased the overall risk profile for the well:

[208] Exh. 7099, pp. 1, BP-HZN-2179MDL00346653.

[209] Exh. 1984, BP-HZN-2179MDL01308980; Exh. 2667, BP-HZN-2179MDL01802532.

[210] Exh. 7099, BP-HZN-2179MDL00346653.

[211] Deposition of Troy Hadaway, pp. 59-60.

[212] Deposition of Troy Hadaway, pp. 60; Exh. 889, pp. 2, TRN-MDL00467823.

[213] Deposition of Troy Hadaway, pp. 60-61; Exh. 889, pp. 4, TRN-MDL-00467823.

[214] *See, e.g.,* Macondo DIMS Report [BP-HZN-2179MDL01582699].

[215] Exh. 4455, pp. 2 (Hafle noting savings of $500,000, $250,000, and $60,000), BP-HZN-2179MDL00367260.

Key Decisions at Macondo		
Decision	**Increased Risk?**	**Saved Time or Money?**
Not using the correct number of centralizers[216]	Yes	Yes
Not waiting for foam stability test	Yes	Yes
Not running cement bond log[217]	Yes	Yes
Using spacer made from lost circulation materials[218]	Yes	Yes
Displacing riser before setting cement plug	Yes	Yes
Displacing well to over 3,000 ft. below the mud line[219]	Yes	Yes
Not installing additional physical barriers during temporary abandonment[220]	Yes	Yes
Not circulating bottoms up prior to cement job	Yes	Yes
Using long string casing instead of liner[221]	Yes	Yes
Performing simultaneous operations during displacement	Yes	Yes
Converting lower ram on BOP to a test ram[222]	Yes	Yes

216 BP-HZN-CEC022690 (Email from Brian Morel noting that it was "too late" to get more centralizers to the rig).

217 SLB-EC-000909 (not running cement bond log saved $118,093.34).

218 BP-HZN-BLY00098875-6, pp. 2 (noting that use of spacer was "brought about by perceived expediency").

219 The decision to displace the well was part of BP's decision to have the Deepwater Horizon complete the well instead of a separate rig. BP noted that having the Deepwater Horizon complete the well would save $2.2 million or possibly more. *See* BP-HZN-2179MDL02534871-75.

220 SLB-EC-000909 (mechanical plug would have cost $53,075.06).

221 BP-HZN-BLY00246658 ("long string provides best economic case . . . liner . . . will add an additional $7-10 MM to completion cost.").

When given the opportunity to save time and money—and make money—tradeoffs were made by BP for the certainty of the measurable thing—production. The perception was that there were no downsides associated with the uncertain, difficult-to-measure thing—failure caused by the lack of sufficient protection which was caused by incentives to achieve "cost efficiencies". As a result of a concatenation of deeply flawed failure and signal analysis, decision-making, communication, and organizational-managerial processes safety was compromised to the point that the blowout occurred with catastrophic effects.

4.4 The Macondo drilling team did not have effective barriers to prevent major system incidents.

There were critical defects embedded in BP's proactive, reactive, and interactive barriers prior to the Macondo blowout. Deficiencies and defects developed by the Macondo drilling team activated these defects, enabling penetration of the multiple barriers. The failures that developed before, during, and after the Macondo blowout show that the Macondo well, as an Engineered System, was deeply deficient and pervasively flawed. Important things that were supposed to have been done correctly were either not done or were done incorrectly. When the Engineered System was tested before, during, and after the blowout, it performed miserably.

As noted above, there were inappropriate imbalances between production and protection. There were significant pressures to complete this well-from-hell as quickly as possible. However, there is no clear evidence of corresponding pressures to provide appropriate protections to counter-balance and mitigate the multiple effects of these production pressures. Much like a pressure gauge on a steam boiler, the real-time risk-meter was moving higher and higher during this period. And there was no safety valve to relieve the building pressure.

4.4.1 The Macondo drilling team did not have effective Process Safety system risk management leadership.

As part of BP Management's "slashing of management layers," BP's Exploration and Production segment underwent a significant reorganization beginning in late 2009. This reorganization resulted in the removal of important members of the GoM D&C leadership team and altered the reporting structure within the GoM D&C organization. However, there is no evidence that BP Management ever formally risk assessed these changes or otherwise considered the effects that the reorganization (i.e., "slashing of management layers") would have on Process Safety and Risk Management within the GoM D&C organization.

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[222] *See* BP-HZN-BLY00116658 ("We are going to save a lot of time and money by utilizing the test rams."); TRN-MDL-00027625 (Test ram "conversion will reduce the built in redundancy of the BOP, thereby potentially increasing Contractor's risk profile . . .").

The GoM D&C reorganization resulted in much of its safety leadership being terminated or transferred shortly before the Macondo blowout. Kevin Lacy, VP of GoM D&C was terminated in December 2009.[223] Shortly thereafter, Harry Thierens, Wells Director, was transferred out of the organization.[224] Finally, Curtis Jackson, HSE director, was terminated and his position was eliminated.[225]

At the time Lacy was terminated, he was spearheading an effort to reform Process Safety and Risk Management in the GoM D&C organization.[226] This included working with Harry Thierens to develop a new risk management process that would replace the BtB CP risk management process.[227] This new risk management process was presented to GoM leadership in November 2009.[228] Shortly, thereafter Lacy was terminated[229] and Thierens was transferred out of the organization.[230] The risk management plan was not completed or implemented before Theirens and Lacy left the GoM D&C organization.[231] Moreover, the Macondo team never saw or used the risk management plan.[232]

After the reorganization, engineering and operations were separated and reported to separate managers. As a result, the only person in the organization that was responsible for both operations and engineering on a given well was the Vice President of the GoM D&C organization.[233]

[223] Deposition of Kevin Lacy, pp. 33, 81, 171.

[224] Deposition of Harry Thierens, pp. 17-21.

[225] Deposition of Curtis Jackson, pp. 12-13.

[226] Deposition of Kevin Lacy, pp. 169-71.

[227] Deposition of Kevin Lacy, pp. 170-71; Exh. 6086, pp. 7, BP-HZN-2179MDL01793819.

[228] *Id.* at 171-72.

[229] *Id.* at 171, 306-307.

[230] Deposition of Harry Thierens, pp. 17-21.

[231] Deposition of Harry Thierens, pp. 108-09.

[232] Deposition of John Guide, pp. 439-440.

[233] Exh. 153, BP-HZN BLY00124223, at 7.

Figure 15: GoM D&C November 2009

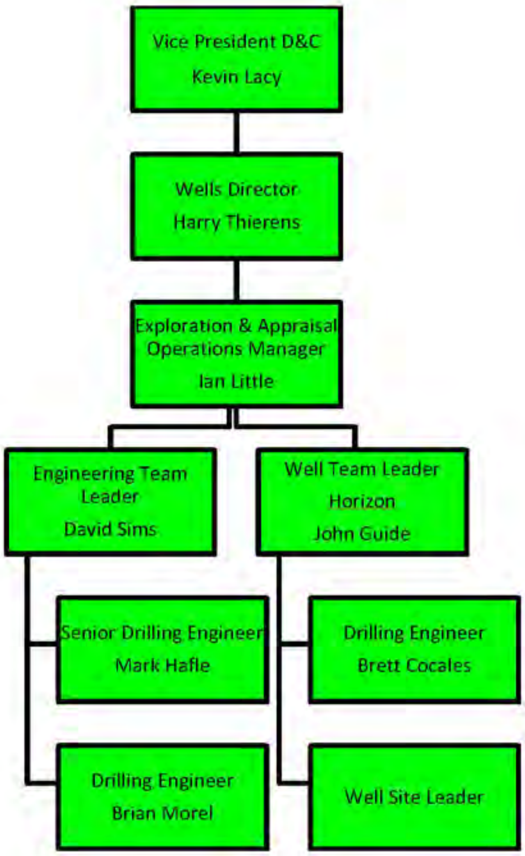
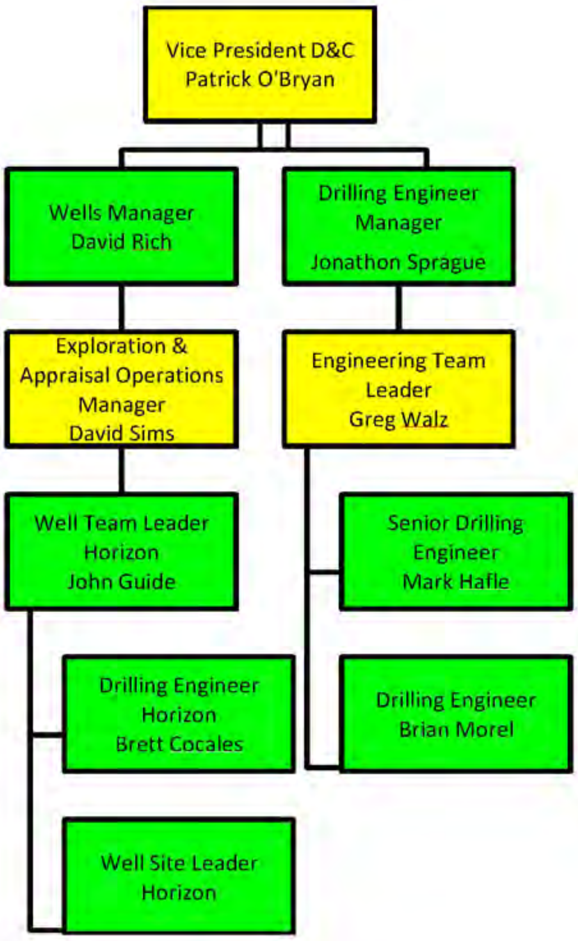


Figure 16: GoM D&C April 2010



The reorganization created significant tensions within the GoM D&C organization. Some members believed that the old structure was better.[234] Moreover, the reorganization caused discontent among members of BP onshore well team. For instance, as a result of the reorganization, David Sims moved from being Guide's peer to his boss. As already pointed out, the tension created by this change was clear in the days leading up to and following the formal transition into the reorganization:

- Sims to Guide: "What did I do to make you mad?"[235]
- Guide to Sims: "You did not listen . . . You never asked the WSL's (Well Site Leader's) opinions."[236]
- Sims to Guide: "It is interesting that you think that because I did not blindly agree to what they suggested, that somehow I must not have been listening."[237]
- Sims to Guide: "I will hand this well over to you in the morning and then you will be able to do whatever you want. I would strongly suggest, for everyone's sake, that you make logical decisions, based on facts, after weighing all the opinions."[238]
- Sims to Guide: "You seem to love being the victim. Everything is someone else's fault. You criticize nearly everything we do on the rig but don't seem to realize you are responsible for everything we do on the rig."[239]

[234] Deposition of John Guide, pp. 369-70.

[235] Exh. 1126, pp. 2, BP-HZN-2179MDL00286815.

[236] *Id.* at 1.

[237] *Id.*

[238] *Id.*

[239] Exh. 1127, pp. 1. (Sims elected not to send Guide this comment although he included it in a draft email).

- Sims to Guide: "Can you meet me tomorrow morning in the meeting room . . .?"[240]

- Guide to Sims: "Are you going to fire me"[241]

The reorganization also resulted in confusion and failed accountabilities among the BP onshore well team. There was no single member of the team that was ultimately responsible for Process Safety and Risk Management.[242] Rather, responsibility was in-cohesively and ineffectively spread throughout the team. For example, Brett Cocales, an operations engineer, acknowledged some responsibility for risk management but described the responsibility as "unclear."[243] As a result, he did little more than sit in on informal, pre-hole risk reviews.[244] Similarly, John Guide, the well team leader, described his risk management responsibilities as primarily related to "occupational safety."[245] He believed that the responsibility for "Process Safety" rested primarily with "engineering."[246] In contrast, Greg Walz, the engineering team leader, accepted responsibility for risk management but only "within [his] team."[247] Significantly, after transferring into the Macondo team in early April, Walz did nothing to confirm that "his team" actually had an effective approach to Process Safety and Risk Management.[248]

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240 Exh. 1129, BP-HZN-2179MDL00311590.

241 *Id.*

242 Deposition of David Rich, pp. 613-14 ("I don't know that there's any one single person in charge of Process Safety. Everybody's in charge of safety. Everybody's accountable for safety. If you mean a single person that leads Process Safety, I don't know who that is. I don't know if we even have one . . . There, there, there was no individual in charge of Process Safety for the Macondo well that I'm aware of.").

243 Deposition of Brett Cocales, pp. 791-93. David Sims shared Cocales feelings noting to interviewers with the Bly investigation that accountability was "not very clear" and it was "more like we are all accountable." [BP-HZN-BLY00125441].

244 Deposition of Brett Cocales, pp. 791-93.

245 Deposition of John Guide, pp. 767-68.

246 Deposition of John Guide, pp. 199-201, 446-48, 452-53, 775-76.

247 Deposition of Greg Walz, pp. 714.

248 *Id.* at 716-22. *See also* BP-HZN-CEC021533 (email from O'Bryan asking "What's getting in the way . . . reorg uncertainty?").

The confusion created by the reorganization was best expressed by John Guide in an email to David Sims three days before the Macondo blowout:

> David, over the past four days there has been so many last minute changes to the operation that the WSL's have finally come to their wits end. The quote is "flying by the seat of our pants." . . . Everybody wants to do the right thing, but, this huge level of paranoia from engineering leadership is driving chaos. This operation is not Thunderhorse. Brian [Morel] has called me numerous times trying to make sense of all the insanity . . . This morning Brian called me and asked my advice about exploring opportunities both inside and outside of the company.
>
> ***What is my authority? With the separate of engineering and operations, I do not know what I can and can't do. The operation is not going to succeed if we continue in this manner.***[249]

There was also a lack of leadership and accountability on the Deepwater Horizon. Shortly before the Macondo blowout, BP's onshore well team pulled a senior well site leader, Ronald Sepulvado, off the rig and replaced him with a less experienced well site leader, Robert Kaluza.[250] Kaluza had never been on the Deepwater Horizon before.[251] Similarly, Kaluza's relief, Don Vidrine, had only been on the Deepwater Horizon for a few months.[252] Transocean expressed concern about changing Sepulvado out for Kaluza at such a critical time in the well. In fact, even BP itself expressed concern with Kaluza's "blind spots" for "important rig operational issues" in his 2009 Individual Performance Assessment.[253] However, BP did not perform a risk assessment of the change out between Kaluza and Sepulvado.

Within the Gulf of Mexico, Kaluza ranked 42 out of 50 in performance for BP well site leaders.[254] Don Vidrine, Kaluza's relief, was ranked 23 out of 50.[255] Ronald Sepulvado was ranked seventh.[256] In contrast to Sepulvado, Kaluza and Vidrine did not understand how to

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[249] Exh. 96, pp. 2 (emphasis added), BP-HZN-BLY0097030.

[250] Deposition of John Guide, pp. 173.

[251] *Id.* at 421.

[252] Exh. 103, pp. 1; BP-HZN-CEC020346.

[253] Exh. 3555, pp. 3-4, BP-HZN-2179MDL00290720; Deposition of Keith Daigle, pp. 356-63.

[254] BP-HZN-2179MDL01844732.

[255] *Id.*

[256] *Id.*

perform Process Safety critical procedures. For instance, both Vidrine and Kaluza accepted the never before heard of "bladder effect" as a justification for moving forward following the failed negative pressure test.[257] While Vidrine did order a second negative pressure test on the kill line, he declared it a success even though the pressure on the drill pipe remained at 1,400 psi throughout.

4.4.2 The Macondo drilling team did not create and follow written policies and procedures for process system safety critical activities.

Many of the operational decisions at the Macondo well were poorly planned and delivered to the rig at the last minute.[258] This poor planning was largely driven by time and cost pressures to complete the Macondo well. At the time of the Macondo blowout, the Macondo well was nearly $60 million over budget and 45 days past schedule.[259] Additionally, the Deepwater Horizon was scheduled to go the Nile and Kaskida wells following Macondo.[260] The Macondo team was facing an upcoming MMS deadline that could have resulted in BP losing the Kaskida lease if not drilled in time.[261] One subsea engineer noted that the Macondo drilling team was "under pressure to finish Macondo so [they could] get [the] Nile P&A moving and not jeopardize the Kaskida well . . ."[262] These time pressures exposed fatal failures in the Macondo drilling team's understanding of the importance of creating and following written procedures for safety critical activities.

Chief among these failures was the negative pressure test. By all accounts, the negative pressure test is a safety critical activity.[263] However, at the time of the Macondo blowout, BP

[257] See, e.g. Exh. 759, pp. 1-2; BP-HZN-CEC020334-61; Deposition of Lee Lambert, 373-74, 387-88, 471-73, 562, 609; Deposition of Miles "Randy" Ezell, 226.

[258] *See, e.g.*, Exh. 1685, pp. 2 (Email from Greg Walz noting that "planning has been lagging behind the operations . . ."), BP-HZN-BLY00068635.

[259] Exh. 119A, BP-HZN-MBI00173371; Exh. 119B, BP-HZN-MBI00178400; Exh. 119C, BP-HZN-MBI00178405; Exh. 119E, BP-HZN-MBI00126333.

[260] Deposition of David Sims, pp. 556-557; Exh. 119E, . BP-HZN-MBI00126333.

[261] *Id.* at 558.

[262] Exh. 119E, BP-HZN-MBI00126333.

[263] *See, e.g.*, Deposition of Walter Guillot, pp. 20; Exh. 102, pp. 8, BP-HZN-BLY00094096.

Management did not have a standard, written procedure for conducting a negative pressure test.[264]

In the absence of a BP Group standard for negative pressure test, the Macondo drilling team did not understand the importance of creating clear written procedures for such safety critical activities. The first forward plan for the temporary abandonment of the Macondo well did not even include a negative pressure test.[265] Thereafter, the procedure for, and order in which, the negative pressure test would be conducted as part of the temporary abandonment changed repeatedly.[266] Ultimately, the rig was provided with the following instruction regarding how to perform a negative pressure test: "with seawater in the kill close annular and do a negative test ~2350 psi differential."[267]

The negative pressure test was a high hazard process in which a critical test was performed with minimal passive and active barriers. The sketchy procedure provided to the rig did not provide any definitive guidance for interpretation of data derived from the negative tests and did not prescribe the corrective action required if the negative tests did not provide assurance that the well was intact. Worse still, the Macondo drilling team had not received any formal training in performing this critical test.

The Macondo drilling team also refused to follow established written policies and procedures. The Macondo drilling team's culture was to keep "*doing what we have been doing*" and, as a result, they refused to create, implement, or follow procedures that did exist.[268] This mentality was most apparent with the BP onshore well team's handling of the cement job for the production casing at the Macondo well.

BP's policies and procedures required that the BP onshore well team receive the results of all cement tests prior to beginning cement operations.[269] However, the BP onshore well team allowed the cementing of the production casing on the Macondo well to begin before receiving the results of a critical foam stability test. In fact, the BP onshore well team did not receive the

[264] Deposition of Walter Guillot, pp. 12; ExH. 102 at 7, BP-HZN-BLY00094096.

[265] BP-HZN-MBI00126180-200.

[266] *See, e.g.*, BP-HZN-MBI00126924 (negative test with base oil after cement plug is set); BP-HZN-MBI00127531 (calling for two separate negative test, one before and the other after cement plug is set).

[267] Exh. 97, BP-HZN-2179MDL00060995.

[268] Deposition of Greg Walz, pp. 727-28.

[269] Deposition of Daryl Kellingray, pp. 106-08; Deposition of Kevin Lacy, pp. 272-73.

results of that test until six days after the Macondo blowout.[270] Subsequent testing and analysis has indicated that the cement used at the Macondo well was, in fact, unstable.[271]

Other policies and procedures that were violated by the Macondo team include:

- DWOP requirement of two, confirmed barriers;[272]
- DWOP requirement of a well control bridging document;
- ETP requirement that temporary abandonment process be risk assessed;[273]
- DWOP requirement that kicks and lost circulation events be entered into BP's Traction database;[274]

4.4.3 The Gulf of Mexico Drilling and Completion organization did not audit Process Safety properly.

As previously noted, BP Management did not include MODUs like the Deepwater Horizon in its Safety and Operations audits. As a result, BP Management never subjected the Deepwater Horizon to a comprehensive, independent audit program, as it did for BP owned assets. In the absence of such an audit program, the GoM D&C refused to properly audit the Macondo drilling team and the Deepwater Horizon.

The GoM D&C organization did not effectively audit Transocean's well control policies and procedures. BP Management delegated responsibility for critical activities such as well control to Transocean. However, a comprehensive audit of Transocean's well control practices and procedures to confirm that the practices and procedures, including compliance therewith,

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[270] Exh. 1709, HAL-0028708.

[271] Macondo Well Evaluation of 60% Foam Quality Foam Stability Testing, Oilfield Testing & Consulting (Aug. 2, 2011), pp. 7; October 28, 2010 Letter from Bartlitt to National Commission, pp. 2.

[272] Deposition of Kevin Lacy, pp. 277-79.

[273] Deposition of Darryl Kellingray, pp. 75.

[274] Deposition of John Guide, 459-65; Exh. 93, pp. 48, BP-HZN-2179MDL00057261.

were consistent with BP or industry expectations was never performed.[275]

The GoM D&C also refused to properly audit itself. As noted above, the Macondo drilling team did not follow a number of key BP policies and procedures during its execution of the Macondo well. One of the key purposes of an audit is to determine whether actual performance is consistent with written policies and procedures. However, it does not appear that BP ever audited the GoM D&C generally or the Macondo team specifically to ensure such conformance.

The GoM D&C did not close out – address – important action items for safety critical equipment in a timely way. For example, a BP rig audit of the Deepwater Horizon in September 2009 identified that the BOP was out of certification.[276] This audit identified an "overdue planned maintenance" back-log of 390 jobs requiring more than 3,500 man-hours of work had developed.[277] Much of this work represented "carry-forwards" from the BP audit performed two years earlier. The audit identified a significant number of findings that had "potential adverse effect(s) on rig emergency preparedness."[278]

The audit recommended that the Deepwater Horizon be removed from service until the important work had been completed. The rig was taken out of service for about 5 days.[279] The BP GoM D&C operations group were under significant internal and external (lease partners) pressures to return the Deepwater Horizon to service as quickly as possible:

> "..don't worry about this small stuff. This amounts to 2 or 3 days in a 100 day project. Partners always have questions and the(y) will shut up once we turn the big machine on. We are not going to tear anything else apart unless absolutely

[275] BP conducted a number of audits of Transocean. See Exh. 275, BP-HZN-IIT-0008871; Exh. 937, TRN-MDL-00351151; Exh. 3400, TRN-MDL-00519065; and Exh. 6166, BP-HZN-MBI00050937. However, none comprehensively covered well control policies and procedures. BP's audits of third-party's were not as "onerous and detailed" as BP's audits of itself. Deposition of Neil Crammond, pp. 276-77.

[276] Exh. 275, pp. 20, BP-HZN-0008871.

[277] *Id.* at p. 2.

[278] *Id.*

[279] Deposition of Neil Crammond, pp. 158-60, 183-84, 300-302.

necessary and we are ready to kick some serious arce! Don't worry - Be happy!"[280]

The audit also recommended that the Deepwater Horizon BOP be recertified by the end of 2009.[281] However, a subsequent rig audit days before the Macondo blowout noted that the BOP was still out of certification.[282] That rig audit described the lack of a BOP certification as Priority A, Condition Level 1 (i.e. a major issue):

Figure 17: Priority Codes and Conditions Level from April 2010 Audit

Priority Codes	A
Priority Definitions	Critical items that may lead to loss of life, a serious injury or environmental damage as a result of inadequate use and/or failure of equipment.

Condition Levels	Level 1
Equipment Definitions	• Equipment is in bad condition; it is not working or should be removed from service until deficiencies are rectified. • Equipment has excessive down time. • Equipment wear is past OEM limits or is obsolete and no longer supported by OEM.

Between the September 2009 audit and the Macondo blowout, the Macondo drilling team did not take any effective steps to close out this safety critical action item. The Deepwater Horizon was returned to service without all of the Process Safety critical maintenance work completed with an explanation: "It's the business decision".[283]

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280 Exh. 6168, p 1, BP-HZN-2179MDL00209289.

281 Exh. 275, pp. 20, BP-HZN-IIT-0008871.

282 Exh. 88, pp. 128, MODUSI-01-0-000001.

283 Deposition of Norman Wong, pp. 74, 11.

4.3.4 The Macondo drilling team did not maintain suitable, Process Safety critical equipment.

BP Management (and the Macondo drilling team) relied on the Deepwater Horizon BOP as a "failsafe," "last line of defense," contingency barrier in the event of an uncontrolled blowout.[284] However, neither BP Management nor the Macondo drilling team used a validated and verifiable risk assessment and management practice to confirm that the BOP was, in fact, failsafe.

Moreover, the Macondo drilling team knowingly increased the risk profile of the BOP by converting the bottom ram of the BOP into a test ram.[285] The Macondo team acknowledged that the conversion increased the risk profile of the Deepwater Horizon.[286] However, as one BP engineer noted, the focus was on the fact that BP was "going to save a lot of time and money by utilizing the test rams."[287] Another time and money "capital efficiency" trade-off that compromised system reliability and safety.

BP Management and Macondo drilling team also ignored a number of MMS studies conducted during the period 2000 – 2010 which concluded that BOP's such as Deepwater Horizon could not reliably stop an uncontrolled blowout. A 2004 study concluded that even given perfect BOP control (actuation) systems, the blind shear rams could not reliably shear drill pipe in deepwater conditions.[288] A study performed in 2002 showed the blind shear rams had a 50% reliability:[289]

Figure 18: Shearing Capabilities with Hydrostatic Pressures Considered

[284] Deposition of Tony Hayward, pp. 235.

[285] TRN-MDL-00027625, pp. 1-26.

[286] *Id.*

[287] BP-HZN-BLY00116657.

[288] *Shear Ram Capabilities Study*, West Engineering Services (2004) [BP-HZN-CEC044076-136].

[289] *Mini Shear Study*, West Engineering Services Inc. (2002).

Similarly, a 2003 study concluded that secondary intervention methods (i.e., ROVs) are similarly unreliable.[290] These deficiencies combined with BOP control systems deficiencies (e.g. unarmored electric and hydraulic control systems routed through the rig moonpool) made the BOPs a "no last line of defense" system.

MMS regulations required that BP utilize the Best Available and Safest Technology (BAST) at the Macondo well.[291] Additionally, MMS regulations required BP to certify that the Deepwater Horizon BOP's blind shear rams were capable of shearing the drill pipe being used at Macondo.[292] BP did neither. Instead, despite the availability of more suitable designs, BP allowed the Macondo well to be drilled with a BOP that could not reliably stop an uncontrolled blowout.[293] Moreover, BP knew that the BOP was out of certification with MMS requirements but looked the other way and allowed the Deepwater Horizon to resume work without the BOP being recertified.[294]

4.3.5 The Macondo drilling team did not learn from prior incidents and near misses.

While drilling the Macondo well, the Macondo drilling team had at least 10 significant well control issues (lost circulation and/or a kick).[295] Prior to the blowout, the most significant of these was a kick that occurred on March 8th. The kick resulted in the drill pipe getting stuck, having to be severed, and a bypass well (sidetrack) being drilled.[296] The rig crew on the Deepwater Horizon on March 8th was substantially the same as the rig crew on April 20th.[297]

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[290] *Evaluation of Secondary Intervention Methods in Well Control*, West Engineering Services (2003), Exh. 3298, TRN-MDL-00494920.

[291] 30 C.F.R. § 250.107.

[292] 30 C.F.R. § 250.416.

[293] Exh. 4423, BP-HZN-2179MDL03106206.

[294] Exh. 275, pp. 20, BP-HZN-IIT-0008871; Deposition of Norman Wong, p. 164-167.

[295] *See generally*, Deposition of Galina Skripnikova.

[296] Deposition of John Guide, pp. 669-70.

[297] *Compare* BP-HZN-2179MDL00273144-50 *with* BP-HZN-2179MDL00272834-41.

Some members of the BP onshore well team complained that BP's elite Tiger team[298] had missed impending signs of the kick.[299] An internal BP analysis indicated that it took the rig crew over 30 minutes to respond to the kick.[300] Additionally, BP internally circulated a "lessons learned email" explaining what BP could do to prevent similar well control events.[301]

News of the March 8th kick was communicated to BP Management offices in London.[302] Additionally, BP circulated a "lessons learned" email among the Macondo team.[303] However, those lessons were not communicated to key members of crew on the Deepwater Horizon at the time of the blowout.[304]

4.4 BP Refuses to Learn from the Macondo Blowout.

Process Safety and Risk Management is an "evergreen" process, meaning that Engineered Systems must constantly be reviewed, assessed, and updated. A critical part of this process is accident investigations and lessons learned. Process Safety and Risk Management process and procedures should include "procedures for investigation of all incidents with serious safety or environmental consequences."[305] "The intent of the investigation should be to learn from the incident and help prevent similar incidents."[306] "Companies should implement a system whereby conclusions of investigations are distributed to similar facilities and/or appropriate personnel within their organization."[307] When performed effectively, investigations and lessons learned act to ensure that necessary barriers are in place to prevent and mitigate future Process Safety accidents.

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[298] BP's Tiger team is responsible for predicting pore pressures and fracture gradients. Deposition of John Guide, pp. 674-75.

[299] Deposition of John Guide, pp. 671-77.

[300] Bly Report, pp. 107.

[301] *Id. See also* Exh. 1323, BP-HZN-2179MDL00040392.

[302] Deposition of Harry Thierens, pp. 51-2.

[303] Exh. 1323, BP-HZN-2179MDL00040392.

[304] Deposition of Randy Ezell, pp. 493-94, 498; Deposition of Joseph Keith, pp. 18-23; Deposition of Micah Burgess, pp. 126-28.

[305] API Recommended Practice 75.

[306] *Id.*

[307] *Id.*

BP acknowledges the importance of performing a full, systemic investigation into all causes of an incident. In particular, BP's Group Practice on Accident Investigation provides as follows:

> BP openly investigates HSSE related incidents with the primary intention of reducing risk across operations. The BP Root Cause Analysis (RCA) process supports this practice and reduces risk when properly applied. The reduction of risk can be achieved by adherence to this practice in identifying those systemic failures within the management systems and applying appropriate corrective actions.[308]

BP's Group Practice on Accident Investigation was largely a response to criticisms from the Baker Panel that BP's investigations did not go far enough to identify systemic or management causes of accidents:

> The Panel is concerned, however, that BP's investigations may miss systemic causes by considering only causes in a direct, linear chain of causation . . . In the situation in which true root causes are not identified, proposed corrective action likely will address immediate or superficial causes, but not the true root cause. *In such cases, corrective action may be ineffective to prevent future incidents arising from the same root causes.*[309]

BP has ignored the requirements of its Group Practice on Accident Investigations and the Baker Panel's recommendations. BP has openly admitted that it "did not conduct an investigation into 'systemic causes' of the Macondo blowout.[310] In short, BP is not just failing to learn, it refuses to learn.

[308] Exh. 1742, pp. 3, BP-HZN-BLY00205082.

[309] The Report of the B.P. U.S. Refineries Independent Safety Review Panel, pp. 222 (Jan. 2007).

[310] Bly Report, pp. 12 ; Deposition of Mark Bly, pp. 83-4, 99-100, 177-78, 235, 261-62 ; Hayward Depo, pp. 33-35, 38-44 ; EX 6002.

CONCLUSION

The opinions in this Report are ours alone. Each of the opinions we express herein are based upon our experience, education, training, and expertise. We have not been asked to make any assumptions, nor have we presumed any facts, beyond those which are evidenced by and from the reliance materials identified herein and on the Reliance List attached as Appendix "E".

Professor Bea's hourly rates are $800 per hour for normal engineering assignments, $1,200 per hour for special assignments (e.g. lectures, short courses, legal proceedings, management consulting), and $400 per hour during authorized travel. Dr. Gale's hourly rates are $295 per hour for general consulting and litigation support activities and $395 per hour for depositions and court room testimony.

At the time of submitting this Rule 26 report (August 26, 2011), discovery is still actively proceeding and the record is incomplete. Dr. Robert Bea and Dr. William Gale respectively request the court to recognize our request for reserving the right to revise, redact and/or supplement any or all portions and contents of this preliminary report as additional discovery materials and facts may be made known to us.

Signed this 26th day of August 2011.

Dr. Robert G. Bea, Ph.D.

Dr. William E. Gale, Jr., Ph.D.

Appendix A

Resume of Dr. Robert G. Bea

Dr. Robert (Bob) Bea

POSITION
Professor Emeritus, Department of Civil & Environmental Engineering
Co-Founder, Center for Catastrophic Risk Management
Founder, Marine Technology & Management Group

DATE & PLACE OF BIRTH
14 January 1937, Mineral Wells, Texas

EDUCATION
1956, A. A., Jacksonville University
1959, B. S. in Civil Engineering, University of Florida
1960, Master of Science in Engineering, University of Florida
1961-1997, Post-graduate studies at Tulane University, Rice University, Texas A&M University, Bakersfield College, University of Houston, Technical and Scientific University of Norway
1998-2001, PhD, The Center for Oil and Gas Engineering, The University of Western Australia

LICENSES
Registered Professional Civil Engineer (retired) in Louisiana, Texas, Florida, Alaska, Washington, Oregon, California.
Registered Professional Geotechnical Engineer (retired) in California. Registered Land Surveyor (retired) in Louisiana.

PROFESSIONAL ASSOCIATIONS
American Society of Civil Engineers, The U. K. Safety and Reliability Society, American Society of Mechanical Engineers, National Academy of Engineering

EXPERIENCE
1954-1959: U. S. Army Corps of Engineers, Engineer-in-Training
1959-1960: S. S. Jacobs Construction Co., Construction Estimator
1960-1976: Shell Oil Company (Offshore drilling and production operations – southern Louisiana; Manager, Head Office Offshore Civil Engineering Group; Chief Mechanical Engineer, Bakersfield Production Division; Offshore Delta Division Construction Engineer; Head Office Production & Financial Control; Royal Dutch Shell Ltd. Production, Engineering & Financial Control; Shell Development Company, Manager, Offshore Technology Development Group
1976-1981: Ocean Services Division, Woodward-Clyde Consultants (Vice President, Chief Engineer, Geotechnical, Structural, Environmental, Field Engineering Operations, Ocean – Offshore Engineering projects in 72 countries)
1981-1989: PMB Engineering - Bechtel Inc. (Vice President, Senior International Consultant, Ocean – Offshore Engineering Operations Gulf of Mexico, U.S. Pacific Coast, U.S. Beaufort and Chuckchi Sea, Canadian Arctic and East Coast developments)

1989 - 2011: University of California Berkeley (Professor, Naval Architecture & Offshore Engineering, Civil & Environmental Engineering, Engineering & Project Management)
2011 - **:** Professor Emeritus, University of California Berkeley, Marine Technology Development Group, Center for Catastrophic Risk Management

PRIMARY EXPERTISE

Risk Assessment and Management: Human & Organization Factors in Quality and Reliability of Engineered Systems
Ocean Environmental Conditions and Forces (earthquakes, wind, waves, currents, mudslides, ice)
Foundations Design and Construction (field explorations, soils testing, piles, mats, pipelines)
Structures Design, Construction, Operations, Maintenance, Re-qualification (fixed & floating platforms, ships, pipelines, shore bases)

HONORS

United States Senate Certificate of Recognition in Honor and Appreciation for help provided to the people of Louisiana during disasters resulting from hurricanes, the Gulf Coast Oil Spill, and the Oil Moratorium, April 5, 2011
Proclamation, Jefferson Parish Council, For Extraordinary Assistance to the Citizens of Jefferson Parish, Louisiana in the Aftermath of the Hurricane Katrina and Deepwater Horizon Oil Rig Disaster 2010
Offshore Technology Hall of Fame 2009
New Orleans City Council Certificate of Appreciation for Investigation of Failures of the New Orleans Flood Protection System during Hurricane Katrina and for Counsel to Provide Adequate Future Hurricane Flood Protection 2007
University of California Berkeley Chancellors Award for Research in the Public Interest 2007
Fellow, American Society of Mechanical Engineers 2005
Life Member, American Society of Civil Engineers, 2004
Offshore Energy Center Hall of Fame, Risk and Reliability Engineering, 2003
American Society of Civil Engineers Ralph B. Peck Award and Medal, 2002
U.S. Department of the Interior Minerals Management Service Corporate Leadership Award for Safety in Offshore Platform Operations, 1999
Offshore Mechanics & Arctic Engineering Technical Achievement Award, American Society of Mechanical Engineers, 1997
National Academy of Management, 1994
National Academy of Engineering, 1989
Marine Board, National Academy of Engineering, 1989 - 1995
Society of Professional Engineers Project of the Year, Freeport-McMoran Main Pass Block 99 Sulfur Mine Facilities, 1993
United States Coast Guard Research Commendation, 1992
American Society of Mechanical Engineers OMAE Technical Achievement Award, 1997
Institution of Engineers Australia Eminent Speaker Award, 1990
Offshore Energy Center Hall of Fame, Hurricane Wind, Wave, and Current Conditions & Forces, 1990
Bechtel Fellow Award, 1987
American Society of Civil Engineers Croes Medal, 1978
J. Hillis Miller Engineering Award, 1960

CONSULTING ABROAD
Canada, Greenland, England, Norway, Denmark, France, Spain, Angola, Nigeria, Gabon, Saudi Arabia, Kuwait, India, Thailand, China, Japan, Indonesia, Borneo, Australia, New Zealand, Mexico, Venezuela, Brazil, Chile, Argentina, Trinidad

BACKGROUND
I have devoted the past 25 years of my professional career to research, teaching, and consulting associated with the Risk Assessment and Management (RAM) and the catastrophic failure of engineered systems. This work has involved detailed studies and investigations of more than 630 major accidents, failures, and disasters associated with complex engineered systems such as the Occidental Piper Alpha platform in the North Sea, the Exxon Valdez tankship, the Petrobras P36 floating production platform offshore Brazil, the NASA Columbia space shuttle, and the flood protection system for the Greater New Orleans Area during Hurricane Katrina. The research, teaching, and consulting has focused primarily on interactions of engineering and organizational–institutional processes associated with catastrophic failures. A primary objective of this work has been development, validation, and application of advanced methods for RAM of complex engineered systems during their life-cycles (concept development through decommissioning).

I have published 288 refereed journal and conference papers that chronicle the studies and research I have performed that addresses RAM of complex engineered systems for offshore platforms, pipelines, and floating facilities for oil and gas exploration and production. I have written 5 books and 7 chapters in textbooks that document this background. I have published an additional 345 un-refereed technical papers and reports. These publications are listed in the last section of this appendix.

I have been recognized for my pioneering contributions to the RAM of offshore oil and gas exploration and production systems by the U.S. Minerals Management Service (MMS), the U.S. Coast Guard, the Offshore Technology Center, the Society of Petroleum Engineers, the American Society of Mechanical Engineers, the American Society of Civil Engineers, the Society of Naval Architects and Marine Engineers, the Academy of Management, and the National Research Council Academy of Engineering.

On July 8, 2010, I received a Proclamation from the New Orleans City Council "For continuing your efforts to support Louisiana and the City of New Orleans in the aftermath of Hurricane Katrina and the Deepwater Horizon Disaster." In September 2010, I received a Proclamation from the Jefferson Parish Council for my "Extraordinary assistance to the citizens of Jefferson Parish, Louisiana, in the aftermath of the Hurricane Katrina and Deepwater Horizon Oil Rig Disaster." On April 5, 2011, I received a Certificate of Recognition from the United States Senate "In Honor and Appreciation for all of the help you have provided to the people of Louisiana during disasters resulting from hurricanes, the Gulf Coast Oil Spill, and the Oil Moratorium."

EXPERIENCE
In 1960, I was employed by Shell Oil Company as a coastal - offshore engineer. During the first two years, I worked as a roughneck and roustabout on drill rigs and production platforms located offshore southern Louisiana (Venice, New Iberia, Lake Charles). During my career with Shell Oil Company, Shell Development Company and Royal Dutch Shell Company, I worked in exploration, drilling, production, refining, transportation, engineering, construction, operations, and research at various locations around the world. I was Chief Offshore Civil Engineer and Manager of the Central Engineering

Division for Shell Oil Company located in New Orleans, Manager of the Marine Technology Research Group at Shell Development Company located in Houston, Texas, Chief Engineer in the Bakersfield California Production District, and Head of the Marine Technology Development Group – Central Offshore Engineering Division located in Houston, Texas.

In 1977, I was appointed vice president and chief engineer of an international consulting engineering and contracting company - Woodward-Clyde Ocean Services (now United Research Services - URS Corporation) providing coastal and offshore engineering services to the international offshore oil and gas industry, including hurricane forecasting, development of reliability based design criteria for offshore platforms and pipelines, geotechnical – foundation engineering, structural engineering, construction engineering and design of flood protection facilities for refineries and chemical processing plants along the Gulf coast.

In 1981, I founded the Ocean Engineering Services Division of PMB and became vice president and senior international consultant for PMB – Bechtel. The Ocean Engineering Services Division offered a wide variety of engineering services world-wide that included concept development, design, construction, maintenance, and decommissioning of marine systems including offshore platforms, pipelines, and floating facilities. Of particular importance was work performed by this Division in arctic and sub-arctic areas in development and testing of innovative oil and gas exploration and production systems to work in this challenging environment. This work included development of risk and reliability based engineering design, construction, operation, and maintenance criteria for these systems. This work involved extensive engineering consulting and field exploration studies for Sohio on the North Slope – Prudhoe Bay, Alaska. In addition, together with colleagues from the Ocean Engineering Services Division, during the summer of 1986 we organized and presented a series of workshops on the topic of Risk Assessment and Management for BP's Board of Directors in London.

As I made a career transition from industry to academia in July 1988, I was brought by Occidental Petroleum to Aberdeen, Scotland as a member of an international team to investigate the failure of the Piper Alpha platform. For the next 3 years, the investigation team struggled to understand this disaster. At the end of this experience, I came to understand that for the vast majority of my career I had not understood several important aspects that caused this disaster. These aspects were chiefly focused in the human, organizational, and governance issues that were instrumental in development of the Piper Alpha platform disaster. This experience was reinforced in 1990 when I headed a joint industry – government sponsored project to investigate the grounding of the Exxon Valdez tanker. The investigation of the grounding of the Exxon Valdez taught many of the same lessons we learned from the failure of the Piper Alpha platform. There were some additional lessons that reinforced what I had learned earlier while working for Shell Oil Company as a result of the Unocal Santa Barbara platform blowout, the Shell Bay Marchand platform blowouts, and the Mississippi Piney Woods well blowout – the means, methods, and processes to control, contain and clean up oil and gas in and on the water were very ineffective. This important part of the consequences of failures could not be effectively mitigated or managed.

The Piper Alpha and Exxon Valdez investigations launched a two decade long series of research, development, and consulting projects that addressed different kinds of failures associated with oil and gas exploration and production systems including platforms, ships, and pipelines. All of these studies were conducted as joint industry – government agency sponsored projects. The different kinds of failures included 'quiet failures' that developed during concept development, design, and construction phases –

these were projects that suffered serious project 'over-runs' and frequently showed up in legal proceedings. There were also 'noisy system failures' that developed during construction, operations, and maintenance phases – these were projects that received significant media, public and government attention. These different kinds of failures sometimes had similar sources; other times they had different sources. These different kinds of failures had very different 'signatures'. The 'quiet' failures generally were sourced in a few people and a few malfunctions of different parts of a particular system. In contrast, the noisy system failures were sourced in many people and organizations and involved a very large number of malfunctions in many parts of the particular system that generally developed over a long period of time. Examples of the noisy system failures that I studied during this time period included the Statoil Sleipner A platform sinking (failure during construction), the Texas Tower Number 4 collapse (failure during operation), the sinking of the Petrobras P36 floating production platform, and the NASA Columbia shuttle accident.

BP CONSULTING EXPERIENCE

The following is a summary of the professional work I have performed for and with BP:

1974 - 1975	British Petroleum, London, North Sea platform design criteria, construction, operations, and maintenance - Dr. John Rigden
1982 – 1985	Sohio – BP, San Francisco and London, Arctic exploration and production islands, structures and pipeline design criteria; workshops on reliability based design of arctic structures, islands, and pipelines – Dr. Tony Kirkby
1990 – 1997	BP Oil Company, BP Marine, Cincinnati, Ohio, ship structural maintenance, role of human errors in design, construction, operation, and maintenance of oil tankers – Mr. Dick Whiteside and Mr. Dave Witmer
1998 – 2002	BP – Amoco, Houston, Texas, risk assessment and management based maintenance of marine pipelines, performance of offshore pipelines – Dr. Bernie Stahl, Mr. Sam DeFranco
2001 – 2002	BP Refining – US and UK, risk assessment and management approaches and strategies applied to BP 'downstream' operations – Mr. Andy Fiedler (BP US), Mr. Martin Hinchcliffe and Mr. Colin Reid (BP UK)
2000 – 2001	BP UK – comparative risk analysis evaluation of minimum structures and jackets (with WS Atkins Consultants Ltd) – Dr. Bernie Stahl, Mr. Sam DeFranco (BP Houston, TX)
2001 – 2005	BP, Houston, Texas – risk assessment and management approaches and strategies applied to BP 'upstream' deepwater platform and pipeline operations – Dr. Edward Clukey, Dr. Bernie Stahl, Mr. Sam DeFranco (BP Houston, TX)

PUBLICATIONS

Refereed Publications

A. Archival Journals

1. R.G. Bea, Discussion of "Friction and Cohesion of Saturated Clays," by T. H. Wu et al., *J. Soil Mechanics and Foundations Div.,* ASCE, Vol. 89, no. SM1, Feb. 1963, pp. 268-277.
2. R.G. Bea, "How Sea Floor Slides Affect Offshore Structures," *Oil & Gas Journal,* Nov. 29, 1971, pp. 88-91.
3. R.G. Bea, "Selection of Environmental Criteria for Offshore Platform Design," *Preprints, Offshore Technology Conference,* Houston, TX, OTC 1839, pp. II-185 - II-193, May 1973; also *J. Petroleum Technology,* Nov. 1974, pp. 1206-1214.
4. R.G. Bea and P. Arnold, "Movements and Forces Developed by Wave-Induced Slides in Soft Clays," *Preprints, 5th Annual Offshore Technology Conference,* Houston, TX, OTC 1899, May 1973, pp. II-731 - II-740; also *J. Petroleum Technology,* April 1975.
5. R.G. Bea, N.W. Lai, A.W. Niedoroda and G.H. Moore, "Gulf of Mexico Hurricane Wave Heights," *Preprints, 15th Annual Offshore Technology Conference,* Houston, TX, OTC 4586, May 1974, pp. 49-62; also *J. of Petroleum Technology,* Sept. 1975, pp. 1160-1172.
6. R.G. Bea, H.A. Bernard, P. Arnold and E.H. Doyle, "Soil Movements and Forces Developed by Wave-Induced Slides in the Mississippi Delta," *J. Petroleum Technology,* April 1975, pp. 500-514.
7. R.G. Bea and P.W. Marshall, "Failure Modes of Offshore Platforms," *Proc. of the Conference on Applications of Statistics and Probability in Engineering,* ASCE, Stanford University, June 1975; also BOSS '76 Conference Proceedings, Vol. II, Trondheim, Norway, pp. 579-635.
8. R.G. Bea, "Offshore Platforms - Platform Design," Petroleum 2000, Seventy-Fifth Anniversary Issue, *Oil & Gas Journal,* Aug. 1977.
9. R.G. Bea, "Earthquake Criteria for Platforms in the Gulf of Alaska," *J. Petroleum Technology,* March 1978, pp. 325-340.
10. R.G. Bea, J.M.E. Audibert and M.R. Akky, "Earthquake Response of Offshore Platforms," *J. Structural Div.,* ASCE, Vol. 105, no. ST2, Feb. 1979, pp. 377-400.
11. R.G. Bea, "Earthquake and Wave Design Criteria for Offshore Platforms," *J. Structural Div.,* ASCE, Vol. 105, no. ST2, February 1979. pp. 401-419.
12. R.G. Bea, "Reliability Considerations in Offshore Platform Criteria," *J. Structural Div.,* ASCE, Vol. 106, no. ST9, Sept. 1980, pp. 1835-1853.
13. R.G. Bea, A.R. Dover and J.M.E. Audibert, "Quality in Soil Borings Makes a Difference," *Oil & Gas Journal,* June 1981, pp. 133-139.
14. R.G. Bea, A.R. Dover and J.M.E. Audibert, "Pile Foundation Design Considerations for Deepwater Fixed Structures," *Proc. of the Third Int. Conf. on Behavior of Off-Shore Structures,* BOSS '82, Hemisphere Publishing Company, New York, 1982, pp. 125-140.
15. R.G. Bea and J.M.E. Audibert, "Offshore Platforms and Pipelines in Mississippi River Delta," *J. Geotechnical Engineering Div.,* ASCE, Vol. 106, no. GT8, Aug. 1980, pp. 853-869.
16. R.G. Bea, J.M.E. Audibert, and M.R. Akky, "Platforms in Earthquakes," *Oil & Gas Journal,* three-part series, March 1981: (1) "Offshore Platform Elastic Response is Analyzed," pp. 135-139, March 9, 1981; (2) "Inelastic Earthquake Response of Offshore Platforms Evaluated," pp. 84-90, March 16, 1981; (3) "Performance of Superstructure and Substructure Elements are Analyzed," pp. 163, 166, 168, 170, 172, March 23, 1981.

17. R.G. Bea, S.G. Wright, P. Sinclair and A.W. Niedoroda, "Wave-Induced Slides in South Pass Block 70, Mississippi Delta," *Proc. Geotechnical Engineering Div.*, ASCE, April 1983, pp. 619-644.
18. R.G. Bea, "Application of Reliability Methods in Design and Analysis of Offshore Platforms." by the Committee on Reliability of Offshore Structures, *J. Structural Engineering,* ASCE, Vol. 109, no. 10, Oct. 1983, pp. 2265-2291.
19. R.G. Bea, "Hurricane Wave Height and Forces," *Oil & Gas Journal,* five-part series, September and October 1983: (1) "Design Criteria Overcorrected after Hurricane Hilda," Sept. 12, 1983, pp. 151-153; (2) "Deepwater Storm Waves Dissipate Across Continental Shelf," Sept. 26, 1983, pp. 100-102; (3) "Wave Height Attenuation Modeled by Computer Program for Shallow Water in Gulf," Oct. 10, 1983, pp. 114-120; (4) "Design Wave Forces Escalate to 100-Year Conditions to Consider Storms, Drag, Fouling," Oct. 24, 1983, pp. 95-99; (5) "Wave Force Design Program Offers Cost Saving," Nov. 7, 1983, pp. 112, 117-118, 120.
20. R.G. Bea and R.P. Aurora, "Design of Pipelines in Mudslide Areas," *J. Petroleum Technology,* Nov. 1983, pp. 1985-1995.
21. R.G. Bea, S. Nour-Omid, T.B. Coull, R.E. Potter and H.R. Bivens, "Innovative Foundations for a New Class of Arctic Structures," *J. Ocean Business,* Offshore, Dec.-Jan. 1983-84, 8 pp.
22. R.G. Bea, S.T. Hong and J.S. Mitchell, "Decision Analysis Approach to Offshore Platform Design," *J. Structural Engineering,* Vol. 110, no. 1, Jan. 1984, pp. 55-74.
23. R.G. Bea, "Foundations for Arctic Offshore Structures," *Marine Technology Society Journal,* Special Issue on Arctic Engineering, Vol. 18, no. 1, Sept. 1984, pp. 22-30.
24. R.G. Bea, "Loading Uncertainties in Extreme Waves," *Marine Structures,* 3: pp. 237-260 (England: Elsevier Science Publishers Ltd., 1990).
25. R.G. Bea and D. McDonald, "Reliability Evaluation of a Jack-Up Drilling Unit," *Transactions,* Society of Naval Architects and Marine Engineers, Vol. 98, 1990, pp. 169-186.
26. R.G. Bea, "Offshore Platform Reliability Acceptance Criteria," *Society of Petroleum Engineers Journal of Drilling Engineering,* June 1991, pp. 131-137.
27. R.G. Bea, S.F. Pawsey and R.W. Litton, "Measured and Predicted Waves Forces on Offshore Platforms," *Journal of Waterway, Port, Coastal and Ocean Engineering,* American Society of Civil Engineers, Vol. 117, no. 5, September/October 1991, pp. 511-532.
28. R.G. Bea, "Pile Capacity for Axial Cyclic Loading," *Journal of Geotechnical Engineering,* American Society of Civil Engineers, Vol. 118, no. 1, January 1992, pp. 34-50.
29. R.G. Bea and M.E. Paté-Cornell, "Management Errors and System Reliability: A Probabilistic Approach and Application to Offshore Platforms," *Journal of Risk Analysis,* Vol. 12, no. 1, 1992, pp. 1-18.
30. R.G. Bea, "Marine Structural Integrity Programs," *Journal of Marine Structures,* Vol. 7, Feb. 1994.
31. R.G. Bea, "Evaluation of Alternative Marine Structural Integrity Programs," *Journal of Marine Structures,* Vol. 7, Feb. 1994.
32. R.G. Bea, "Ship Structural Maintenance: Recent Research Results and Experience," *Transactions,* The Institute of Marine Engineers, Vol. 105, Part 5, Sept. 1993.
33. R.G. Bea, "Session VI Summary: Structures," *Applied Mechanics Reviews,* ASME Book No. AMR128, Vol. 46, no. 5, May 1993, pp. 227-228.
34. R.G. Bea, "Evaluation of Uncertainties in Loadings on Offshore Structures due to Extreme Environmental Conditions," *Journal of Offshore Mechanics and Arctic Engineering,* Vol. 115, November 1993.

35. R.G. Bea, C.A. Cornell, J.E. Vinnem, J.F. Geyer, G.J. Shoup, and B. Stahl, "Comparative Risk Assessment of Alternative TLP Systems: Structure and Foundation Aspects," *Journal of Offshore Mechanics and Arctic Engineering,* Vol. 116, May 1994.
36. R.G. Bea and W. Moore, "Management of Human Error in Operations of Marine Systems," *Marine Technology Society Journal,* Vol. 28, No. 1, Spring 1994.
37. H. Banon, B.G. Bea, F.J. Bruen, C.A. Cornell, W.F. Krieger and D.A. Stewart, "Assessing Fitness for Purpose of Offshore Platforms, I: Analytical Methods and Inspections," *Journal of Structural Engineering,* Vol. 120, No. 12, December 1994.
38. R.G. Bea and K. Roberts, "Human and Organization Factors in Design, Construction and Operation of Offshore Platforms," *Journal. of Society of Petroleum Engineers,* SPE 30899, Sept. 1995.
39. S.T. Staneff, C.W. Ibbs, and R.G. Bea, "Risk-Management System for Infrastructure-Condition Assessment," *Journal. of Infrastructure Systems,* ASCE, Vol. 1, No. 4, Dec. 1995.
40. R.G. Bea, "Nonlinear Performance of Offshore Platforms in Extreme Storm Waves," *J. of Waterway, Port, Coastal, and Ocean Engineering,* ASCE, Vol. 122, No. 2, March/April, 1996.
41. T. Mannarelli, K.H. Roberts and R.G. Bea, "Learning How Organizations Mitigate Risk," *J. of Contingencies and Crisis Management,* Vol. 4, No. 2, June 1996, pp. 83-92.
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3) March 1, 2009 to July 1, 2010: Lafarge North America Inc. – Barge ING 4727 Lower 9th Ward Breaches - Defendants

4) November 1, 2009 to August 1, 2010: Tenet Memorial Hospital Flooding - Defendants

Appendix B

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Fire Safety Engineering Science

Ph.D. University of California, Berkeley, CA, December, 1993
Ad Hoc Interdisciplinary Program
Fire Safety Engineering Science
Ph.D. Dissertation Subject: *Fire and Life Safety /Risk Management*

Professional Registrations

Professional Fire Protection Engineer - State of California[†]

Professional Mechanical Engineer - State of California

Professional Mechanical Engineer - State of Alaska

Certified Safety Professional (C.S.P.) - Nationally Recognized

Certified Fire and Explosion Investigator (C.F.E.I.) - Nationally Recognized

Certified Fire Investigation Instructor (C.F.I.I.) - Nationally Recognized

Private Investigator (P.I.) – State of Oregon (inactive)

[†] Dr. Gale was among the first one hundred engineers in the United States to become professionally registered in fire protection engineering. He holds State of California FPE Registration Number 72, awarded in January 1976.

Professional Affiliations

Member	National Fire Protection Association (NFPA)
Member	Society of Fire Protection Engineers (SFPE)
Member	American Institute of Chemical Engineers (AIChE)
Member	Society for Risk Analysis (SRA)
Member	American Society of Safety Engineers (ASSE)
Member	International Association of Arson Investigators (IAAI)
Member	California Conference of Arson Investigators (CCAI)
Member	National Association of Fire Investigators (NAFI)
Member	Combustion Institute
Member	U.C. Berkeley Deepwater Horizon Study Group
Associate Member	American Academy of Forensic Science (AAFS)
Former Member	American Society of Civil Engineers (ASCE) -- Committee on Reliability of Offshore Structures
Former Member	Marine Technology & Management Group, UC Berkeley
Former Member	NFPA Committee #17 (Dry Chemical Systems) NFPA Committee # 17A (Wet Chemical Systems)
Former Member	American Petroleum Institute Committee on Safety and Fire Protection (API - COSFP)
Former Member	California State Fire Marshal's Fire Extinguisher Advisory Committee

Professional Experience

Dr. Gale has over forty years of professional experience in project engineering, design and construction, and loss prevention consulting, both domestically and overseas. He is an engineering specialist in all aspects of loss prevention, hazard and failure analysis, risk management and safety, including risk assessment, process safety management, facility safety, and major incident investigations involving fires, explosions and releases of hazardous materials. An experienced origin and cause investigator, Dr. Gale is certified by the National Association of Fire Investigators (NAFI) as a Certified Fire and Explosion Investigator (CFEI) and a Certified Fire Investigation Instructor (CFII). He is also certified by the Board of Certified Safety Professionals as a CSP in Engineering Aspects and is a registered Professional Engineer.

Dr. Gale's engineering experience spans both the realms of the owner-operator and the designer-constructor, affording him a detailed working knowledge and insight from each perspective. He is frequently consulted on major fire and explosion losses, and is recognized as an expert in safe operating procedures (SOP) and human & organizational error (HOE). His broad-ranging experience includes petroleum refineries and offshore platforms, solvent extraction and bio-diesel operations, co-generation and power plants, semi-conductor manufacturing and chemical plants, mining operations and merchant vessels, commercial warehouses, apartments, high rise buildings, as well as numerous residential fires and explosions. Dr. Gale has provided international loss prevention engineering and risk management consulting services since 1991 and is a principal of **Bundy, Gale & Shields**, LLC, international fire investigators and loss prevention consultants. Prior to becoming a full-time consultant, Dr. Gale was employed by Bechtel where he founded and managed Bechtel's Loss Prevention Group in San Francisco. He left Bechtel in 1990 as Chief Loss Prevention Engineer to establish his own consulting practice. Preceding his ten years with Bechtel, Dr. Gale worked as both an employee of and consultant to a number of Fortune 500 companies, including Chevron Oil Corporation and Brown & Root, Inc.

Fields of Experience include:

- Fire and explosion investigations involving all types of industrial, commercial, institutional and residential occupancies, ranging from oil and gas production and refining, pipeline explosions and fires, chemical and manufacturing facilities, warehouses and cold storage buildings, schools and hospitals, to apartment buildings and high-rise condo units, historic buildings under renovation, and single family homes of all sizes and values, including natural gas and propane related incidents
- forensic and failure analysis, litigation support and technical consultation, fact investigation, origin and cause investigations, gas and dust explosions, water damage losses, construction defects, hazardous and reactive materials, plant operations, human and organizational errors, safe operating practices
- facility loss prevention engineering assessment adequacy for large industrial, commercial, institutional, and military projects, including special high-valued facilities, e.g., semi-conductor plants, co-generation facilities, textile manufacturing and mill operations, chemical plants and plastics manufacturing
- facility and process safety for petroleum refineries and petrochemical plants, chemical plant operations, marine terminals and offshore platforms, LNG/CNG & NGL facilities, pipeline and marketing terminals, service stations
- product liability issues, construction/manufacturing defect assessment and standard-of-care analysis, codes and standards application and compliance
- hazard analysis and risk assessment studies, including scenario evaluation and ranking, Hazard and Operability (HAZOP) studies, and other predictive hazard analysis methods and investigative techniques
- federal and state risk management and prevention program compliance, e.g., OSHA-PSM, EPA-RMP; Chemical Safety Board (CSB) and NTSB investigations
- evaluation of human factors in accident causation; determination of root cause(s)
- assessment of conceptual and detailed loss prevention design criteria for new construction and revamp projects; standard of care evaluations
- life safety and fire loss prevention surveys and facility safety audits; incident reconstruction, program development and plan review, contingency assessments
- material selection and design for fire resistive construction; fire protection of construction elements, fireproofing/firesafing design, specification compliance
- system design evaluation of smoke, fire and gas detection, fire alarm signaling systems, fire and explosion suppression systems, fire sprinkler systems, commercial kitchen fire suppression system failure analysis
- large and small scale fire testing; CFD computer fire modeling, demonstrative evidence and trial preparation assistance; incident simulation/reconstruction

Representative Hazard Analysis and Risk Assessment Projects

- a major LNG/LPG receiving terminal modernization in Georgia;
- a new crude oil pipeline and marine terminal in Russia;
- a new pipeline and gas compression/treating facility in Thailand
- a new crude oil pipeline and pump stations in Washington
- a MTBE/Methanol loading terminal in Qatar
- expansion of an existing gas receiving and treating plant in Thailand
- a new barge-mounted CNG transport system
- life safety analysis for a Taiwan semi-conductor tool manufacturing plant
- OSPR risk assessment of petroleum product pipelines in California waters
- loss prevention and life-safety review of new and existing offshore platforms in the Gulf of Mexico
- HAZOP studies for numerous petroleum refinery processing units in California

Employment History

Formerly Chief Loss Prevention Engineer for Bechtel; formed and managed the Bechtel Petroleum/Bechtel National Loss Prevention Engineering Group and served as principal consultant on in-house projects with regard to fire protection and safety-related design matters from 1980 - 1990. Supported a variety of projects in all business-line areas. Functional manager of loss prevention engineers assigned to specific projects, forecast manpower and staffing requirements, and maintained company's leadership role and position of technical excellence with regard to loss prevention engineering technology. Represent company in professional organizations and conferences; provide technical support to in-house counsel on various litigation actions. Member of the American Petroleum Institute's Task Force that developed a new recommended practice (RP) for the fire protection of liquefied petroleum gas (LPG) storage facilities, API RP-2510A.

Highlights of Bechtel Work History (1980-1990)

- develop new methodology to quantify the term "adequate ventilation," subsequently adopted by the American Petroleum Institute, Institute of Petroleum (U.K.) and Canadian authorities.
- technical specialist for two multi-million dollar fire loss investigations and litigation defense cases involving Canadian tar sand mining and upgrading operations
- develop RMPP/PSM methodology for major California oil refineries
- fire protection and safety design, specifications, and drawings for over a one billion dollar grass-roots gas-to-gasoline facility in New Zealand
- fire protection and safety design, specifications, and drawings for an integrated modular oil and gas gathering center, North Slope of Alaska
- lead systems safety engineer for D.O.D. - S.D.I. laser defense project
- lead engineer of Safety Analysis Review (SAR) team for D.O.E. facilities
- project fire-safety engineer for the design and construction of a new high energy anechoic chamber for military systems
- off-project safety consultant for a new grass roots heavy oil upgrader facility in Canada
- instrumental in establishing fire safe design criteria and UBC code analysis for construction and approval of Alaska North Slope oil and gas processing modules
- worked closely with the late Professor R. Brady Williamson on risk assessment methods

Provided loss prevention engineering and risk management services for:

- the world's largest barge-mounted sea water treatment plant for water injection service on the North Slope of Alaska
- several offshore oil and gas production platforms for various clients in California and Australian waters
- several major refinery expansions and a grass-roots 100,000 BPD refinery
- several pipeline pumping/compressor station facility expansions and new construction for major oil companies and public utilities.
- feasibility studies and risk assessment for new LPG and LNG marine terminals, and a barge mounted transportation system for high pressure compressed natural gas (CNG).
- several DOD and DOE projects involving weapon systems and power plants

Prior Experience

Brown & Root, Inc., San Francisco, CA. (1976 - 1980)

Staff engineering specialist and discipline manager of fire protection engineering. *British Petroleum North Slope Project*: responsible for fire protection related design and system startup for the original North Slope oil and gas gathering centers. *Petroleous Mexicanos - Bay of Campeche* development: established minimum safety design criteria for offshore platform layout and fire protection. *Chevron Oil - Casa Blanca Platform Project, Madrid, Spain*: resident senior fire protection engineer responsible for all fire protection engineering design, drawings, and specifications for Spain's first fixed offshore production platform.

The FPE Group, San Francisco, CA. (1973 - 1976)

Staff consultant and fire protection specialist for oil and gas facilities. Conceptual and detailed design for a variety of projects, including several new offshore production platforms and mobile drilling units. Conducted fire loss prevention surveys in a wide range of facilities, including commercial buildings, health care facilities & hospitals, computer facilities, as well as heavy industries, such as foundries. Resident consultant engineer in New Plymouth, New Zealand on the *Maui A gas condensate production platform design for Shell, B.P., & Todd*. Worked closely with the Ansul Company in testing new fire extinguishing agents and application systems development. Designed and specified fire protection systems and equipment for facility protection, including fire sprinkler system and fire detection and alarm systems for commercial, industrial, and institutional applications.

Standard Oil Company of California (Chevron), S.F., CA (1968 - 1973)

Staff fire protection engineer in the corporate engineering fire protection group, specializing in oil and gas production and processing facility fire protection. Performed numerous fire loss prevention surveys of company facilities, both onshore and offshore, including oil and gas production platforms, drilling rigs, refineries, marketing terminals, gas plants, and pipeline stations. Conducted major fire loss investigations, taught oil and gas fire school field training sessions for the Western Oil & Gas Association, and developed new corporate design practices and standards related to fire protection and loss prevention engineering.

Prior Chevron positions included reservoir Development Engineer, and oil field Design & Construction Engineer. Development engineering activities included subsurface formation evaluation, well logging, bottom hole location analysis, and well drilling and completion programs. Design and construction involved design of oil field production and secondary recovery equipment for both rural production leases and urban drill sites, including large capacity pumps, field gas compressors, gas treating plants, motor control centers, oil dehydration and treating facilities and storage tank-farms.

Dr. Gale began his professional career more than forty years ago in 1967 with Standard Oil Company as an engineering trainee in a student summer-jobs program at the Perth Amboy, N.J. refinery. He performed a variety of duties dealing with energy conservation, pressure vessel certification and fire protection. Since that time he has been involved in numerous petroleum refinery, chemical and petrochemical plant projects as well as incident investigations of all kinds.

Representative Litigation Support and Consulting Engagements

- **Abeyta Nelson, P.C. (Yakima, WA)** – a products defect and personal injury case stemming from an explosion involving the mixing and ignition of propane and oxygen
- **ACE Westchester Specialty Claims** – investigation of a $ multi-million fire loss involving NBC Universal's TV transmission station and equipment on top of Mt. Loma Prieta, Los Gatos, CA
- **Adams and Reese (New Orleans)** – a +$300 million refinery explosion and fire in the FCC involving multiple fatalities; investigation of a large fire loss involving an historic racetrack
- **Alaska National Insurance** – investigation of a restaurant fire involving a LP-gas range
- **Alexander, Holburn, Beaudin & Lang** – $30 million dollar fire loss in a Canadian lumber mill
- **Allied Insurance Group** -- service station fire/fatality investigation
- **Allswang, Smith & Walsh** – wrongful death action involving a mentally challenged victim
- **Alper & McCulloch** – two separate fire incidents involving restaurant kitchen fires and commercial cooking fire suppression system design and certification issues; a water damages incident involving a multi-tenant residential loft conversion warehouse; a water damages case involving a major medical center
- **Anderson, McPharlin & Conners** – personal injury from an explosion in a petroleum storage tank
- **Applied Materials** – Loss Prevention Consultant for life safety and fire protections systems in new semi-conductor manufacturing tool facilities in Taiwan and Santa Clara
- **Architectural Diagnostics**, Ltd. (Honolulu) – construction defects in two high rise towers
- **ARCO Legal Department** – refinery fire investigation involving a delayed coker
- **ARNS Law Firm** – flash fire during startup of a refinery catalytic reformer furnace following a turnaround
- **Auchard & Stewart** – resident fire involving ignition of a gasoline spill in a garage
- **Barger & Wolen** – marine litigation fire investigation/engineer support
- **Barnhorst, Schreiner & Goonan** – product liability action resulting from water damage to a high rise office building from sprinkler system failure
- **Bartlett, Kirch & Lievers** – a product liability action stemming from personal injuries in a fire involving the mixing and use of flammable liquids for use as a solvent
- **Bays Deaver Lung Rose & Baba** (Honolulu) – multi-million dollar condo fire in Hawaii
- **Bearnson & Peck** – multiple fatality garden apartment fire investigation in Logan, Utah
- **Bechtel Corporation** – litigation support in two actions involving major fire losses involving a fluid coker and tar sands unit in synthetic petroleum refineries; liaison with the firms of:

Thelen, Marrin, Johnson & Bridges (U.S.); **Field & Field Perraton** (Canada); **Singleton Urquhart Macdonald** (Canada)**; Code Hunter Wittmann** (Canada); **Maxon Young and Lloyds of London**

- **Bechtel Construction** (**BECON**) – investigation a multiple fatality explosion in a polyesters fiber manufacturing facility
- **Bechtel Environmental** – Loss Prevention and risk analyses consulting for OSPR compliance regarding several petroleum products pipelines near marine waterways
- **Bechtel Offshore** – Loss Prevention and risk analyses consulting for offshore production platforms in the Gulf of Mexico
- **Bechtel Power Inc.** – performing technical support involving issues of code compliance re: cable and cable tray fire protection in nuclear power plants
- **Betts, Patterson & Mines** – product liability investigation involving a commercial building fire
- **Bickel & Associates** – multi-million dollar condo fire in San Francisco Pacific Heights
- **Bishop Barry Howe Haney & Ryder** – litigation support in several refinery asbestos litigation cases
- **Bishop Barry Drath –** investigation of an explosion and fire involving two houseboats in Sausalito, CA
- **Bisnar|Chase –** product liability action involving a portable camping catalytic heater
- **Bledsoe, Cathcart, Diestel, Livingston & Pedersen** – destruction of a luxury home alleging spontaneous combustion of oil soaked rags; fire in a residential high rise apartment building
- **BoatU.S., Marine Insurance Claims** (**MIS TEAM) –** investigation of a fire aboard the yacht "C'EST LA VIE" caused by spontaneous combustion of oil stain-soaked rags
- **Boccardo Law Firm –** investigation of the 2005 Los Gatos, CA Auto Mall natural gas explosion and fire
- **Borton, Petrini & Conron –** residential apartment complex fire involving wrongful death
- **Boughey, Garvie & Bushner** – fire investigation in a residential apartment unit
- **Bragg & Dziesinski** – personal injury action involving injuries received from a kitchen stove-top fire; investigation of a residential aquarium fire; product liability action involving a surge suppressor in a house fire; product liability action involving a beverage dispenser in a restaurant fire; a radio station wild-land fire; investigation of telephone vault cable damage from a steam leak; Lodi delta marina fire investigation; residential fire at a private school on 17-mile drive in Carmel, a warehouse fire in Emeryville, CA
- **Bragg & Kuluva –** investigation of a fire in a commercial building allegedly caused by a 'swamp-cooler'
- **Branson Law Firm –** a civil action involving a natural gas explosion during a construction project; gas explosion in a hunting cabin resulting in two fatalities; personal injury action involving expulsion of caustic solution from a tallow tank; wrongful death action involving high tension power lines; personal injury action involving rupture of a high pressure gas line; wrongful death in a natural gas plant explosion
- **BroanNuTone –** large-loss fire investigation involving a commercial complex & restaurant in Astoria, OR
- **Brown Peterson & Marks/Brown Brown & Klass** – investigation of the Harris Grade wildland and peat bog fire involving several civil actions from associated fatal automobile accidents
- **Budge & Heipt** – investigate a multiple-fatality, 3-alarm fire in a large apartment complex in SeaTac, WA
- **Bullivant Houser Bailey –** investigation of a cold storage warehouse ESFR sprinkler system; investigation of a fire involving charcoal lighting fluid; condo fire sprinkler investigation
- **Burnet, Duckworth & Palmer** (Canadian Law Firm) **–** investigation of a major school fire; investigation of a manufacturing plant explosion and fire involving magnesium dust and TCE storage
- **Burnham & Brown** – investigation of a fire in a large aircraft hangar under renovation; investigation of a South of Market (SF) apartment complex fire
- **Burr, Pease & Kurtz** (Anchorage, AK) – investigation of a fire involving polymeric roof coating
- **Butler, Snow, O'Mara, Stevens & Cannada** – explosion and fire in a large rubber recycling plant resulting in five fatalities and several injuries

- **Butler Viadro –** personal injury suit related to high-rise construction defects & water intrusion issues
- **Cardozo, Curtis & Arata –** vehicle fire and personal injury suit involving refueling
- **Callahan, McCune & Willis –** investigation of a $40 million winery warehouse fire in Napa Valley, CA
- **Carlson, Calladine & Peterson** – investigation of two explosions involving rocket fuel production; investigation of a +$100 million Mare Island, California wine warehouse fire and related code issues; investigation of several multi-billion dollar Southern California wildfire losses in October, 2007
- **Carlton Fields –** residential fire involving fire alarm system response performance
- **Carroll Burdick & McDonough –** residential fire investigation allegedly involving a luxury automobile
- **Carroll Warren & Parker –** fatal residential natural gas explosion in Mississippi
- **Casper Meadows Schwartz & Cook –** investigation of a fatal propane gas explosion involving hot work
- **Clapp, Moroney, Bellagamba and Vucinich** – multiple fatality apartment complex fire investigation; an infant fatality apartment complex fire investigation
- **Clapp, Peterson & Stowers (Fairbanks, Alaska) –** a residential apartment complex fire investigation in Alaska; a products liability action involving thermoelectric generators used in the Yukon Measurement and Debriefing System [YMDS], a war simulator and training system utilizing mountain-top instrument PODS
- **Cobian & Valls** – fire investigation involving a wood processing and storage warehouse in San Juan, PR
- **Cosgrave, Vergeer & Kester** – apartment complex fire involving several fatalities
- **Cosgrove, Flynn & Gaskins** – civil action involving a natural gas explosion in a mobile home
- **Cox, Wootton, Griffin & Hansen –** fire investigation involving a plastic recycling plant
- **Cozen & O'Connor –** apartment complex fire involving several fatalities; natural gas compressor explosion and fire; explosion and fire in a furniture stripping facility; investigation of a school fire involving hazardous materials; municipal offices building fire loss and fire protection analysis; investigation of a roof-top air conditioning unit fire in an professional and medical office complex; Chili's restaurant kitchen fire; water damages case involving the failure of fire sprinkler system riser's thrust block tie-rod connectors
- **Crosby, Heafy, Roach & May –** civil action involving a major refinery fire; personal injury and product liability action involving failure of a fire extinguisher
- **Cuff, Robinson & Jones –** explosion investigation involving the use of MEK to remove epoxy
- **Culbreth Schroeder –** residential fire investigation involving an electric clothes dryer
- **Davis, Cedilla & Mendoza –** fatal residential structure fire involving two children
- **Dechert, Price and Rhoads –** product liability action involving a $1 Billion textile mill fire
- **Delaney, Wiles, Hayes, Gerety, Ellis & Young** (Anchorage, AK) – see **Burr, Pease & Kurtz**
- **Dickinson, Wright, Moon, Van Dusen & Freeman –** major refinery fire and wrongful death involving product liability issues re: piping components
- **Donahue, Bates, Blakemore & Mackey –** water damages case involving a resort in Squaw Valley, CA
- **Dorsey & Whitney –** major fatal explosion in a aerosol canister filling plant involving EtO
- **Drath, Clifford, Murphy, Wennerholm & Hagen** – investigation of a brewery/restaurant fire
- **Dreyer, Babich, Buccola & Wood** – personal injury investigation involving hydrostatic testing of a newly installed 24-inch water main and fire hydrant system; multiple fatality 8-alarm retirement home fire in California; a multiple injury and fatality incident involving a residential natural gas explosion; a fatal explosion and flash fire involving discharge of a residential fire sprinkler system containing antifreeze; a multiple injury and fatality incident involving a natural gas pipeline explosion and fire in San Bruno, CA; investigation of a fatal residential fire in Santa Rosa, CA.
- **Dunlap & Soderland –** investigation of a leaking fire sprinkler system in a large condominium complex
- **Edwards, Kenny & Bray (Vancouver) –** fire involving a residential structure under construction

- **Electric Insurance Company –** investigation of a museum fire in a cold storage vault for old cellulous nitrate films; investigation of several residential fires allegedly involving various kitchen appliances
- **Electrolux Corporation –** product liability action stemming from an alleged clothes dryer fire
- **Ericksen, Arbuthnot, Kilduff, Day & Lindstrom** – water damages case involving fire hydrant issues
- **Erickson Law/Nordyne –** residential fire involving an attic mounted horizontal natural gas furnace
- **Farbstein & Blackman** –fire investigation involving a multi-unit Victorian in northern California
- **Farmers Insurance Company** – fire investigation of a 12 unit San Francisco 1907 Victorian apartment complex; a multiple fatality apartment complex fire in Daly City; an infant fatality fire in a garden apartment complex; a personal injury apartment fire in San Francisco; an apartment complex fire in Pittsburgh; a residential gas explosion in Los Altos, CA; a residential quadraplex fire and its propane system in Scotts Valley, CA; a residential fire in Newman, CA, allegedly involving a oil-filled radiator heater; an alleged lithium battery fire in Vacaville, CA; residential gas fire in Fresno, CA; mobile home gas explosion in Marysville, CA, residential gas fire in Sacramento, CA; residential fire in San Mateo, CA; a residential propane gas explosion in Monterey, CA
- **Federated Insurance Company** – Burger King restaurant fire in Visalia; restaurant fire in Fresno
- **Field and Field Perraton** (Calgary) – civil action involving a fire in a large furniture manufacturing complex involving polyurethane foam/textiles
- **Field and Field Perraton** (Edmonton) – several civil actions involving timber harvesting machinery fires (Timber Feller-Bunchers)
- **Field Warwick & Sanders –** residential fire involving a propane-fueled floor furnace; propane-fueled fire involving a mountain cabin in the high sierras (**Field & Sanders**).
- **Fineberg & Gresham –** personal injury involving an oil-field fire incident and a glycol dehydrator unit
- **Fisher Law Offices/ Richard White Law Offices –** construction defect action involving fire sprinkler and alarm system deficiencies in large residential apartment complexes
- **Foley & Lardner –** multi-million dollar manufacturing facility fire loss involving propane cylinder storage
- **Foley & Mansfield –** litigation support in a asbestos litigation case involving several Iranian refineries
- **Foley Mcintosh, Frey & Claytor –** investigation of a multiple-alarm medical center fire
- **Fonda & Hilberman –** civil action stemming from burn injuries in a residential apartment fire
- **Ford, Walker, Haggerty & Behar –** product liability action involving a LP-Gas fueled barbecue fire; fire investigation involving a commercial nut processing facility in LA; personal injury case involving release of high temperature steam from a butterfly valve; fire involving hot work in a oil refinery; infant-death fire investigation involving multi-purpose butane lighter
- **FPL Energy, LLC** – investigation of a fire in a 1.8 MW wind turbine on a 65 meter high tower
- **Frazer Greene Upchurch & Baker –** fatal toxic gas release in a sodium hydrosulfite plant
- **Frilot Partridge LLP –** analysis of maximum incident radiant heat from a refinery fire incident
- **Frilot, Partridge, Kohnke & Clements –** products liability action involving ignition of gasoline
- **Frohnmayer, Deatherage, Jamieson, Moore, Armosino & McGovern –** product liability investigation
- **Garvey Schubert Barer –** investigation of a 4-alarm fire in a oil recycling plant
- **Gelfand & Glaser –** wrongful death action involving an explosion in a compressed gas facility
- **Genetech –** Loss Prevention consulting on a new warehouse containing hazardous materials
- **Gibbes, Graves, Mullins, Ferris, Hortman & Harlow –** personal injury action involving explosion of a 55 gallon drum; product labeling at issue
- **Gibson Law Offices –** multi-alarm large-loss fire investigation involving a hotel and adjacent residence
- **Gibson & Robb –** fire investigation involving destruction of a coastal transport freighter

- **Glaspy & Glaspy –** investigation of a fatal incident involving the explosion of an air compressor receiver; investigation of a residential fire involving a fireplace insert
- **Gordon & Rees –** residential fire involving a propane-fueled barbecue
- **Gordon Thomas Honeywell Malanca Peterson & Daheim –** construction defects case involving investigation of a fire sprinkler system in a condominium complex
- **Graham & James –** apt. complex fire involving two infant deaths; commercial fish processing vessel fire
- **Greene, Broillet & Wheeler –** investigation of a camp-fire incident involving cooking with hot grease
- **Grotefeld & Deneberg –** investigation of two fires involving the largest coal ship-loader on the west coast
- **Gwilliam, Ivary, Chiosso, Cavalli & Brewer –** civil action stemming from the over-pressurization of a low pressure gas distribution system resulting in several fires; multiple fatality fire involving a petroleum refinery crude oil distillation column naphtha line
- **Hagens Berman** – multiple fatality explosion and fire in a polysilicon manufacturing plant
- **Hall & Evans –** large mountain-top four story wood-frame residential fire investigation in Colorado
- **Hamilton Beach Proctor-Silex** – residential fire investigation and product liability analysis
- **Hardin, Cook, Loper, Engel & Bergez –** hazardous material release action; personal injury action in a major petroleum refinery
- **Hamilton Beach Proctor Silex –** residential fire investigation involving kitchen appliances
- **Hancock, Rothert & Bunshoft –** plaintiff in a marina fire involving several luxury yachts
- **Hanson Bridgett LLP –** single family residential fire investigation in Novato, CA
- **Hatch, Allen & Shepherd –** fatal fire investigation involving a "hot-oiler" truck during offloading; investigation of unit fire in a New Mexico refinery's HF alkylation plant
- **Hennelly & Grossfeld –** fire investigation involving a solar power electric generating plant
- **Hewitt & Prout –** explosion investigation involving an underground gasoline storage tank
- **HEXCEL Corp. –** consulting services regarding marketing opportunities in loss prevention
- **Hillis Clark Martin & Peterson –** residential fire investigation involving a natural gas service riser
- **Hoffman & Grantham** – a products liability action involving a bathroom fan fire
- **Holland & Hart –** investigation of a gas explosion and fire in a Montana industrial park**;** +100,000 acre wildland fire in New Mexico
- **Horak, Talley, Pharr & Lowndes –** tank explosion in a petrochemical plant causing two deaths
- **House, Kingsmill & Riess –** large residential apartment complex fire in Texas
- **Hoyle, Morris & Kerr –** expert in several civil actions stemming from a large fire in a chemical reprocessing plant
- **Industrial Indemnity –** various industrial fire losses
- **Jacobsen & McElroy –** investigation of a steam explosion (BLEVE) in a wood stove's heat exchanger
- **Jenkins, Goodman & Neuman –** products liability action involving a 20 lb. propane tank
- **Jenkins Goodman Neuman & Hamilton** – products liability actions involving: a apartment fire in Hawaii, a condo fire caused by a chiminea fire-pit, and a residential fire allegedly caused by a faulty refrigerator
- **John Wiley Law Offices** – upscale SF condo high-rise fire investigation and water damages analysis
- **Jones, Clifford, McDevitt & Johnson –** Investigation of a fatal fire involving cleaning of a gasoline tank in a petroleum bulk plant
- **Jones & Scheich –** intentional tort action involving a vapor release and fire in a refinery alkylation unit resulting in personnel injuries
- **K&L Gates –** residential fire investigation allegedly involving a natural gas utility service riser

- **Kelley, Drye & Warren –** fire investigation involving a mobile home manufacturing plant; investigation of a fire involving destruction of the town library in upper New York
- **Kerr & Wagstaffe –** investigation of a wine warehouse fire (see Carlson, Calladine & Peterson)
- **Kilmer, Voorhees & Laurik –** arbitrator in a case involving a fire in heavy mobile equipment
- **LaFollette Johnson –** RV fire allegedly involving a leaking propane refrigerator (tendered to DNB)
- **LaPlante & Spinelli** – products liability action involving a thermostatic gas control valve
- **Lane, Powell, Spears & Lubersky –** apartment complex fire involving several fatalities
- **Larry N. Kloenhammer –** luxury home fire during remodeling resulting in subrogation
- **Larson & Burnham –** civil action involving a fatality during a pipeline pigging and purging operation involving a vacuum truck
- **Larson Hart & Shepherd** – multiple fatality explosion and fire in a polysilicon manufacturing plant [see Hagens Berman]
- **Law Office of Cary Dictor –** fire investigation involving transportation of goods by moving van
- **Law Offices of Gary L. Hall (Hanover Insurance) –** investigation of a personal injury burn incident involving a nitro-methane fueled model race-car; investigation of a fire in a University of California library
- **Law Office of Gregory A. Yates** – fatality and multiple personal injury incident involving an two-story garden apartment fire in southern California
- **Law Office of Jeffrey F. Paccassi**– personal injury involving an apartment building fire hose cabinet
- **Law Office of Kenneth N. Meleyco** – personal injury involving an oil refinery coke silo bag-house fire
- **Law Office of Kenneth W. Turner** – residential house natural gas explosion investigation in Los Altos
- **Law Office of Kent B. Seitzinger –** products liability action involving a new home near Fresno, CA
- **Law Offices of Mark R. Mittelman –** investigation of a 12 unit S.F. Victorian fire resulting in 3 deaths
- **Law Office of Neil Jon Bloomfield –** investigation of a restaurant kitchen fire
- **Law Office of William Delaney and Law Office of Timothy Jarres –** plaintiff in civil action involving a fire in a foam plastics manufacturing plant
- **Lazano, Smith & Smith –** civil action involving inadequately designed fire water system
- **Lempres & Wulfsberg –** high-rise tower construction defects case involving firesafing
- **Leon & Leon –** fire investigation of two commercial structures in Oakland, CA
- **Lewis, D'Amato, Brisbois & Bisgaard –** fire involving above-ground refueling facility; product defect investigation and fire risk analysis for an automobile manufacturer
- **Lewis, Brisbois, Bisgaard & Smith –** product liability re: a propane fueled barbecue fire
- **Liedle, Getty & Wilson, LLP –** fire investigation involving a polyurethane foam manufacturing plant; investigation of a large-loss gas explosion in a 1200 room hotel under construction
- **Liedle, Lounsberry, Larson & Lidl –** investigation of a fatal scald incident involving a new water heater
- **Lieff, Cabraser, Heimann & Bernstein –** class action litigation involving gypsum wall board fire ratings
- **Lombardi, Loper & Conant** – investigation of a multi-unit apartment complex fire in Sacramento; investigation of a large propane distribution center fire in San Francisco; investigation of a $multi-million fire involving a new school under construction in Dublin, CA; fire and personal injury involving propane cylinder filling; investigation of two forklift truck fires for a major manufacturer
- **Louderback & Louderback –** investigation of code issues re: automobile paint spraying shop
- **Low, Ball & Lynch** – a five alarm restaurant and hotel fire incident involving analysis of a commercial kitchen fire suppression system
- **Lucas & Tonn –** fire investigation in regard to a wood-fueled boiler plant fire in a school

- **Luce Forward Hamilton & Scripps –** investigation of the November, 2004 multiple-fatality gasoline pipeline rupture and fire in Walnut Creek, California; construction defects investigation involving fire resistive construction in a high-rise hotel renovation project
- **Lyddan Law Group –** investigation of the 23,000 acre Copper Hill wildland fire in Santa Clarita, CA
- **Markel Corporation –** investigation of a 30 ft. steel hull sailboat fire at the Emeryville marina**;** investigation of a houseboat fire involving a RV combination ammonia absorption refrigerator
- **Maynard, Cooper & Gale –** chemical plant fire involving a urethane manufacturing facility
- **McCormick Barstow –** residential propane explosion and fire injuring two children; mini-mart fire involving a beverage dispenser and ice-cube maker
- **McElroy, Deutsch & Mulvaney –** fire in a luxury Victorian involving analysis of alarm system; fire involving a retail shopping mall; fire in a large industrial multi-occupancy warehouse
- **McGinn & Associates –** explosion and fire in a natural gas liquids (NGL) processing plant
- **McGinn Carpenter Montoya & Love –** large, multiple-injury refinery fire involving HF-Alkylation Unit
- **McKenna, Long & Aldridge –** investigation of a large-loss wildland fire in Malibu, California
- **Mersereau & Shannon –** + Million $ fire in a vacant warehouse and associated fire sprinkler issues
- **Middlebrook, Kaiser & Popka –** explosion and fire resulting from a natural gas pipeline leak
- **Milberg Weiss Bershad Hynes & Lerach –** class action involving product liability issues
- **Miller Canfield Paddock and Stone –** investigation of a multiple-fatality propane gas explosion
- **Minasian, Minasian, Minasian, Spruance, Baber, Meith & Soares** – explosion and fire involving a gas leakage from a plastic underground gas service line
- **Moffatt Thomas Barrett Rock & Fields –** residential house fire investigation near Sun Valley, ID
- **Montgomery, Barnett, Brown, Read, Hammond & Mintz** – action stemming from a large refinery fire and explosion
- **Morgan, Lewis & Brockius** – tank explosion in a petrochemical plant causing two deaths
- **Morgan Miller Blair –** construction defects case involving the Omega Sprinkler recall
- **Morgenstein & Jubelirer –** residential fire investigation involving a laptop computer
- **Morison, Ansa, Holden, Assuncao & Prough –** investigation of a large lumber yard fire in Oregon
- **Morrison & Foerster** – major chemical plant fire and fatalities
- **Murchison & Cumming** – petroleum storage tank explosion and fire during cleaning operations
- **Murphy Pearson Bradley & Feeney** – residential fire involving a newly installed dishwasher
- **Nageley Meredith & Miller** – propane fueled barbecue product liability action
- **National Farmers Union Insurance Company –** fire in a telephone exchange building in Alaska
- **Nelson Kinder Mosseau & Saturley –** fire in a historic building being renovated to loft apartments
- **Nixon Peabody –** two separate fire cases involving 20 lb. portable LP-Gas cylinders
- **Norman, Hanson & DeTroy** – product liability action re: a fire in an LP-Gas fueled barbecue
- **Nutter, McClennen & Fish** – investigation of a triple-fatality fire in a five star hotel in Rome, Italy
- **Nyemaster, Goode, West, Hansell & O'Brien** – product liability action re: poultry processing plant fire; a multi-million dollar residential fire in Des Moines; a large-loss fire in a bio-diesel refining plant in Iowa; investigation of a large-loss grain elevator dust explosion; investigation of a large-loss pig-farm fire
- **Pacific Gas & Electric Co.** – fire investigation in a residential dwelling
- **Parichan, Renberg, Crossman & Harvey** – industrial complex fire loss in Fresno, California
- **Parker Shumaker Mills –** fire sprinkler water damages investigation in a large warehouse

- **Perkins Coie** – code compliance investigation re: an Alaskan commercial fish processing plant
- **Pearson & Associates –** flash fire involving a release of silane in a silicon manufacturing plant
- **Peter C. Hsieh, Esq. –** high rise condo water damage case in Honolulu from a failed sprinkler head
- **Pillsbury Winthrop Shaw & Pittman –** large loss fire involving fuel oil tank demolition at a power plant
- **Plaintiff Steering Committee (PSC) –** large loss multiple fatality offshore oil rig blowout, fire and oil spill
- **Polsky Sanderson (Calgary) –** investigation of a oil-sands mining operations fire near Ft. McMurray
- **Preferred Dealer Protection Claim Center** – investigation of a luxury automobile fire
- **Prindle, Amaro, Goetz, Hillyard, Barnes & Reinholtz –** several manufacturer product liability actions
- **Price, Okamoto, Himeno & Lum** (Honolulu) – see Lempres & Wulfsberg
- **Prout & LeVangie –** wildland fire in Alameda County, CA
- **Reuben & Novicoff –** analysis of an incident on an offshore platform injuring a contract worker
- **Richardson Callahan** – fatal toxic gas release in a sodium hydrosulfite plant (w/Frazer Greene…)
- **Riddell Williams** – products liability case involving a $1Billion multiple fatality explosion and fire loss in a major automobile manufacturer's power plant; investigation of a major steel mill fire in Dearborn; investigation of a Tennessee school fire; investigation of a multi-million $ NJ condominium complex fire; products liability action involving a game-box
- **Robins Kaplan Miller & Ciresi –** investigation of a multiple-fatality oil refinery unit explosion and fire
- **Rogers Scott & Helmer –** investigation of a gasoline fueled fire in a drug treatment center
- **Rome McGuigan & Sabanosh** – investigation of a fire in a semi-conduction manufacturing plant
- **Ropers, Majeski, Kohn & Bentley –** product liability action involving steel connectors used in chimneys
- **Rosen & Associates –** investigation of two fires in the largest coal ship-loader on the west coast
- **Rust, Armenis & Schwartz** – product liability case in defense of an LP-gas fueled barbecue manufacturer
- **Safeco Insurance Company** – technical consulting re: a fire involving a kitchen exhaust hood
- **Sandall, Olsen & Ott /White & Baker** – petroleum tank fire involving cleaning operations
- **Sayre & Chavez –** investigation of a multiple-fatality fire in a mobile home on a dairy farm
- **Schwabe, Williamson & Wyatt PC –** residential estate fire investigation RE construction defects
- **Schrifrin Gagnon Dickey –** investigation of a retail outlet fire in SF Fisherman's Wharf area
- **Selman Breitman** – product liability action involving a packaged fireplace product in a residence; investigation of a residential fire involving a horizontal FAU attic furnace
- **Shea & Shea** – residential natural gas explosion investigation; analysis of electrocution of a firefighter
- **Shook Hardy Bacon –** product liability action involving a lightning-caused residential fire in Florida; a large-loss casino/hotel fire in Nevada; a large loss warehouse fire in a historic district of Jeffersonville, IN
- **Simoncini & Wenzel** – investigate explosion and fire from a pipeline failure in one of the world's largest hydrogen plants located in a major petroleum refinery
- **Simoncini & Associates – a** luxury home fire during remodeling involving cause determination; a +$ million home fire allegedly involving a packaged HVAC unit; investigation of a restaurant rotisserie fire
- **Smith, Anderson, Blount, Dorsett, Mitchell & Jernigan –** fatal explosion incident involving welding on a tire rim; claims dispute involving cutting and welding on hazardous process piping
- **Smith Moore LLP –** large loss poultry processing plant fire involving a commercial jet-stream oven
- **Smith, Sovik, Kendrick & Sugnet, P.C. –** Co-generation plant fire investigation involving a large gas turbine and automatic fire detection/suppression system
- **Snell & Wilmer –** investigation of a two story residential structure fire involving electrical abnormalities

- **St. Clair, McFetridge & Griffin** – a major refinery fire litigation and a second action involving a marine wharf and several luxury yachts
- **Stone & Associates** – investigation of a large-loss 5-alarm fire in an historic Monterey shopping district
- **Stritmatter, Kessler Whelan Withey Colucco** – multiple fatality explosion/fire in a silicon manufacturing facility involving the release of silane, trichlorosilane, and silicon tetrachloride
- **Sweeney & Sheehan** – multiple fatality explosion/fire in a chemical manufacturing plant; multiple fatality dust explosion in a North Carolina pharmaceutical plant
- **Tharpe & Howell** – investigation of a residential fire allegedly involving a propane-fueled HVAC unit
- **Thayer Harvey Gregerson Hedberg & Jackson** – residential fire involving a halogen security lamp
- **Thelen, Marrin, Johnson & Bridges** – fire and personal injury action in a petroleum refinery
- **Thelen, Reid, Brown, Raysman & Steiner** – maritime investigation involving the loss of the *Wind Song*
- **Thelen, Reid & Priest** – investigation of the largest fire loss in the history of Santa Maria, CA involving the destruction of a fruit packing plant; investigation of a fatal dust explosion in a large recycling plant
- **Thompson Hine** – large loss poultry processing plant fire involving a commercial jet-stream oven
- **Tooze, Duden, Creamer, Frank & Hutchinson** – wrongful death action involving the rupture of a LP Gas pipeline in a manufacturing plant due to external impact
- **Tousley Brain Stehpens** – class action litigation involving gypsum wallboard fire ratings
- **Ulmer & Berne** – wrongful death and personal injury action involving the release of liquid sodium in a metals fabrication facility
- **Valerian, Patterson & Stratman** – garden apartment building fire involving a floor furnace
- **Van De Poel, Levy & Allen** – fire investigation involving several AMTRAK passenger cars
- **Walkup Melodia** – personal injury product liability case involving ethanol-fueled fireplaces; contract worker burn-case involving turnaround preparation of a distillation column in a refinery crude unit
- **Wartnick, Chaber, Harowitz, Smith & Tigerman** – asbestos exposure action
- **Watson Law Group/Allianz** – litigation support involving a 900,000 $ft.^2$ factory fire in Mexico
- **Watson & Renner/Yates & Leal** – litigation support in a Superfund Site liability action
- **Weil & Associates** – product liability case involving a fire in Modesto commercial building food-court
- **Wendel, Rosen, Black & Dean** –a product liability action involving a LP-Gas fueled construction heater
- **Whirlpool Corporation** – several products liability cases involving various Whirlpool products
- **Wieder & McAuliffe** – product liability action involving multi-tenant commercial building in Washington
- **Wiezorek & Payne**– product liability action involving an alleged residential gas furnace fire
- **Wild, Carter & Tipton** – investigation of a restaurant kitchen fire and failure of wet chemical system
- **William L. Veen Law Offices** – plaintiff involving an accident during a turnaround in a petroleum refinery; personal injury action involving a swimming pool filter assembly accident
- **Williams, Kastner & Gibbs** – fire involving carpet cleaning-equipped vehicle
- **Willis & DePasquale** – fatal fire involving 8 units of a San Jose condominium complex
- **Wilson, Elser Moskowitz Edelman & Dicker** – residential fire investigation; explosion and fire investigation involving a gasoline tank truck and passenger car collision near New York City; container ship explosion and fire in the middle-east waters killing four crew members; products liability action involving an induction cook-top in a residential occupancy; construction defects investigation in a high-rise condo building; water damages investigation involving a luxury apartment complex in southern California; two construction defects cases involving large condo complexes in Cupertino, CA and Petaluma, CA
- **Wingert, Grebing, Anello & Brubaker** – fire involving ignition during fueling operations

- **Winingham, Roberts, Fama, Kramer & Ramberg** – product liability action involving alleged leakage of side-by-side gasoline-diesel auxiliary fuel tanks mounted on a P/U truck bed
- **Wise, Wiezorek, Timmons & Wise** – fire involving three commercial businesses and residence
- **Wolfe Firm** – fire investigation involving a quick change motor oil facility
- **Wright, Robinson, Osthimer –** investigation of a large fire loss involving a winery warehouse; investigation of a large industrial park and lumber company fire
- **Wulfsberg, Reise, Ferris & Sykes** – investigation of an offshore platform explosion and fire and related design and construction issues

Representative Petroleum, Pipeline, & Petrochemical Facility-Related Experience

Investigations and Projects

- BP Deepwater Horizon Multiple District Litigation (MDL) No. 2179, May, 2011
- BP Deepwater Horizon Study Group, University of California, Berkeley, April, 2010
- PG&E gas transmission pipeline explosion and fire, San Bruno, CA, Sept., 2010[1]
- NTSB investigation of residential gas explosion, Rancho, Cordova, CA December, 2008
- BP-Amoco Refinery Explosion and Fire, Texas City, TX, March, 2005
- Kinder Morgan Pipeline Explosion and Fire – Walnut Creek, CA, November, 2004
- Giant Industries Refinery explosion and fire, Gallup, New Mexico, April, 2004
- Muskeg River Mine propane fire at the Athabasca Oil Sands project, 75 km north of Ft. McMurray, January, 2003
- Murphy Oil Refinery ROSE Unit fire analysis, Meraux, LA, June, 2003
- AGP solvent extraction and bio-diesel manufacturing plant explosion and fire, Sergeant Bluff, Iowa, August, 2003 (multiple fatalities and injuries)
- TOSCO Avon Refinery Crude Unit No. 50 Fire Investigation, Martinez, CA, February, 1999 (multiple fatalities and injuries)
- Concept Sciences, Inc. Chemical Plant Explosion and Fire Investigation, Lehigh Valley Industrial Park, PA, February, 1999 involving reactive chemical (hydroxylamine); five fatalities and multiple injuries
- KOSA/Ticona Polyester Fiber Plant Explosion & Fire Investigation, Selby, North Carolina, September, 1999 involving DMT tank explosion
- Celanese Chemicals, Inc. Bucks, Alabama Plant Hazardous Materials Release Investigation, September, 1999 involving reactive chemicals (sodium hydrosulfite) and the release of sulfur dioxide
- Advanced Silicon Materials, Inc. Plant Fire Investigation, Moses Lake, WA, October, 1998; multiple fatality incident involving the release of highly hazardous materials in a silicon manufacturing plant (silane, trichlorosilane, and silicone tetrahydride)
- El Paso Field Services Chaco Cryogenic NGL Extraction Plant Explosion & Fire Investigation, Farmington, New Mexico, August, 1998
- APG/Accra Pac Group Chemical Plant Explosion and Fire Investigation, Elkhart, Indiana, June, 1997 involving reactive chemicals (ethylene oxide)

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[1] Thirty-six homes totally destroyed and eight fatalities – multiple injuries due to a high pressure gas pipeline failure

- Rhône Poulenc Basic Chemical Plant Fire, Martinez, CA, 1994
- Chevron Richmond Refinery Isomax/TKC Fire Litigation, 1993
- Shell Martinez Manufacturing Complex and Wilmington Complex
  Risk Management and Prevention Program Projects, 1989-1990
- Chevron El Paso Refinery, TX
  Fire Protection System Modernization Project, 1990
- Chevron El Segundo Refinery
  No. 4 Crude Unit Modernization and Hazop Project, 1990
- Union Oil Company San Francisco Refinery (Rodeo, CA)
  Waste Effluent Treating Facilities Project, 1988-1989
- Shell Norco FCC Fire and Explosion Litigation, Norco, LA, 1988-1990
- Alaska Pacific Refining Inc. Valdez Refinery Project & Loading Wharf
  Grass-roots facility design project (canceled), 1987-1988
- Syncrude Fluid Coker Fire Litigation, Fort McMurray, Canada 1987-1994
- EPRI/DOE Advanced Fine Coal Spherical Agglomeration Pilot Plant, Homer City
  Prototype design development and hazard analysis (CCFT) project, 1987
- Union Oil Company San Francisco Refinery (Rodeo, CA)
  Coking Unit No. 200 Revamp, 1985
- Husky Oil Bi-Provincial Project
  Grass Roots Upgrader Facility, 1985-1990
- Chevron Canada Ltd. Burnaby Refinery
  Burnaby FCC Modernization Project, 1981
- Valero Refinery (Saber Refining Co.), Corpus Christi, TX.
  LPG Storage Facility Fire Protection Modernization Project, 1987
- ARAMCO Ras Tanura Refinery Modernization Project, 1982-1983
- Mobil Oil Gas-to-Gasoline Project complex in New Zealand, 1981-1983
- ARCO Cherry Point Refinery
  Coke Calciner Project, 1984
- ARCO Watson Refinery
  FCCU Power Recovery Project, 1984
- ARAMCO Qasim Refinery Project
  Grass-roots design and construction project (canceled in procurement cycle), 1982-84
- Chevron Sudan Kosti Refinery – Engineering Study, 1982
- Chevron Chemical Co.
  Oak Point Expansion Project, 1981
- Shell Oil Co. Martinez Manufacturing Complex
  Hydrotreater Modification Project, 1983
  LOP Control Center Modification Project, 1980-81
- Chevron Richmond Refinery
  Richmond Lube Oil Project (RLOP), 1982-1983

Isomax Control Room Project, 1981

- Standard Oil Co. of California Loss Prevention Survey Experience (staff Fire Protection Engineer under Donald M. Johnson, 1971-1973) including: Chevron El Paso Refinery, Chevron Salt Lake City Refinery, Chevron El Segundo Refinery, and the Chevron Richmond Refinery
- Several LNG facility studies/designs including ENRON Gas Elba Island study, ARCO Hainan LNG plant study, Fletcher Challenge LNG Export Terminal feasibility study (New Zealand), and Beca Carter Hollings & Ferner Port Taranaki LPG feasibility study.

Other Large Loss Fire and Explosion Investigations

- Cannery Café & No. 10 Sixth St. Complex Fire, Astoria, OR, December 16, 2010
- Casa de Vallejo Senior Residential Apartment House fire, Vallejo, CA, August, 2008[2]
- Hilton Bayfront hotel explosion, San Diego, CA, May, 2008[3]
- Malibu Canyon Wildfire Conflagration of October, 2007
- Guejito and Rice Wildfire Conflagrations of October, 2007
- Robert Lewis Stevenson (RLS) School fire, Pebble Beach, CA, April, 2007
- Residential Propane Gas Explosion and Fire, Arroyo Grande, CA, April, 2007
- *Just-Foam* polyurethane surf-board blank factory fire, Oceanside, CA, March, 2007
- Good Day Café and Quality Inn 5-Alarm Fire, Vallejo, CA, January, 2007
- Greenwood Plaza fire, Bozeman, Montana, March, 2006
- Fallon Middle School fire, Dublin, CA, November, 2005
- Wines Central Warehouse fire,[4] Mare Island, Vallejo, CA, Oct., 2005
- Hertz Rental Center Propane explosion and fire, S.F., CA, October, 2005
- Gasoline Tank Truck Trailer explosion and fire, Cameron County, TX, February, 2005
- Los Gatos Auto Mall Gas Explosion and Fire, Los Gatos, CA, January, 2005
- Grand Hotel Parco dei Principi hotel fire in Rome, Italy, March, 2004
- The Old Butternut Coffee Building loft apartment renovation project fire, Jan. 2004
- P&W Space Propulsion explosions & fires (amm. perchlorate rocket fuel), Aug. 2003
- Wayne Farms Poultry Processing plant fire, Oakwood, GA, May, 2003
- Woolstock Co-Op Grain Elevator Dust Explosion, Woolstock, IA, Sept., 2002
- Chateau du Triomphe Estate Fire, Dallas, TX, July, 2002 (+$45 million loss)[5]
- Casiano Berry Supplies Warehouse Fire (Weyerhaeuser), Santa Maria, CA, June, 2001
- USS-POSCO Industries (UPI) Cold Rolling PLTCM Fire Loss Investigation, Pittsburgh, CA, May 31, 2001
- Double Eagle Steel Coating Company Plant Fire Investigation, Dearborn, MI, Dec, 2001
- Mauna Lani (Hawaii) Condo Fire Investigation, Feb., 2001
- Jesse M. Lange Bulk Plant Explosion & Fire Investigation, Chico, CA Feb., 2001
- Willow Street Brewery Fire Investigation, San Rafael, CA, February, 2001

[2] Nine-alarm fire resulting in four fatalities

[3] An explosion in the 5th floor mechanical room of this brand new 30 story waterfront hotel with 1,190 rooms injuring 14 workers – 5 critically was due to odor fade & ignition of natural gas being used to purge fuel gas piping.

[4] The estimated loss in this 240,000 sq. ft. warehouse fire is over $100,000,000.00.

[5] This fire destroyed the three story 43,000 ft.^{3} mansion reputed to be the largest residential loss in U.S. history

- Intermack Services Ltd. Estate Fire Investigation, Scarsdale, NY, January, 2001
- Frank-Rombauer Cellars Warehouse Fire Investigation, Napa Valley, CA, June, 2000
- Copper Valley Telephone Coop Exchange Fire Investigation, Glennallen, AK, April, 2000
- Champion Home Builders -- Titan Manufacturing Plant Fire, Sangerfield, NY, Jan,, 1999
- Maersk Tokyo Container Ship Explosion and Fire (near Dubai), Feb., 1999
- UICC's semiconductor fabrication plant fire in Hsinchu, Taiwan, October, 1997
- Mystic Bulk Carriers Gasoline Tank Truck Fire Investigation, Yonkers, NY, Oct., 1997
- Amigo Bag and Linen Recycling Plant Fire, Richmond, CA, September, 1997
- ACME Super Market Fire, Klugetown Shopping Center, Pompton Lakes, NY, Oct., 1997
- Oak Tree Apartment Fire Investigation, Seattle, WA, September, 1997
- International Paper Co. Riegelwood, NC Plant Explosion - Fire Investigation, May, 1997
- Lockheed Hangar Fire Investigation, Mountain View, CA, August, 1996
- Jackson Avenue Warehouse Fire Investigation, Edison, NJ, September, 1995
- Paliser Furniture Manufacturing Plant Fire, Airdrie, Alberta (Canada), September, 1990

Special Interest Large Loss Investigations

Fatal Dust Explosions in Polymer Processing Plants

The U.S. Chemical Safety Board [www.csb.gov] has made note of these three large-loss explosion and fire incidents, all of which have been linked to the ignition of combustible dust:

- MBA Polymers Plant Explosion & Fire Investigation, Richmond, CA, October, 2000 (one fatality, plant destroyed)
- Rouse Polymerics Plant Explosion & Fire Investigation, Vicksburg, MS, May, 2002; five fatalities, multiple injuries – reported as the single largest industrial loss in Mississippi's history (multiple fatalities and injuries)
- West Pharmaceutical Plant Explosion and Fire Investigation, Kinston, NC, Jan. 2003; (multiple fatalities and injuries – reported loss over $150 million)

Other Dust Explosion incident investigations

- Woolstock Grain Elevator Explosion (severe), Sept. 2002, Woolstock, IA
- Malden Mills Explosion & Fire Investigation, Methuen, MA, December, 1995 (largest loss in MA history - total losses/claims reportedly exceeded $1.5 Billion)

Fire incidents involving historic buildings

- Horner Novelty Company fire, Jeffersonville, Indiana[6]
- The Historic Pajaro Wall Street Inn Residential Hotel (ca. 1912), Watsonville, CA
- The Historic Malden Mills (ca. 1906) fire, Methuen/Lawrence, MA, December, 1995
- The Old Butternut Coffee Building "9ines" Loft Renovation Project, Omaha, NE
- The +100 year old Alvarado Street business district fire, Monterey, CA, Feb. 7, 2007
- The historic Cannery Café wharf district fire in Astoria, OR, Dec. 16, 2010

[6] Fire destroyed an entire city block of ca. 1880 buildings in the historic downtown district in January, 2004

Honors

Outstanding Technical Paper - 1986 Bechtel Merit Award Recipient
"Module Ventilation Rates Quantified," published in the trade journal, Oil and Gas Journal, December 23, 1985[7]

Honors List - 7th Edition of the Piping Handbook, McGraw Hill Publishing, 1999, for contributions made to Chapter C10, "Hazardous Piping Systems"

Recent Publications – Deepwater Horizon Study Group White Paper:
Perspectives on Changing Safety Culture and Managing Risk, **© William E. Gale, Jr., Inc.**
Appendix C, Deepwater Horizon Study Group Progress Report 3, U.C. Berkeley Center for Catastrophic Risk Management, Dec. 5, 2010[8]

Websites www.FireExperts.com www.JurisPro.com ExpertPages.com

Email WEGale@FireExperts.com

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Fee Schedule on Request

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[7] The calculation procedure developed by Dr. Gale was adopted by several code & standard writing bodies including the American Petroleum Institute (API RP-500), the National Fire Protection Association (NFPA 30), the Institute of Petroleum (U.K.), and Canadian authorities.

[8] The U.C. Berkeley CCRM's ***Deepwater Horizon Study Group*** was formed in May, 2010 in response to British Petroleum's Deepwater Horizon well blowout and oil spill on April 20, 2010. It is a group of academic researchers and practitioners from diverse disciplines who share their knowledge of safety, organizational reliability and the mitigation of adverse human and natural events on a pro-bono basis without regard to special interests groups. Ref. http://ccrm.berkeley.edu/deepwaterhorizonstudygroup/index.shtml

Appendix C

Summary of BP Deepwater Drilling Activity (>3000 ft) in Gulf of Mexico

(October 2004-April 2010)

Generally[1]

Exploration Wells **176**

Development Wells **212**

Total	**388**

By Owner(All Wells)

BP **101**

Contractor **221**

Unknown **66**

Total	**388**

By Owner (Exploration)

BP **47**

Contractor **103**

Unknown **26**

[1] The data referenced in this appendix is attached. This data was obtained by the Plaintiffs' Steering Committee from Energy Data Solutions, L.L.C.

Total	**176**

By Owner (Development)

BP	**54**
Contractor	**118**
Unknown	**40**
Total	**212**

Filename	RigName	ApiWellNum	MmsCompanyNum	BusAscName	WaterDepth	RigIdNum	WellTypeCode	WorkCommencesDate
-10091	DIAMOND OCEAN CONFIDENCE	608054002800	02481	BP Exploration & Production Inc.	6857	45924	E	19-Dec-05
-9998	DIAMOND OCEAN CONFIDENCE	608054002800	02481	BP Exploration & Production Inc.	6857	45924	E	19-Dec-05
-11765	DIAMOND OCEAN CONFIDENCE	608054002801	02481	BP Exploration & Production Inc.	6857	45924	E	17-Jan-05
-11766	DIAMOND OCEAN CONFIDENCE	608054002801	02481	BP Exploration & Production Inc.	6857	45924	E	17-Jan-05
-13870	DIAMOND OCEAN CONFIDENCE	608054002801	02481	BP Exploration & Production Inc.	6857	45924	E	04-Feb-05
-13871	DIAMOND OCEAN CONFIDENCE	608054002801	02481	BP Exploration & Production Inc.	6857	45924	E	04-Feb-05
-272370	T.O. DEEPWATER HORIZON	608074028300	02481	BP Exploration & Production Inc.	4705	46428	E	01-Mar-08
-246278	T.O. DEEPWATER HORIZON	608074028300	02481	BP Exploration & Production Inc.	4705	46428	E	01-Mar-08
-141705	T.O. DEEPWATER HORIZON	608074028300	02481	BP Exploration & Production Inc.	4705	46428	E	16-Dec-06
-269739	T.O. DEEPWATER HORIZON	608074028300	02481	BP Exploration & Production Inc.	4705	46428	E	01-Mar-08
-273008	T.O. DEEPWATER HORIZON	608074028300	02481	BP Exploration & Production Inc.	4705	46428	E	01-Mar-08
-274409	T.O. DEEPWATER HORIZON	608074028300	02481	BP Exploration & Production Inc.	4705	46428	E	09-May-08
-70801	T.O. DEEPWATER HORIZON	608084001100	02481	BP Exploration & Production Inc.	5873	46428	E	19-Feb-06
-81006	DIAMOND OCEAN CONFIDENCE	608084001101	02481	BP Exploration & Production Inc.	5873	45924	E	11-Apr-06
-81119	T.O. DEEPWATER HORIZON	608084001101	02481	BP Exploration & Production Inc.	5873	46428	E	11-Apr-06
-90511	T.O. DEEPWATER HORIZON	608084001102	02481	BP Exploration & Production Inc.	5859	46428	E	24-May-06
-149388	DIAMOND OCEAN CONFIDENCE	608084001103	02481	BP Exploration & Production Inc.	5859	45924	E	05-Jan-07
-146020	DIAMOND OCEAN CONFIDENCE	608084001103	02481	BP Exploration & Production Inc.	5859	45924	E	05-Jan-07
-283798	T.O. DISCOVERER SPIRIT	608084001104	02481	BP Exploration & Production Inc.	5859	45883	E	18-Jun-08
-206625	T.O. DEEPWATER HORIZON	608084001200	02481	BP Exploration & Production Inc.	5431	46428	E	25-Aug-07
-204966	T.O. DEEPWATER HORIZON	608084001200	02481	BP Exploration & Production Inc.	5431	46428	E	17-Aug-07
-221173	T.O. DEEPWATER HORIZON	608084001201	02481	BP Exploration & Production Inc.	5431	46428	E	12-Oct-07
-163616	HOLSTEIN SPAR RIG	608114026000	02481	BP Exploration & Production Inc.	4344	47715	E	15-Apr-07
-163617	HOLSTEIN SPAR RIG	608114026000	02481	BP Exploration & Production Inc.	4344	47715	E	15-Apr-07
-180771	HOLSTEIN SPAR RIG	608114026001	02481	BP Exploration & Production Inc.	4344	47715	E	17-May-07
-188295	HOLSTEIN SPAR RIG	608114026002	02481	BP Exploration & Production Inc.	4344	47715	E	14-Jun-07
-188296	HOLSTEIN SPAR RIG	608114026002	02481	BP Exploration & Production Inc.	4344	47715	E	14-Jun-07
-226482	HOLSTEIN SPAR RIG	608114026003	02481	BP Exploration & Production Inc.	4344	47715	E	07-Nov-07
-301182	HOLSTEIN SPAR RIG	608114026003	02481	BP Exploration & Production Inc.	4344	47715	E	16-Aug-08
-282715	* COIL TUBING UNIT	608114026003	02481	BP Exploration & Production Inc.	4344	45016	E	25-Apr-08
-268123	* COIL TUBING UNIT	608114026003	02481	BP Exploration & Production Inc.	4344	45016	E	07-Apr-08
-303364	HOLSTEIN SPAR RIG	608114026003	02481	BP Exploration & Production Inc.	4344	47715	E	16-Aug-08
-268122	* COIL TUBING UNIT	608114026003	02481	BP Exploration & Production Inc.	4344	45016	E	07-Apr-08
-301181	HOLSTEIN SPAR RIG	608114026003	02481	BP Exploration & Production Inc.	4344	47715	E	16-Aug-08
-282716	* COIL TUBING UNIT	608114026003	02481	BP Exploration & Production Inc.	4344	45016	E	25-Apr-08
-269768	* COIL TUBING UNIT	608114026003	02481	BP Exploration & Production Inc.	4344	45016	E	25-Apr-08
-269769	* COIL TUBING UNIT	608114026003	02481	BP Exploration & Production Inc.	4344	45016	E	25-Apr-08
-264561	* COIL TUBING UNIT	608114026003	02481	BP Exploration & Production Inc.	4344	45016	E	07-Apr-08
-226790	HOLSTEIN SPAR RIG	608114026003	02481	BP Exploration & Production Inc.	4344	47715	E	07-Nov-07
-264560	* COIL TUBING UNIT	608114026003	02481	BP Exploration & Production Inc.	4344	45016	E	07-Apr-08
-303363	HOLSTEIN SPAR RIG	608114026003	02481	BP Exploration & Production Inc.	4344	47715	E	16-Aug-08
-331201	HOLSTEIN SPAR RIG	608114026004	02481	BP Exploration & Production Inc.	4344	47715	E	15-Nov-08
-342507	INTERNATIONAL FRONTIER	608114026004	02481	BP Exploration & Production Inc.	4344	49157	E	09-Feb-09
-280455	HOLSTEIN SPAR RIG	608114026004	02481	BP Exploration & Production Inc.	4344	47715	E	01-Jun-08
-342506	INTERNATIONAL FRONTIER	608114026004	02481	BP Exploration & Production Inc.	4344	49157	E	09-Feb-09

-331215	HOLSTEIN SPAR RIG	608114026004	02481	BP Exploration & Production Inc.	4344	47715	E	15-Nov-08
-425581	INTERNATIONAL FRONTIER	608114026004	02481	BP Exploration & Production Inc.	4344	49157	E	27-Sep-09
-425582	INTERNATIONAL FRONTIER	608114026004	02481	BP Exploration & Production Inc.	4344	49157	E	27-Sep-09
-323680	HOLSTEIN SPAR RIG	608114026004	02481	BP Exploration & Production Inc.	4344	47715	E	15-Nov-08
-323679	HOLSTEIN SPAR RIG	608114026004	02481	BP Exploration & Production Inc.	4344	47715	E	15-Nov-08
-137892	UNSPECIFIED - DO NOT DELETE	608114026103	02481	BP Exploration & Production Inc.	4420	1	D	20-Dec-06
-137890	UNSPECIFIED - DO NOT DELETE	608114026103	02481	BP Exploration & Production Inc.	4420	1	D	20-Dec-06
-299324	INTERNATIONAL FRONTIER	608114031300	02481	BP Exploration & Production Inc.	4344	49157	D	10-Aug-08
-299325	INTERNATIONAL FRONTIER	608114031300	02481	BP Exploration & Production Inc.	4344	49157	D	10-Aug-08
-265770	INTERNATIONAL FRONTIER	608114031400	02481	BP Exploration & Production Inc.	4344	49157	D	09-Apr-08
-285826	HOLSTEIN SPAR RIG	608114031400	02481	BP Exploration & Production Inc.	4344	47715	D	15-Jun-08
-283346	HOLSTEIN SPAR RIG	608114031400	02481	BP Exploration & Production Inc.	4344	47715	D	15-Jun-08
-265818	INTERNATIONAL FRONTIER	608114031400	02481	BP Exploration & Production Inc.	4344	49157	D	09-Apr-08
-285825	HOLSTEIN SPAR RIG	608114031400	02481	BP Exploration & Production Inc.	4344	47715	D	15-Jun-08
-283347	HOLSTEIN SPAR RIG	608114031400	02481	BP Exploration & Production Inc.	4344	47715	D	15-Jun-08
-295951	HOLSTEIN SPAR RIG	608114031401	02481	BP Exploration & Production Inc.	4344	47715	D	24-Jul-08
-295952	HOLSTEIN SPAR RIG	608114031401	02481	BP Exploration & Production Inc.	4344	47715	D	24-Jul-08
-113442	HOLSTEIN SPAR RIG	608114031501	02481	BP Exploration & Production Inc.	4344	47715	D	12-Sep-06
-356697	HOLSTEIN SPAR RIG	608114031501	02481	BP Exploration & Production Inc.	4344	47715	D	04-Apr-09
-356678	HOLSTEIN SPAR RIG	608114031501	02481	BP Exploration & Production Inc.	4344	47715	D	04-Apr-09
-345806	HOLSTEIN SPAR RIG	608114031501	02481	BP Exploration & Production Inc.	4344	47715	D	05-Mar-09
-354592	HOLSTEIN SPAR RIG	608114031501	02481	BP Exploration & Production Inc.	4344	47715	D	05-Mar-09
-131376	HOLSTEIN SPAR RIG	608114031501	02481	BP Exploration & Production Inc.	4344	47715	D	29-Oct-06
-353771	HOLSTEIN SPAR RIG	608114031501	02481	BP Exploration & Production Inc.	4344	47715	D	05-Mar-09
-113438	HOLSTEIN SPAR RIG	608114031501	02481	BP Exploration & Production Inc.	4344	47715	D	12-Sep-06
-345805	HOLSTEIN SPAR RIG	608114031501	02481	BP Exploration & Production Inc.	4344	47715	D	05-Mar-09
-131377	HOLSTEIN SPAR RIG	608114031501	02481	BP Exploration & Production Inc.	4344	47715	D	29-Oct-06
-526423		608114031600	02481	BP Exploration & Production Inc.	4344		D	27-Jan-10
-426741		608114031700	02481	BP Exploration & Production Inc.	4344		D	09-Jan-10
-299328	INTERNATIONAL FRONTIER	608114031800	02481	BP Exploration & Production Inc.	4344	49157	D	10-Aug-08
-299329	INTERNATIONAL FRONTIER	608114031800	02481	BP Exploration & Production Inc.	4344	49157	D	10-Aug-08
-235512	HOLSTEIN SPAR RIG	608114031800	02481	BP Exploration & Production Inc.	4344	47715	D	12-Dec-07
-235513	HOLSTEIN SPAR RIG	608114031800	02481	BP Exploration & Production Inc.	4344	47715	D	12-Dec-07
-164063	HOLSTEIN SPAR RIG	608114031900	02481	BP Exploration & Production Inc.	4344	47715	D	16-Mar-07
-148721	HOLSTEIN SPAR RIG	608114031900	02481	BP Exploration & Production Inc.	4344	47715	D	04-Feb-07
-164058	HOLSTEIN SPAR RIG	608114031900	02481	BP Exploration & Production Inc.	4344	47715	D	16-Mar-07
-186320		608114031900	02481	BP Exploration & Production Inc.	4344		D	25-Jun-07
-70387	HOLSTEIN SPAR RIG	608114032000	02481	BP Exploration & Production Inc.	4344	47715	D	15-Apr-06
-70392	HOLSTEIN SPAR RIG	608114032000	02481	BP Exploration & Production Inc.	4344	47715	D	15-Apr-06
-84400	HOLSTEIN SPAR RIG	608114032001	02481	BP Exploration & Production Inc.	4344	47715	D	03-May-06
-325761	HOLSTEIN SPAR RIG	608114032001	02481	BP Exploration & Production Inc.	4344	47715	D	15-Dec-08
-325759	HOLSTEIN SPAR RIG	608114032001	02481	BP Exploration & Production Inc.	4344	47715	D	15-Dec-08
-335853	HOLSTEIN SPAR RIG	608114032001	02481	BP Exploration & Production Inc.	4344	47715	D	15-Dec-08
-335838	HOLSTEIN SPAR RIG	608114032001	02481	BP Exploration & Production Inc.	4344	47715	D	15-Dec-08
-341921	HOLSTEIN SPAR RIG	608114032002	02481	BP Exploration & Production Inc.	4344	47715	D	01-Feb-09
-372386	INTERNATIONAL FRONTIER	608114032002	02481	BP Exploration & Production Inc.	4344	49157	D	20-Jun-09
-343907	HOLSTEIN SPAR RIG	608114032002	02481	BP Exploration & Production Inc.	4344	47715	D	01-Feb-09
-341922	HOLSTEIN SPAR RIG	608114032002	02481	BP Exploration & Production Inc.	4344	47715	D	01-Feb-09
-343906	HOLSTEIN SPAR RIG	608114032002	02481	BP Exploration & Production Inc.	4344	47715	D	01-Feb-09

-373580	INTERNATIONAL FRONTIER	608114032002	02481	BP Exploration & Production Inc.	4344	49157	D		20-Jun-09
-261465	* COIL TUBING UNIT	608114032200	02481	BP Exploration & Production Inc.	4344	45016	D		28-Mar-08
-85887		608114032200	02481	BP Exploration & Production Inc.	4344		D		16-May-06
-261466	* COIL TUBING UNIT	608114032200	02481	BP Exploration & Production Inc.	4344	45016	D		28-Mar-08
-144533	HOLSTEIN SPAR RIG	608114032300	02481	BP Exploration & Production Inc.	4344	47715	D		02-Jan-07
-144532	HOLSTEIN SPAR RIG	608114032300	02481	BP Exploration & Production Inc.	4344	47715	D		02-Jan-07
-147437	HOLSTEIN SPAR RIG	608114032300	02481	BP Exploration & Production Inc.	4344	47715	D		11-Jan-07
-129901	HOLSTEIN SPAR RIG	608114032300	02481	BP Exploration & Production Inc.	4344	47715	D		15-Nov-06
-149953	HOLSTEIN SPAR RIG	608114032301	02481	BP Exploration & Production Inc.	4344	47715	D		23-Jan-07
-149946	HOLSTEIN SPAR RIG	608114032301	02481	BP Exploration & Production Inc.	4344	47715	D		23-Jan-07
-426739		608114032301	02481	BP Exploration & Production Inc.	4344		D		10-Jan-10
-236873	* COIL TUBING UNIT	608114032600	02481	BP Exploration & Production Inc.	4344	45016	D		01-Dec-07
-236874	* COIL TUBING UNIT	608114032600	02481	BP Exploration & Production Inc.	4344	45016	D		01-Dec-07
-238795	INTERNATIONAL FRONTIER	608114032600	02481	BP Exploration & Production Inc.	4344	49157	D		21-Dec-07
-238796	INTERNATIONAL FRONTIER	608114032600	02481	BP Exploration & Production Inc.	4344	49157	D		21-Dec-07
-242237	HOLSTEIN SPAR RIG	608114032600	02481	BP Exploration & Production Inc.	4344	47715	D		13-Jan-08
-89844	HOLSTEIN SPAR RIG	608114032600	02481	BP Exploration & Production Inc.	4344	47715	D		01-Jun-06
-231364	* COIL TUBING UNIT	608114032600	02481	BP Exploration & Production Inc.	4344	45016	D		01-Dec-07
-84716	HOLSTEIN SPAR RIG	608114032600	02481	BP Exploration & Production Inc.	4344	47715	D		01-Jun-06
-242236	HOLSTEIN SPAR RIG	608114032600	02481	BP Exploration & Production Inc.	4344	47715	D		13-Jan-08
-255659	HOLSTEIN SPAR RIG	608114032601	02481	BP Exploration & Production Inc.	4344	47715	D		04-Mar-08
-255658	HOLSTEIN SPAR RIG	608114032601	02481	BP Exploration & Production Inc.	4344	47715	D		04-Mar-08
-112687	HOLSTEIN SPAR RIG	608114032700	02481	BP Exploration & Production Inc.	4344	47715	D		24-Aug-06
-112688	HOLSTEIN SPAR RIG	608114032700	02481	BP Exploration & Production Inc.	4344	47715	D		24-Aug-06
-96357	HOLSTEIN SPAR RIG	608114032700	02481	BP Exploration & Production Inc.	4344	47715	D		23-May-06
-83666	HOLSTEIN SPAR RIG	608114032700	02481	BP Exploration & Production Inc.	4344	47715	D		23-May-06
-351257	T.O. DEVELOPMENT DRILLER II	608114034902	02481	BP Exploration & Production Inc.	5405	48018	D		01-May-09
-344687	T.O. DEVELOPMENT DRILLER II	608114034902	02481	BP Exploration & Production Inc.	5405	48018	D		01-Apr-09
-344686	T.O. DEVELOPMENT DRILLER II	608114034902	02481	BP Exploration & Production Inc.	5405	48018	D		01-Apr-09
-360218	T.O. DEVELOPMENT DRILLER II	608114034902	02481	BP Exploration & Production Inc.	5405	48018	D		01-May-09
-351256	T.O. DEVELOPMENT DRILLER II	608114034902	02481	BP Exploration & Production Inc.	5405	48018	D		01-May-09
-360217	T.O. DEVELOPMENT DRILLER II	608114034902	02481	BP Exploration & Production Inc.	5405	48018	D		01-May-09
-315784	INTERNATIONAL FRONTIER	608114037802	02481	BP Exploration & Production Inc.	4427	49157	D		22-Oct-08
-315783	INTERNATIONAL FRONTIER	608114037802	02481	BP Exploration & Production Inc.	4427	49157	D		22-Oct-08
-147273		608114037802	02481	BP Exploration & Production Inc.	4427		D		11-Jan-07
-164002	PRIDE MAD DOG SPAR RIG	608114037900	02481	BP Exploration & Production Inc.	4427	47854	D		15-Mar-07
-140501	PRIDE MAD DOG SPAR RIG	608114037900	02481	BP Exploration & Production Inc.	4427	47854	D		16-Dec-06
-430421	INTERNATIONAL FRONTIER	608114037901	02481	BP Exploration & Production Inc.	4427	49157	D		28-Dec-09
-172014	PRIDE MAD DOG SPAR RIG	608114037901	02481	BP Exploration & Production Inc.	4427	47854	D		14-Apr-07
-430422	INTERNATIONAL FRONTIER	608114037901	02481	BP Exploration & Production Inc.	4427	49157	D		28-Dec-09
-241867	PRIDE MAD DOG SPAR RIG	608114038000	02481	BP Exploration & Production Inc.	4427	47854	D		30-Jan-08
-278253	PRIDE MAD DOG SPAR RIG	608114038000	02481	BP Exploration & Production Inc.	4427	47854	D		06-Jun-08
-241866	PRIDE MAD DOG SPAR RIG	608114038000	02481	BP Exploration & Production Inc.	4427	47854	D		30-Jan-08
-278254	PRIDE MAD DOG SPAR RIG	608114038000	02481	BP Exploration & Production Inc.	4427	47854	D		06-Jun-08
-204048	PRIDE MAD DOG SPAR RIG	608114038100	02481	BP Exploration & Production Inc.	4427	47854	D		29-May-07
-227745	PRIDE MAD DOG SPAR RIG	608114038100	02481	BP Exploration & Production Inc.	4427	47854	D		06-Nov-07
-178723	PRIDE MAD DOG SPAR RIG	608114038100	02481	BP Exploration & Production Inc.	4427	47854	D		29-May-07
-227744	PRIDE MAD DOG SPAR RIG	608114038100	02481	BP Exploration & Production Inc.	4427	47854	D		06-Nov-07
-232396	PRIDE MAD DOG SPAR RIG	608114038101	02481	BP Exploration & Production Inc.	4427	47854	D		30-Nov-07

-232397	PRIDE MAD DOG SPAR RIG	608114038101	02481	BP Exploration & Production Inc.	4427	47854	D	30-Nov-07
-443842		608114038404	02481	BP Exploration & Production Inc.	4129		E	01-Mar-10
-71759	T.O. DEVELOPMENT DRILLER II	608114039900	02481	BP Exploration & Production Inc.	6824	48018	D	10-Feb-06
-71758	T.O. DEVELOPMENT DRILLER II	608114039900	02481	BP Exploration & Production Inc.	6824	48018	D	10-Feb-06
-129036	T.O. DEVELOPMENT DRILLER II	608114040000	02481	BP Exploration & Production Inc.	6822	48018	D	01-Dec-06
-129035	T.O. DEVELOPMENT DRILLER II	608114040000	02481	BP Exploration & Production Inc.	6822	48018	D	01-Dec-06
-72469	T.O. DEVELOPMENT DRILLER II	608114040200	02481	BP Exploration & Production Inc.	6824	48018	D	25-Apr-06
-241272	T.O. DEVELOPMENT DRILLER II	608114040200	02481	BP Exploration & Production Inc.	6824	48018	D	06-Jan-08
-333617	T.O. DEVELOPMENT DRILLER II	608114040300	02481	BP Exploration & Production Inc.	6824	48018	D	15-Jan-09
-333616	T.O. DEVELOPMENT DRILLER II	608114040300	02481	BP Exploration & Production Inc.	6824	48018	D	15-Jan-09
-229012	T.O. DEVELOPMENT DRILLER II	608114040401	02481	BP Exploration & Production Inc.	6822	48018	D	10-Dec-07
-229013	T.O. DEVELOPMENT DRILLER II	608114040401	02481	BP Exploration & Production Inc.	6822	48018	D	10-Dec-07
-216724	T.O. DEVELOPMENT DRILLER II	608114040401	02481	BP Exploration & Production Inc.	6822	48018	D	06-Sep-07
-115624	T.O. DEVELOPMENT DRILLER II	608114040500	02481	BP Exploration & Production Inc.	6825	48018	D	24-Aug-06
-345520	T.O. DEVELOPMENT DRILLER II	608114041100	02481	BP Exploration & Production Inc.	6825	48018	D	23-Feb-09
-295212	T.O. DEVELOPMENT DRILLER II	608114041100	02481	BP Exploration & Production Inc.	6825	48018	D	01-Mar-08
-345519	T.O. DEVELOPMENT DRILLER II	608114041100	02481	BP Exploration & Production Inc.	6825	48018	D	23-Feb-09
-248388	T.O. DEVELOPMENT DRILLER II	608114041100	02481	BP Exploration & Production Inc.	6825	48018	D	01-Mar-08
-196956	T.O. DEVELOPMENT DRILLER II	608114041300	02481	BP Exploration & Production Inc.	6829	48018	E	17-Jul-07
-196955	T.O. DEVELOPMENT DRILLER II	608114041300	02481	BP Exploration & Production Inc.	6829	48018	E	17-Jul-07
-43343	DIAMOND OCEAN CONFIDENCE	608114043600	02481	BP Exploration & Production Inc.	6736	45924	E	15-Aug-05
-43340	DIAMOND OCEAN CONFIDENCE	608114043600	02481	BP Exploration & Production Inc.	6736	45924	E	15-Aug-05
-162484	DIAMOND OCEAN CONFIDENCE	608114044800	02481	BP Exploration & Production Inc.	3944	45924	D	15-Mar-07
-161790	DIAMOND OCEAN CONFIDENCE	608114044800	02481	BP Exploration & Production Inc.	3944	45924	D	14-Mar-07
-443840		608114044800	02481	BP Exploration & Production Inc.	3944		D	01-Mar-10
-443837		608114045900	02481	BP Exploration & Production Inc.	4065		E	01-Mar-10
-185618	DIAMOND OCEAN CONFIDENCE	608114045900	02481	BP Exploration & Production Inc.	4065	45924	E	07-Jun-07
-185572	DIAMOND OCEAN CONFIDENCE	608114045900	02481	BP Exploration & Production Inc.	4065	45924	E	07-Jun-07
-162953	DIAMOND OCEAN CONFIDENCE	608114045900	02481	BP Exploration & Production Inc.	4065	45924	E	
-157665	T.O. DEEPWATER HORIZON	608114049000	02481	BP Exploration & Production Inc.	5233	46428	E	21-Feb-07
-345122	T.O. DEEPWATER HORIZON	608114052500	02481	BP Exploration & Production Inc.	4216	46428	E	15-Feb-09
-345123	T.O. DEEPWATER HORIZON	608114052500	02481	BP Exploration & Production Inc.	4216	46428	E	15-Feb-09
-345400	T.O. DEEPWATER HORIZON	608114052500	02481	BP Exploration & Production Inc.	4216	46428	E	15-Feb-09
-345398	T.O. DEEPWATER HORIZON	608114052500	02481	BP Exploration & Production Inc.	4216	46428	E	15-Feb-09
-348308	T.O. DEEPWATER HORIZON	608114052501	02481	BP Exploration & Production Inc.	4222	46428	E	02-Mar-09
-348293	T.O. DEEPWATER HORIZON	608114052501	02481	BP Exploration & Production Inc.	4222	46428	E	02-Mar-09
-443843		608114052501	02481	BP Exploration & Production Inc.	4222		E	01-Mar-10
-242721	T.O. DEEPWATER HORIZON	608124001401	02481	BP Exploration & Production Inc.	7591	46428	E	01-Feb-08
-19040	T.O. DEEPWATER HORIZON	608124001500	02481	BP Exploration & Production Inc.	9556	46428	E	23-Mar-05
-206393		608124002100	02481	BP Exploration & Production Inc.	6844		E	
-99658	DIAMOND OCEAN CONFIDENCE	608124002100	02481	BP Exploration & Production Inc.	6844	45924	E	29-Jun-06
-250198		608164029501	02481	BP Exploration & Production Inc.	3232		D	01-Mar-08
-264136	NABORS P-10	608164029501	02481	BP Exploration & Production Inc.	3232	93150	D	21-Apr-08
-264146	NABORS P-10	608164029501	02481	BP Exploration & Production Inc.	3232	93150	D	21-Apr-08
-273714	NABORS P-10	608164029501	02481	BP Exploration & Production Inc.	3232	93150	D	21-Apr-08
-255018		608164029501	02481	BP Exploration & Production Inc.	3232		D	01-Mar-08
-255017		608164029501	02481	BP Exploration & Production Inc.	3232		D	01-Mar-08
-273713	NABORS P-10	608164029501	02481	BP Exploration & Production Inc.	3232	93150	D	21-Apr-08
-219403		608164029501	02481	BP Exploration & Production Inc.	3232		D	01-Nov-07

-250199		608164029501	02481	BP Exploration & Production Inc.	3232		D	01-Mar-08
-219404		608164029501	02481	BP Exploration & Production Inc.	3232		D	01-Nov-07
-270924	T.O. MARIANAS	608164038301	02481	BP Exploration & Production Inc.	3455	44574	D	20-Mar-08
-270925	T.O. MARIANAS	608164038301	02481	BP Exploration & Production Inc.	3455	44574	D	20-Mar-08
-255220	T.O. MARIANAS	608164038301	02481	BP Exploration & Production Inc.	3455	44574	D	20-Mar-08
-262637	T.O. MARIANAS	608164038301	02481	BP Exploration & Production Inc.	3455	44574	D	20-Mar-08
-280502	T.O. MARIANAS	608164038302	02481	BP Exploration & Production Inc.	3455	44574	D	05-Jun-08
-285598	T.O. MARIANAS	608164038302	02481	BP Exploration & Production Inc.	3455	44574	D	05-Jun-08
-282890	T.O. MARIANAS	608164040200	02481	BP Exploration & Production Inc.	3460	44574	D	14-Jun-08
-282891	T.O. MARIANAS	608164040200	02481	BP Exploration & Production Inc.	3460	44574	D	14-Jun-08
-195741	DIAMOND OCEAN CONFIDENCE	608164040500	02481	BP Exploration & Production Inc.	3868	45924	D	13-Jul-07
-334184	T.O. MARIANAS	608164040500	02481	BP Exploration & Production Inc.	3868	44574	D	28-Dec-08
-286819		608164040500	02481	BP Exploration & Production Inc.	3868		D	22-Aug-08
-334152	T.O. MARIANAS	608164040500	02481	BP Exploration & Production Inc.	3868	44574	D	28-Dec-08
-192064	T.O. DISCOVERER ENTERPRISE	608164040500	02481	BP Exploration & Production Inc.	3868	45381	D	05-Jul-07
-286359		608164040500	02481	BP Exploration & Production Inc.	3868		D	22-Aug-08
-195740	DIAMOND OCEAN CONFIDENCE	608164040500	02481	BP Exploration & Production Inc.	3868	45924	D	13-Jul-07
-192063	T.O. DISCOVERER ENTERPRISE	608164040500	02481	BP Exploration & Production Inc.	3868	45381	D	05-Jul-07
-198967	DIAMOND OCEAN CONFIDENCE	608164040703	02481	BP Exploration & Production Inc.	3560	45924	D	28-Jul-07
-286824		608164040703	02481	BP Exploration & Production Inc.	3560		D	22-Aug-08
-198966	DIAMOND OCEAN CONFIDENCE	608164040703	02481	BP Exploration & Production Inc.	3560	45924	D	28-Jul-07
-286380		608164040703	02481	BP Exploration & Production Inc.	3560		D	22-Aug-08
-337448	T.O. MARIANAS	608164040703	02481	BP Exploration & Production Inc.	3560	44574	D	05-Feb-09
-337324	T.O. MARIANAS	608164040703	02481	BP Exploration & Production Inc.	3560	44574	D	05-Feb-09
-325704	T.O. MARIANAS	608164040900	02481	BP Exploration & Production Inc.	3856	44574	D	01-Dec-08
-286825		608164040900	02481	BP Exploration & Production Inc.	3856		D	22-Aug-08
-286391		608164040900	02481	BP Exploration & Production Inc.	3856		D	22-Aug-08
-325703	T.O. MARIANAS	608164040900	02481	BP Exploration & Production Inc.	3856	44574	D	01-Dec-08
-332018	T.O. MARIANAS	608164040900	02481	BP Exploration & Production Inc.	3856	44574	D	01-Dec-08
-332019	T.O. MARIANAS	608164040900	02481	BP Exploration & Production Inc.	3856	44574	D	01-Dec-08
-197396	DIAMOND OCEAN CONFIDENCE	608164040900	02481	BP Exploration & Production Inc.	3856	45924	D	20-Jul-07
-197395	DIAMOND OCEAN CONFIDENCE	608164040900	02481	BP Exploration & Production Inc.	3856	45924	D	20-Jul-07
-473409	Wotan	608174054601	02481	BP Exploration & Production Inc.	6738	49196	E	01-Jun-10
-473410	Wotan	608174054601	02481	BP Exploration & Production Inc.	6738	49196	E	01-Jun-10
-104029	T.O. DISCOVERER ENTERPRISE	608174088405	02481	BP Exploration & Production Inc.	5636	45381	D	23-Jul-06
-321736	T.O. DISCOVERER ENTERPRISE	608174088405	02481	BP Exploration & Production Inc.	5636	45381	D	07-Nov-08
-119975	T.O. DISCOVERER ENTERPRISE	608174088405	02481	BP Exploration & Production Inc.	5636	45381	D	16-Sep-06
-330224	T.O. DISCOVERER ENTERPRISE	608174088405	02481	BP Exploration & Production Inc.	5636	45381	D	07-Nov-08
-104028	T.O. DISCOVERER ENTERPRISE	608174088405	02481	BP Exploration & Production Inc.	5636	45381	D	23-Jul-06
-119976	T.O. DISCOVERER ENTERPRISE	608174088405	02481	BP Exploration & Production Inc.	5636	45381	D	16-Sep-06
-206704		608174093000	02481	BP Exploration & Production Inc.	5422		D	01-Sep-07
-206702		608174093000	02481	BP Exploration & Production Inc.	5422		D	01-Sep-07
-206716		608174093200	02481	BP Exploration & Production Inc.	5423		D	04-Sep-07
-206717		608174093200	02481	BP Exploration & Production Inc.	5423		D	04-Sep-07
-457095		608174093400	02481	BP Exploration & Production Inc.	5422		D	10-Apr-10
-454194		608174093400	02481	BP Exploration & Production Inc.	5422		D	10-Apr-10
-457094		608174093400	02481	BP Exploration & Production Inc.	5422		D	10-Apr-10
-454195		608174093400	02481	BP Exploration & Production Inc.	5422		D	10-Apr-10
-326067		608174093500	02481	BP Exploration & Production Inc.	5422		D	01-Dec-08

-326066		608174093500	02481	BP Exploration & Production Inc.	5422		D	01-Dec-08
-325729		608174095200	02481	BP Exploration & Production Inc.	5422		D	01-Dec-08
-325730		608174095200	02481	BP Exploration & Production Inc.	5422		D	01-Dec-08
-286403	T.O. DISCOVERER ENTERPRISE	608174095302	02481	BP Exploration & Production Inc.	6262	45381	D	28-Jun-08
-286402	T.O. DISCOVERER ENTERPRISE	608174095302	02481	BP Exploration & Production Inc.	6262	45381	D	28-Jun-08
-289196	T.O. DISCOVERER ENTERPRISE	608174095302	02481	BP Exploration & Production Inc.	6262	45381	D	28-Jun-08
-302603	T.O. DISCOVERER ENTERPRISE	608174095302	02481	BP Exploration & Production Inc.	6262	45381	D	28-Jun-08
-302602	T.O. DISCOVERER ENTERPRISE	608174095302	02481	BP Exploration & Production Inc.	6262	45381	D	28-Jun-08
-289197	T.O. DISCOVERER ENTERPRISE	608174095302	02481	BP Exploration & Production Inc.	6262	45381	D	28-Jun-08
-226318	T.O. DISCOVERER ENTERPRISE	608174095302	02481	BP Exploration & Production Inc.	6262	45381	D	03-Dec-07
-324573	THUNDER HORSE PDQ	608174098300	02481	BP Exploration & Production Inc.	6033	48896	E	25-Nov-08
-368597	THUNDER HORSE PDQ	608174098300	02481	BP Exploration & Production Inc.	6033	48896	E	01-Jun-09
-368596	THUNDER HORSE PDQ	608174098300	02481	BP Exploration & Production Inc.	6033	48896	E	01-Jun-09
-324574	THUNDER HORSE PDQ	608174098300	02481	BP Exploration & Production Inc.	6033	48896	E	25-Nov-08
-174652	THUNDER HORSE PDQ	608174098300	02481	BP Exploration & Production Inc.	6033	48896	E	13-May-07
-174654	THUNDER HORSE PDQ	608174098300	02481	BP Exploration & Production Inc.	6033	48896	E	13-May-07
-185701	THUNDER HORSE PDQ	608174098300	02481	BP Exploration & Production Inc.	6033	48896	E	13-May-07
-224953	THUNDER HORSE PDQ	608174098300	02481	BP Exploration & Production Inc.	6033	48896	E	01-Nov-07
-209424	THUNDER HORSE PDQ	608174098300	02481	BP Exploration & Production Inc.	6033	48896	E	13-May-07
-2637	T.O. DISCOVERER ENTERPRISE	608174098601	02481	BP Exploration & Production Inc.	6034	45381	E	06-Oct-04
-443391	THUNDER HORSE PDQ	608174098601	02481	BP Exploration & Production Inc.	6034	48896	E	21-Feb-10
-443392	THUNDER HORSE PDQ	608174098601	02481	BP Exploration & Production Inc.	6034	48896	E	21-Feb-10
-440547	THUNDER HORSE PDQ	608174098900	02481	BP Exploration & Production Inc.	6033	48896	E	07-Feb-10
-300584	THUNDER HORSE PDQ	608174098900	02481	BP Exploration & Production Inc.	6033	48896	E	01-Sep-08
-244257	THUNDER HORSE PDQ	608174098900	02481	BP Exploration & Production Inc.	6033	48896	E	25-Jan-08
-4788	T.O. DISCOVERER ENTERPRISE	608174098900	02481	BP Exploration & Production Inc.	6033	45381	E	06-Nov-04
-244256	THUNDER HORSE PDQ	608174098900	02481	BP Exploration & Production Inc.	6033	48896	E	25-Jan-08
-300583	THUNDER HORSE PDQ	608174098900	02481	BP Exploration & Production Inc.	6033	48896	E	01-Sep-08
-440548	THUNDER HORSE PDQ	608174098900	02481	BP Exploration & Production Inc.	6033	48896	E	07-Feb-10
-121937	T.O. DISCOVERER ENTERPRISE	608174099300	02481	BP Exploration & Production Inc.	5610	45381	E	30-May-06
-27064	T.O. DISCOVERER ENTERPRISE	608174099300	02481	BP Exploration & Production Inc.	5610	45381	E	22-Apr-06
-27063	T.O. DISCOVERER ENTERPRISE	608174099300	02481	BP Exploration & Production Inc.	5610	45381	E	22-Apr-06
-5402	T.O. DISCOVERER ENTERPRISE	608174099800	02481	BP Exploration & Production Inc.	6033	45381	E	14-Nov-04
-244357	THUNDER HORSE PDQ	608174099800	02481	BP Exploration & Production Inc.	6033	48896	E	08-Feb-08
-259315	THUNDER HORSE PDQ	608174099800	02481	BP Exploration & Production Inc.	6033	48896	E	08-Feb-08
-273409	THUNDER HORSE PDQ	608174099800	02481	BP Exploration & Production Inc.	6033	48896	E	20-May-08
-273410	THUNDER HORSE PDQ	608174099800	02481	BP Exploration & Production Inc.	6033	48896	E	20-May-08
-445705	THUNDER HORSE PDQ	608174099800	02481	BP Exploration & Production Inc.	6033	48896	E	02-Mar-10
-289810	THUNDER HORSE PDQ	608174099800	02481	BP Exploration & Production Inc.	6033	48896	E	20-May-08
-289809	THUNDER HORSE PDQ	608174099800	02481	BP Exploration & Production Inc.	6033	48896	E	20-May-08
-445701	THUNDER HORSE PDQ	608174099800	02481	BP Exploration & Production Inc.	6033	48896	E	02-Mar-10
-335825	THUNDER HORSE PDQ	608174101400	02481	BP Exploration & Production Inc.	6036	48896	E	10-Jun-07
-352386	THUNDER HORSE PDQ	608174101400	02481	BP Exploration & Production Inc.	6036	48896	E	21-Feb-09
-184492	THUNDER HORSE PDQ	608174101400	02481	BP Exploration & Production Inc.	6036	48896	E	10-Jun-07
-345418	THUNDER HORSE PDQ	608174101400	02481	BP Exploration & Production Inc.	6036	48896	E	10-Jun-07
-346740	THUNDER HORSE PDQ	608174101400	02481	BP Exploration & Production Inc.	6036	48896	E	21-Feb-09
-346741	THUNDER HORSE PDQ	608174101400	02481	BP Exploration & Production Inc.	6036	48896	E	21-Feb-09
-165685	THUNDER HORSE PDQ	608174102900	02481	BP Exploration & Production Inc.	6035	48896	D	05-Apr-07
-178368	THUNDER HORSE PDQ	608174102900	02481	BP Exploration & Production Inc.	6035	48896	D	05-Apr-07

-178367	THUNDER HORSE PDQ	608174102900	02481	BP Exploration & Production Inc.	6035	48896	D	05-Apr-07
-244397	THUNDER HORSE PDQ	608174102900	02481	BP Exploration & Production Inc.	6035	48896	D	25-Jan-08
-244395	THUNDER HORSE PDQ	608174102900	02481	BP Exploration & Production Inc.	6035	48896	D	25-Jan-08
-167305	UNSPECIFIED - DO NOT DELETE	608174102900	02481	BP Exploration & Production Inc.	6035	1	D	20-Jan-07
-165686	THUNDER HORSE PDQ	608174102900	02481	BP Exploration & Production Inc.	6035	48896	D	05-Apr-07
-144998	UNSPECIFIED - DO NOT DELETE	608174102900	02481	BP Exploration & Production Inc.	6035	1	D	20-Jan-07
-61132	T.O. DEEPWATER HORIZON	608174107400	02481	BP Exploration & Production Inc.	4304	46428	E	23-Nov-05
-60871	T.O. DEEPWATER HORIZON	608174107800	02481	BP Exploration & Production Inc.	4304	46428	E	22-Dec-05
-60870	T.O. DEEPWATER HORIZON	608174107800	02481	BP Exploration & Production Inc.	4304	46428	E	22-Dec-05
-65478		608174107801	02481	BP Exploration & Production Inc.	4304		E	01-Jan-06
-65477		608174107801	02481	BP Exploration & Production Inc.	4304		E	01-Jan-06
-67035	T.O. DEEPWATER HORIZON	608174107802	02481	BP Exploration & Production Inc.	4304	46428	E	11-Jan-06
-67034	T.O. DEEPWATER HORIZON	608174107802	02481	BP Exploration & Production Inc.	4304	46428	E	11-Jan-06
-106988	GSF EXPLORER	608174107900	02481	BP Exploration & Production Inc.	4602	44575	E	
-127011	GSF EXPLORER	608174107900	02481	BP Exploration & Production Inc.	4602	44575	E	12-Oct-06
-162124	GSF EXPLORER	608174107902	02481	BP Exploration & Production Inc.	4602	44575	E	13-Mar-07
-156247	GSF EXPLORER	608174107902	02481	BP Exploration & Production Inc.	4602	44575	E	20-Feb-07
-170254	GSF EXPLORER	608174107902	02481	BP Exploration & Production Inc.	4602	44575	E	12-Apr-07
-169529	GSF EXPLORER	608174107902	02481	BP Exploration & Production Inc.	4602	44575	E	
-230725	T.O. MARIANAS	608174110000	02481	BP Exploration & Production Inc.	6929	44574	D	05-Dec-07
-179045	T.O. MARIANAS	608174110000	02481	BP Exploration & Production Inc.	6929	44574	D	14-May-07
-179044	T.O. MARIANAS	608174110000	02481	BP Exploration & Production Inc.	6929	44574	D	14-May-07
-172611	T.O. MARIANAS	608174110000	02481	BP Exploration & Production Inc.	6929	44574	D	19-Apr-07
-172612	T.O. MARIANAS	608174110000	02481	BP Exploration & Production Inc.	6929	44574	D	19-Apr-07
-145386	T.O. MARIANAS	608174110000	02481	BP Exploration & Production Inc.	6929	44574	D	07-Jan-07
-145387	T.O. MARIANAS	608174110000	02481	BP Exploration & Production Inc.	6929	44574	D	07-Jan-07
-230727	T.O. MARIANAS	608174110000	02481	BP Exploration & Production Inc.	6929	44574	D	05-Dec-07
-145528	T.O. MARIANAS	608174110000	02481	BP Exploration & Production Inc.	6929	44574	D	04-Jan-07
-111823	DIAMOND OCEAN CONFIDENCE	608174110100	02481	BP Exploration & Production Inc.	6933	45924	D	16-Aug-06
-179241	T.O. MARIANAS	608174110100	02481	BP Exploration & Production Inc.	6933	44574	D	18-May-07
-179239	T.O. MARIANAS	608174110100	02481	BP Exploration & Production Inc.	6933	44574	D	18-May-07
-169877	T.O. MARIANAS	608174110100	02481	BP Exploration & Production Inc.	6933	44574	D	13-Apr-07
-169876	T.O. MARIANAS	608174110100	02481	BP Exploration & Production Inc.	6933	44574	D	13-Apr-07
-319980	T.O. DISCOVERER ENTERPRISE	608174110400	02481	BP Exploration & Production Inc.	5610	45381	D	10-Nov-08
-162371	T.O. DISCOVERER ENTERPRISE	608174110400	02481	BP Exploration & Production Inc.	5610	45381	D	09-Mar-07
-189562	T.O. DISCOVERER ENTERPRISE	608174110400	02481	BP Exploration & Production Inc.	5610	45381	D	05-Apr-07
-118717	T.O. DISCOVERER ENTERPRISE	608174110400	02481	BP Exploration & Production Inc.	5610	45381	D	09-Sep-06
-146571	T.O. DISCOVERER ENTERPRISE	608174110400	02481	BP Exploration & Production Inc.	5610	45381	D	14-Jan-07
-168805	T.O. DISCOVERER ENTERPRISE	608174110400	02481	BP Exploration & Production Inc.	5610	45381	D	05-Apr-07
-183162	T.O. DISCOVERER ENTERPRISE	608174110500	02481	BP Exploration & Production Inc.	5634	45381	D	26-May-07
-119244	T.O. DISCOVERER ENTERPRISE	608174110500	02481	BP Exploration & Production Inc.	5634	45381	D	15-Sep-06
-185357	T.O. DISCOVERER ENTERPRISE	608174110501	02481	BP Exploration & Production Inc.	5634	45381	D	03-Jun-07
-170116	T.O. DEEPWATER HORIZON	608174111601	02481	BP Exploration & Production Inc.	6535	46428	E	13-Apr-07
-198603	T.O. DISCOVERER ENTERPRISE	608174112100	02481	BP Exploration & Production Inc.	5673	45381	E	22-Jul-07
-194322	T.O. DISCOVERER ENTERPRISE	608174112100	02481	BP Exploration & Production Inc.	5673	45381	E	06-Jul-07
-213255	T.O. DISCOVERER ENTERPRISE	608174112101	02481	BP Exploration & Production Inc.	5673	45381	E	14-Sep-07
-213259	T.O. DISCOVERER ENTERPRISE	608174112101	02481	BP Exploration & Production Inc.	5673	45381	E	14-Sep-07
-203111	T.O. DISCOVERER ENTERPRISE	608174112101	02481	BP Exploration & Production Inc.	5673	45381	E	05-Aug-07
-262667	T.O. DISCOVERER ENTERPRISE	608174112101	02481	BP Exploration & Production Inc.	5673	45381	E	29-Mar-08

-203110	T.O. DISCOVERER ENTERPRISE	608174112101	02481	BP Exploration & Production Inc.	5673	45381	E	05-Aug-07
-268959	T.O. DISCOVERER ENTERPRISE	608174112102	02481	BP Exploration & Production Inc.	5673	45381	E	20-Apr-08
-268418	T.O. DISCOVERER ENTERPRISE	608174112102	02481	BP Exploration & Production Inc.	5673	45381	E	20-Apr-08
-394989	T.O. DISCOVERER ENTERPRISE	608174112102	02481	BP Exploration & Production Inc.	5673	45381	E	15-Oct-09
-481037		608174112102	02481	BP Exploration & Production Inc.	5673		E	15-Jun-10
-394987	T.O. DISCOVERER ENTERPRISE	608174112102	02481	BP Exploration & Production Inc.	5673	45381	E	15-Oct-09
-483444		608174112102	02481	BP Exploration & Production Inc.	5673		E	15-Jun-10
-483401		608174112102	02481	BP Exploration & Production Inc.	5673		E	22-Jun-10
-483403		608174112102	02481	BP Exploration & Production Inc.	5673		E	22-Jun-10
-516453		608174112102	02481	BP Exploration & Production Inc.	5673		E	08-Jan-11
-516451		608174112102	02481	BP Exploration & Production Inc.	5673		E	08-Jan-11
-452221		608174112102	02481	BP Exploration & Production Inc.	5673		E	01-Apr-10
-228630	T.O. DISCOVERER ENTERPRISE	608174112200	02481	BP Exploration & Production Inc.	5631	45381	E	16-Nov-07
-228629	T.O. DISCOVERER ENTERPRISE	608174112200	02481	BP Exploration & Production Inc.	5631	45381	E	16-Nov-07
-324062	T.O. DISCOVERER ENTERPRISE	608174112201	02481	BP Exploration & Production Inc.	5631	45381	E	02-Dec-08
-285937	T.O. DISCOVERER ENTERPRISE	608174112201	02481	BP Exploration & Production Inc.	5631	45381	E	21-Jun-08
-324063	T.O. DISCOVERER ENTERPRISE	608174112201	02481	BP Exploration & Production Inc.	5631	45381	E	02-Dec-08
-285619	T.O. DISCOVERER ENTERPRISE	608174112201	02481	BP Exploration & Production Inc.	5631	45381	E	21-Jun-08
-229728	T.O. DISCOVERER ENTERPRISE	608174112201	02481	BP Exploration & Production Inc.	5631	45381	E	17-Nov-07
-232810	T.O. DISCOVERER ENTERPRISE	608174112201	02481	BP Exploration & Production Inc.	5631	45381	E	28-Nov-07
-266263	T.O. DISCOVERER ENTERPRISE	608174112201	02481	BP Exploration & Production Inc.	5631	45381	E	01-May-08
-266262	T.O. DISCOVERER ENTERPRISE	608174112201	02481	BP Exploration & Production Inc.	5631	45381	E	01-May-08
-232809	T.O. DISCOVERER ENTERPRISE	608174112201	02481	BP Exploration & Production Inc.	5631	45381	E	28-Nov-07
-285616	T.O. DISCOVERER ENTERPRISE	608174112201	02481	BP Exploration & Production Inc.	5631	45381	E	21-Jun-08
-258958	T.O. DEEPWATER HORIZON	608174113400	02481	BP Exploration & Production Inc.	4986	46428	E	16-Mar-08
-332588	T.O. DEEPWATER HORIZON	608174113401	02481	BP Exploration & Production Inc.	4986	46428	E	28-Nov-08
-248871		608174113600	02481	BP Exploration & Production Inc.	4625		E	09-Feb-08
-333051	T.O. DISCOVERER ENTERPRISE	608174113800	02481	BP Exploration & Production Inc.	5609	45381	D	21-Dec-08
-251999	T.O. DISCOVERER ENTERPRISE	608174113800	02481	BP Exploration & Production Inc.	5609	45381	D	21-Feb-08
-333052	T.O. DISCOVERER ENTERPRISE	608174113800	02481	BP Exploration & Production Inc.	5609	45381	D	21-Dec-08
-286831		608174114500	02481	BP Exploration & Production Inc.	5598		E	22-Aug-08
-286834		608174114500	02481	BP Exploration & Production Inc.	5598		E	22-Aug-08
-267818	T.O. DEEPWATER HORIZON	608174114500	02481	BP Exploration & Production Inc.	5598	46428	E	20-Apr-08
-320672	T.O. MARIANAS	608174114500	02481	BP Exploration & Production Inc.	5598	44574	E	21-Oct-08
-320671	T.O. MARIANAS	608174114500	02481	BP Exploration & Production Inc.	5598	44574	E	21-Oct-08
-294575	T.O. DEEPWATER HORIZON	608174114800	02481	BP Exploration & Production Inc.	6090	46428	E	22-May-08
-308430	T.O. DEEPWATER HORIZON	608174114900	02481	BP Exploration & Production Inc.	6095	46428	E	02-Sep-08
-315619	T.O. DEEPWATER HORIZON	608174114901	02481	BP Exploration & Production Inc.	6095	46428	E	15-Oct-08
-51361	T.O. DEEPWATER HORIZON	608184005701	02481	BP Exploration & Production Inc.	3619	46428	E	28-Oct-05
-109144	T.O. DEEPWATER HORIZON	608184005702	02481	BP Exploration & Production Inc.	3619	46428	E	06-Aug-06
-109852	T.O. DEEPWATER HORIZON	608184005702	02481	BP Exploration & Production Inc.	3619	46428	E	06-Aug-06
-63667	DIAMOND OCEAN CONFIDENCE	608184005800	02481	BP Exploration & Production Inc.	4291	45924	E	08-Jan-06
-62765	DIAMOND OCEAN CONFIDENCE	608184005800	02481	BP Exploration & Production Inc.	4291	45924	E	08-Jan-06
-62763	DIAMOND OCEAN CONFIDENCE	608184005800	02481	BP Exploration & Production Inc.	4291	45924	E	08-Jan-06
-63170	DIAMOND OCEAN CONFIDENCE	608184005800	02481	BP Exploration & Production Inc.	4291	45924	E	08-Jan-06
-63669	DIAMOND OCEAN CONFIDENCE	608184005800	02481	BP Exploration & Production Inc.	4291	45924	E	08-Jan-06
-64510	DIAMOND OCEAN CONFIDENCE	608184005800	02481	BP Exploration & Production Inc.	4291	45924	E	13-Jan-06
-64511	DIAMOND OCEAN CONFIDENCE	608184005800	02481	BP Exploration & Production Inc.	4291	45924	E	13-Jan-06
-62996	DIAMOND OCEAN CONFIDENCE	608184005800	02481	BP Exploration & Production Inc.	4291	45924	E	08-Jan-06

Appendix D

Summary of BP Financial Information

TOTAL CASH COST (millions)				
	BP Group	**Exploration & Production**	**Gulf of Mexico**	**Gulf of Mexico D&C**
2008	30,200[1]	10,831[2]	1,098[3]	Unknown
2009	~26,200[4]	9,811[5]	856[6]	Reduced by $250-300[7]
2010	24,800[8]	9,000[9]	1,115[10]	Further Reductions[11]

UNIT CASH COST ($/boe)				
	BP Group	**Exploration & Production**	**Gulf of Mexico**	**Gulf of Mexico D&C**
2008	Unknown	11.78[12]	12.63[13]	Unknown
2009	Unknown	10.01[14]	7.67[15]	Unknown
2010	Unknown	8.1[16]	Unknown	Unknown

[1] Exh. 2250, pp. 47.
[2] Exh. 2255, pp. 5.
[3] Exh. 2254, pp. 23 (normalized).
[4] Exh. 6017, pp. 3. According to Tony Hayward, for the BP Group, cash costs were reduced by $4 billion in 2009.
[5] Exh. 2255, pp. 5.
[6] Exh. 2254, pp. 23 (normalized).
[7] Deposition of Kevin Lacy, pp. 774.
[8] Exh. 2250, pp. 47.
[9] Exh. 2250, pp. 47.
[10] Exh. 2261, pp. 15.
[11] Deposition of Kevin Lacy, pp. 775.
[12] Exh. 2254, p. 22.
[13] Exh. 2254, p. 22.
[14] Exh. 2254, p. 22.
[15] Exh. 2254, p. 22.
[16] BP-HZN-2179MDL01780081, p. 54.

CAPITAL EXPENDITURES				
	Exploration & Production		Gulf of Mexico	
	Total	Safety & Operational Integrity	Total	Safety & Operational Integrity
2010[17]	15,440[18]	600[19]	2,750[20]	22[21]

TOTAL PRODUCTION (mboed)				
	BP Group	Exploration & Production	Gulf of Mexico	Gulf of Mexico D&C
2008	Unknown	3,838[22]	284[23]	Unknown
2009	Unknown	3,998[24]	439[25]	Unknown
2010	Unknown	3,960[26]	430[27]	Unknown

17 As of October 2009.
18 BP-HZN-2179MDL00980450, pp. 20.
19 BP-HZN-2179MDL00980450, pp. 21.
20 BP-HZN-2179MDL00980450, pp. 20
21 BP-HZN-2179MDL00980450, pp. 20. As of June 2010, the Gulf of Mexico planned to spend $36 million on capital expenditures for Safety and Operational Integrity. BP-HZN-2179MDL00981514, pp. 36.
22 Exh. 2254, pp. 18.
23 Exh. 2254, pp. 22.
24 Exh. 2254, pp. 18.
25 Exh. 2254, pp. 19.
26 Exh. 2254, pp. 18-19.
27 Exh. 2255, pp. 4.