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

PHASE 2 EXPERT OPINIONS
BASIS OF OPINIONS
ANALYSIS & DISCUSSION

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Prepared for:

The Plaintiff Steering Committee (PSC) for MDL No. 2179

At the behest of
Plaintiff Liaison Counsel, James P. Roy and Stephen J. Herman
and
Brian Barr & Scott Summy of the Plaintiff Executive Committee

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

April 5, 2013

TREX-011750R.1

Opinions:

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1. **BP Management knowingly ignored required Process Safety Management mitigations for blowout source control in deepwater exploration wells drilled by contractor-owned Mobile Offshore Drilling Units in the Gulf of Mexico.**

2. **BP Management's Process Safety Management blowout source control failures resulted from a [redacted] disregard of the risk of loss of primary containment and an uncontrolled flow of oil and gas from the Macondo well.**

Executive Summary

The Macondo oil spill was stopped on July 15, 2010, eighty-seven (87) days after it started, when a 3-Ram capping stack was installed on the wellhead and the well was shut-in.[1] For the first time in 87 days, no oil flowed into the Gulf of Mexico from the Macondo well.

The length of time required to cap the well and stop the uncontrolled flow of oil on July 15 was due to BP's failure to prepare. BP Management ignored basic Process Safety Management fundamentals and failed to build an effective Safety Management System. Stopping the flow of crude and shutting-in the well should not have taken 87 days to accomplish, and it could have been done much faster if BP was prepared to deal with a blowout in deepwater – but it was not. BP was fully aware of the risks of deepwater blowouts and the enormous potential consequences of such events and [redacted] ignored its Process Safety Management obligations.

BP had been operating in deepwater in the Gulf of Mexico since the mid-1980s and was proud to be the leading producer of Gulf of Mexico crude oil -- largely due to its deepwater assets.[2] Despite its extensive experience in Gulf of Mexico operations, BP planned no Fit-For-Purpose mitigation controls to intervene and bring a deepwater blowout immediately under control. The only proven source control process that BP had in place was the drilling of a relief well – a process known to take 100-150 days. After all, drilling wells is the business BP knows well.[3] BP's Regional Oil Spill Response Plan had no specific source control provisions for a deepwater blowout and contemplated continued uncontrolled flow of crude while it tried to determine, in the midst of crisis, how to go about shutting-in the damaged well and stopping the flow of oil as the public waited for the relief wells to be completed. This was the intent of the plan.[4]

[1] Stipulated Facts Concerning Source Control Events, In re: Oil Spill by the Oil Rig "Deepwater Horizon" in the Gulf of Mexico on April 20, 2010, MDL 2179, 2:10-md-02179-CJB-SS, Doc. No. 7076 (Aug. 9, 2012).
[2] Deposition Testimony of Richard Morrison ("Morrison Dep.") at 290 ("Q. And you would agree that BP – well, with the statement that BP is the largest deepwater operator in the Gulf of Mexico? A. Yes, from the standpoint of leasehold – and I think Production."); Deposition Testimony of Lamar McKay ("McKay Dep.") at 42.
[3] Deposition Testimony of Charles Holt ("Holt Dep.") at 65 ("Q. And BP would have obtained that knowledge on how to drill a relief well simply by the fact that it drills wells in the Gulf of Mexico, correct? A. Correct, yeah.").
[4] McKay Dep. at 49-50 ("I think the response plan worked."); Deposition Testimony of Earnest Bush ("Bush Dep.") at 148 ("I believe [the Plan] performed as is stated in the Oil Spill Plan of what it's supposed to do.").

BP's only written, pre-incident plan for spill response was its Regional Oil Spill Response Plan.[5] The evidence in the record shows that BP's Oil Spill Response Plan only addressed oil clean-up and containment once the oil reached the surface – and did not have a specific source control plan for stopping the flow of oil at the wellhead.[6] As explained by its then Vice President of Exploration, Andy Inglis: "BP responded to (sic) in line with the plan that was laid out, which was that the collection of oil at the surface and to drill a - - a relief well."[7] Source control was only briefly mentioned in the Plan on a single page as subsequently addressed herein. What was the plan? Drill a relief well and wait while BP put together a team of "experts" *after* the blowout to determine the best way to stop the flow of oil.[8] No actual source control plan (beyond a relief well) existed.[9] According to former CEO, Tony Hayward, "[w]e did not have a plan to intervene to prevent flow subsea until the relief well was there."[10]

This report shows that BP Management [redacted] ignored warning after warning that it needed to be prepared to respond to and to mitigate the consequences of a deepwater blowout. The enormous consequences from the Macondo event were preventable had BP followed its Process Safety Management obligations and heeded its own standards. Tragically, the warnings were disregarded and no meaningful source control mitigations were developed beforehand.

Source control equipment and technology available to industry was known to be limited and ineffective, and BP knew it did not possess the appropriate plans and equipment to quickly control the source of release.[11] Yet BP kept drilling in deeper and deeper waters without an effective post-blowout source control plan or any of the pre-fabricated equipment needed. BP was put on notice of the high consequences of failing to have appropriate mitigation source control measures in 1979 with the Ixtoc I blowout and spill, and it ignored the ensuing calls for needed research and development. BP continued drilling in ever deeper and deeper waters and wells without developing new source control measures or technology. In September of 2009, the Mobile Offshore Drilling Unit

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[5] TREX 769; Deposition Testimony of James Wellings ("Wellings Dep.") at 247 ("Q. You personally knew that in a deepwater environment, if BP was facing a situation of a failed BOP, that it had no pre-built equipment or pre-approved plans other than drilling a relief well, correct? A. That's correct.").

[6] Bush Dep. at 15 ("the rest of the Plan deals with the response to the oil on the surface"); 16 ("[source control was] left to our Soure Control Experts within BP"); 28 ("This Plan is not - - not about Source Control. This Plan is about how to respond to an oil spill on the surface") ; 63-64 ("This plan - - was not meant to address Source Control…. This plan was written to address response to the oil on the surface of the water"); 68 ("I don't know where [the source control] plan is…I did not see the plan"); 100; 106.

[7] Deposition Testimony of Andy Inglis ("Inglis Dep.") at 148-149.

[8] TREX 769 at Section 6(c).

[9] Deposition Testimony of Richard Lynch ("Lynch Dep.") at 183-184 ("No I didn't have a plan."); Holt Dep. at 64 ("To my knowledge, the only tools that were in place, the only plans that were in place by BP and the industry was drilling a relief well."); Wellings Dep. at 53-54 (The plan to drill a relief well was "the only plan that I'm aware of.").

[10] Deposition Testimony of Tony Hayward ("Hayward Dep.") at 255.

[11] *Id.* at 254-55 ("the ability to intervene in the subsea was not in any way, shape or form complete.").

Deepwater Horizon drilled BP's Tiber well, and set a world record in the process. The Tiber well -- *the deepest oil and gas well ever* -- was drilled to a vertical depth of 35,050 feet in 4130 feet of water.[12]

Long before the record setting Tiber well was drilled or the Macondo blowout, a Joint Industry Study ("DEA-63") (1991) detailed in depth the risks of a deepwater blowout and procedures that may be useful to stop such an event.[13] In 1998, the International Association of Drilling Contractors warned industry that "the consequences which result from a sustained blowout in a deepwater environment will be far-reaching and could, conceivably, have a lasting impact on public perception."[14] The International Association of Drilling Contractors stated, "[t]herefore, the identification of potential hazards and the development of a systematic response have rightfully become an essential element in sound business practice. The methodology associated with this hazard identification and response strategy formulation is often referred to as the Blowout Contingency Plan."[15] A Blowout Contingency Plan is called for that addresses source control and details "the equipment and services likely to be required in the event of a major deepwater blowout."[16] The Blowout Contingency Plan needs to recognize equipment capability issues and vertical intervention methods for source control.[17]

BP had no well Blowout Contingency Plan for the Macondo well (or any Gulf of Mexico well for that matter) and had no readily available equipment to respond to a deepwater blowout.[18] Nor had they ever rehearsed or otherwise conducted drills with their well teams and crews on how to respond once a BOP fails to control a deepwater blowout.[19] BP kept drilling without a source control plan and without any research and

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[12] *Deepwater Horizon Drills World's Deepest Oil & Gas Well*, http://www.deepwater.com/fw/main/IDeepwater-Horizon-i-Drills-Worlds-Deepest-Oil-and-Gas-Well-419C151.html.

[13] Joint Industry Program for Floating Vessel Blowout Control, DEA-63 (1991) ("DEA-63"); Drilling Engineers Association, MMS Report No. 150AA.

[14] TREX 7353 at 4-9.

[15] *Id.*

[16] *Id.* at 4-17.

[17] *Id.* at 4-28 ("Equipment compatibility issues need immediate attention. Manufacturers currently do not have standards for equipment compatibility. This could prove to be a major stumbling block in developing sound procedures for handling deepwater events. Items such as wellhead equipment are unique by manufacturer and can have long delivery lead times.").

[18] Lynch Dep. at 183-184 ("Q. You didn't have a plan for this kind of scenario, did you? A. This type of scenario was something new and different to our entire industry. So, no, I did not have a plan."); 201 ("Q. Do you believe you had the tools necessary in your possession to deal with capping this well on April 23rd, or did you have to come up with something? A. Because of the scenario, we had to create tools to do that.").

[19] Bush Dep. at 19-20; Wellings Dep. at 82 ("Q. In any of the well-control training you had prior to Macondo, did any of that well-control training address a situation like Macondo where you had a failed BOP, other than drill a relief well? A. No. The well-control training we had did not address the Macondo-type situation."); Morrison Dep. at 87 ("Q. Did these drills, at least the ones you participated

development of a source control program. BP knew that "industry has extended delivery schedules that make auxiliary equipment such as ram preventers and subsurface equipment a scarce commodity."[20] BP did nothing from 1998 to 2010 to remedy this known issue.

In 2004, a study conducted by Texas A&M, *et al.*, called attention to the need for further source control research and development.[21] The premise for the project was to assume that well control efforts have failed for whatever reason and explore the various failure scenarios to determine whether primary well control can be recovered using presently-available tools and techniques. The study found that "in failure scenarios where there has been a catastrophic failure either of the surface equipment, the wellhead system or high casing, or at almost any point where influx is flowing outside of the blowout preventers, options become very rapidly non-existent." The study warned that "new blowout controls are necessary."[22] Again, BP did nothing in response.

It was not until the worst was realized on April 20, 2010, that BP began to invest time and money into formulating a plan to intervene and stop the flow of oil from a deepwater blowout.[23] Unfortunately, the genesis of that plan was reactionary and developed as the Macondo crisis unfolded,[24] and poor decisions were made during its evolution.[25] BP failed to meet the standard of care for Process Safety Management. Had BP met the standard of care regarding Process Safety Management source control obligations for the past several decades, the harm to the Gulf Coast could have been substantially

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in, ever involve deepwater blowouts? A. No."); Deposition Testimony of Mark Patteson at 66-67 ("Q. You didn't drill on how to shut in a blown out deepwater well, did you? A. We - - in my experience, we never conducted a full-fledged drill on a well that was flowing."); Deposition Testimony of James Rohloff ("Rohloff Dep.") at 106.

[20] TREX 7353.

[21] "Modeling Ultra-Deepwater Blowouts and Dynamic Kills and the Resulting Blowout Control Best Practice Recommendations, Final Project Report – Phase One Prepared for the Minerals Management Service Under the MMS/OTRC Cooperative Research Agreement, 1435-01-99-CA-31003 Task Order 18132 Project Number 408, December 2004.

[22] Modeling Ultra-Deepwater Blowouts and Dynamic Kills and the Resulting Blowout Control Best Practices Recommendations, SPE/IADC 92626, presented 23-25 February 2005.

[23] TREX 9104; Inglis Dep. at 162 ("A. In terms of - - containment activities, that wasn't part of the plan. I think money was spent on the surface with companies like MSRC, but I think in terms of actual containment activities as you describe them, there wasn't any research going on. Q. Meaning zero dollars? A. Zero dollars."); McKay Dep. at 64-65 ("Q. So if I understand what you're saying, the Macondo incident ended up being a very large research and development project for BP? A. The incident was difficult, and it was multifaceted. So there was - - there was technology that was developed through the incident.").

[24] Holt Dep. at 44 ("Q. At the end of the day, BP was essentially creating plans on how to kill this well, true? A. Yes."); Deposition Testimony of Lars Herbst ("Herbst Dep.") at 315 ("Q. You would agree with me that it would have been a good idea to have thought about how to do this before the incident happened, correct? A. I would agree with that."); TREX 5051.

[25] Phase II Expert Report of Gregg Perkin (March 22, 2013).

reduced and the Macondo Well most likely would have been shut-in much sooner – perhaps within a matter of weeks rather than a period of 87 days.[26]

This report examines the factual basis for BP's failures; namely, the Process Safety Management failures that are part of the response to the Macondo well disaster. Moreover, the deductions reached and opinions expressed herein are linked to my previously submitted expert report. To the extent the factual findings, reliance materials and opinions offered in my Phase 1 Report are material here, I incorporate them by reference. The focus of this report is specifically on "source control" and how BP Management's failures to implement Fit-For-Purpose mitigation barriers, and refusal to heed lessons learned from previous industry and BP Process Safety Management failures, caused the Macondo blowout to evolve into the biggest oil spill in U.S. history.

My investigation concludes that BP Management failed in their obligations to properly prepare for an uncontrolled deepwater blowout. BP Management failed to properly develop and implement appropriate Process Safety Management processes given the recognized hazards associated with an exploratory deepwater well blowout. BP Management was keenly aware that an uncontrolled blowout was a foreseeable and a foreseen event with a high consequence risk. BP Management knew that Gulf of Mexico deepwater operations imposed additional well control risks that demanded proper contingency planning.[27] BP Management knew the importance of immediately controlling the source of a spill given the enormous consequences that would result from a sustained, uncontrolled deepwater blowout with a worst-case scenario of 162,000 barrels per day. BP de-emphasized and failed to appropriately consider the high consequence risk of a well blowout and to implement appropriate mitigation controls.

BP Management's Process Safety Management pre-incident and post-blowout mitigation failings allowed the consequences of a high risk event (uncontrolled blowout) to go unmitigated. The fundamental BP Management Process Safety Management deficiencies that failed to prevent the Macondo blowout discussed in Phase 1 also failed to effectively mitigate the Macondo blowout and properly manage the consequences. BP Management chose to ignore the well known Process Safety Management adage, "*When we fail to prepare, we prepare to fail*," with devastating results.[28]

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[26] TREX 9564; TREX 9345; TREX 5359; TREX 5059; Hayward Dep. at 474 ("you would have to believe that the ability to stop the well flowing would be achieved faster than we were able to in this case"); Holt Dep. at 622-623 ("Having some of that work done and having a plan, as I agreed to, having a plan ahead of time would have made this easier to do.... Having a plan, having some equipment in place could have made a difference in this response.").

[27] TREX 11400.

[28] Salka, John, The Engine Company, Fire Engineering Books, The PennWell Corporation, 2009.

Section 1. Process Safety Management: Mitigation Barriers

The universal goal of Process Safety Management is to prevent and mitigate major accidents involving the release of hazardous materials such as flammable liquids and gases (Figure 1).[29] Process Safety Management is composed of two major parts: Prevention and Mitigation.

Prevention is focused primarily on assessment and management of the 'likelihoods' (probability) of a major system failure (Figure 2). Mitigation is focused primarily on assessment and management of the 'consequences' (short and long term, on and off site) associated with a major system failure. This report focuses on BP's improper reliance on prevention measures and the absence of appropriate mitigation barriers.

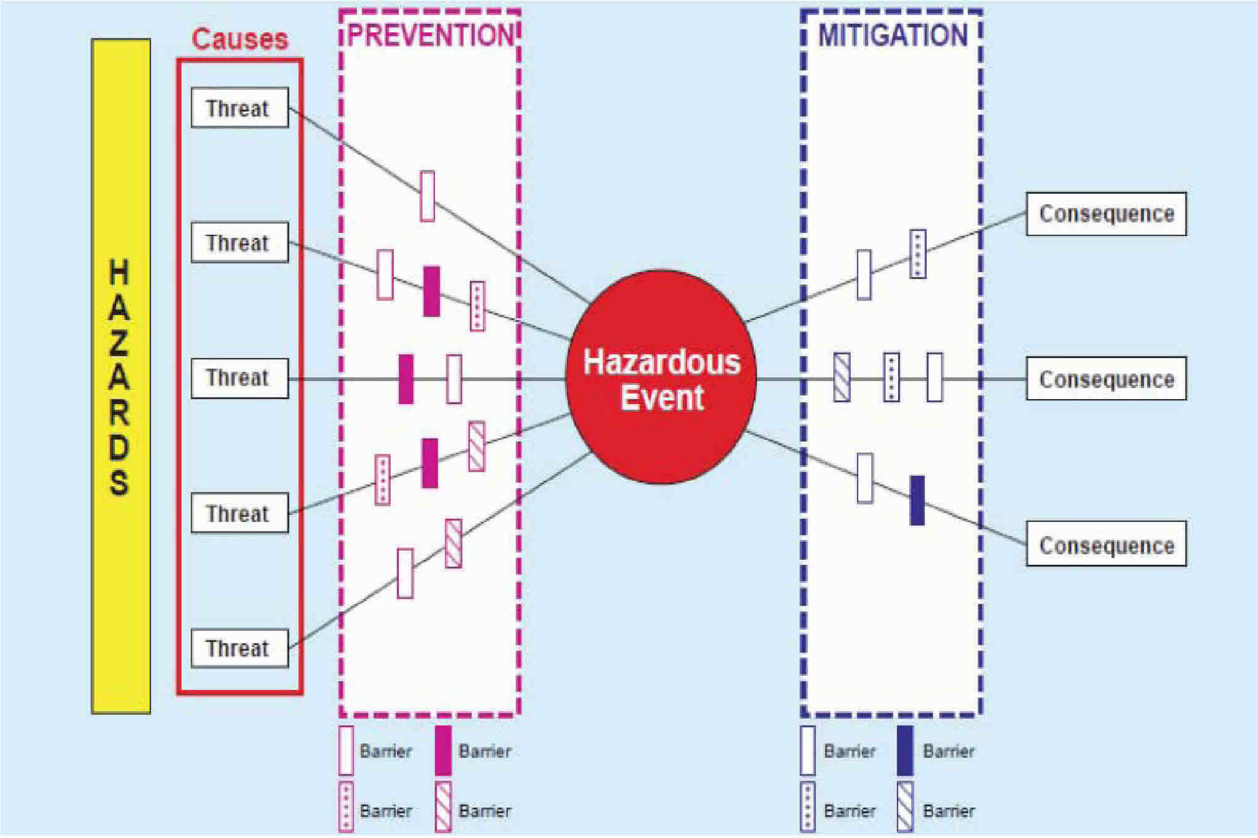

Figure 1: Process Safety Prevention and Mitigation Barriers (Herbst 2011)[30]

[29] Process Safety Management is known also as Integrity Management, System Reliability, System Risk Assessment & Management, and in BP as the Operating Management System and Major Accident Risk Analysis.

[30] Deepwater Horizon Lessons Learned on Containment, by Lars Herbst, BOEMRE GULF OF MEXICO Regional Director, April 18, 2011 at 2.

As indicated in Figure 2, systems having **higher potential consequences require lower likelihoods of failure**. The goal of Process Safety Management during the life-cycle of an engineered system is to manage, engineer, construct, operate, and maintain the 'System' so it has acceptable performance and Quality characteristics, i.e., to design and maintain an engineered system that is 'Fit-For-Purpose' during its life-cycle.[31]

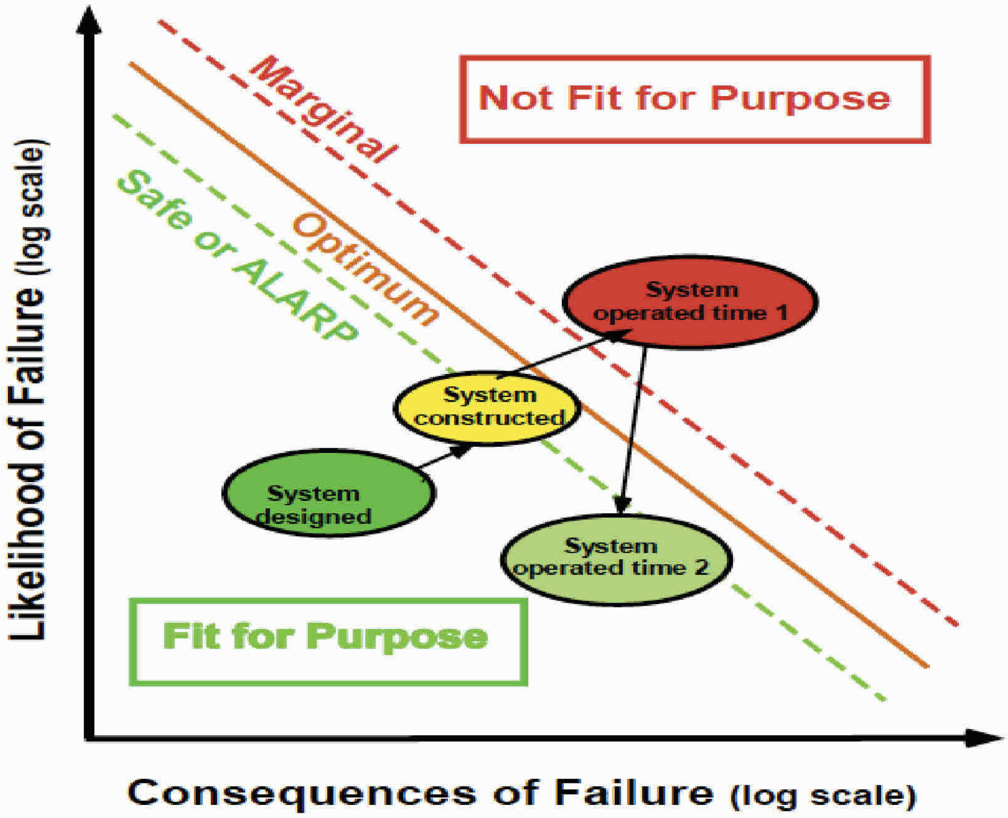

Figure 2: Process Safety Management Assessment and Management of Likelihoods and Consequences of Failures to assure that Systems are 'Fit-For-Purpose,' e.g., 'Safe' (where the risks are deemed As-Low-As-Reasonably-Practicable).

The goal of Process Safety Management Prevention and Mitigation processes is to assure that the likelihoods and consequences of a major system failure are 'Acceptable' or 'As Low as Reasonably Practicable' (Figure 3) during the life of a system. The As Low As Reasonably Practicable region is developed from a collaborative process involving industry

[31] The term 'System' addresses the Interconnected, Interactive, and Interdependent components that include Operating Teams (daily responsibilities for performing the life-cycle activities of the System), Organizations (management and leadership, planning, organizing, leading and controlling determining means, methods, goals, objectives, guidelines, required Protection and Production and Quality characteristics), Procedures (formal, informal, computer based), Equipment (life support, electronic, hydraulic, optical, communications, etc), Structures (elements providing physical support and protection), Environments (internal, external, social), and Interfaces among the foregoing.

(representing stockholder and commercial interests) and government (representing the general public and environmental interests).[32]

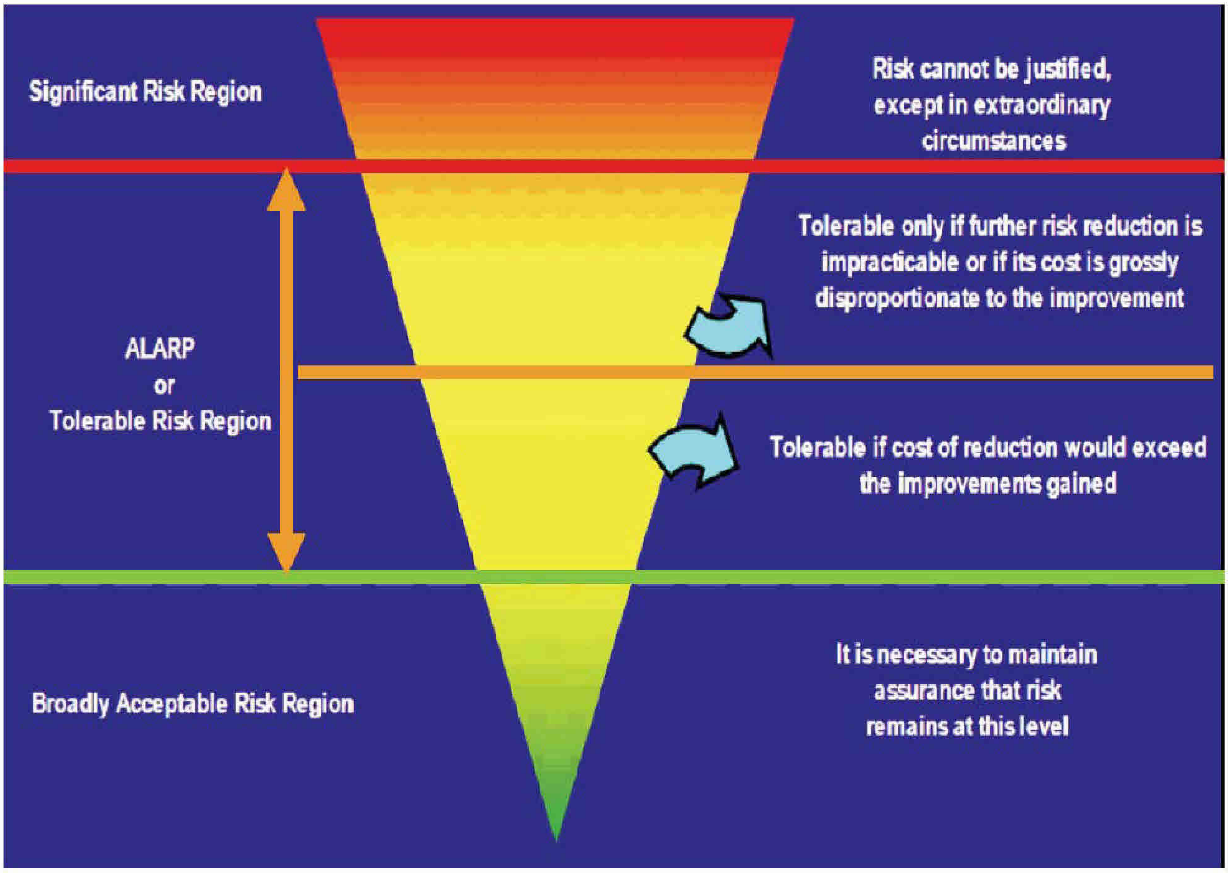

Figure 3: The Process Safety Management As Low As Reasonably Practicable Tolerable Risk Region.[33]

Three general approaches have been used to define the As Low As Reasonably Practicable region: Cost-Benefit economic analyses, Historic Precedents analyses, and Standards of Care (Standards of Practice) analyses.[34] Through Historic Precedents and Standards of Care decisions, the law serves as an important instrument to encourage acceptable assessment and management of system risks.

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[32] D.N.D. Hartford, Legal Framework Considerations in the Development of Risk Acceptance Criteria, Structural Safety, Vol. 31, 2009, Elsevier Publishers; Edward Wenk, Jr., How Safe is Safe? Coping with Mother Nature, Human Nature and Technology's Unintended Consequences, Center for Catastrophic Risk Management, Deepwater Horizon Study Group Working Paper, Jan. 2011, http://ccrm.berkeley.edu/deepwaterhorizonstudygroup/dhsg_resources.shtml.

[33] A Probabilistic Approach to Risk Assessment of Managed Pressure Drilling in Offshore Applications, U.S. Minerals Management Service Technology Assessment and Research Study 582, Final Report 31 October 2008, Mohr Engineering Division of Stress Engineering Services, Houston, Texas.

[34] R. Bea, Quality Goals: Acceptable Reliability and Risk, Center for Catastrophic Risk Management, University of California Berkeley, 2003.

Currently, a Joint Industry – Government sponsored development project is addressing "Blowout Risk Assessment."[35] The Project is sponsored by the United States Department of Interior, Bureau of Safety and Environmental Enforcement, and sixteen (16) oil and gas exploration and production companies, including BP. It is developing a risk assessment tool to evaluate the risks related to well design and operations in the Gulf of Mexico. The Project is addressing three key areas: design and planning, execution in the field, and blowout source control and collection. The Project includes a 'comparative risk assessment' model that compares the blowout risks assessed for a specific well with other overall risks that have been "deemed to be acceptable" (Figure 4).

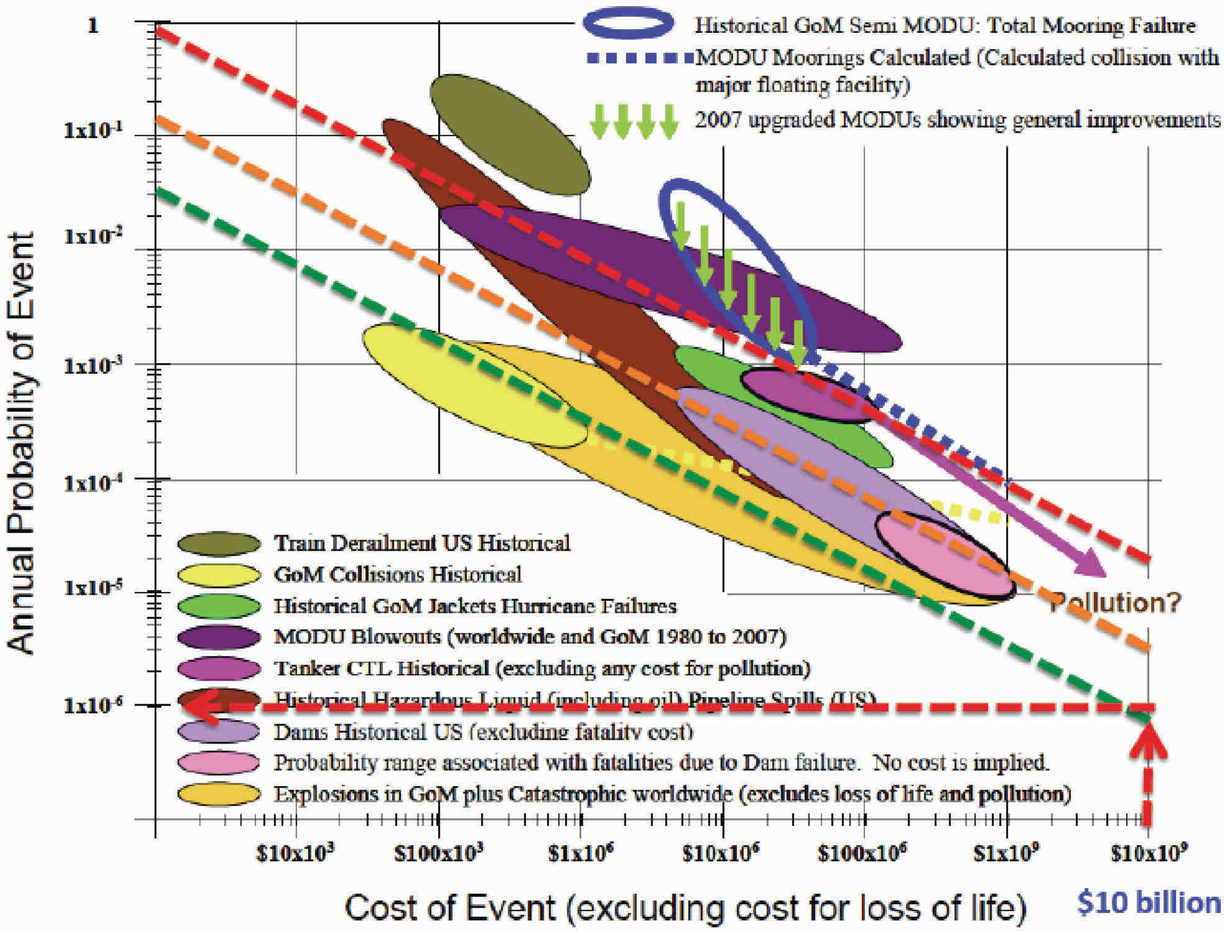

Figure 4: Blowout Risk Assessment "risks that have been deemed to be acceptable."[36]

This 'Fitness-For-Purpose' assessment guideline provides quantified expressions of "acceptable" combinations of the likelihoods (annual probabilities) and consequences (expressed in 2011 U.S. dollars excluding costs for losses of human life) of risks associated with a variety of offshore and onshore hazardous systems. For example, if the costs associated

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[35] Blowout Risk Assessment, Joint Industry Project, Delmar Engineering, Houston, TX, https://web-server-1.delmarus.com/Engineering/Joint%20Industry%20Projects/borajip.html.

[36] *Id.* at 8.

with a blowout are estimated to exceed U.S. $10 billion, the 'acceptable' (As Low As Reasonably Practicable) annual probability of such events are indicated to be less than $1x10^{-6}$ (1/1 million) per year.

The annual probability of failure is substantially greater for 'traditional shallow water' operations in the Gulf of Mexico (Figure 4, $1x10^{-2}$ to $1x10^{-3}$ per year). The primary reason for this difference is related to the magnitude of consequences associated with major system failures.

In shallow water, an uncontrolled blowout would not involve hydrocarbon reservoirs and wells that could produce 100,000 to 300,000 barrels of oil per day and take 100 to 150 days to stop using a relief well. The 'non-traditional' wells drilled recently in the deepwaters of the Gulf of Mexico have potential consequences that are significantly greater than those previously confronted in shallow water. The higher consequences of an uncontrolled deepwater blowout therefore require substantially lower likelihoods to be deemed an acceptable risk. Reaching this risk target of acceptability requires being able to effectively and rapidly stop uncontrolled blowouts involving wells drilled into these high productivity High Temperature – High Pressure reservoirs – not relying on relief wells taking 100 to 150 days to complete to stop the blowout.

Cost – Benefit economic analyses of the As Low As Reasonably Practicable or Tolerable Risk Region incorporate proper recognition of short and long term, direct and indirect present valued, and likelihood weighted future costs, including the invested costs, to avoid damages and injuries to the environment, resources, people, and productivity (Figure 5). Comprehensive Cost – Benefit analyses can provide very useful information to inform management decision-making to avoid the 'traps' of excessive cost reductions (cost cutting, excessive efficiencies) that result in unacceptable reductions in system robustness (damage and defect tolerance), and 'Quality'

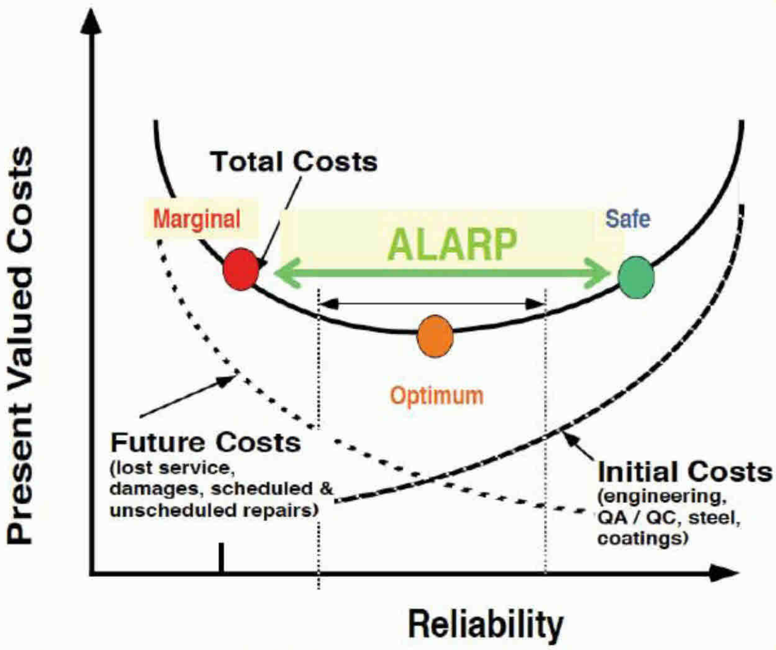

Figure 5: Cost – Benefit economics evaluations of the As Low As Reasonably Practicable range of system reliability (likelihood of realizing desirable system Quality performance characteristics).

Protection, Mitigation and reliability.[37]

If for some reason during its life-cycle the system 'migrates' into the Not-Fit-For-Purpose risk region as illustrated in Figure 2, it is incumbent on the system owner – operator to stop and return the system to the Fit–For-Purpose or Tolerable Risk Region "as quickly as possible" before continuing operations (Figure 6).[38] Operations ought to be suspended if it is determined that the risks are above the maximum acceptable risk level.

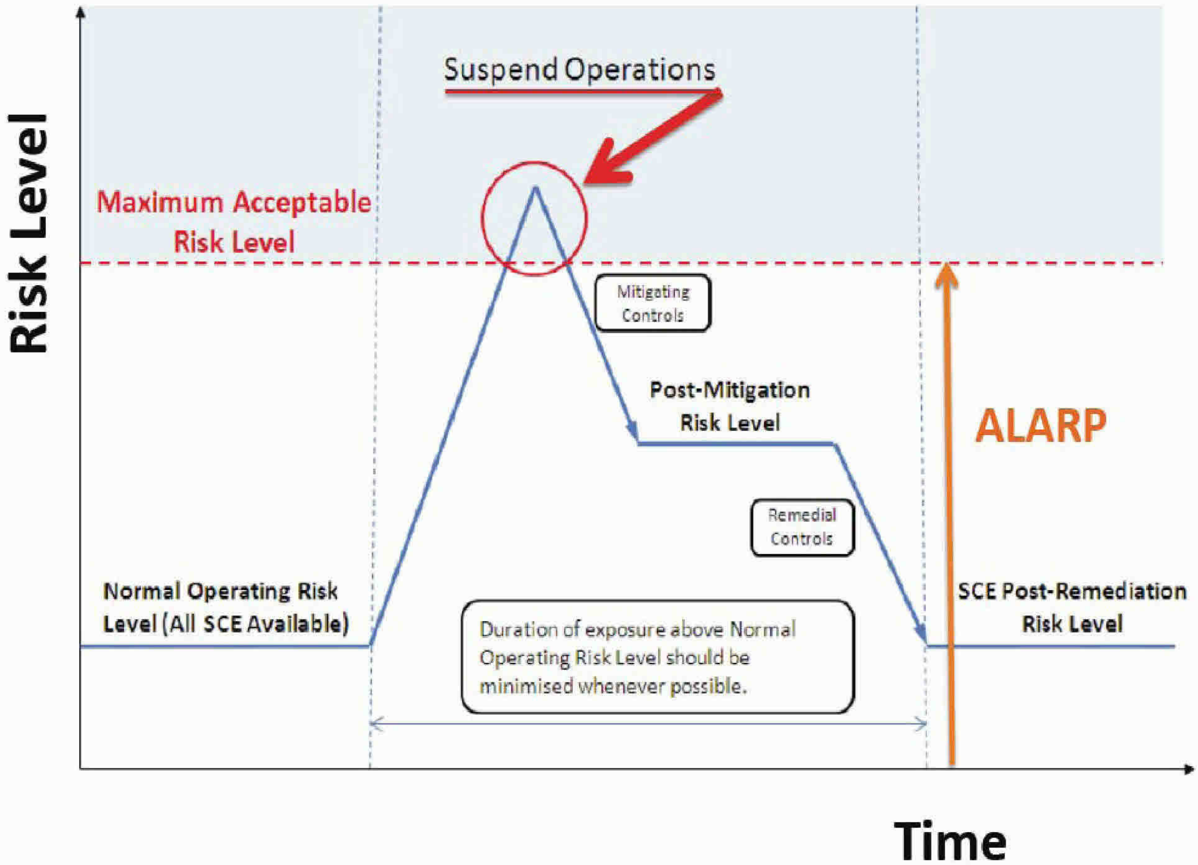

Figure 6: Returning the system to an acceptable risk level after it is determined the risks exceed the maximum acceptable level.

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[37] Quality of the system results from the combination of Serviceability (fitness for intended purposes), Safety (freedom from undue exposure to injury and harm), Compatibility (meets environmental, social, governmental, and industrial requirements), and Durability (freedom from unexpected degradations in Quality). This definition of system performance requirements is intended to make potentially conflicting system performance characteristics explicit so they can be addressed in balanced ways. R. Bea, "Design for Reliability: Human and Organizational Factors," Ch. X, *Handbook of Offshore Engineering*, S. Chakrabarti (Ed.), Elsevier Ltd. 2005.

[38] The return to the Tolerable Risk Region is accomplished fundamentally by lowering the likelihoods and consequences of major system failures through the use of effective Proactive, Reactive, and Interactive Prevention and Mitigation Process Safety Management processes.

In BP Management's case, the management policy is that risks may be deemed acceptable if they are too expensive to mitigate or eliminate.[39] In other words, if it costs too much, upper management is willing to take the risk while the system is being managed to obtain lower risks – if the rewards are great enough. From a Process Safety Management perspective, it is clear that this BP Management policy encourages excessive, [redacted] risk taking for prolonged periods of time. It was BP Management Policy to focus solely on Prevention barriers and attempt "to reduce the probability of occurrence, rather than to properly mitigate the consequences."[40]

Process Safety Management Prevention and Mitigation Response 'barriers' (Figure 7) include Proactive (performed before activities), Interactive (performed during activities), and Reactive (performed after activities) approaches to identify, manage, and control system failure likelihoods and consequences.[41] These barriers are intended to be fully integrated and implemented throughout the entire life (concept development through decommissioning) of a system. These 'barriers' are based on three fundamental strategies: 1) reduce the likelihoods of failures (addressed in Phase 1 Report), 2) reduce the consequences of failures (addressed in this Report), and 3) increase the proper detection, analysis, and correction of escalation risks and developing failures (addressed in Phase 1 and Phase 2 Reports).

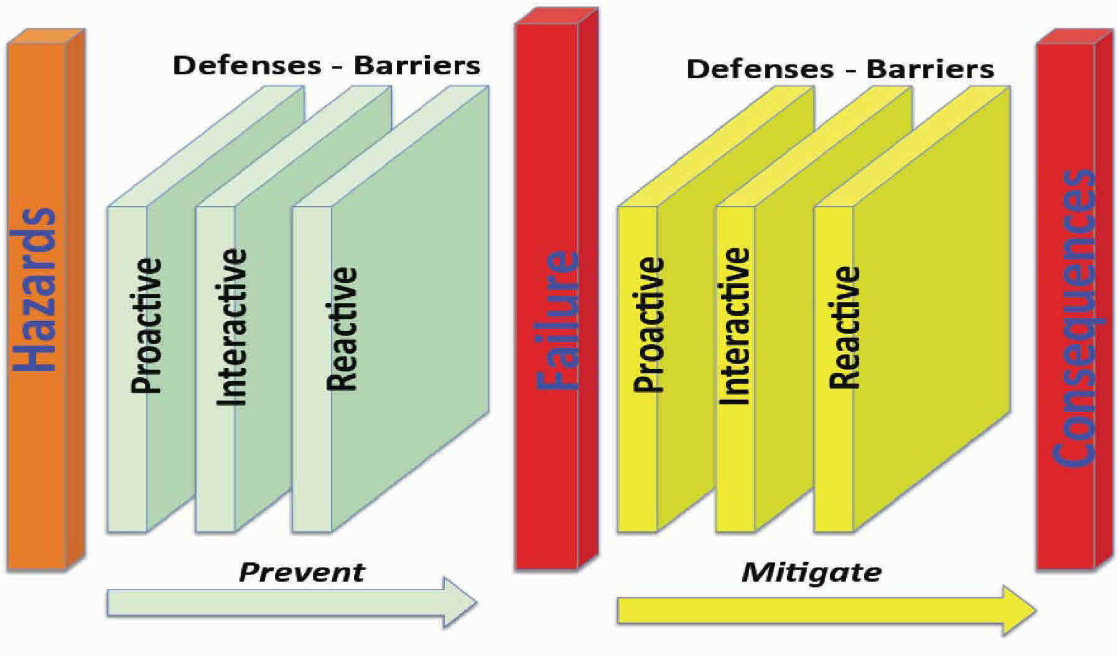

Figure 7: Failure Prevention Barriers and Consequence Mitigation Barriers.

In the case of an uncontrolled blowout associated with an exploratory deepwater well, the consequence barriers can be grouped into those associated with two primary categories

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[39] BP Gulf of Mexico SPU Drilling, Drilling Risk Management Plan, § 3.5, Mitigation, see BP-HZN-2179MDL01334280-1334300 at 12.

[40] *Id.* at BP-HZN-2179MDLO1334291.

[41] *Id.* at BP-HZN-2179MDL01334232 at 1334250.

of controls: 1) source controls, and 2) discharge controls. This report addresses the post blowout 'source control' issues and the absence of barriers put in place to mitigate the consequences of system failure.

The role of Process Safety Management 'Prevention and Mitigation Barriers' during the development of a system failure is illustrated in Figure 8. The barriers are intended to stop hazardous activities from developing disaster causation 'Spears' that penetrate or defeat the Prevention and Mitigation Barriers. The barrier 'Holes' (defects and deficiencies in the Process Safety Management) are created by Active Activities, such as unsafe operator acts, and by Latent Activities, such as undetected defects embedded in the system during hazardous activities. Active holes are developed by the system 'operators' who work at the 'sharp end' of the Disaster Spear. Latent holes are developed by the system's responsible organization 'management' components distributed along the 'shaft' (blunt end) of the activity Disaster Spear.

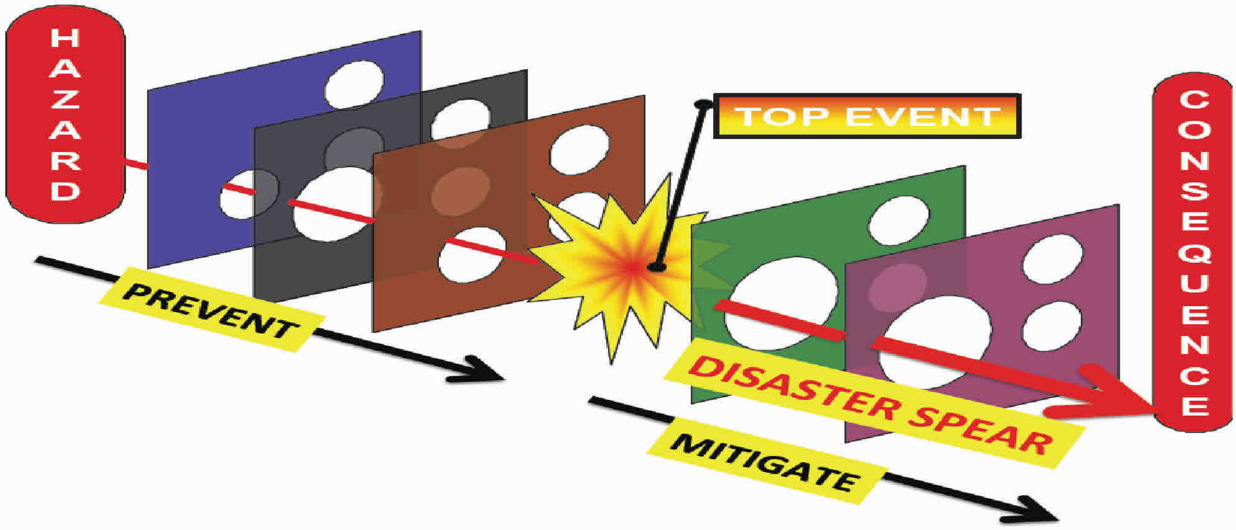

Figure 8: Defective Prevention and Mitigation Barriers allow Disaster Spear penetration to cause major system disasters.

The numbers, sizes, and alignment of barrier holes are determined primarily by organizational management Latent Activities (e.g. developing unresolved conflicting goals such as "Better, Faster, Cheaper").[42] The 'energy' required for the disaster spear to penetrate the aligned barrier defects is provided by system's responsible organizational management, i.e., systemic malfunctions in the management organization. It is for this reason that major system failures, accidents and disasters are called "Organizational Accidents."[43] Latent Activities are founded in lack of sufficient organizational management Process Safety Management Cognizance (of major system accident risks), lack of Commitment and Capabilities (to properly assess and manage major accident risks), dysfunctional safety

[42] Columbia Accident Investigation Board Report, Aug. 2003, Government Printing Office, Wash. D.C.

[43] J. Reason, *Managing the Risks of Organizational Accidents,* Ashgate Publishers, 1997.

Cultures (providing inadequate Protection for Production), and absence of Counting (providing valid and validated quantified assessments of short and long term costs and benefits).

The 'Top Event' (sometimes referred to as the Initiating Event or Failure Event) is shown in Figures 7 and 8 as having barriers on both sides. If prevention barriers fail, then it is essential to have in place barriers that will counteract and control (mitigate) the failure. These counter measures address aspects of vital importance in responding to the Top Event in an effective manner. For example, mitigation barrier considerations address the system's vulnerability to escalation from a loss of containment event and seek to 'harden' the system's tolerance to such events, such as increasing structural or thermal robustness by providing redundancy, resilience, and similar means of increased capacity to counter failure consequences. The mitigation barriers must be Fit-For-Purpose. In the case of Macondo, a vital but overlooked mitigation barrier was emergency response planning and source control.

As shown in Figure 9, BP Management considered that their Key Mitigations for Loss of Well Control primarily were based on BP's Deepwater Operations Plan and regulatory compliance and training.[44] These are, of course, vitally important aspects of process safety aimed at preventing a blowout. Note, however, the passing mention of contingency plans as a part of the Capital Value Process for well delivery and Deepwater Operations Plan, done with a *check-the-box pro forma* mentality. BP Management checked the box but refused to take any meaningful contingency mitigation measures to manage the source control risk. This problem was identified by Gulf of Mexico SPU Vice President Kevin Lacy in the 2010 Process Safety Planning presentation (Jan. 12, 2010) in which he notes under problem statement:

> "...it's become apparent that process safety major hazards & 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." "...the identification and management of hazards is not being performed consistently well throughout this SPU." And noting that this lack of understanding has led to "...[C]onsidering loss of containment incidents as minor environmental events and overlooking the potentially serious process safety consequences."[45]

[redacted]

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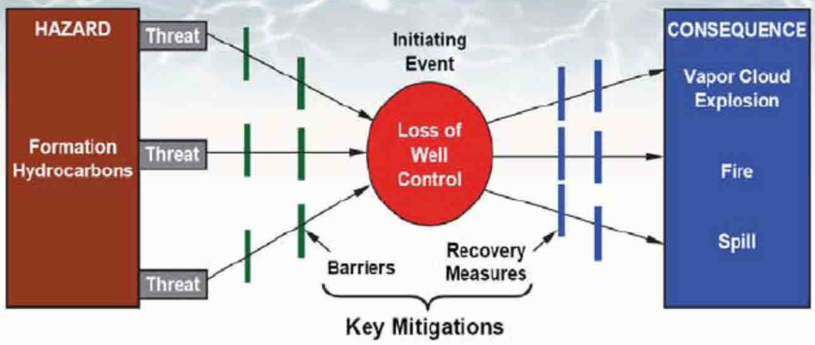
[44] TREX 7352; TREX 2200.

[45] TREX 2919.

[46] TREX 296-1; TREX 4147.

[redacted]

Risk #1 - Loss of Well Control



Key Mitigation	Accountability	Comment	Status
Follow DWOP requirements & MMS regulations with regular testing & inspection	Diehl - Drilling	MMS BOP pressure and function testing requirements in place	☑
	Porter - Wells	MMS SSSV function testing requirements in place	☑
Casing design & well control standards and contingency plans in place	Leary/Little	Part of CVP for Well Delivery and DWOP	☑
Drilling staff resourcing and development plans	Wise	Mandatory MMS "Subpart O - Well Control Training Plan" in place	☑
Contractor selection and training	Leary/Little	MMS requirement for well control certification for drilling personnel in place	☑
EPTG & peer review of drilling/completion plans and designs	Leary/Little	Covered in CVP process for Well Delivery	☑

Integrity Management
Reducing Risk in GoM

Figure 9: BP's Key Mitigations for Loss of Well Control[48]

[47] Deposition Testimony of Kalwant Jassal ("Jassal Dep.") at 284-289 ("Q. Okay. You say "Well Control," following it down to "PP/FG uncertainty," and down to "Lost Circulation," all of the potential risks that might be involved, y'all get down to "Zonal Isolation." And as I read it the "Actions" called for -- there are no "Actions" called for with regard to any of these risks. The "Impact" on all but a couple of them, or a few of them, is listed as "Cost." Am I correct in that, sir? A. Yes."); TREX 296-1.
[48] BP-HZN-2179MDL01563657-1563691 at 30.

Section 2: BP Management Identified Deepwater Blowouts as a High Risk, High Consequence Event

BP Management understood that drilling a deepwater well like Macondo was a high risk and dangerous venture that was not As Low As Reasonably Practicable.[49] BP knew that a deepwater blowout was BP's highest risk in the Gulf of Mexico.[50] The nature of this high consequence risk obligated BP Management to provide Process Safety Management Mitigation controls in the event this known risk was realized. BP Management chose to plan nothing beyond the Oil Spill Response Plan.[51] Acceptable and effective Process Safety Management As Low As Reasonably Practicable Mitigation barriers were non-existent.

BP Management did not require proper <u>assessment</u> of the risks associated with source control of an uncontrolled blowout of the Macondo well.

BP's Major Accident Risk Process document identifies the probabilities of experiencing a 'leak' (blowout) during exploratory drilling of a High Pressure–High Temperature well as about 2/1000 per well per year.[52] The 2009 SINTEF blowout frequency study identified a similar blowout frequency as 1/1000 per well or about 4/1000 per well per year.[53] Given that there is approximately a 50% failure rate of the BOP blind shear rams to seal such a well,[54] there would be an uncontrolled blowout frequency of approximately 1/1000 to 2/1000 per well per year.[55] Application of this data to BP's Major Accident Risk Matrix makes the likelihood of the Macondo exploratory well's uncontrolled blowout, and the associated consequences, an 'Unacceptably High Risk' that is 'well above' BP's 'Group Reporting Line,' and that requires BP Management's approval before the system and project can be implemented (Figures 10 and 11).

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[49] TREX 5946.

[50] Morrison Dep. at 227-231 ("Loss of well control is one of the top risks"); Hayward Dep. at 196 ("[Deepwater Blowouts are] one of the highest risks for the corporation. It was the highest risk in the Gulf of Mexico and one of the highest risks for the Exploration and Production Unit."); Inglis Dep. at 125 ("[W]ith respect to deepwater drilling in the Gulf of Mexico two of the major risks are loss of well control and the riser failure and loss of containment.").

[51] Wellings Dep. at 53-54; Holt Dep. at 64 – 65 ("Q. And BP would have obtained that knowledge on how to drill a relief well simply by the fact that it drills wells in the Gulf of Mexico, correct? A. Correct, yeah."); Inglis Dep. at 148-149, 160; Hayward Dep. at 255.

[52] TREX 4152 (BP Group Practice 48-50, Major Accident Risk Process, June 5, 2008, Table C-5 (blowout data from Scandpower) for exploratory High Pressure-High Temperature wells, frequency = 1.7×10^{-3}).

[53] TREX 7192, *SINTEF Report: Deepwater Kicks and BOP Performance*, Holand and Skalle, July 24, 2009; TREX 4156 (Risk Analysis in Offshore Development Projects," SINTEF Report, Norwegian Institute of Technology, Trondheim, Norway, 1983).

[54] TREX 5054.

[55] West Engineering BOP report, 2006, West Shear-Ram BOP Capabilities MMS Study 204-1 and West Engineering MMS Final Report 463; Blow-out Prevention Equipment Reliability Joint Industry Project (Phase I – Subsea), Final Report, West Engineering Services, 15 Jan. 2010; TREX 6299.

Mississippi Canyon Block 252 well

bp

Integrity Management Standard Risk Matrix

Major Accident Risk MAR

Health and Safety	Health and Safety - 3rd Parties	Environmental Impact	Financial Loss	Reputation	Severity Level	Possible, but not known to have occurred in the E&P Industry ($<10^{-6}$ / yr)	Has not occurred in the E&P Industry (10^{-6} to 10^{-5} / yr)	Has not occurred in the E&P Industry in the last 10 years (10^{-5} to 10^{-4} / yr)	Occurs once in 100 facility lifetimes (10^{-4} to 10^{-3} / yr)	Occurs once in 10 facility lifetimes (10^{-3} to 10^{-2} / yr)	Occurs once in the facility lifetime (10^{-2} to 10^{-1} / yr)	Occurs once, or more, every 5 years (10^{-1} to 1 / yr)	Occurs more than 5 times a year > 1 / yr
						1	2	3	4	5	6	7	8
>200 acute or chronic (actual or alleged) fatalities	>50 acute or chronic (actual or alleged) fatalities	>100,000 bbls of oil in sensitive coastal waters; >1,000,000 bbls of oil in other coastal waters. Prolonged regional/global contamination	>$10 billion	Global outrage, global brand damage and/or affecting international legislation.	A	MEDIUM	HIGH	HIGH	HIGH	HIGH	HIGH	HIGH	HIGH
>50 acute or chronic (actual or alleged) fatalities)	>10 acute or chronic (actual or alleged) fatalities	>10,000 bbls of oil in sensitive coastal waters. >100,000 bbls of oil in other coastal waters. Short term damage at regional level. Prolonged contamination affecting extensive nature conservation	$1-10 billion	International media coverage. Regional outrage, for example North America, Europe. Regional brand damage. Likely to lead to change of regulations at regional level.	B	MEDIUM	MEDIUM	HIGH	HIGH	HIGH	HIGH	HIGH	HIGH
>10 acute or chronic (actual or alleged) fatalities)	1 or more acute or chronic (actual or alleged) fatalities. Multiple permanent injuries or irreversible health effects	>10,000 bbls Oil, >1,000 bbls oil in sensitive area, >100 Te of classified material. Long Term damage affecting extensive area.	$100 million - $1 billion	Regional media coverage or severe national outrage. Threat of, or loss of license to operate for affected business/site. Likely to lead to change of regulations an National level.	C	LOW	MEDIUM	MEDIUM	HIGH	HIGH	HIGH	HIGH	HIGH
1 or more acute or chronic (actual or alleged) fatalities. Multiple permanent injuries or irreversible health effects.	Permanent injury or irreversible health effect affecting single person. Non permanent injuries or short term health effects affecting multiple people	Uncontained release of reportable quantity e.g. >100 bbls oil, less if in sensitive location or >10 Te classified material). Extensive short term pollution/contamination. Prolonged pollution/contamination affecting limited area.	$10 to $100 million	National media attention or sever local outrage. Prosecution by regulator.	D	LOW	LOW	MEDIUM	MEDIUM	HIGH	HIGH	HIGH	HIGH
One or more permanent / disabling injuries	One or more serious injuries requiring medical care beyond first response.	Release offsite with immediate remediation or onsite release with prolonged damage.	$1 to $10 million	State media coverage	E	LOW	LOW	LOW	MEDIUM	MEDIUM	HIGH	HIGH	HIGH
One or more loss time injuries	One or more minor injuries.	Onsite release that is remediated immediately	$100,000 to $1 million	Local media coverage	F	[illegible]	[illegible]	[illegible]	[illegible]W	MEDIUM	MEDUM	HIGH	HIGH
One or more first aid injuries	No offsite impacts	Contained onsite release.	<$100,000	No community notification	G	LOW	LOW	LOW	LOW	LOW	MEDUM	MEDIUM	HIGH

Approval Levels apply to Major Hazards which are contained within this boundary

Figure 10: Major Accident Risk Assessment of a Macondo Well Uncontrolled Blowout.

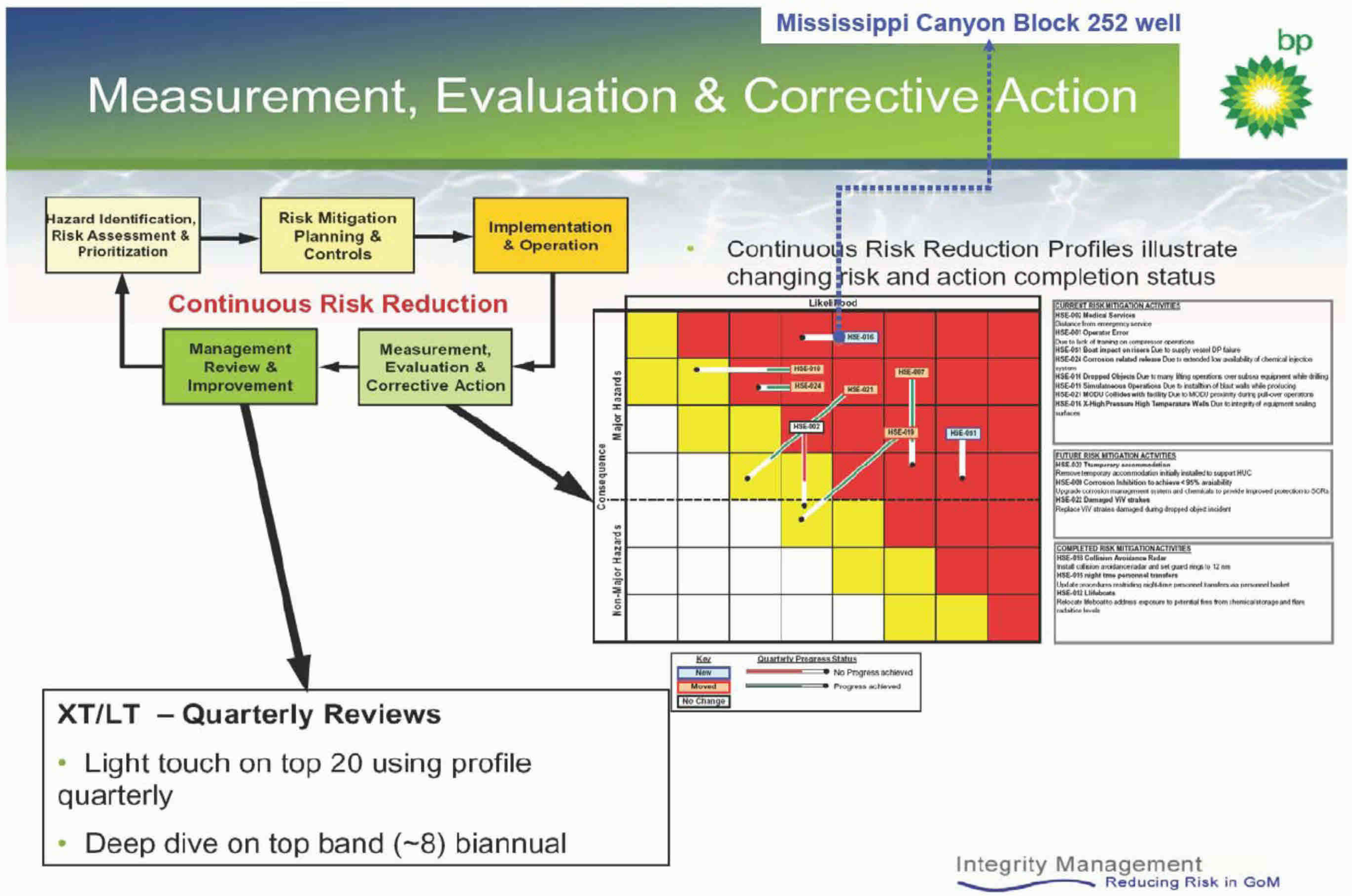

Figure 11: Major Accident Risk Management Policy Above The Group Reporting Line (generally represented by the yellow colored squares).

Figure 12 shows the portion of the actual BP Macondo Risk Register that assessed the likelihood (probability) and consequences (impacts) of an uncontrolled blowout. The probability was assessed as "Moderate" with "High Manageability" and the consequences as "Cost."[56] Clearly, the sole consequence of "Cost" was not accurate. BP intentionally ignored high consequences in assessing Macondo well system risk and deviated from any reasonable standard of care by knowingly operating outside of Process Safety Management As Low As Reasonably Practicable requirements.

BP's assessments were based on unsubstantiated feelings and beliefs that lacked the rigor of an objective and unbiased risk assessment analysis.[57] The participants had no significant formal training or qualifications in Process Safety Management risk assessment and management of complex systems.[58] The BP Macondo management and drilling team erroneously concluded that there were no significant challenges to safety. And, the so-called Risk Champions in BP's safety management system failed in their responsibilities to ensure risk was being properly managed and that Process Safety Management was in fact more than just intellectual pabulum.[59] Realistic, rigorous Process Safety Management processes and procedures were not performed. The result was a serious compromise of Process Safety Management for the Macondo system. BP Management's inappropriate risk analysis of the Macondo well system allowed operations outside of Process Safety Management As Low As Reasonably Practicable requirements without implementing appropriate Process Safety Management post-blowout source control Mitigation Barriers.

	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**

Figure 12: Macondo risk register excerpts – Well Control Post Response assessments (red highlight added for emphasis).

Process Safety Management requires the proper (valid) assessment of the risks (likelihoods and consequences of major system failures) associated with a system. Assessment of both the likelihoods and consequences of failure must be valid and validated

[56] Deposition Testimony of Cheryl Grounds ("Grounds Dep.") at 108-12; TREX 1741.
[57] TREX 5946 (Phase 1 Report of Dr. Robert G. Bea and Dr. William E. Gale, Jr. (August 26, 2011)).
[58] Grounds Dep. at 96, 190.
[59] Deposition Testimony of Patrick O'Bryan at 250-251.

(using external and internal validation processes). An important Process Safety Management adage is: *One can't Manage what one can't properly Measure.* BP Management did not require development of a valid assessment – proper Measurement of the likelihood and consequences associated with effective source control of an uncontrolled blowout of the Macondo well.

BP Management did not require proper management of the risks associated with source control of an uncontrolled blowout of the Macondo well before the well was drilled.

Process Safety Management requires design, construction, operation, and maintenance of systems that have As Low As Reasonably Practicable Fit-For-Purpose Risks. As shown in Figures 9 and 10, the BP Management Major Accident Risk analysis Risk Matrix does not define an 'unacceptable' or 'Not Fit-For-Purpose' risk region. Rather, risks that fall above the 'Group Reporting Line' are referred to BP Management for decision concerning continuing operations while approved plans are implemented to bring the system to or below the Group Reporting Line.[60] An example Group Reporting Line for environmental impacts contained in the BP Major Accident Risk guidelines is shown in Figure 13.[61]

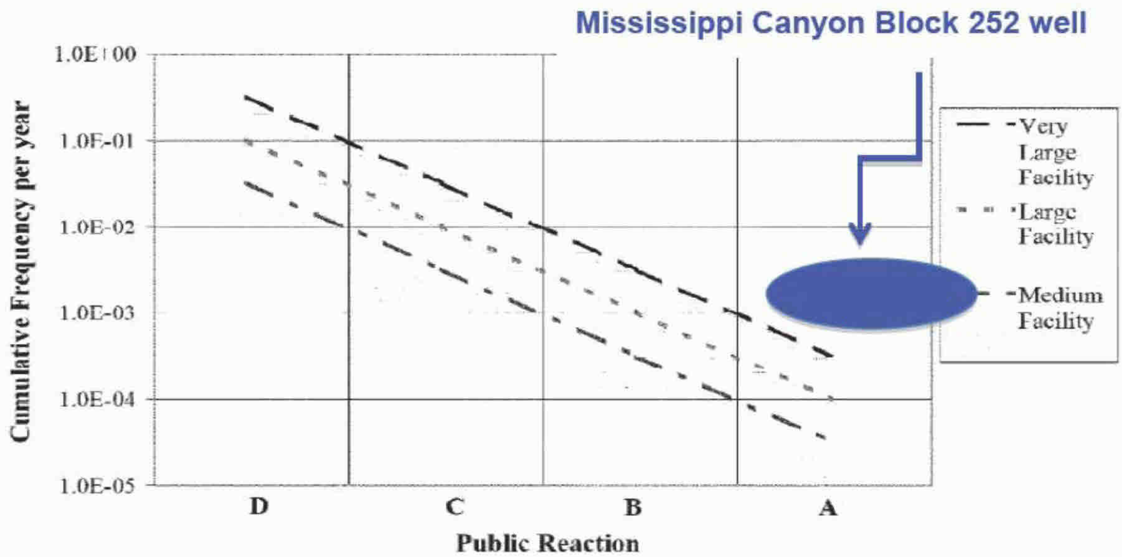

Figure 13: BP Management's Environment Group Reporting Line for Fixed Facilities.

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[60] *Major Accident Risk Process*, GP 48-50, BP Group Engineering Technical Practices, 5 June 2008, BP-HZN-2179MDL00407937.

[61] A = global outrage, greater than 100,000 bbl released in sensitive coastal environment,
B = regional outrage, greater than 10,000 bbl released in sensitive coastal environment,
C = threat of loss of license to operate, greater than 1,000 bbl released in sensitive coastal environment,
D = prosecution by regulator, greater than 100 bbl released in sensitive coastal environment.

In the case of the Macondo well, it is clear that the potential risks before the project was implemented were above the BP Group Reporting Line: The risks were not Fit- For-Purpose or As Low As Reasonably Practicable. BP Management chose to exempt the exploratory drilling project from BP's Operating Management System[62] and Major Accident Analysis. Instead, BP Management chose to use BP's pre-Texas City Beyond the Best[63] risk assessment process performed by BP employees who did not have the required formal risk analysis knowledge and experience. The assessments relied primarily on unsubstantiated feelings, experience founded on earlier successful projects, general experience of the industry associated with shallow water's less hazardous and lower risk operations, and a corporate management culture that encouraged excessive cost cutting and increased production pressures. This combination of factors not only led to dramatic underestimates of the risks associated with a blowout, but they also led to similar dramatic overestimates of BP's abilities to address the source control challenges (Figure 12).

Process Safety Management requires design, construction, operation, and maintenance of systems that have As Low As Reasonably Practicable Fit-For-Purpose Risks during the entire service lives of a system. Process Safety Management requires continuous effective planning, organizing, leading, and controlling processes based on integrated Proactive, Reactive, and Interactive system Risk Assessment and Management approaches that develop effective and acceptable Mitigation Barriers. BP Management did not require effective Proactive, Reactive, and Interactive management of the consequences associated with source control of an uncontrolled blowout of the Macondo well.

BP Management Was Aware of the High Consequences that Could Result from Realization of the Risk of a Blowout.

BP Management was aware of the high consequences that could stem from a failure to implement appropriate mitigation barriers. It knew these consequences were well beyond simply "Cost."

In 1979, a blowout in the Gulf of Mexico put BP on notice that blowouts and loss of well control were a foreseeable risk and the high consequences that could result from a failure to prepare appropriate source control measures:

> "The well blew out, the blowout preventer failed, and the drilling rig caught fire and eventually sank. Oil gushed into the Gulf of Mexico at a staggering rate from the damaged riser that had attached the platform to the well. Nobody knew what to do, although engineers tried various measures to stem the flow, including a containment dome. Chemical dispersants to break up

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[62] TREX 6205 (*E&P OMS* January, January 2009 – Version 2.0); TREX 268 (Gulf of Mexico SPU, Gulf of Mexico Drilling and Completions, *Gulf of Mexico D&C Operating Plan/Local OMS Manual*, November 1, 2009); TREX 866 (Gulf of Mexico SPU Operating Plan (OMS Handbook), December 3, 2008).

[63] TREX 2681 (*Beyond the Best common process*, BP Exploration and Production, Drilling and Completions, June 2006).

the oil were applied at one of the highest rates in history. Some of the oil was trapped well below the Gulf's surface, with undetermined effects. It seemed as though the spill might drag on forever." [64]

The above language describes the Ixtoc I spill in terms eerily similar to Macondo. Like in Macondo, the BOP failed to seal the well and prevent the disaster.[65] The Ixtoc I blowout caused extensive oil spill pollution and shoreline damage for the nearly ten months it took to kill the well. An estimated volume of nearly 140 million gallons of oil were released into the Gulf of Mexico, impacting coastal areas from the southern Gulf all the way to South Texas.

The blowout at Ixtoc I was a wake up call BP failed to heed. BP had ample opportunities to learn from Ixtoc I and to avoid a near repeat of that event with the Macondo disaster. However, BP continued to ignore the high consequences of this risk and implement meaningful source control measures:

> "There appeared to exist a long-standing belief by BP ... the ultimate risk of a deepwater blowout was essentially zero. The fact that a deepwater blowout would be a 'high consequence' event that could have driven response planning prioritization and funding also did not appear to have significant impact on decisions to provide adequate plans and equipment should such a low probability event occur."[66]

The industry did not ignore the event and its implications entirely. Indeed, one outcome of the Ixtoc I incident was that it served to launch research into blowout source control. This post-Ixtoc I work consistently informed BP that deepwater drilling had inherent dangers; that the risk of a blowout was high, especially in deepwater; that technologies already existed for shallower well control but that these technologies needed to be modified for deepwater conditions; and that further research was necessary. One joint industry research project was the 1991 Joint Industry Program for Floating Vessel Blowout Control, DEA-63.[67] DEA-63 offered multiple conclusions on how to mitigate such high consequences. This joint industry report even predicted an event nearly identical to Macondo and suggested the application of known industry technologies like a capping stack or a modified BOP-on-failed BOP.[68] Yet, BP, an industry leader in deepwater drilling, failed to act.[69]

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[64] "The lost legacy of the last great oil spill," Mark Schrope, Scientific American, July 14, 2010, ref. http://www.scientificamerican.com/article.cfm?id=the-lost-legacy-Ixtoc-oil.

[65] TREX 1300; TREX 9099.

[66] TREX 9099.

[67] DEA-63, *supra* note 13.

[68] *Id.* at 7.13.

[69] Deposition Testimony of David Barnett ("Barnett Dep.") at 202 ("Q. Did you see any evidence that that DEA Study was incorporated by BP into BP's Governance Plans before Macondo? A. I couldn't say that I did, no.").

In 1998, the International Association of Drilling Contractors published Deepwater Well Control Guidelines.[70] The guidelines, while intended to be applicable worldwide, focused on the Gulf of Mexico.[71] These guidelines should have served as yet another wake up call for BP to plan for a deepwater blowout. The guidelines stress the importance of having a plan for direct intervention activities that are pursued alongside relief well operations. They make clear that while direct intervention technology exists, it is imperative for deepwater drillers to study vertical intervention scenarios "to allow development of detailed kill plans with contingency plans for problem areas within each scenario."[72] Most importantly, the guidelines point out that "consequences which result from a sustained blowout in a deepwater environment **will** be far-reaching and could, conceivably, have a lasting impact on public perception."[73] The guidelines re-emphasized the exact strategies discussed in DEA-63 without action by BP.[74]

In 1999, a study titled, "Final report of the PCCI Marine and Environmental Engineering on Oil Spill Containment, Remote Sensing and Tracking for Deepwater Blowouts: Status of Existing and Emerging Technology," was released.[75] This study, funded by MMS, concluded: "As the industry advances into deepwater exploration, the risks of blow out increase, due to difficulties related to kick detection and control procedures under deepwater conditions."[76]

In 2003, a drilling conference of the Society of Petroleum Engineers – International Association Of Drilling Contractors on "Recent Advances in Ultra Deepwater Drilling Calls for New Blowout Intervention Methods," identified the higher likelihood of blowouts in deepwater wells and called for continued research on deepwater drilling blowout intervention techniques in light of the fact that current considerations are based on shallower deepwater drilling up to 1500 feet deep.[77] Preparedness was even directly questioned when it was asked, "No blowout has yet occurred in ultra-deep water (water depths of 5000 ft or greater) but statistics show it is likely to happen. Are we ready to handle it?" While the Macondo well was drilled at 5,000 feet, BP never invested in any such research and development efforts and, therefore, was wholly unprepared to respond to the oil spill.[78]

BP, as the largest producer in the Gulf of Mexico, should have known about these studies, knew about the high risks inherent in deepwater drilling in the Gulf of Mexico, and recognized its lack of preparedness for such an event. However, in response to the identified high consequence risks and knowing that appropriate mitigation barriers were

70 TREX 7353.

71 *Id.* at Forward.

72 *Id.* at 4-37.

73 *Id.* at 4-9.

74 *Id.* at 4-41 (Figure 4-5).

75 TREX 5053.

76 *Id.*

77 TREX 6299.

78 TREX 9104.

not in place, BP did nothing to address source control mitigation. In [redacted] disregard of the Gulf environment and economy, it proceeded to drill Macondo anyway.

According to BP's Initial Exploration Plan, an oil spill caused by a blowout of the Macondo well would be ***unlikely to have a significant negative environmental impact***:

> "In the event of an unanticipated blowout resulting in an oil spill, it is unlikely to have an impact based on the industry wide standards for using proven equipment and technology for such responses, implementation of BP's Regional Oil Spill Response Plan which address available equipment and personnel, techniques for containment and recovery and removal of the oil spill."[79]

Instead of devoting any significant resources and efforts to prepare for post-blowout source control in a meaningful way, BP Management egregiously downplayed both the risks and consequence of an uncontrolled blowout. BP Management placed all barriers to loss of well control on prevention.[80] Thus, BP ignored a fundamental and universal principal of both offshore and onshore Process Safety Management, *i.e.*, Emergency Response Planning with regard to Loss of Containment and stopping the flow of crude oil. Instead, BP Management allowed the use of a 'check-the-box' Risk Assessment and Management process in which they rationalized that the well's BOP would work as intended and that, should a blowout and spill occur, they could effectively handle a blowout flow rate of 300,000 barrels of oil per day:

> "Since BP Exploration & Production Inc. has the capability to respond to the appropriate worst-case spill scenario included in its regional OSRP approved on November 14, 2008, and since the worst-case scenario determined for our Exploration Plan does not replace the appropriate worst-case scenario in our regional OSRP, **I hereby certify that BP Exploration & Production Inc. has the capability to respond, to the maximum extent practicable, to a worst-case discharge, or a substantial threat of such a discharge, resulting from the activities proposed in our Exploration Plan.**"[81] (emphasis added)

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[79] TREX 768.

[80] Deposition Testimony of James Dupree ("Dupree Dep.") at 114 ("Risk mitigation plans, that's correct. Most of the mitigation plans were - - were of a preventative nature, you know prevention."); 183 ("Well most of the risk was on prevention. You know, most of the risk management was prevention of such an occurrence."); Deposition Testimony of Andrew Frazelle ("Frazelle Dep.") at 219-220 ("I think when we look at it is, if you look at it from a – a barrier standpoint is that we were looking at well control training for people more on the prevention side of things versus the reactionary side of things. Q. And this is the same well control training that you concluded after April 20th was inadequate, correct? A. Yes, sir.").

[81] TREX 768 at 7.1. Worst-Case Scenario Determination: BP estimated a worst-case uncontrolled flow from a blowout of Macondo at 162,000 BPD, which was within their stated and certified capability to respond to a worst-cast spill of 300,000 BPD. This estimate was later decreased to 250,000 BPD in their Gulf of Mexico Regional Oil Spill Plan of 6.30.09, TREX 10301.

It is now abundantly clear that BP's certification was false. BP could not effectively respond to the Macondo spill as the oil spread over the surface of the waters of the Gulf of Mexico (discharge control), nor could it stop the discharge at its source.[82] BP was utterly unprepared to deal with the consequences of a High Pressure – High Temperature well blowout in deep water and had no plan in place to rapidly and effectively stem the source of the release (source control).[83]

[redacted]

BP Failed to Implement Appropriate Mitigation Barriers to Bring its System to Meet As Low As Reasonably Practicable Requirements.

BP Management failed to implement Fit-For-Purpose Mitigation barriers that assured that the likelihoods and consequences of a major Macondo system failure were As Low As Reasonably Practicable (Figures 2, 3, 9, 10, 12). As detailed below, BP Management implemented four inadequate measures as barriers. None of these measures were Fit-For-Purpose. These measures were: 1) BP's Regional Oil Spill Response Plan; 2) the BOP; 3) ROV Intervention to actuate the BOP; and 4) drilling a relief well. None of these are an effective Process Safety Management Mitigation Barrier. Of these, only the Oil Spill Response Plan was prepared pre-crisis.

The Oil Spill Response Plan Was Not a Source Control Plan. As part of the regulatory requirements, BP had to have an Oil Spill Response Plan to drill. The Plan, however, did not address in any material fashion the necessary source control mitigation

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[82] TREX 9096; TREX 7354; TREX 5051 ("We need to significantly enhance sub-sea intervention capability in deepwater."); Herbst Dep. at 349 ("Q. The next bullet point is 'Industry regional response plans proved inadequate to address Deepwater Horizon spill." Did I read that? A. Yes. Q. You agree with that? A. Yes."); Lynch Dep. at 168 ("Q. Based on what you observed and your analysis of the situation, could they [respond to a worst case scenario]? A. Not given any of the scenarios, no, obviously not."); McKay Dep. at 89-90 (commenting on TREX 7354, "Q. And the first box there says, 'Previous Capability: Limited pre-developed deepwater strategy or capability in subsea containment across industry.' Correct? A. Yes. Q. You agree with that, right? A. I agree with once—limited capability of subsea containment across industry, yeah.").

[83] TREX 9096; TREX 9098; Herbst Dep. at 348 ("I would say that they were not prepared to respond to whatever the actual rate that was on this incident."), 412-413 ("I would say that they did not prepare correctly. I'm not sure if I could cite the exact regulation that they failed.").

barriers. The entirety of the Source Control Plan was stated in Section 6(c) of the Oil Spill Response Plan (Figure 14 as bordered by the RED box) and consisted of "assemble a team of technical experts to respond to the situation" – a **'we will think about it when it happens'** approach.

BP
Regional Oil Spill Response Plan – Gulf of Mexico

Section 6
Spill Detection & Source Identification & Control

C. **Source Control**

BP operators have been trained to respond to spill events according to severity at each. Source control will be maintained with the following systems and procedures:

•	BP facilities are equipped with Emergency Support Systems (ESS) as required by 30 C FR 250 and A PI R P 14C (i.e., su mps, gas/fire det ection, su bsurface safety co ntrol v alves, em ergency sh utdowns, e tc.). The systems operate by alarming facility oper ator(s) and aut omatically shutting dow n i ndividual processes or the entire platform.
•	In the event the incident scenario does not allow automatic control, the operator has the flexibility t o co ntrol a r elease by manually engaging E SS devises or closing valves, etc. provided that the personnel are not exposed to the released substances.
•	In the event the spill source cannot be controlled by the facility operator or remotely with a safety system, BP will activate the Oil Spill Response Plan and assemble a team of technical experts to respond to the situation. The team will be comprised of personnel familiar with the f acility including production superintendents, foremen, facility eng ineers, a nd pr oduction and/ or d rilling engineers. The D eputy I ncident Commander or O perations Section Chief will be responsible for monitoring information produced by the team, as well as their progress, and reporting the results to the Incident Commander.

Figure 14: Source Control – BP's Gulf of Mexico Regional Oil Spill Response Plan.

The Oil Spill Response Plan focused nearly exclusively on discharge controls. Despite the regulatory requirement to control the source of a spill "immediately," BP's stated plan was designed solely to collect oil on the surface while a relief well was being drilled. While "source control" was acknowledged in the Plan as the second priority, behind only the safety of citizens,[84] the entirety of the source control plan was addressed in three bullet points on one page.[85] Of those three bullet points, only one actually addressed the implementation of source control measures. "[T]he rest of the plan deals with response to the oil on the surface."[86]

BP had no other source control plan. BP had no plan designed to meet the regulatory requirement in 30 C.F.R. §254.5 that stated, "Nothing in this part relieves you from taking all appropriate actions necessary to immediately abate the source of a spill and remove any spills of oil." This was the expectation of the approver of BP's Oil Spill Response Plan.[87] The federal government expected BP to live up to its obligations under the regulations and BP failed in doing that. "We expected them to be able to contain a

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[84] Lynch Dep. at 129.

[85] Bush Dep. at 16.

[86] *Id.* at 17, 28 ("The Plan is not - - not about Source Control. This Plan is about how to respond to an oil spill on the surface. This portion of the Plan [Section 6(c)] is trying to understand, at what point, does the Oil Spill Plan come into play.").

[87] Herbst Dep. at 303 ("Q. In fact the regulations in place at the time of the Macondo incident requires a company to be prepared to handle such a blowout, correct? A. That's correct."); 315 ("Q. Their obligation under regulation is to abate the source as quickly as possible, correct? A. Yes.").

deepwater blowout . . . they did not, obviously, contain it as quick as our expectations were."[88]

The source control plan announced in section 6(c) was to activate the Oil Spill Response Plan and "assemble a team of technical experts to respond to the situation." In essence, BP was planning to plan. Prior to Macondo, BP "did not have someone who provided Source Control expertise to the Oil Spill Plan."[89] Thus, as the Macondo incident developed, BP could not provide anyone with any immediate, proven, plans or procedures on how to control the source and mitigate the impact of this catastrophe.[90] Simply said, BP was once again 'flying by the seat of its pants' and had ignored a fundamental principle of Process Safety Management – consequence mitigation emergency response planning and loss of containment control.

This was not an appropriate mitigation plan. "Planning" was a reactionary implementation of *ad hoc*, unproven, untested source control measures to see what, if any, of the ideas showed promise. Such reactionary measures in the absence of a meaningful plan of action are doomed to trial and error.[91] As Charles Holt, a Section 6(c) technical expert for BP, stated, "the best time to create a plan is not in the middle of a crisis...it's much better to have a plan in place prior to a crisis."[92] As a result of failing to develop a meaningful response plan in advance, the Oil Spill Response Plan "didn't incorporate all the things we would have needed in order to attack this type of event."[93]

Process Safety Management requires carefully integrated continuous Proactive, Reactive, and Interactive processes that address proper As Low As Reasonably Practicable assessment and management of system likelihoods and consequences of major failures. Process Safety Management Reactive and Interactive processes are critically dependent on adequate and effective Proactive planning and preparation processes. BP Management [redacted] failed to provide adequate and effective proactive planning directly leading to the prolonged spill and the poor decisions made during the response.

BP Management Inappropriately Relied Upon the BOP as a Prevention and Mitigation Barrier. As explained below, and as expanded on in the Phase 2 Expert Report of Gregg Perkin, there were unwarranted and unrealistic beliefs in the abilities of the BOP and post-blowout ROV interventions to effectively control the source of a blowout.[94] Rather than a comprehensive plan that called for an immediate ability to intervene and

[88] *Id.* at 398.
[89] Bush Dep. at 11-12.
[90] TREX 5051.
[91] TREX 11227.
[92] Holt Dep. at 33-34, 45, 343 ("You know, from a - - from a standpoint of being prepared, ideally, you use that term ideally, being prepared would be that you have some plans in place beforehand. So having plans in place beforehand, you know, would have been of benefit."); Bush Dep. at 61-62.
[93] Dupree Dep. at 645-646; McKay Dep. at 41 ("There was no other physical equipment in the inventory built to kill a well.").
[94] TREX 1166; TREX 3624; TREX 3174.

stop the flow from an uncontrolled deepwater well – an appropriate mitigation barrier for such a high consequence risk – BP's primary risk mitigation plan [redacted] focused on prevention of a blowout and was almost completely dependent on the BOP functioning.[95, 96] It did not contemplate or investigate mitigation plans or procedures as BP Management "believed the blowout preventer would mitigate such a need for it."[97] The complete reliance upon a BOP was misplaced and an obvious failure of Process Safety Management. This is especially so in light of the known problems of BOP systems and reliability issues investigated by West Engineering Services, EQE, and others.[98]

From prior experience, BP Management knew that BOPs could fail.[99] BP understood that BOPs are not fail-safe and cannot be depended upon as a complete Prevention Barrier. Yet BP Management ignored the warnings from the Ixtoc I blowout experience,[100] and a series of joint industry – government sponsored reports from West Engineering[101] and others, which repeatedly warned that BOPs are likely to fail in deepwater and not be able to seal a wild well.

Further, the BOP is *not* a mitigation barrier. There is an old saying that goes something like this: *It makes no sense to close the barn door after the horse has bolted.* In the case of a blowout preventer, the same is true. BOPs are intended to be used to shut in a

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95 Frazelle Dep. at 219-22; Dupree Dep. at 183; Hayward Dep. at 254-255, 277 ("We believed in the event of a blowout, the blowout preventer, as its name implies, would stop the blowout.").

96 Lynch Dep. at 117.

97 Hayward Dep. at 276.

98 TREX 10543 (Analysis of Well Containment and Control Attempts in the Aftermath of the Deepwater Blowout in MC252, Report to National Commission on the BP Deepwater Horizon Oil Spill and Offshore Drilling, M. Tyagi, J.R. Smith, Î. A. Bourgoyne, Louisiana State University, Jan. 11, 2011); TREX 8524 (National Commission on the BP Deepater Hoirzon Oil Spoill and Offshore Drilling, Stopping the Spill: The Five-Month Effort to Kll the Macondo Well, Staff Working Paper No. 6, Jan. 11, 2012); Risk Assessment of the Deepwaer Horizon Blowout Preventer (BOP) Control System, April 2000 – Final Report, EQE International, TRN-HCEC-00056391.

99 TREX 5051; Inglis Dep. at 140-141 (acknowledging BOPs are not 100% reliable and can fail); 144-146 (describing that the failure of a blowout preventer leading to an uncontrolled blowout can happen and is foreseeable).

100 "IXTOC I: Case Study of a Major Oil Spill," Peter G. Myer, University of Rhode Island, Marine Affairs, April 1, 1984; Deposition Testimony of Michael Saucier at 72 ("Q. Is that a correct statement, that a BOP is fail-safe to avoid blowouts? A. No.").

101 *Mini Shear Study*, West Engineering Services, prepared for the U.S. MMS, Dec. 2002; *Shear Ram Capabilities Study*, West Engineering Services, prepared for the U.S. MMS, Sept. 2004; *Acceptability and Safety of Using Equipment, Particularly BOP and Wellhead Components at Pressures in Excess of Rated Working Pressure*, West Engineering Services, prepared for the U.S. MMS, Sept. 2006; *Blowout Prevention Equipment Reliability, Joint Industry Project (Phase I – Subsea)*, West Engineering Services, prepared for Joint Industry – Government Project, May 2009; *Final Report, Blowout Prevention /Equipment Reliabilty Joint Industr Project (Phase I – Subsea, January 2010*, West Engineering Services, prepared for Joint Industry – Government Project, Jan. 2010; *JIP Study on BOP Reliability 2004 – 2006: Subsea Conrol Systems Were Most Prone to Failure*, Jeff Sattler, West Engineering Services and Frank Gallander, Chevron Oil Co., Drilling Contractor, September 2010.

well **__before__** control is lost. BP knew it was highly problematic to rely on them to shut in a well under dynamic flow conditions, i.e., after the blowout is in progress.[102] It has been recognized in the industry for many years that a blowout **Preventer** is **NOT** a blowout **Stopper**.[103] Indeed, as early as 2001, BP Management was aware that a BOP would not effectively stop a blowout that was in progress, such as on its deepwater Crazy Horse Production Drilling Quarters ("PDQ") platform (later renamed Thunder Horse). BP knew that a blowout preventer could not be relied on to be a blowout stopper. [104] However, BP Management chose to act otherwise: "We believed in the event of a blowout, the blowout preventer, as it name implies, would stop the blowout." "BP….believed that the blowout preventer prevented a well blowing out, if it started to blowout, and therefore, that we had mitigated this risk."[105]

From a Process Safety Management perspective, BOPs are considered *a preventive barrier* and should not be construed to be a consequence mitigation barrier. This fact was ignored by BP Management, as Tony Hayward admitted before the U.S. House of Representatives on June 17, 2010 (i.e., principal reliance on BOP equipment).[106]

Figure 15 from BP's "Bly Report" (Bly, Figure 1) illustrates BP's concept of Macondo's preventative barriers that were in place and that had to be breached in order to have an explosion and fire onboard the Deepwater Horizon from a well blowout.[107] Note, however, that the BOP is shown ***to the right of the event**, i.e.*, as shown, it is depicted as a consequence/escalation mitigation and not as a preventative barrier as illustrated herein by Figures 7 and 8, and as discussed in my Phase 1 Expert Report.[108] In fact, the BOP barrier is a preventative barrier and should be located to the left of (*i.e.*, before) the Top

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[102] Holt Dep. at 48-50.

[103] TREX 7353 at 2-65; TREX 1300 at 3-4; TREX 5054 at 3, 13-14; Herbst Dep. at 567-568; Deposition Testimony of Geoff Boughton ("Boughton Dep.) at 442.

[104] TREX 4423; TREX 7353, at 2-65 ("Some form of emergency closure should be part of any deepwater, dynamically positioned rig BOP operating system to allow closure of the well in the event of the need to disconnect or failure of the control system. None of the secondary systems evaluated will reliably promote the Blowout Preventer system to a **"Blowout Stopper"** system. Capping a flowing well will still require measures such as dynamic kill from a relief well. For this reason the focus is on prevention of events such as an unplanned disconnect."(emphasis added)).

[105] Hayward Dep. at 277, 344.

[106] Testimony of Tony Hayward, Chief Executive, BP plc, United States House of Representatives Committee on Energy and Commerce Subcommittee on Oversight and Investigations, June 17, 2010 (*"There are events that occurred on April 20 that were not foreseen by me or BP, but which we need to address in the future as lessons learned from this terrible tragedy." "**LESSON 1**: Based on the events of April 20 and thereafter, we need to be better prepared for a subsea disaster. It is clear that our industry needs to significantly improve our ability to quickly address deep-sea accidents of this type and magnitude…**LESSON 2**: Based on what happened on April 20, we now know we need better safety technology. We in the industry have long relied on the blowout preventer as the principal piece of safety equipment. Yet, on this occasion it apparently failed, with disastrous consequences. We must use this incident as a case study to avoid a similar failure in the future."*).

[107] TREX-00001 at 32 (Deepwater Horizon Accident Investigation Report, Sept. 8, 2010).

[108] TREX-20001-Pub.pdf, Bea/Gale Expert Report, Aug. 26, 2010, Figure 2, pg. 6, *Barriers and Escalation Controls*

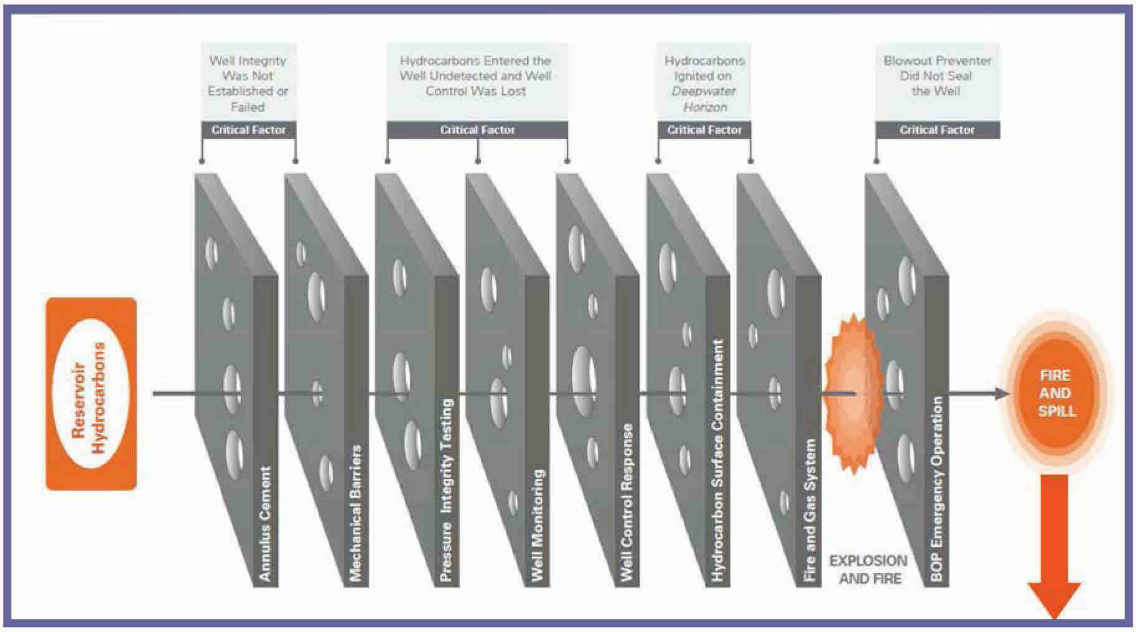

Figure 15: From BP's Bly Report "Figure 1," Barriers breached and relationship of barriers to the critical factors".

Event (Explosion and Fire), rather than shown as a Consequence Mitigation as depicted in the Bly Report.

BP Management also relied on ROV intervention as a post-blowout source control response without due regard for the potential environmental and economic consequences of a prolonged spill event.[109] To start, given the appropriate position of the BOP as a preventative barrier, ROV intervention cannot serve as a mitigation barrier. Still, even if it could, BP knew such a procedure was wholly unreliable. Subsequent ROV intervention to shut-in a flowing well in the event of loss of topside BOP control was known to be highly problematic.[110] Indeed, it was well known in the industry that reliance on ROV systems to shut in a flowing well when the primary system has failed is highly likely to fail.[111]

[109] Phase II Expert Report of Gregg Perkin (March 22, 2013); Hayward Dep. at 255-256.
[110] TREX 3624; TREX 3174; TREX 7353; TREX 4423; West Engineering Services, Inc., *Evaluation of Secondary Intervention Methods in Well Control*, U.S. Minerals Management Service Solicitation 1435-01-01-RP-31174, March, 2003 at 66; Phase II Expert Report of Gregg Perkin (March 22, 2013); Deposition Testimony of James Wells at 192-193; Deposition Testimony of Pat Campbell at 163-167; Holt Dep. at 49-56; Deposition Testimony of Harry Theirens at 30-32, 197-198, 464-467, 662-672, 682-684, 686-689; Deposition Testimony of David Barnett at 200-204; Inglis Dep. at 136-137, 139-142, 145-146; Boughton Dep. at 442-443.
[111] TREX 1166 at 27, 66, 82; TREX 7353 at 4-31; TREX 3624 (West Engineering Services, Inc., Evaluation of Secondary Intervention Methods in Well Control for U.S. Minerals Management Service, at 27, 82 (Mar. 2003)).

These facts were well known to BP as evidenced, for example, by its consideration of this issue on the Thunder Horse Production, Drilling, Quarters platform in 2001.[112] A Wells Subsea Team Leader described this issue nearly a decade earlier with uncanny foresight:

> *"**Situation:***
> *Horizon has driven off*
> *Well is flowing at 100,000 – 300,000 bbls / da*
> *BOP is open – no rams closed*
> *Do not know if Dead-Man has actuated or not*
> *ROV flow rate for override is 0.2 GPM*
> ***Question:***
> *Can we close the shear reams with ROV over-ride without further damage to the BOP at 100, 200, 300 BPD flow rate*
> ***Answer:***
> ***"No."*** (emphasis added) [113]

Finally, BP Management 'believed' the source control relief well-based plan was an effective strategy to respond to a Macondo well blowout with a Worst Case discharge of 162,000 barrels of oil per day in a deepwater environment. The relief well was forecast to take at least 100 days to complete.[114] If realized, this plan could have resulted in a total discharge of more than 16 million barrels of oil into the Gulf of Mexico – more than 5 times that of the world 'record setting' Ixtoc I oil spill. It is obvious that BP Management ignored the real possibility – the relatively high likelihood of a blowout -- and failed to appropriately manage the level of the risk associated with a failure of the Macondo well BOP and the extremely high consequences of the realization of this risk.[115] BP Management demonstrated gross disregard with respect to assessment and management of the Macondo well blowout source containment; the Macondo source containment risk was not As Low As Reasonably Practicable.

BP Management minimized both the likelihood and consequences of an uncontrolled blowout at Macondo. Even though BP Management recognized that exploratory drilling of a High Pressure–High Temperature well into formations having very small drilling windows (margin between formation fracture gradient and pore pressure) had been demonstrated by experience to have a high likelihood of an uncontrolled

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[112] TREX 4423; *Combining Modeling With Response In Potential Deep Well Blowout: Lessons Learned From Thunder Horse*, CJ Beegle-Krause, Ph.D., NOAA Office of Response and Restoration, and Walton (Tad) Lynch, Sr. HSE Advisor–BP Exploration and Production, 2005 International Oil Spill Conference.
[113] TREX 4423.
[114] TREX 10526; TREX 9105; Deposition Testimony of Robert Sanders at 63; Wellings Dep. at 53-54; Deposition Testimony of Nicky Pellerin at 21-22 (stating that a well was estimated to take 120 days to drill).
[115] The term 'relatively high likelihood' in this Report references to the As Low As Reasonably Practicable likelihood and consequences for the Macondo well. Economic, Historic, and Standards of Care As Low As Reasonably Practicable guidelines indicate an annual likelihood of an controlled blowout for these conditions should be 1x10-6 per annum (pa) or lower.

blowout,[116] BP Management chose to rely on the Macondo BOP, subsequent Remote Operated Vehicle BOP intervention, and drilling a relief well that would take 100 – 150 days to complete.[117] Because BP Management failed to provide a Fit-For-Purpose Mitigation Barrier, it failed its Process Safety Management obligations and was operating outside of the As Low As Reasonably Practicable requirements.

BP Management knew how to make its systems As Low As Reasonably Practicable before Macondo but failed to invest any funds, resources, or efforts in source control technology.

It is not the case that BP simply did not know of any source control technology that could stop the flow of oil in a deepwater blowout scenario. Indeed, BP Management knew, as early as 2001, that "capping stacks" existed and were, according to BP, the Best Available Technology (preferable to a relief well) for a blowout in other environments.[118] Given the unavailability of other appropriate mitigation barriers, this failure was inexcusable. BP Management did nothing to develop or apply this technology to its high risk exploratory deepwater drilling operations in the Gulf of Mexico.[119] BP has admitted that all of the interventions attempted during the response were based upon existing technology.

BP Management refused to take the warnings into account and ignored warning after warning that the systems being employed in drilling exploratory deepwater wells were not properly prepared for an uncontrolled blowout.[120] Then BP CEO Tony Hayward admitted that criticism of the company was *entirely fair*, and is quoted in a *Financial Times* interview that, "What is undoubtedly true is that we did not have the tools you would want in your toolkit," admitting that this was an appropriate criticism.[121] Hayward confirmed at his deposition that BP did not have the necessary equipment to respond to a deepwater

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[116] *Major Accident Risk (MAR) Process*, GP 48-50, BP Group Engineering Technical Practices, 5 Jun 2008, BP-HZN-2179MDL00407937.

[117] *Deepwater Kicks and BOP Performance*, SINTEF Industrial Management Safety and Reliability, Report No. STF38 A01419, Per Holand (SINTEF/Exprosoft) and Pål Skalle (NTNU), July 24, 2001 (This SINTEF study that was prepared for the U.S. MMS identifies the likelihood of a blowout involving a high pressure, temperature exploratory well to be approximately 1/1000 per well); *High pressure, high temperature developments in the United Kingdom Continental Shelf*, Research Report 409, Heath and Safety Executive, 2005.

[118] TREX 9346 ("*As a result of our investigation, BP Exploration Alaska believes well capping constitutes the best available technology for source control of a blowout. BP Exploration Alaska will continue to refine and improve our well-capping plans, tactics, decision trees, and timelines for inclusion to our -- inclusion into our production and exploration drilling plans.*"); TREX 9171; TREX 9827; TREX 9828; BP-HZN-2179MDL01428028 – 1428044; TREX 9552; TREX 5053; TREX 11263; TREX 11264.

[119] Holt Dep. at 621 (stating that BP did not research or develop capping stack technology); TREX 9104; Wellings Dep. at 44-45; 54; 95; DEA-63; TREX 10166; TREX 8886.

[120] See Phase II Expert Report of Greg Perkin (March 22, 2013).

[121] Hayward Dep. at 343; *The Guardian*, G. Wearden, 6.3.10.

blowout: "We didn't have a capping stack that would go instantly into place. We didn't have some of the things you would ideally want."[122]

The events described above exemplify the importance of Process Safety Management: If these source control mitigation options that were readily available would have been properly developed and tested before the Macondo well was drilled, the system could have been initiated in an As Low As Reasonably Practicable Fit-For-Purpose condition rather than a Not Fit-For-Purpose condition. But BP Management did not require proper assessment and management of the risks associated with source control of an uncontrolled blowout of the Macondo well before the well was drilled. BP Management instead made the calculated decision not to invest a single dollar in source control readiness or technology in connection with its deepwater drilling in the Gulf of Mexico.[123] Had BP Management met its corporate, regulatory, and industrial Process Safety Management requirements, the Macondo well would have most likely been shut-in much earlier and thereby mitigated the consequences of this recognized risk.[124]

Conclusion

BP Management's Process Safety Management blowout source control failures resulted from a [redacted] disregard of the potential loss of primary containment and an uncontrolled flow of reservoir fluids from the Macondo well. Consequently, not only did BP Management fail to properly assess and manage this risk, it utterly failed in planning for such an eventuality. Its emergency response plan amounted to nothing more than suggesting that if such an event occurs, we will then gather together the needed experts and figure out what to do, without regard to pre-planning for possible needed equipment or rehearsal of possible response scenarios. This egregious and reprehensible approach to Process Safety Management resulted in the unprecedented discharge of millions of barrels of crude oil into the Gulf of Mexico.

BP Management's Process Safety Management Mitigation failures during the Macondo well project and lack of effective emergency source control preparations for a risk they knew was their highest in the Gulf of Mexico resulted in unnecessary confusion, conflicting and erroneous information, undue delays, bad choices, frustration and undue delays in marshaling an effective source control response. The result worsened the unmitigated source and discharge control consequences of the Macondo blowout in ways that resulted in great environmental and economic harm. The results of BP's inaction and misrepresentations are now abundantly clear: BP was unprepared to intervene and to

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[122] Hayward Dep. at 343.

[123] TREX 9104; Hayward Dep. at 254-55, 276-77; Rohloff Dep. at 102, 138-139, 141-142.

[124] TREX 4926; TREX 10877; TREX 5359; TREX 9172; TREX 9564; TREX 10712; TREX 10713; TREX 9573; TREX 9574; Rohloff Dep. at 218-220, 380-385, 396-397.

arrest the uncontrolled Macondo well blowout, other than resorting to drilling a relief well, causing the largest oil spill in the country's history.

The opinions in this Report are mine alone.[125] Each of the opinions I express herein is based upon my experience, education, training, and expertise. I have not been asked to make any assumptions, nor have I presumed any facts, beyond those evidenced by and from the reliance materials identified in my Phase 1 Expert Report of August 26, 2011, the sources and information considered, cited herein, and in the Phase 2 Expert Report Consideration Document List attached herein as Appendix "B".

Signed this 5th day of April 2013.

Dr. Robert G. Bea, Ph.D.

[125] In my preparation of this report, I consulted with Dr. William E. Gale, Jr. I did not rely on Dr. Gale, however, for the opinions express herein.

Appendix A – Curriculum Vitae of Dr. Robert G. Bea, PE

Attached.

Appendix B – Phase 2 Expert Report Consideration Materials

Attached.

Appendix C – Expert Consulting Fees

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.