Assessment of Process Safety for Transocean Deepwater MODUs

Well Control
Blowout Preventers
Testing and Maintenance
Training

SUPPLEMENTAL REPORT

Prepared for:

Transocean-TODDI HSE Committee
October 2017
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1. INSTRUCTIONS

On February 19, 2013, Transocean reached an agreement with the United States (U.S.) Department of Justice (DOJ) to resolve certain outstanding civil and potential criminal charges arising from the Macondo well incident.

As part of the Consent Decree, Transocean agreed to take specified actions relating to operations in U.S. waters, including, among other things, the design and implementation of, and compliance with, additional systems and procedures; Blowout Preventer (BOP) certification and reports; measures to strengthen Well Control competencies, drilling monitoring, recordkeeping, incident reporting, risk management and oil spill training, exercises and response planning; communication with Operators; alarm systems; transparency and responsibility for matters relating to the Consent Decree; and technology innovation, with a primary emphasis on more efficient and reliable BOPs.

The Consent Decree also provides for the appointment of (i) an independent auditor to review, audit and report on Transocean’s compliance with the injunctive provisions of the Consent Decree and "(ii) an independent process safety consultant to review, report on and assist with respect to the process safety aspects of the Consent Decree, including operational risk identification and risk management (Process Safety)."

This review is undertaken in compliance with provision (ii) above.

The selection of Offshore Risk & Technology Consulting Inc. as the Independent Process Safety Consultant (PSC) was approved by the DOJ, the U.S. Environmental Protection Agency (EPA), U.S. Bureau of Safety and Environmental Enforcement (BSEE), U.S. Coast Guard (USCG) and the U.S. Department of Interior in May 2014.

Based on the Consent Decree, Transocean and the PSC agreed to the scope of work, as is described in Appendix D (Scope of Work).

The first report required under the Consent Decree was issued in September 2015 (First Report). The Consent Decree and the Scope of Work requires a re-evaluation and subsequent report to be issued by October 2, 2017, which was extended to October 17, 2017 (Supplemental Report) because of a declared force majeure relating to Hurricane Harvey.

1.1 SCOPE OF WORK

The Scope of Work is specific in its requirements for examination of areas of Process Safety with a sampling of Mobile Offshore Drilling Units (MODUs) operating on the U.S. Continental Shelf (U.S. Vessels):

- Review of the Transocean Health, Safety & Environmental (HSE) Safety Cases (documenting all Process Safety activities undertaken in the Transocean system on specific MODUs);
- Review and evaluation of the audit and compliance policies and requirements;
- Review and evaluation of the maintenance processes, requirements and tracking of Well Control equipment in particular BOPs; and
- Review of training and competency assessments for rig workers involved in Process Safety activities.

Any material deficiencies would be defined as a "major non-compliance." A major non-compliance is a deviation from requirements that (i) results in the impairment or degradation of a
Major Hazard Barrier without mitigation; (ii) poses a serious threat to safety of personnel, the vessel or the environment; or iii) indicates the lack of effective systemic implementation of a requirement.

The First Report was based on the Scope of Work, and this Supplemental Report focuses on changes in the systems that Transocean uses to manage Process Safety as well as additional information from queries that have arisen, which were not addressed in the First Report.

Much of the explanations, background, and fundamentals described in the First Report are the same for this Supplemental Report and therefore are not repeated herein.

Some further details on the review process reported in the following pages is described in Appendix E.
2. INTRODUCTION

Process Safety refers to prevention of major accident events, which include blowouts, collision, stability events, etc.: issues that might involve loss of multiple lives with possible loss of the MODU and other severe consequences. Occupational safety events, though often tragic, are not considered in the term Process Safety. Process Safety is a term reserved for rare events with high consequential losses. Traditionally corporate safety departments have concentrated on occupational safety since that can be easily measured, tracked and progress shown. The potential for a Process Safety event of catastrophic magnitude, however, is not related to the potential of an occupational event as demonstrated by the following diagram.

![Diagram showing the difference between Process Safety and Occupational Safety](image)

Figure 1: Conceptual view of the differences between Process Safety and occupational safety


Process Safety within Transocean is known as “Operational Integrity” (OI). A primary document is Operational Integrity and Health, Safety & Environmental Policies (OI and HSE) HQS-HSE-PP-01, September 4, 2017.

2.1 PSC REVIEW AS OF SEPTEMBER 2015

In September of 2015, the First Report was completed. The review at that time involved:

- Review of more than 140 internal documents consisting of Management Policies and Procedures, Safety Cases, Major Accident and Hazard Reviews, training, competency and roles of personnel, an examination of the Maintenance policies and procedures, examination of the Supply Chain policies and procedures, a number of other Alerts, methodology in selection of Safety Critical Equipment (SCE) as well as a host of intermediate documents;
- Review of more than 120 external documents some of which were evaluated to compare and contrast the information and documentation for safety and competency of personnel against an “industry standard;”
Interviews with crew, managers, and various other Transocean personnel involved in Process Safety and compliance; and

Participating with Transocean personnel and commenting on/critiquing Well Control Training as well as discussions of a Major Accident Hazard Risk Assessment (MAHRA) workshop that provided insight into the culture at Transocean.

Process Safety issues were queried, tracked and each of those queries was closed out with no adverse major findings identified. In many cases identified, work was already underway in order to improve several areas that Transocean had decided were in need of adjustment.

A leap forward occurred for Process Safety by the creation of a Safety Case for each of the U.S. Vessels. The Safety Cases emulate European and Australian regulatory regimes.

The Bowtie method used in the MAHRA workshops was being refined and crew involvement was excellent. The risk assessment and barrier thinking was well established. Transocean had evolved a methodology, which included there being a master set of Bowtie diagrams from which crews of specific rigs developed a bespoke set for the rig to which they were assigned.

The participation of the crew in the MAHRA sessions increased their situational awareness and led to an observed positive cultural shift. Using the documentation for the Safety Case, following the International Association of Drilling (IADC) template, led to a voluminous repetition of data that had to be concurrent in several documents. Transocean undertook to streamline the Safety Case from the original IADC HSE template since the IADC template had been developed without consideration that the Safety Case might exist in a regulatory regime concurrently with prescriptive regulation. It is a recognized challenge to have a prescriptive Company Management System (CMS) that can satisfy the International Maritime Organization’s (IMO) ISM, BSEE’s SEMS, BSEE 30 Code of Federal Regulations (CFR), and the USCG 33 and 46 CFR, as well as the notion of a separate Safety Case system. Transocean effectively addressed that challenge.

The First Report concluded that there were a few minor issues that were to be adjusted. For example, the Safety Case training was to be added to the Training Matrix to ensure it would be examined in audits. In most of the training (i.e. Crew Competency), Transocean was ahead of the PSC’s observations of the industry. Some of the new additions such as reporting on Inhibits were a major positive change.

Because of the advances made in safety by the advanced Bowtie methods that were developed, it was necessary to revamp the Safety Cases. With that, there were some issues with the Register of Permitted Operations (a.k.a. simultaneous operations, ROPO), which needed close review to ensure that all the issues had been tackled together while increasing the visibility of the ROPO chart for the crews.

One issue, which has been a question for the industry for years, was to be re-examined; the issue of who is the Person-in-Charge (PIC) during a major event from a marine point of view, versus a major issue that may arise from a drilling activity.

Two issues that were discussed and needed further examination in this Supplemental Report were the knowledge of the crew on previous Process Safety incidents and near misses, and safety culture concepts such as concepts of Confirmation Bias, Groupthink, and normalization of deviance.

The overall conclusion of the First Report was that Transocean had addressed, or was addressing, all the major issues that were queried by the PSC’s review of documentation, crew interviews, management interviews, training, and MAHRA discussions.
Although not part of the Scope of Work, it became clear that one of the major issues for the industry, which had been addressed at a descriptive level, was the interpretation of the American Petroleum Institute (API) RP 97 Well Construction Interface document. This document did not provide specific requirements nor had a template been produced to cover the specific details to be included in a Bridging Document. This lack of robust guidance in the content of Bridging Document(s) covering the drilling company, the Operator, and contractors interacting onboard may lead to a potential lack of reliability in the Process Safety system. Transocean was working to improve the content of their Bridging Document requirements but this could not be accomplished alone as it requires agreement with the Operator.

2.2 Contextual Awareness

With the downturn in the offshore drilling market and laying up of a large number of offshore drilling rigs, Transocean has had to undertake several changes within the organization while still making progress with their mission to improve Process Safety. Those changes are being examined in this Supplemental Report to ensure there is no negative impact on Process Safety.

Although the overall corporate organization and governance structure of the Transocean management systems has remained much the same as when the First Report was conducted in 2015, the systems have evolved as has the training and competency development. Transocean has developed in areas of risk management, risk identification, risk assessment and communication of the outcome of those assessments to the employees and rig crews.

Change is an opportunity to re-examine the critical elements of the safety management process. As this Supplemental Review was carried out, it was important to examine whether the changes impacted existing hazards or created new hazards, whether the risk arising from existing hazards was altered, and whether the controls that are in place to manage the risks are still suitable and effective in light of the changes.

Some of the changes examined and considered in more detail included:

The importance of safety is often emphasized by programs that reward safety behavior although since Process Safety events are by their nature rare, such awards are not common. It is generally recognized and accepted that bonus strategies can affect risk perceptions. Personal injury events dominate the safety statistics and there are many efforts made to reduce occupational risks as they can be easily tracked with year-on-year performance measured. It was thus decided to add an examination of the safety portion of any bonus awards and the effect, if any, that is perceived to benefit or detract specifically from Process Safety.

As part of this Supplemental Review, instances of three severe historical blowouts within the industry were examined to try to ascertain whether the causes of the accidents had been addressed by the Transocean procedures together even though these blowouts did not involve Transocean rigs. This review of historical blowouts included interviewing a Transocean subject matter expert.

A weakness in the industry is that regulators often do not ensure that sufficient and detailed investigations are carried out so that the lessons are appropriately learned and shared. While
Transocean investigates all their incidents and track kicks in detail, there is not a standard process for sharing the learnings from accidents between drilling contractors. Further, when there is sharing, it is important to ensure that changes are made to procedures to prevent the same conditions.

BSEE’s mandated changes in 2016 have elements of immediate requirements and elements of future requirements for the BOP equipment. The new elements considered for this Supplemental Review were:

- Performance criteria for BOPs, which are already developed by Transocean;
- Formal 3rd party certification program of the BOP;
- Shear testing demonstrating that the BOP will shear any electric-, wire-, and slick-line to be used in the well 30 CFR 250.732 by April 30, 2018 to an authorized verification organization;
- Shear tubing with exterior control lines; shear electric, wire, and slick-line to be used in the well; and install a gas bleed line with two valves for the annular preventer 30 CFR 250.734 by April 30, 2018;
- Real-time monitoring requirements 30 CFR 250.724 by April 29, 2019;
- Dual shear rams 30 CFR 250.734 by April 29, 2021 with specified requirements:
  - Capable of shearing at any drilling tubulars and lines;
  - Accumulator capacity to operate each ram;
  - Capability to deliver fluid to each Remotely Operated Vehicle (ROV) function;
  - Emergency functioning to close two shear rams in sequence;
  - Sequencing of the dual shear rams;
  - Mitigating compression of the pipe stub between the shear rams; and
  - Subsea dedicated bottles for autoshear/deadman
- Mechanism coupled with each shear ram to position the entire pipe, completely, within the area of the shearing blade 30 CFR 250.735 by May 1, 2023.

As changes are made to the various procedures, Transocean issues internal advisories, which are very helpful in providing an understanding in summary form, noting when procedures move to a new location in the management system, or significant changes are made (Advisories). Additionally, a list of the Advisories is made available so that no crew member is missed in the distribution, for example, when a crew member is off the rig.

This Supplemental Report analyzes the Transocean Management System in its context of the U.S. regulatory system, which is a wholly prescriptive system. One risk in a heavily regulated workplace is the potential lack of risk awareness as the crew follows rules to get the job done; there are not always rules for some situations that may arise. Infusing risk methods, which are used in other goal setting regimes (e.g. UK HSE) into a prescriptive system, is not an easy task. Transocean is making progress, however, in this area while still complying with SEMS, ISM Code, BSEE, USCG, EPA Regulations, and their Operators’ requirements.
A. REVIEW OF HSE SAFETY CASE

SECTION REDACTED
NON-CONFIDENTIAL SUMMARY OF INFORMATION: This section introduces the use of a Company standard major accident hazard risk assessment process (Bowtie) that is used as the basis for completing rig-specific major accident hazard risk assessments. In addition, the development of major hazard barriers (controls) is introduced.

1. THE REVIEW PROCESS

SECTION REDACTED
NON-CONFIDENTIAL SUMMARY OF INFORMATION: This section describes the methodology taken by the report author to review a sample of Transocean’s rig-specific Safety Cases. The methodology includes a comparison to the industry standard (the IADC HSE Case Guidelines) plus a review of relevant Company Management System and rig-specific documents. In addition, Transocean’s internal Safety Case training is reviewed.

1a. Internal Documents Reviewed

SECTION REDACTED
NON-CONFIDENTIAL SUMMARY OF INFORMATION: This section lists the specific internal documents reviewed as part of the wider process to assess Transocean’s Safety Cases.

1b. 3rd Party Documents Reviewed


3. IMCA DP Safety Flash 01/14 December 2014, Loss of Gyros on DP-3 Drill Ship (for approx. 35 minutes) (on same switchboard).


Offshore Risk & Technology Inc.
Dr. M. Sharples


11. Offshore Drilling Risks—1: Study: Risk indicators have varying impact on mitigation M. Sam Mannan, Ray A. Mentzer, Tony Rocha-Valadez, Anne Mims, Texas A&M University, Oil & Gas Jnl., 05/05/2014.


17. International Safety Rating System DNV

18. Simple Structured Risk Assessment (Learning from experience – the importance of Near Miss and Incident Reporting/ Investigation) David Slater, Cardiff University 2011. Presentation on Bowties and Barriers.


28. Wellhead Fatigue Analysis: Surface casing cement boundary condition for subsea wellhead fatigue analytical models By Lorents Reinås, University of Stavanger (Statoil) 2012.


32. Deepwater Kicks and BOP Performance, Per Holand (SINTEF Exprosoft) and Pål Skalle (NTNU) for Minerals Management Service (MMS), July 2001.


34. NOPSEMA (Australia) Safety Case Guidance Notes


42. IADC Pink List for DRILLING, Last Update 2012.


44. Pull Your BOP Stack - Or Not? A Systematic Method to Making This Multi-Million Dollar Decision, Jeff Sattler, WEST Engineering Services, SPE/IADC 11962 Netherlands.

45. NOV Product Sheet on 20K Ram.


48. Loss of Well Control Occurrences and Size Estimators Presentation, TAP Forum, February 17, 2017, Double Tree at IAH, Houston Per Holand, ExproSoft

49. Loss of Well Control events reported in the SINTEF Offshore Blowout Database for the period 2000–2014 are carefully studied in this report. The events are classified with respect to the operational phases: exploration drilling, development drilling, workover activities, well


52. "Marine Accident Report-Explosion and Fire Aboard the U.S. Mobile Offshore Drilling Unit Zapata Lexington, Gulf of Mexico, September 14, 1984, NTSB MAR-85/11 October 1, 1985."

53. "Investigation of September 1984 Blowout and Fire Lease OCS-G 5893, Green Canyon Block 69

54. Gulf of Mexico, Off the Louisiana Coast, MMS, OCS REPORT 86-0101 by K. W. Blake, D. J. Bourgeois, D. C. Howard, C. J. Schoennagel."

55. Self-Elevating MODU Ocean King (Undocumented); blowout, explosion and fire at position 28-00N, 96-26.7 W, Matagorda Island Block 669, Gulf of Mexico on 30 August 1980 with multiple injuries and loss of life. USCG 16 October 1980.


60. International Safety Rating System DNV. Presentation for Dynamic Barriers 2012

61. Chevron comments on Well Control Rules from BSEE 2/26/16.

62. IADC Comments to OMB-OIRA on Well Control Rule 3/7/16


64. Methane Gas Flammable Limits http://www.water-research.net/index.php/methane viewed 2/2/2017


66. Chapter Nine Organizing and Directing Well-Control Operations (on Diverters), Textbook


68. Phase II of the IOGP/IADC BOP Reliability JIP Announcement.

70. There is much more than the SIL certification that is needed: For Emergency Shutdown System (ESD) valves, there are three main steps. Ref: MAU-0040 SIL 4 WP-web.pdf.


75. "Wells and Well: Evaluation of deepwater kicks and future countermeasures

76. Paal Skalle, Per Holand, and Sigbjørn Sangesland, Norwegian University of Science and Technology and

77. SINTEF/ExproSoft 2001. "


81. Predicting Subsurface Gas Dispersion from Blowouts, PTIL September 2014 Jan Erik Olsen & Paal Skjetne, SINTEF.

82. OGP Safety Alert #257 Well Control incident 76 bbl. kick.

83. OGP 485 List of Well Design and Control Standards.

84. OGP 476 on Well Control Training.

85. The Leading Online Support Hub for Better Well Cementing viewed at http://better-cementing-for-all.org/


87. "Effective Well Control - Prevention & Response Lars Herbst, Gulf of Mexico Regional Director BSEE Conference 5-28-14. "


90. An Analysis of OSD's Well Incident Database; Results can Improve Well Design and Target Well Control Training. SPE 56921 Offshore Europe Aberdeen 1999.
91. Wells Group, Strategy and Business Plan 2010-13, Playing Our Part in Lifecycle Well Integrity, UK HSE.

92. Four steps to successful Well Integrity Management, Lloyd's Register of Shipping, www.lr.org/oilandgas.


94. BHP Survey Monkey charts on DVS culture.

95. BSEE Probabalistic Procedures Guide Draft.
1c. Interviews

**SECTION REDACTED**

**NON-CONFIDENTIAL SUMMARY OF INFORMATION:** This section details the people interviewed as part of the review of Transocean’s Safety Cases. This includes a summary of the subject matter.

1d. On-Site Assessments

Below is a summary of some of the events attended that discussed issues of importance to understanding where the drilling industry has progressed regarding Process Safety for the purposes of comparing overall industry progression to Transocean’s Process Safety system.

<table>
<thead>
<tr>
<th>Date</th>
<th>Event</th>
</tr>
</thead>
<tbody>
<tr>
<td>5/18/2016</td>
<td>Attend BSEE sponsored OESI session: Barriers (with Transocean Employee Name Redacted) on barriers and met with MB Mulcahy, the investigator on Macondo, to understand some of the issues that are accepted and those disputed by the industry</td>
</tr>
<tr>
<td>9/7/2016</td>
<td>Attend IADC Technology Forum &quot;Barriers in Well Control,&quot; and additional discussion on the issues of entrained gas</td>
</tr>
<tr>
<td>11/8/2016</td>
<td>Attend IADC Technology Forum on Innovations in Drilling Safety at GE Oil &amp; Gas</td>
</tr>
<tr>
<td>11/11/2016</td>
<td>Visit National Oilwell Varco (NOV) re BOP inspections (Name Redacted) and control systems current standard being offered</td>
</tr>
<tr>
<td>1/10/2017</td>
<td>Attendance at SPE/Chemical Safety Board Presentation on &quot;Finding the Gaps&quot; on the Macondo incident</td>
</tr>
<tr>
<td>2/17/2017</td>
<td>Attendance at OESI BSEE Technology Assessment Program including presentation on Blowouts</td>
</tr>
<tr>
<td>4/17/2017</td>
<td>BSEE Meeting including conversation with Transocean Employee Name Redacted Well Control for Transocean. Topics covered were Methane Gas Detection, Kick Prediction and Real-Time monitoring. Discussion with Name Redacted of Offshore Operator's Committee as to trend/changes in the industry w.r.t BOP ownership and management, and shift of responsibilities from the Operator to drilling contractor. For the latter Name Redacted a former BSEE official also opined</td>
</tr>
<tr>
<td>5/10/2017</td>
<td>Transocean Employee Name Redacted giving overview of changes post Macondo and philosophy about the change to the Maintenance system to add predictive ability</td>
</tr>
</tbody>
</table>

2. THE ASSESSMENTS, EVALUATION AND CONCLUSIONS

**SECTION REDACTED**

**NON-CONFIDENTIAL SUMMARY OF INFORMATION:** This section describes the background of the Safety Cases and clarifies the position of the report author with respect to comments made in the following sections.
2a. Assessments / Evaluations

(i) Summary of Policy and/or Procedure

The Review examined each section/subject encompassed by the Safety Case. Each is commented on briefly below in relation to the Review topics:

Management Commitment to (Process) Safety

SECTION REDACTED

NON-CONFIDENTIAL SUMMARY OF INFORMATION: This section comments on the Transocean governance process for the Safety Case and the rig-specific major accident hazard risk assessment that is documented therein. This includes a summary of the roles for senior Transocean management, rig management / supervision and other internal resources.

Zero Harm Campaign

SECTION REDACTED

NON-CONFIDENTIAL SUMMARY OF INFORMATION: This section describes steps the company has taken to improve safety performance and share lessons learned. This includes a summary of the roles and requirements for senior Transocean management, rig management / supervision and other internal resources.

Safety Critical & Barrier Terminology

Spare parts, as described in the First Report, can be expedited for SCE (e.g., Well Control parts or alarm components) by ordering and shipping based on designating them “Material Special Handling” and designated “Rig Down” (quickest), “Hot Air” (deliver by air ASAP), or “Normal.”

The following systems are considered generally as related to drilling and Well Control not all of which are the subject of this review:

- BOP Stack (Subsea);
- Marine Riser System;
- Choke and Kill System;
- Diverter System;
- Mud / Gas Separator Primary System e.g., Poor Boy Degasser;
- Drilling Instrumentation System;
- Station-keeping System, including Navigation Systems, DP System, including Power Management and Thruster/Propulsion;
- Mud System and Mud Processing Area Ventilation;
- Cement System; and
- Ex Equipment (electrical equipment installed in industry specified hazardous areas).

**Placards, Whistleblower Opportunities, and the Chief Compliance Officer**

**SECTION REDACTED**

NON-CONFIDENTIAL SUMMARY OF INFORMATION: This section comments on Transocean’s arrangements for providing a means of communicating legal and ethical compliance issues to senior management.

**Hazard Identification, Bowties, and the Register of Permitted Operations**

**SECTION REDACTED**

NON-CONFIDENTIAL SUMMARY OF INFORMATION: This section comments on Transocean’s processes for major accident hazard identification and risk assessment as documented in a sample of Safety Cases.

**Well Control Handbook**

**SECTION REDACTED**

NON-CONFIDENTIAL SUMMARY OF INFORMATION: This section comments on Transocean’s enhancements of the Well Control Handbook. This includes some of the added features, an overview of the Well Control methods, and added paragraphs for better clarification.

**Operational Integrity Barrier Planning Tool**

**SECTION REDACTED**

NON-CONFIDENTIAL SUMMARY OF INFORMATION: This section details an overview of the Barrier Planning Tool (BPT), as well as Transocean’s procedures and activities as defined in the BPT, which was introduced in 2015.
Transocean                                           Process Safety Consultant Supplementary Report

Security and Emergency Management Policies

SECTION REDACTED

NON-CONFIDENTIAL SUMMARY OF INFORMATION: This section describes the changes to the Security and Management Policies Manual, which was revised July 14, 2016. Although not directly relevant to the subject of the Supplemental Report, the author notes that the manual is compliant with the International Ship and Port Facility Security code.

Marine Compliance - Marine Areas of Change of interest to the PSC

SECTION REDACTED

NON-CONFIDENTIAL SUMMARY OF INFORMATION: This section describes items of interest within the Marine Compliance Procedures. This section lists specific drills, their frequency and crew participation as required in Transocean’s policies and procedures. This section also includes additional commentary by the author relating to changes in certain sections.

Emergency Response

SECTION REDACTED

NON-CONFIDENTIAL SUMMARY OF INFORMATION: This section details an overview of the Emergency Response Plan and the significant revisions taken place in 2016. This section also lists the Emergency Response Manuals reviewed of Transocean rigs as well as the author’s commentary on the review.

Performance Monitoring

SECTION REDACTED

NON-CONFIDENTIAL SUMMARY OF INFORMATION: This section comments on Transocean’s processes, including proactive and reactive performance measures, for monitoring performance,
Deepwater Field Operations Manual

SECTION REDACTED

NON-CONFIDENTIAL SUMMARY OF INFORMATION: This section comments on a new Transocean procedure with detailed instructions for performing operations in deepwater. In this section, the author gives examples of instructions to be followed during an operation.

Operations Policies and Procedures

SECTION REDACTED

NON-CONFIDENTIAL SUMMARY OF INFORMATION: This section describes the author’s review of the Operations Policies and Procedures, noting the well requirements are documented herein and describes the addition of a new policy on well barriers.

Advisories

SECTION REDACTED

NON-CONFIDENTIAL SUMMARY OF INFORMATION: This section describes the author’s comments on Transocean’s updated list of Advisories and comments on the review of the Policy and Procedure documents.

(ii) Industry Standard Compliance

This Supplemental Review found that Transocean was in compliance with the industry standard and using Best Available and Safest Technology (BAST) (e.g. Dual BOP stacks, enhanced Well Control Training, etc.) in order to carry out its business safely.

There is no requirement for regulatory or industry compliance with the Safety Case, and it is not a standard practice to provide Safety Cases for MODUs in the U.S. regulatory regime. The IADC has developed and updated its IADC HSE (Safety) Case Template in 2015, and this template provided guidance in formation of the Safety Case documents.

The appropriate industry standard for a Bridging Document to bridge the safety management systems of Transocean with its Operators and with their contractors is the API Bulletin 97 Well Construction Interface Document Guidelines, First Edition. This has not been adopted as a regulatory requirement and is, in the view of the PSC, a deficiency on the part of the regulator in the application of BAST. There is a requirement for compliance for a bridging document in the BSEE SEMS requirements of which API Bulletin 97 presents a minimum industry standard. Without detailing the concepts in API Bulletin 97 with a template documenting the interaction, qualifications, training, and responsibilities among the Operator, Drilling Contractor, attending
vessels, and (typically) 13 Operator contractors on board, the bridging documents do not provide a road-map to make the platform suitably safe from a Process Safety perspective.

(iii) Confirmation of Compliance or Identification of Non-compliance

The Safety Cases all followed the IADC HSE Case Template, which is the appropriate template. The Safety Case and Safety Management System are mandated in the corporate management system Governing Principles document.

Although the Safety Case is not an industry or regulatory standard in North America, the policy of Transocean to provide one, which is compliant with the IADC HSE (Safety) case, does demonstrate a best practice beyond the minimum requirements.

2b. Conclusions

The primary conclusion from the First Report and this Supplemental Report related reviews is that Transocean has adopted the best practice tool of the Safety Case to communicate Process Safety. The Safety Case is a summary confirming that a Process Safety system is in place and that the Company has a Process Safety focus that exceeds the current regulatory and industry requirements:

- Policies and procedures are, and the organization is, in place to lead the Company in preventing major accident events in the areas within the Scope;
- The Safety Case has demonstrated that the potential for major accidental events have been identified and appropriate controls put in place;
- The MSA, now focused on Process Safety events, shows that when any observation or non-conformance is found they are closed out in a timely manner;
- SCE protecting the rig from a major accident relating to a well event receives the priority attention from the maintenance operations. Drills were verified as being conducted;
- A system exists where spares can be prioritized as described in the Supply Chain manual for SCE such that they can be obtained on a rush basis;
- The Safety Cases have been upgraded from the examples in the First Report. These have vastly improved, including the ROPO and the improved MAH worksheet, together leading to the new Bowties is now “state-of-the-art.” Crew participation ensures that there is a full understanding of the roadmap to Process Safety;
- It has been re-verified that Transocean’s maintenance program for each rig requires an independent audit of 20% of the electrical equipment in hazardous areas each year and in each five-year period 100% of the equipment is verified (in addition to the normal verification that takes place when a repair is made). In the future, as the risk based approach to this inspection requirement is adopted, a new procedure will
require a combination of Close, Close Visual, and Detailed inspections depending on where the equipment is installed in a Zone 0, Zone 1, Zone 2 or Safe Area.

SECTION REDACTED
NON-CONFIDENTIAL SUMMARY OF INFORMATION: This section provides details of Transocean’s proprietary training and preventative maintenance and inspection programs.

B. REVIEW OF AUDIT AND COMPLIANCE POLICIES AND REQUIREMENTS

1. THE REVIEW PROCESS

SECTION REDACTED
NON-CONFIDENTIAL SUMMARY OF INFORMATION: This section describes the internal systems and process in place for the document and close out of action items resulting in a variety of audits, inspections, visits and surveys that take place on Transocean rigs. This section also includes the author’s commentary on the Independent Auditor’s review for proper documentation and close out of action items.

1a. Internal Documents Reviewed

SECTION REDACTED
NON-CONFIDENTIAL SUMMARY OF INFORMATION: This section is a list of internal documents relating to audits or surveys that took place onboard Transocean rigs. In addition, this section lists internal policies, procedures and systems reviewed.

1b. 3rd Party Information Reviewed


9. Loss of Well Control Occurrence and Size Estimator, BSEE Technology TAP 765aa by Dr. Per Holland Exprosoft A/S.


15. Process Safety Human Factors TAP 732a ABS funded by BSEE.


17. OCIMF Requirements for Suitability of a Semisubmersible MODU Inspector List.


22. Minutes of Coast Guard teleconference with international DP assurance providers January 14, 2013.


24. The basics of verification, Richard Nott, Lloyd’s Register EMEA.

25. 30 CFR 250 Interim Final Ruling Regulatory Mandates, Presentation by MODUSPEC, 2014


30. BSEE Director Delivers Remarks at the Second Annual Center for Offshore Safety Forum, April 10, 2014.

31. Reliability of Deepwater Subsea BOP Systems and Well Kicks, Per Holand and Hammad Awan TAP 674, August 2012.


34. 30 CFR §250.517 Blowout Preventer System Tests, Inspections, and Maintenance.

36. "Well Intervention and the BSEE Well Control Rule: Who Will You Call?"


39. ABS Process Safety Assessment for BSEE May 19, 2015 TAP 732 AA.

40. IADC Regulations with Effect on Drilling Contractors 2016 06 30 Summary.


42. NTL No. 2009-G17 Designated Safe Welding Areas on Rigs, 2014.


44. Requirements for MODUs and Other Vessels Conducting Outer Continental Shelf Activities with Dynamic Positioning Systems; Proposed Rule Federal Register DP Qualifications 2014-27594.

45. IADC Industry Perspective BSEE/ANL EWD Workshop, Steve Kropla, Galveston Nov 2, 2011.


47. "Proposed Well Control Rule Fact Sheet, BSEE 2016."


53. BSEE Increased Safety Measures for Energy Development on the Outer Continental Shelf; Final Rule August 2012.

54. IADC WellCAP® Well Control training, BSEE Forum 2012.


60. QC-FIT Evaluation of Seal Assembly & Cementing Failures Interim Summary of Findings, BSEE. December 2014-02.


64. OIL AND GAS MANAGEMENT Stronger Leadership Commitment Needed at Interior to Improve Offshore Oversight and Internal Management, BSEE GAO 2017 Report 683485.

65. Safety Case Guidance Notes, NOPSEMA.


69. Presentation on API Q2.

### 1c. Interviews

**SECTION REDACTED**

**NON-CONFIDENTIAL SUMMARY OF INFORMATION:** This section details the people interviewed as part of the review of Transocean’s audit and compliance policies and procedures.

### 1d. On-site Assessments

**SECTION REDACTED**

**NON-CONFIDENTIAL SUMMARY OF INFORMATION:** This section describes a review of the internal system for the document and closeout of action items resulting from a variety of audits, inspections, visits and surveys that take place on Transocean rigs. This section includes a summary of report type and the date the audit, inspection, visit or survey was performed along with the author’s commentary on any process related findings.
Digital Transformation Platform DEEPWATER 2.0 on Site Assessment

SECTION REDACTED
NON-CONFIDENTIAL SUMMARY OF INFORMATION: This section describes proprietary details of a new Transocean program, Deepwater 2.0 and includes the author’s commentary from an in-person meeting with Transocean personnel regarding the details of the program.

2. THE ASSESSMENTS, EVALUATION AND CONCLUSIONS

SECTION REDACTED
NON-CONFIDENTIAL SUMMARY OF INFORMATION: This section describes a review of company policies and procedures relating to audit and compliance onboard Transocean rigs. The section also describes the types of internal and external audits reviewed.

2a. Assessments / Evaluations

This Supplemental Report review focused on the various Audits, including results of BSEE inspections related to the BOP and control systems, and the marine integrity reviews ensure that there were no major non-conformances in the area of the DP system that supports the control of well activities.

SECTION REDACTED
NON-CONFIDENTIAL SUMMARY OF INFORMATION: This section includes a table that details the specific organization or document requirements (USCG, BSEE, ISM or Internal audits, etc.) and how they meet specific requirements as defined by the regulatory organization or the internal policy or procedure. In addition, this section includes a list of internal or external audit reports for Transocean rigs that were reviewed.
Maintenance Management Assessment

The Governing Principles document that describes the scope of the management system was revised in alignment with the API specification API Q2. The content of some of the Audits has changed to some extent, and the audits take place with some modification of emphasis to Process Safety events.

SECTION REDACTED
NON-CONFIDENTIAL SUMMARY OF INFORMATION: This section summarizes the internal requirement and new process for Maintenance Management Assessments, formerly known as Management System Audits, which assesses hardware, people, and the rig. This section lists a sample of MMA’s and MSA’s reviewed by the author and additional commentary.

OPITO Audit and Certification

The Transocean system of competence training is audited to OPITO requirements, which are considered a top industry standard. OPITO has established the industry recognized criteria to be used in approval of a Company’s Competence Management System to demonstrate employee competency to Operators and regulatory bodies while addressing issues such as regular auditing and ensuring continual improvement. The requested audits are to take place at the organization’s offices, as well as selected operational sites.

SECTION REDACTED
NON-CONFIDENTIAL SUMMARY OF INFORMATION: This section summarizes the process for conducting onshore and offshore competency assessments of CAMS employees, including assessor criteria and proper record keeping.

The competency assessment concentrated on the Driller, Dynamic Positioning Operator (DPO) (including Senior DPO, DPO III and DPO II), and Senior Subsea Supervisor and Subsea Supervisor positions.

SECTION REDACTED
NON-CONFIDENTIAL SUMMARY OF INFORMATION: This section summarizes the audit and single corrective action issued by OPITO during the annual audit of Transocean’s Competency Assessment Management System.
(i) Summary of Policy and/or Procedure

The MSA encompasses a comprehensive audit focused on major accident events for Process Safety and use a selected number of Bowties to examine the compliance of the rig and crews.

SECTION REDACTED

NON-CONFIDENTIAL SUMMARY OF INFORMATION: This section summarizes the internal requirement and process for Management System Audits.

IADC WellCAP® Replaced by IADC WellSharp® Certification

The Transocean system for Well Control is audited to the IADC WellSharp® standard, which was verified as current. The Maersk Training school follows the IADC program and itself is certified by IADC. Transocean uses feedback from its participants to audit the quality of instruction and to ensure the participants come away with the knowledge imparted. Several samples of feedback were reviewed, and the comments (particularly from senior personnel attending) confirmed that the quality of instruction is being audited satisfactorily.

The WellSharp® is somewhat advanced from the WellCAP® program with more difficult questions being taught in the class and on the tests. The program still follows a basic Well Control curriculum, which is industry standard, however, with important topics added such as barrier management, risk management, directional/horizontal drilling, and a better focused simulator session.

SECTION REDACTED

NON-CONFIDENTIAL SUMMARY OF INFORMATION: This section summarizes the new WellSharp program requirement, including learning opportunities for better recognizing actual or potential Well Control events as well as proper prevention and/or action.

Self-Verification/Division Verification Audits

SECTION REDACTED

NON-CONFIDENTIAL SUMMARY OF INFORMATION: This section summarizes the internal requirement and process for self-verification audits and provides a sample of questions in use.

(ii) Industry Standard Compliance: External Audits

Audits by Class, Flag State including ISM Code Audits, and USCG, are standard industry audits. Action arising from these standard industry audits can include the Certification being withdrawn for major non-conformances that are not dealt with in a timely manner and ultimately the potential shut-down of operations.

Audits by BSEE similarly can cause a shut-down of operations and a withdrawal of the Permit-to-Drill.
SEMS Audits mandated for the Operator, with the secondary effect of requiring compliance by the drilling contractor, are standard industry requirements. These requirements and third-party auditor requirements are set out by the Center for Offshore Safety. The audit requirements of these audits are prescriptive - and were set out in the First Report.

(iii) Confirmation of Compliance or Identification of Non-Compliance

From the audits sampled and the FOCUS session where several rigs records were interrogated, there were no material deficiencies.

2b. Conclusions

The Transocean Process Safety related audits appear to be carried out diligently. No Process Safety material deficiencies were found and any non-conformances identified in the audits were normal with acceptable times for closing them out.

Because of the continuing improvements to the Safety Cases and related educational efforts, it is expected that the audits “bubble up” issues. Transocean is continuing to improve the system as well as the knowledge of the crew who work on the rigs. Skilled positions are now termed professional craftsmen out of respect for their skills. With the recent improvements in the maintenance system and the improvements in specifying precise reasons for wear, tear and failure on the components, there will likely be some non-conformances until full familiarization and indoctrination of the crews. Overall, the progress made to date is impressive and is evaluated to be in the spirit of ensuring best practice.

The continuing MSA Audits are a benefit to assuring that the crew are understanding and following the detailed procedures set out and that the crew are also on a path of continual improvement.
C. REVIEW OF MAINTENANCE PROCESSES, REQUIREMENTS AND TRACKING; WELL-CONTROL EQUIPMENT, PARTICULARLY WITH RESPECT TO THE BOP SYSTEM

The Supplemental Report review involved understanding the significant improvements to the maintenance system and how these improvements impact the current use of the system.

SECTION REDACTED

NON-CONFIDENTIAL SUMMARY OF INFORMATION: This section summarizes specific changes to Transocean’s system used to track maintenance on all rigs.

The maintenance systems reviewed included the BOPs, Well Control systems and audits of the same. The DP systems were also examined to ensure drive-offs and drift-offs do not occur from maintenance issues.

A new industry maintenance concept pioneered by Transocean is to involve the OEM of the BOP (e.g. Cameron and GE) and some associated drilling equipment in the quality assurance and quality control (QAQC) of maintenance processes. As part of this, the rationale for handling spares for the Well Control Engineering (WCE) changed since the First Report, and therefore there were some minor changes in the safety criticality designation of Well Control equipment (e.g. on the maintenance of SCE that was not being used or needed to be watched at the current time). Other changes include having two BOPs on board each rig in the U.S. One effect of the two BOPs is a slight decrease in the number of crew that handles maintenance and this was also reviewed.

Findings from the MSAs and MMAs on BOPs and control systems were scrutinized, and a verification of the procedures was carried out in order to confirm compliance with API Std 53 to the extent of ensuring no material non-conformances.

Since the previous review, some of the issues increased the awareness of Process Safety and Major Accident Events by reconfiguring certain procedures from strictly Health, Safety & Environmental (HSE) and Occupational Health and Safety to Process Safety, which is termed OI in Transocean.

Additionally, some comments in this Supplemental Report result from a review of the proposed future requirements of the BOP systems as a result of the BSEE Final Well Control Rule.

1. THE REVIEW PROCESS

An initial meeting was held on November 15, 2016 with Transocean Subsea and Maintenance subject matter experts regarding the change in policy to Dual BOPs. The review plan contemplated the potential issues that might arise with scheduling one versus two BOPs while maintain compliance with the regulatory requirements for inspection. The process described appeared very logical and acceptable.

The review process for maintenance consisted of attendance at an intensive three-day Maintenance Course with senior crew members from several rigs attending between June 6-8, 2017. The attendance at this course also provided an opportunity for the PSC to interview crew members. The details, most of which are relevant to Process Safety, are reported in Appendix C. A further meeting was held with the subject matter experts to discuss, specifically, if any
vulnerabilities existed that had not been accounted for in the new arrangement for the OEM of the BOP and associated facilities to share the responsibility for maintaining the equipment.

The updates to the policy of spare parts on the BOP, Well Control, and DP equipment led to a re-examination of the analysis methodology, which changed the past practice, allowing a logical decreasing in inventory of spares. Explanations were provided on how spares are handled both on-board and in the warehouse with a requirement for a minimum required number of spares and a maximum desired number of spares both depending on the criticality rating, how fast the components can be obtained and the anticipated failure rate. This was also explored and scrutinized in the Maintenance Course the PSC attended in June 2017.

A verification was carried out on the procedures to ensure that SCE related to Well Control was always priority for maintenance and the procedures were up-to-date with the requirements imposed by the Performance Standards. Additionally, checks were made to ensure that the path of the SCE could be followed throughout the Supply Chain to assure confirmation of quality control input (see Section B) as well as to assure that the maintenance of replacement SCE could be obtained with urgency in the supply processes when required.

The updates of the various manuals were reviewed, as well as the Advisories on changes to the maintenance system. All of these reviews were satisfactory. During the interview with the Subsea Supervisor, his view of the cooperation and potential conflicts with the OEM representative and the Certification representative (Lloyd's) were appropriate and satisfactory.

1a. Internal Documents Reviewed

SECTION REDACTED

NON-CONFIDENTIAL SUMMARY OF INFORMATION: This section provides a listing of all Company documents reviewed as part of the process.

1b. 3rd Party Information Reviewed


2. "Pull Your BOP Stack - or Not? A Systematic Method of Making a Million Dollar Decision, Jeff Sattler, WEST Engineering Services SPE/IADC 119762 SPE/IADC Drilling Conference Amsterdam, 2009


4. National Oilwell Varco 20K Ram Spec Sheet

5. Surface BOP Reliability Issues for Deepwater Floating Drilling Rigs, Shanks (Transocean), Pruitt & Schroeder, IADC World Drilling Conference, "Enhancing Efficiency through Drilling Technology” Spain, 2002

6. New Generation of Subsea BOP equipment: controls smaller, stronger, cleaner, smarter, By Frank Springett & Dan Franklin, IADC Magazine Well Control

8. "Recommended Practice DNV-RP-E102: Recertification of Blowout Preventers and Well Control Equipment for the Outer Continental Shelf, June 2010

9. 60-Daily Checklist for OIM/Master, Driller, etc. for HPHT Wells

10. "Presentation on BOP well control drilling preventers, Matanović Davorin, Professor, 2015."


15. "What new design requirements are needed to provide assurance that BOPs will cut and seal effectively", Chauviere, GE Oil & Gas, BSEE Forum 2012


17. API Monogram and BOP Licensing, John Modine, Director Global Industry Services API, BSEE Forum May 2012


20. 5,000 psi Blind Shear Ram Bolting Torque Engineering Bulletin (posted with permission from GE) January 16, 2016


22. BOP System Hierarchy and Definitions


24. Reliability of Deepwater Subsea BOP Systems and Well Kicks BSEE TAP Program 674aa. The objectives of this study were to: Establish an updated reliability overview of deepwater subsea BOPs used in the Gulf of Mexico, U.S. OCS waters based on analysis of wells spudded during 2007 - 2009 and a quantified overview of the deepwater well kick frequencies and important parameters contributing to the deepwater kick frequency in the various areas

25. Shear Compliance, Offshore Engineer, November 2016 (Referring to the Final Well Control Rule)
1c. Interviews

SECTION REDACTED
NON-CONFIDENTIAL SUMMARY OF INFORMATION: This section describes the personnel interviewed as part of the process, their titles, subject matter covered.

1d. On-Site Assessments

SECTION REDACTED
NON-CONFIDENTIAL SUMMARY OF INFORMATION: This section describes the details of the author’s interactions with Transocean personnel and the instructor of the Maintenance Course during the onsite assessment portion of the process.

2. THE ASSESSMENTS, EVALUATION AND CONCLUSIONS

2a. Assessments / Evaluations

(i) Summary of Policy and/or Procedure

SECTION REDACTED
NON-CONFIDENTIAL SUMMARY OF INFORMATION: This section describes the proprietary details of the Companies Computerized Maintenance Management System, including an extensive, detailed breakdown on multiple levels of functionality and how the methodology used to review the Companies maintenance system and processes. It further explains the manner in which equipment is categorized and how spares are managed.

The Drilling Safety Rule, now incorporated into the CFRs, addresses requirements for compliance with documents incorporated by reference that relate to BOP equipment:

- Requires independent third-party verification of BSR capability 30 CFR§ 250.515;
- Requires independent third-party verification of subsea BOP stack compatibility;
- Establishes new requirements for subsea secondary BOP intervention (it should be noted that the ROV facility on board is under the control of the Operator not the drilling contractor);
- Requires function testing for subsea secondary BOP intervention;
- Requires documentation for BOP inspections and maintenance;
- Establishes new requirements for specific Well Control training to include deepwater operations 30 CFR§ 250.1503 (which was already in place at Transocean);
- Requires that an Operator must have a minimum of two barriers in place before removing the BOP, and that the BSEE District Manager may require additional barriers, 30 CFR§ 250.451(j) (Transocean OI document reflects this policy change GOV-CMS-PP-01 Quality Management Policies 01.01.2017); and
- States that a dual float valve is not considered a sufficient mechanical barrier.
Documentation was reviewed to show that Certificates for the verification are being provided and reported as part of the Consent Decree reports. This review confirmed that the CFRs related to the Drilling Safety Rule requirements have been incorporated into the procedures.

**Dual BOPs**

**SECTION REDACTED**

**NON-CONFIDENTIAL SUMMARY OF INFORMATION:** This section summarizes the internal process and procedure for managing dual BOPs on a Transocean rig. This section also includes a table showing an example of Cameron equipment and identifying, for each piece of equipment, which is the responsibility of Cameron and Transocean.

**Inhibit Register**

An inhibit is the process of disabling or overriding an alarm or protective function to temporarily allow continued equipment operation during an abnormal condition.

Inhibits are normally applied to protective and sensing devices (i.e. gas detector, pressure switch, limit switch, temperature sensor, smoke detector, etc.) A pressure switch and gas detector might be used to protect the drill shack (no longer a shack but a sophisticated operations room) against an influx of gas. This is important because of the computer and control devices in that location. The person initiating an inhibit to equipment or systems must perform a risk assessment, notify the equipment operator immediately and record the inhibit in the CMMS Inhibit Register. As soon as practical, the inhibit must be removed to restore integrity of the equipment or system.

The Inhibit Register is one tracked system and inhibits are also reported in the maintenance morning report and handover log, recorded against the equipment tag on a job and available to be viewed ashore. With all systems, however, it takes diligent assurance to reinforce the importance and explain why it is necessary to not “override” or “bypass” items. The result will be that the crews cooperate and embrace the procedures when they know what they are for. This is a culture change for the oil and gas industry that Transocean has pioneered.

A Permit to Work is generally required for inhibiting a protective device. There are situations where limit switches are sensibly inhibited, and for these cases, a Permit to Work is not required (i.e. overriding the lower limit switch on a crane boom to lower it into its boom rest). The crews are trained to know the requirements of the Consent Decree to maintain within the maintenance system an up-to-date status of all inhibits made to fire and gas alarm systems on the rig and inhibits on designated SCE. The requirement for inhibits was emphasized in the Maintenance Course reported in Appendix C.

The maintenance system also contains an ability to determine, based on location of the rig, the time it requires to provide equipment to the rig. The urgency is specified by the rig maintenance personnel (and authorized by the OIM/Master or his/her delegate) and is labelled for Material Special Handling with a speed requirement (i.e. “Rig Down” (quickest), “Hot Air” (deliver by air ASAP), or “Normal”). The historical information is tracked and provided in order that the maintenance supervisors on the rig can better manage their orders for equipment and determine logical spares inventory. These statistics are important to managing the efficiency of
the rig. The historical statistics can also account for time spent with clearing customs and rates of duty being paid, as well as anticipating time delays for equipment held up in customs.

Transocean have increased the quality audits of equipment vendors and vendor supplies (e.g. lubrication products as part of the strategy to ensure that the reliability of the equipment is increased). Crews are encouraged to request acquisition of equipment or supplies that will improve reliability (e.g. thermal imaging cameras to capture misalignment on motor shafts and other equipment, and having the lubrication products chemically analyzed to ensure that they are appropriate for the equipment longevity).

Performance Standards for Blowout Preventer (BOP)

The Maintenance Management Audits were reported in this Supplemental Report, Section B.

A key requirement of the Safety Case program is to determine, for all safety critical elements, the expectations of the system with regard to its performance.

In addition, as part of the First Report, the PSC reviewed the BOP pre-deployment checklist and that was re-examined by the PSC for changes. It was noted that check step 73 had changed to comply with the BSEE CFR requirement for testing on pods as noted in DTH-CG1-OPS-CSP-01-08 issued March 28, 2017.

Specific Comments on Maintenance Scope Related to BOPs

A careful review and evaluation was made of Transocean’s maintenance processes, requirements and tracking for BOPs. This review included review of how manufacturer’s recommendations for maintenance on specific BOPs are captured and how the practice of Transocean, in using only OEM parts or the rigorous method of qualifying equivalencies, is carried out. Additionally, the Transocean review of audits of manufacturers (see Section B) was carried out to ensure compliance with API Std 53. That information was evaluated along with Transocean practices of how those issues are internally monitored in the CMMS.
Maintenance Crew Culture

U.S. Chemical Safety and Hazard Investigation Board (CSB) Investigation Report Volume 3 dealt with the issue of Human Factors and safety culture. Throughout investigations into major accidents, the theme of “Human Factors” has been one of the key issues, and this is equally true of blowouts.

SECTION REDACTED
NON-CONFIDENTIAL SUMMARY OF INFORMATION: This section details the author’s observations during the Maintenance Course and Crew Briefing where safety culture was the subject, which included a review of several Case Studies. This section also includes commentary by the author of how Transocean is educating the crew on key issues based on the findings of the Macondo incident in the CSB Report.

(ii) Industry Standard Compliance, if Any

Regulatory and Industry Standards for Maintenance of BOPs

For the BOP maintenance processes, the primary requirements for current practice in the industry are contained in API Std 53.


Diverters, shut-in devices, and rotating control devices are not addressed in the 4th Edition (see API RP 64 and Spec 16RCD, respectively) because their primary purpose is to safely divert or direct flow rather than to confine fluids to the wellbore.

The BOP System Requirements are included in the CFRs in detail:

- 250.440 What Are The General Requirements For BOP Systems And System Components?
- 250.441 What Are The Requirements For A Surface BOP Stack?
- 250.442 What Are The Requirements For A Subsea BOP System?
- 250.443 What Associated Systems And Related Equipment Must All BOP Systems Include?
- 250.444 What Are The Choke Manifold Requirements?
- 250.445 What Are The Requirements For Kelly Valves, Inside BOPs, And Drill-String Safety Valves?
- 250.446 What Are The BOP Maintenance And Inspection Requirements?
- 250.447 When Must I Pressure Test The BOP System?
- 250.448 What Are The BOP Pressure Tests Requirements?
- 250.449 What Additional BOP Testing Requirements Must I Meet?
- 250.450 What Are The Recordkeeping Requirements For BOP Tests?
- 250.451 What Must I Do In Certain Situations Involving BOP Equipment Or Systems?
- 250.734 What Are The Requirements For A Subsea BOP System?
- 250.735 What Associated Systems And Related Equipment Must All BOP Systems Include?
- 250.737 What Are The BOP System Testing Requirements?
- 250.738 What Must I Do In Certain Situations Involving BOP Equipment Or Systems?
- 250.739 What Are The BOP Maintenance And Inspection Requirements?
Future of the BOPs from a Regulatory Standpoint

The main regulatory change, which has come forward since the First Report, is the BSEE Well Control Rule promulgated on April 14, 2016. The goal was to improve the reliability of offshore equipment and systems in order to avoid a catastrophic accident in the future. Some requirements commenced in July 2016. After discussions with the regulators regarding current technology, certain of the regulatory requirements have been delayed. There appears to be some flexibility available and likely continued delay of the current requirement dates. The primary areas of focus of the April 2016 Well Control Rule were on increased BOP shear requirements, enhanced accumulator systems, and real-time monitoring. With each of the additional requirements, it is important to examine the implications/potential consequences.

In the area of BOPs, there is an increased requirement for configurations, inspections, testing, failure reporting, and maintenance/repair by trained personnel. This is mainly mandating, through the industry, developed document API Std 53 be complied with in all aspects.

Regarding the additional instrumentation requirements on BOPs, there is an industry concern about the robustness of the sensors and whether actions taken as a result of a sensor giving non-compliant information (for whatever reason) may not be required or appropriate. Subsea crew on the rig know whether rams have closed or not by the current procedures when the hydraulics and electrical cables are intact. These are inferred conclusions not direct measurement; when functioning the valves, gallon count and readback pressures are used to validate the operation of a function. Additionally, the BOP control panel lights show the position of the last function accordingly. Adding more sensors has to be done with some caution otherwise it may unnecessarily increase downtime, based on sensors that may not be totally reliable in the deepsea environment. In addition, there is a risk that crews could get used to a systemic normalization of deviation if too often a sensor is itself the issue not the device being monitored.

The requirement to center the drillpipe eminated from the results of the Macondo well, when prior to this, out-of-centering shearing was not previously documented. It is now clear that the most likely explanation from recent forensics by the Chemical Safety Board and DNV, is that this is an issue that needs a solution. The centralizer mechanism is being developed but is not yet ready at this time. This requirement is not due, per 30 CFR 250.735, until May 1, 2023. According to the CSB investigation, there is little doubt that the BOP did function on the Macondo well, although there is still on-going discussion as to when. The maintenance for the pods now encompasses additional checks to ensure the pods can be maintained with robustness. The requirement for double shear rams may be helpful in some scenarios. Thus, there is some justification for the new requirements, although the details are still under discussion by the industry. Flexibility on the compliance dates and further understanding may modify the requirements in time.

A specific issue is the requirement to completely break down the BOP into its components every five years. In the issues of system reliability, it has long been the case that after breakdown of the equipment, there is a higher risk of failure during startup than during steady-state use. The risk of failure does become higher after a certain period of time while the system is getting fatigued and sealing parts are getting old. This is known in engineering circles as the “bath-tub curve” because of its shape.
In all cases, Transocean is complying and intends to continue to comply with the API Std. 53 requirements. It is understood that there has been a suggestion to BSEE to allow for a staggard inspection in some conditions where at each maintenance opportunity a section of the BOP is taken apart, inspected, reassembled, and credited against the five year inspection, provided that suitable documentation is provided. All components must go through this inspection once every five years. In time, with better documentation of reliability, it may be appropriate to amend the time-based inspections with one based on reliability facts and figures to optimize the “bath-tub” effect.

As previously discussed in this Supplemental Report, Transocean has taken a step to prevent rig downtime by equipping those rigs available in the GOM with Dual BOPs. Previously, very few rigs in the global fleet had been equipped with Dual BOPs as part of their original equipment. The BOP testing interval API Std 53 mandates a pressure test every 14 days, which is now mandated by regulation and presents no new barrier to compliance. It is possible that a variation of this time requirement can be allowed by the regulator on special circumstances if sufficient documentation is submitted and approved by the BSEE District Manager. It appears that no one has requested a deviation since the rule was put into place.

The BOP equipment failure reporting is an important step to understanding the issues for future logical regulation, as without data, the regulator must rely on anecdotal evidence for potential changes. Sharing with the OEMs is an important issue to ensuring that they will be able to understand the issues and improve the BOPs in the future. While this has been a desire in the past, it has now become a requirement to report the root cause failure within 30-120 days. IADC has 30 participants consisting of 16 drilling contractors, 11 Operators, and three equipment manufacturers that began collecting BOP performance data in 2015. Transocean is a participant.

Leaks and other issues with the BOP control systems must be reported in the weekly activity reports.

The Accumulator Systems are now required to meet the volume specifications of the existing industry standard API Std 53 and to have accumulator bottles dedicated to auto shear and deadman functions. The requirements have also been extended to five years, although this had not generally been an issue of concern until recently and is more of a precautionary improvement to an already generally adequate system.
“Must share with OEMs”…requires notification of serious problems in a timely manner. Root cause failure; within 30-120 days to identify and report, is now mandated. There is also a requirement for this information being communicated in a timely manner on an activity report, or operations can be suspended.

**Updated BSEE Compliance Deadlines for Major Provisions:**

<table>
<thead>
<tr>
<th>Requirement</th>
<th>Deadline</th>
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<tbody>
<tr>
<td>Use of BAVOs (comply within 1 year of publication of a list of BAVOs)</td>
<td>April 29, 2016</td>
</tr>
<tr>
<td>Capability to shear and seal tubing with exterior control lines (comply within 2 years of April 29, 2016)</td>
<td>April 29, 2018</td>
</tr>
<tr>
<td>Real Time Monitoring requirements (comply within 3 years of April 29, 2016)</td>
<td>April 29, 2019</td>
</tr>
<tr>
<td>Install remotely controlled locks on surface BOP sealing rams (comply within 3 years of April 29, 2016)</td>
<td>April 29, 2020</td>
</tr>
<tr>
<td>Install dual shear rams on subsea BOPs (comply within 5 years of April 29, 2016)</td>
<td>April 29, 2021</td>
</tr>
<tr>
<td>Installation of a gas bleed line with two valves for the annual prevents (comply within 2 years of April 29, 2016)</td>
<td>April 29, 2022</td>
</tr>
<tr>
<td>BOPs must be able to shear electric-, wire-, and slick-line (comply within 2 years of April 29, 2016)</td>
<td>April 29, 2023</td>
</tr>
<tr>
<td>Install surface BOPs on floating facilities (comply within 1 year of April 29, 2016)</td>
<td></td>
</tr>
<tr>
<td>Have dedicated subsea accumulator capacity for autoshear and deadman function on subsea BOPs (comply within 5 years of April 29, 2016)</td>
<td></td>
</tr>
<tr>
<td>Install BOP systems that have the capability to center drill pipe during shearing operations (comply within 7 years of April 29, 2016)</td>
<td></td>
</tr>
</tbody>
</table>

Ref: Christopher Scheefer Capgemini North America 2/15/2016

The future “real-time” requirement is described and applied to three different activities covered by the rule:

- Data collection – BSEE requires that you must gather and monitor real-time well data;
- Data transmission – BSEE requires that you must transmit the data as they are gathered;
- Remote data availability – BSEE requires that “Onshore personnel who monitor real-time data must have the capability to contact rig personnel during operations.” This implies that the data analysis capability must be available to remote resources during the operation being monitored.
How this affects the Drilling Contractor is yet to be seen. There does appear to be a move for major oil companies to shift responsibility to the Drilling Contactor but this has yet to materialize. Transocean is currently working on plans to have remote monitoring on their rigs in the future.

(iii) Confirmation of Compliance or Identification of Non-compliance

The requirements were reviewed, and it was determined that the maintenance records include the latest standards requirements. In addition, the audits examined show Transocean documentation is in compliance with the mandated requirements and is complaint with all the regulatory requirements incorporated in API Std 53. It is concluded that Transocean is in compliance with the industry standards.

The maintenance system was examined in detail. The addition of the performance standards is Transocean driven, although it does meet the intent of the regulatory requirements in the UK, Canada, and Australian regulatory system. The maintenance system and the statistical data is now designed to identify any deviations from regulations and Company policies and practices. This complies with best practice in the industry.

2b. Conclusions

The maintenance system appears to be very robust and the electronic retrieval system performed satisfactorily through all the scenarios put to the instructor during the three-day Maintenance Course. The interviews of participants and interview of the instructor at the Maintenance Course, who encouraged questions, confirmed that satisfactory answers were provided in every case. The instructor was knowledgeable on all rig equipment and encouraged the crew to report detail in order to understand reliability measurements on the equipment including time to failure and time to repair.

Transocean embracing maintenance improvement by going through the experiences/incidents on their own rigs with the crew is a major change that will result in a much better Process Safety culture. Crews are now told the why they are doing their tasks rather than just telling them to do them, which is resulting in useful feedback and learning. This is a necessary element in getting the new system up and producing more reliably, which in turn will go to the financial benefit of the Company from lesser downtime. From discussions with the crew members, it appears that the general safety culture is more open and respectful of the professional craft person’s views, and Transocean Rig Managers are open to questions and are providing rational explanations to the crews.

The maintenance system is very comprehensive and focused not only on reducing downtime, but in reducing the probability of a major accident occurrence, particularly in the area of well protection equipment including the BOP. This is detailed in the First Report describing a rigor that would be admired by an efficient military organization: Best Practice and State-of-the-Art.

Transocean has also demonstrated its willingness to improve the ability of the industry to reduce the probability of blowouts by participating and sharing data in the industry IADC BOP Performance Data project with OEMs and other drilling contractors.
D. REVIEW OF TRAINING AND COMPETENCY ASSESSMENT OF RIG WORKERS INVOLVED IN PROCESS SAFETY ACTIVITIES

Training is a Company and regulatory requirement. Marine positions on MODUs have specified internationally recognized regulatory licensing requirements that for the U.S. are addressed by Flag States and USCG regulations, many of which are embedded in IMO requirements. Regulatory requirements for training of Industrial (Well Control) personnel are addressed by BSEE in 30 CFR §250.1500-1600. The dynamic positioning officer marine requirements to comply with the regulation are voluntary in the U.S., although recommended by the IMO.

SECTION REDACTED

NON-CONFIDENTIAL SUMMARY OF INFORMATION: This section comments on Transocean’s training program as summarized in the U.S. Waters Training Matrix dated October 13, 2016. This section also includes additional commentary on Transocean’s Competency Assessment Program, crew briefing sessions with Operations, required skills to meet required competency criteria, internal policies and procedures as well as a required certification process.

1. THE REVIEW PROCESS USED:

This Supplemental Report review relied in part on the validity of regulatory certificates and crew competency test completions as well as the DPO certification (a Company requirement) by the Independent Auditor. This review focused on the content and quality of the procedures, knowledge and information supplied to the crews, the many aspects of safety culture as well as the impact of all the training. The U.S. Training Matrix provided a basic check on requirements for regulatory entry requirements and basic Company training.

Competence was assessed by the review of the CAMS and comparison to the program evolving at IADC, which attempts to provide an industry standard for Competence. Verification of competence was also subjectively assessed through attendance by observing participation and interaction with crews at the events attended including the Maintenance Course and Crew Briefing. Review of the Operational Excellence course, which serves to improve safety culture and attendance at a Crew Briefing sponsored by BHP, a major oil company, also assisted in forming an opinion on the state of progress in the Transocean safety culture.

IADC WellSharp® Certification for the Maersk Training School on Well Control was examined as was the OPITO Certification. Certification to OPITO is the only industry-wide recognized standard for Competence.

Review of various procedures, operational alerts and other documents confirmed the way knowledge is imparted to the crafts that they need to do their jobs/tasks.

1a. Internal Documents Reviewed

SECTION REDACTED

NON-CONFIDENTIAL SUMMARY OF INFORMATION: This section lists internal documents reviewed relating to how Transocean assesses competency of offshore employees.
1b. 3rd Party Documents Reviewed


4. Inspectors Toolkit Human Factors in Major Hazards HSE October 2005

5. "Meeting the Physical Demands for Evacuation and Rescue Aboard an Oil and Gas Installation"

6. Moderator: Michael Stephens, 2016 IADC HSE Committee Co-Chair; Director-HSE, Nomac Drilling. IADC Conference HSE&T Houston, February 7 & 8 2017."


15. How Two Innovative, IADC-accredited Training Programs are Improving Marine and Drilling Compliance Offshore Technical Compliance (OTC) has developed two new IADC-accredited
interactive regulatory compliance training programs; one for marine and one for offshore drilling. White Paper.

16. "Well Control and Training Scenarios, Master of Science in Petroleum Engineering/

17. Drilling Engineering, Spring semester, Marianne Hamarhaug, University of Stavanger 2011 "

18. DNV-GL Recommended Practice for Certification scheme for dynamic positioning operators, IMCA M 04/14.


22. KH WC Drilling Problems P4 Presentation.

23. Minimum Entry Qualification Requirements dp officers, Nautical Institute 2015.


25. "Special Focus: Well Control &, Virtual instructor takes well control training to the crew”

26. As the offshore drilling industry continues to move into more challenging environments, well control is becoming increasingly critical. A new digital system allows rig crews to continually practice their responses—to a myriad of well control situations—and facilitates objective assessment of drillers’ skill levels, knowledge and training needs, Dan Gilkey, Check-6, and David Gouldin, Seadrill Ltd., World Oil January 2015 Vol 236 No. 1."


28. IADC KCA Reports for various positions DP, Driller, Master, Senior DPO, Senior Subsea, Senior Toolpusher semis and drillships accessed July 2014.

29. Improving Human Performance, Tackling the Challenges to Develop Effective Safety Cultures, O&G Journal June 2014.


31. Training on Tool Box Talk - is there a video that shows how it should be done? that is used in Training.

32. IMCA M 117 – The training and experience of key DP personnel.


36. Application of Remote Real Time Remote Monitoring on the Oil and Gas Operations National Academy Press
37. Beyond Compliance Strengthening the Safety Culture of the Oil and Gas Industry National Academy Press, 2016

1c. Interviews

SECTION REDACTED

NON-CONFIDENTIAL SUMMARY OF INFORMATION: This section details the people interviewed as part of the review of Transocean’s competency assessment policies and procedures. This includes a summary of the subject matter.

1d. On-site Assessment

SECTION REDACTED

NON-CONFIDENTIAL SUMMARY OF INFORMATION: This section refers to Appendix C below.

2. THE ASSESSMENTS, EVALUATION AND CONCLUSIONS

2a. Assessments / Evaluations

(i) Summary of policy and/or procedure

The Training Program is documented in the U.S. Waters Training Matrix, October 13, 2016. The training plan complies with the regulatory requirements. The Training Matrix was reviewed for appropriateness of the courses provided for each of the key positions included in this review. In the latest Training Matrix, the requirement for Subsea Hydraulics training for all personnel has been removed since there was a significant overlap on this topic with respect to the BOP OEM training. This change is considered satisfactory. Transocean has no plans to remove any BOP OEM training requirements for Subsea personnel even in view of the addition of the OEM maintenance agreement. The Training Matrix does not include Well Control training for the DPOs. This does exist for the Chief Mate and Senior Chief Mate positions but is there simply for developmental reasons as they work toward Master/OIM/Master position where Supervisor level training is a requirement.

Safety Case Training is mandated for personnel on Transocean MODUs, as described in the Training Matrix. The Safety Case Introductory Video and Safety Case Training for Critical Roles were reviewed for all safety critical positions for the First Report. These have not been changed. The requirements cover all Transocean personnel on the rig for the Safety Case Awareness, and any with Safety Critical Roles, which include all the senior personnel on the rig. The Safety Case training is to demonstrate and provide assurance that risks associated with hazards relevant to the operation of the rig have been identified. Furthermore, the course provides an overview of the Company’s Management System controls for risks that have been identified and evaluated to ensure they are being effectively managed. The critical role training ensures understanding for each specific position in how that specific role must perform good barrier management and how that specific role’s daily activities relate to specific barriers that prevent threats resulting in severe consequences.
The Safety Case training contains training on the concept of Bowties. There are now a number of presentations and training sessions (e.g. OI, Operational Leadership) that included further detailed examples using the Bowties and practice using the Major Hazard Barrier management concepts. A record of attendees is maintained and is included in the MAHRA Report, which is referenced in the Safety Case.

**SECTION REDACTED**

**NON-CONFIDENTIAL SUMMARY OF INFORMATION:** This section describes specific training related to the safety case, maintenance, operational excellence and lessons learned.

Based on the First Report review, there was an impression that Transocean was reviewing case studies and making appropriate changes to the procedures but not necessarily presenting these operational lessons to the crews. It is now clear that instructors are sharing the information on lessons learned. Another factor discussed in the meeting was to focus on communications. For example, the language in the oil and gas industry is significantly different than that the marine world, which is again significantly different from normal engineering language. With the change in procedures to Standard Technical English in the procedures, eventually there may be less differences and potential miscommunications between parties.

The focus on Human Factors is very significant going forward and reflects best practice. Clearly, Transocean is addressing the importance of this in their everyday work.

The training in the Social Psychology concepts of Groupthink, Confirmation Bias, Normalization of Deviance and Lack of Situational Awareness, among others, is a key step forward and reflective of best practices in tackling the Human Factor issues that have long eluded the industry.

**Dynamic Positioning Officer (DPO) Training**

**SECTION REDACTED**

**NON-CONFIDENTIAL SUMMARY OF INFORMATION:** This section describes Transocean’s policy for ensuring competency for those offshore employees in the position of Dynamic Positioning Operator.

The Transocean DPO training program meets voluntary regulatory requirements of the USCG, the Certification requirements of the MODU Flag state, the best industry standards, and best practice. The detailed competency and experience required to comply with Transocean’s requirements is laid out in the DPO competency discussion below.

**Industrial Training Requirements (related to Well Control)**

Since the First Report, IADC has re-affirmed its program under their training requirements related to Well Control into courses entitled “WellSharp®.” The three courses that replace WellCAP® are:

- IADC WellSharp® Introductory Level Well Control - Validity is five years
- IADC WellSharp® Driller Level Well Control - Validity is two years
- IADC WellSharp® Snr Supervisor Level Well Control - Validity is two years
The objectives of these courses are to gain better understanding of basic Well Control measures and required calculations, understand best practice with operation of the equipment, and to re-familiarize the participants with detecting and controlling influxes in the wellbore.

Course requirements by course type for the IADC program are listed on the IADC web site and details of the enhancements can be found at http://www.iadc.org/wellsharp/ with some example tests. The following is the required minimum Transocean training level per job descriptions for personnel involved in Well Control Operations. The (yrs.) indicates the repeat period:

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<tr>
<td>NON-CONFIDENTIAL SUMMARY OF INFORMATION: This section includes a table of specific courses related to well control and details the positions that are required to complete these courses. This section also provides additional detail on Transocean’ methodology of training plans training.</td>
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Task Planning, Risk Assessment and Chronic Unease

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<tr>
<td>This section describes the new Task Planning and Risk Assessment, its process and Five Key Expectations, which replaced the THINK policy. This section also describes the added layer of the “Chronic Unease” initiative within the OI and HSE Policies Manual to further encourage use of crew to call a “Time out for Safety”. It also details how to apply this initiative. This section also describes the adoption of a concept as well as the procedures of “Defense in Depth,” a safety practice to minimize risk.</td>
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Competency and On-the-Job Training

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<td>NON-CONFIDENTIAL SUMMARY OF INFORMATION: This section describes Transocean’s policy for ensuring competency for certain offshore employees.</td>
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The Driller CAP (D-CAP) (HQS-HRM-PR-05 Rev. 4 4.1.2017) was reviewed.

SECTION REDACTED

NON-CONFIDENTIAL SUMMARY OF INFORMATION: This section describes Transocean’s policy for ensuring competency for those offshore employees in the position of Driller.

The Subsea CAP (S-CAP) (HQS-HRM-PR-06 01 Rev. 04. 4.1.2017) was reviewed.

SECTION REDACTED

NON-CONFIDENTIAL SUMMARY OF INFORMATION: This section describes Transocean’s policy for ensuring competency for those offshore employees in the position of Senior Subsea Supervisor or Subsea Supervisor.

The Dynamic Positioning CAP (DP-CAP) (HQS-HRM-PR-07 01 Rev. 05. 4.1.2017) was reviewed.

SECTION REDACTED

NON-CONFIDENTIAL SUMMARY OF INFORMATION: This section describes Transocean’s policy for ensuring competency for those offshore employees in the position of Dynamic Positioning Operator.

On-the-Job Training

The Transocean OJT Modules were reviewed in 2015 and have not changed since then.

Well Control Handbook Assessment OJT

SECTION REDACTED

NON-CONFIDENTIAL SUMMARY OF INFORMATION: This section describes required training for personnel to understand the procedures and policies in the Well Control Handbook and the process for ensuring well control competency for offshore employees.
Self-Verification - Division Verification (SV-DV)

SECTION REDACTED

NON-CONFIDENTIAL SUMMARY OF INFORMATION: This section summarizes the internal requirement and process for self-verification audits. More details of the program are outlined in Section B of this Supplemental Report.

(ii) Industry standard compliance, if any

Transocean’s Marine Manning requirements were reviewed for industry compliance and have not changed except with the position of the Master/OIM/Master. The marine manning is verified by the USCG as compliant. The Master/OIM/Master change is where the key leadership responsibilities of the rig are now carried out by a single individual who has had both Marine Training as a Master and completed the qualifications of an OIM. Although the prior arrangements were well understood on board for Emergency Response, the development of personnel who are qualified in both marine and drilling matters is a much better solution and satisfies an ongoing USCG issue as to whether the vessel on DP being continuously “underway.” Additionally, there is no change to the DPO regulatory required qualifications nor have the requirements of Transocean changed (which are far greater than the regulatory minimum).

The drilling and Well Control personnel training requirements are stipulated by the regulator, BSEE and this is the industry standard. The basic Well Control training, as covered by the IADC WellSharp®, is the only regulatory required training. The applicable citation is 30 CFR 250.1500 - 1510.

There is no U.S. standard on compliance for competence. However, there is the ISO 17969 Petroleum, petrochemical, and natural gas industries, which are guidelines that can be used for well operations personnel. ISO 17969 focuses on how to develop, implement, maintain and improve a CMS. This supports competency management general principles. The annexes list example competence profiles for positions responsible for well integrity. It is applicable to Operators, service companies and drilling contractors working on wells and well operations.

The IADC has not embraced the ISO 17969 standard. The IADC Knowledge, Skill, and Ability (KSA) database, which currently contains technical competencies for 73 rig-based positions was reviewed but the KSA does not provide competencies focused on Process Safety.
(iii) Confirmation of Compliance or Identification of Non-compliance

Competence depends not only on the individual but also on the instructional information provided to carry out the activities assigned to the individual. Two documents illustrate the information available in procedures, which instruct on carrying out the activities relevant to this review. These are OI and HSE Policies Manual (HQS-HSE-PP-01 09.04.17) and the Emergency Response Manual (DPT-HSE-PR-01 12.12.16) (the Deepwater Proteus manual was used for this review).

SECTION REDACTED
NON-CONFIDENTIAL SUMMARY OF INFORMATION: This section is a list and description of additional policies and procedures where Transocean details activities that are relevant to employee competency.

These two example documents appear to be comprehensive in the assignments of both activities and responsibilities.

2b. Conclusions

This Supplemental Review concludes that the training now received by Transocean personnel is best practice. The emphasis on Human Factors training in social psychology issues as outlined in this report, to the PSC’s knowledge, is well in advance of the industry (although based on the discussion with crew, deepwater Operators have started to embrace this approach). This effort is to be applauded, particularly in a down market, where many companies are not increasing the spending on safety matters. At Transocean, the safety culture is in the forefront of the industry.

The embracing of training in the Safety Case techniques of managing barriers has been practiced by many of the leading regulatory agencies in Norway, UK, Canada and Australia. Barrier management through Safety Cases requires a change from prescriptive regulation and compliance mentality to a more sophisticated one of using performance standards for SCE and only works with the proper Company safety culture. This Supplemental Report shows that Transocean has embarked on this journey.

Based on the review conducted and the PSC’s knowledge and experience of Process Safety, the Transocean Competence Assurance management system is deemed “state-of-the-art” and has set the standard for best practice.

As a Post Script Comment: Guidance on the Bridging Document has been provided in API Bulletin 97 Ref 1. This document has not yet been mandated by regulation, nor does it contain specific recommendations on the training or competence or procedures to be put in place for the Operator or its subcontractors on board.

E. FINAL CONCLUSIONS

Human Factors: This Supplemental Report applauds Transocean’s efforts made to change the historical safety culture in the offshore drilling industry. The Crew Briefing (Appendix A) and the Maintenance Course (Appendix C) demonstrate that Transocean’s safety management system policies meant to manage MAHs are effectively addressing the concerns of inadequate incorporation of Human Factors into safety management practices and hazard assessments. These concerns are described in the U.S. Chemical Safety Board Report Volume 4 on Human Factors and safety culture. There has been a significant effort to install crew understanding of Confirmation Bias, Groupthink, Normalization of Deviance, and Lack of Situational Awareness and also to educate the crew about their responsibility to call a TOFS or Stop the Job if they experience Chronic Unease. Additionally, the policy of incorporating “classroom sessions” of discussion with the crews of company potential major events such as loss of Well Control (including the Macondo event), flooding and fire, etc. demonstrates effective organizational learning from previous incidents. Transocean is also documenting and instructing its crew on the clear roles and responsibilities of managing barriers (individually and collectively) and responding to concerns to reduce risk to ALARP. Throughout the Company, there are significant advances in stressing the importance of actively monitoring the effectiveness of barriers and safety management systems.

Several National Academy Press documents commissioned by BSEE and USCG have provided comments on the issues of safety culture. It is noted that the comments were compiled by many experts in fields other than offshore drilling. In comparing the ideas of what constitutes safety culture in these documents and what Transocean has put in place, it is clear that Transocean has taken a concept of safety culture and developed it with specifics, which meet the overall criteria outlined.

It is clear from the interviews and sessions attended that Transocean has recognized the benefit of investing in safety in light of the long-term risks to their operations and their corporate reputation of failing to do so. There are challenges within the workplace, among contractors, or between contractors and their customers. Some cultural issues have ethnic or national origins. While this is a long and complex journey to get the safety culture to an optimum level, Transocean has made great strides in this respect.

The various Process Safety related enhancements made by Transocean (for example using Dual BOPs and implementing a RCM scheme) are all steps that improve the Company’s operational ability and OI (Transocean’s term for Process Safety). The move to have Safety Cases for all the rigs, specifically indoctrinating the crew to their responsibility for barriers, together with the change in MSAs and MMAs, will provide for a better result both financially and for safety. Transocean is at the forefront of improving offshore industry safety and best practice by identifying and educating its crews on the Human Factors, which influence the safety culture.

Documents regarding Transocean’s safety policies and programs and the implementation of those programs have been reviewed and requested enquiries were answered through interviews of subject matter experts to explain the systems in place. The review included documents from top to bottom in the hierarchy from the Governing Principles describing the overall CMS to the operating manuals and maintenance manuals, which describe the relevant policies and procedures. The Transocean system of Process Safety is very comprehensive and contains the information required to minimize the probability and consequence of a major accident event. The Safety Cases continue to improve and the five-year review of Safety Cases previously developed are scheduled to occur as planned. The updated Safety Cases will include the latest Bowties and Barriers Ratings.
In comparison to the customary practice for Process Safety in the offshore drilling industry, Transocean has incorporated best practice for Process Safety in its safety program.

Transocean took a major step in developing Safety Cases for each of their MODUs operating in U.S. waters. These Safety Cases summarize the management commitment to Process Safety, the Process Safety characteristics of the physical MODU, the personnel training and competence aboard, and the hazard identification and barriers put in place to prevent Process Safety incidents. The Safety Cases also include an audit trail requirement. All of this is infusing “safety case culture” into the workforce.

The addition of scenario training by enhanced courses, and particularly the practice of providing the experience of past well control events to the crew from which they can learn, is an exemplary practice.

From the review of Process Safety related documentation, the audits on BOP and associated equipment, the competence of training personnel as well as the quality and content of the instruction courses, the conclusion is that Transocean is using “best practice” in its system of managing Process Safety with respect to Well Control, BOPs and related training.
F. OTHER BACKGROUND REFERENCES


5. Human Factors what does it mean to you and how can you improve? Lloyd’s Register Presentation.


10. Deepwater Horizon: A Systems Analysis of the Macondo Disaster Sep 6, 2016 by Earl Boebert and James M. Blossom.


12. The Failure of Monitoring Prior to Blowout, Prepared for CSB by Andrew Hopkins

13. Culture Values and Practices, can you have one without the other? By Peter Wilkinson.

14. USA vs Robert Kaluza & Donald Vidrene Summary Case Criminal 12-265.


16. The Path to Disaster: The Deepwater Horizon BP’s disaster in the Gulf of Mexico, Professor Patrick Hudson & Tim Hudson, 4th Annual Plexus Industrial Safety Lecture, Industrial Psychology Research Centre, 14th August, 2013.

17. DWH Final Report: Focus on Four Areas, PSA 20140219, PSA Norway.


19. Deepwater Horizon: Taking the lessons to heart - Petroleum Safety Authority Norway.pdf

20. Lessons Learned from Macondo OESI provided by Transocean.


24. Safety indicators for drilling (Hopkins) for CSB.

25. Reforms since the Deepwater Horizon Tragedy, BSEE, Dept. of Interior (Lessons).


27. Finding the Gaps SPE 1.10.2017_ Mary Beth Mulcahy Chemical Safety Board.


31. Before and After Macondo: Offshore Safety and Environmental Regulation in Historical Context, Tyler Priest C.T. Bauer College of Business University of Houston.


33. Lloyd's Register SMS and Safety Culture/Climate DWH Closing Meeting 16 Mar 2010 Exhibit 4261.

34. BSEE Presentation on Macondo for International Regulatory Form for Offshore Safety Lars Herbst 2010.


36. Appendix V. BP Deepwater Horizon GOM Incident Investigation Dispersion Analysis (from Baker Risk) (provided by Auditor)


40. USA vs Robert Kaluza & Donald Vidrene Summary Case 14-30122-CR0 11 March 2015.
APPENDIX A: DEEPWATER INVICTUS CREW ENGAGEMENT BHP Billiton

SECTION REDACTED

NON-CONFIDENTIAL SUMMARY OF INFORMATION: This section details the author’s attendance at a Crew Engagement Briefing offered by BHP Billiton for the crew of a Transocean rig. This section summarizes the attendees, activities and the subjects covered, as well as additional commentary by the author.
APPENDIX B: OBSERVATIONS ON MAERSK TRAINING CENTER:

SECTION REDACTED

NON-CONFIDENTIAL SUMMARY OF INFORMATION: This section details the author’s visit to the Maersk Training Center and the people interviewed as part of the review of courses. This includes a summary of the subject matter.
APPENDIX C: TRANSOCEAN MAINTENANCE COURSE

SECTION REDACTED

NON-CONFIDENTIAL SUMMARY OF INFORMATION: This section provides the author’s detailed notes and observations of the Maintenance Course. This includes a list of crew personnel in attendance, including their title and assigned rig, and additional commentary by the author regarding what the course consists of, its objectives and overall goal. This section also describes an overview of a new Transocean electronic system, AIM, developed to record and feed back information for trending purposes and other issues relating to Transocean’s maintenance program.

Today, rig crews know, based on procedures and checklists, what to do to maintain and prevent breakdown of the equipment. This understanding will increase with the additional information and capabilities of the new system. This is emphasized by the management quote:

“Our maintenance strategy has become mission critical. Customers, regulators and executive management all insist that our maintenance management is best in class and that is strictly followed. If you see a problem you must report it and non-compliance is not an option”

“Maintenance strategies are developed and executed to ensure safe and environmentally responsible operations, regulatory compliance and operational efficiency.”

The Primary Standards for all the rigs to be met were discussed:

Company Regulatory Requirements
- ISM Code;
- SEMS (U.S. CFR Title 30, 33, 46) API 75 SEMS;
- ISO 9001 Quality;
- ISO 14001 Environment;
- API Q2 Quality Management System Requirements; and
- API Std 53 Blowout Prevention Equipment Systems for Drilling Wells.

Maintenance Guidelines
- ISO 14224 Reliability & Maintenance Data for Equipment;
- ISO 55000 Asset Management;
- Norsok Z-008 Risk based maintenance and consequence classification; and
- EN 15341 Maintenance Key Performance Indicators.

There have been some changes in the designations on SCE when there is a rating designation of “Developing” (e.g. there is something to watch but not yet to change out). Since the TRN is always the highest with no diminishing multiplier applied for any SCE, this was not a concern nor did it need to be evaluated further as part of the PSC review.

The determination for Transocean working to improve industry culture can be illustrated by an example provided by the instructor. Transocean had found that some springs in subsea valves were failing with a high frequency, but the OEM did not respond to investigate and fix the issue. Therefore, Transocean’s upper management took the information to the OEM’s Quality Certifier, presented the data, and the OEM then focused on this important Transocean concern.
APPENDIX D: SCOPE OF WORK

TRANSOCEAN CONSENT DEGREE INDEPENDENT PROCESS SAFETY CONSULTANT

[DEVELOPED JOINTLY BETWEEN TRANSOCEAN AND OFFSHORE RISK & TECHNOLOGY INC. BASED ON CONSENT DEGREE AND PERFORMANCE PLAN LANGUAGE]

Per Consent Decree and Performance Plan. The role of the Independent Process Safety Consultant is to assist Transocean in evaluating its process safety, including operational risk identification and management of risk, by reviewing Transocean’s practices related to the process safety related aspects of the Consent Decree, specifically BOP testing and maintenance, training, and Well Control. Primary deliverable involves two reports; one presented by October 2, 2015 and the other by October 17, 2017.

Based on a review of Transocean’s systems and processes, as well as a good understanding of how offshore drilling companies in the Gulf of Mexico should and do address process safety, the following will be the four areas that the Process Safety Consultant will review in order to prepare the two required reports. In addition, prior to each report being completed, the Process Safety Consultant will conduct at least two rig visits to interview employees involved in the process and evaluate first hand whether there is good knowledge and compliance with process safety.

1. A careful review and analysis of the extensive process safety related information contained in the Transocean HSE Safety Case applicable to the individual rigs operating in waters of the US. The Safety Cases are over 350 pages in length and address numerous related issues. These include, in sequence as outlined in the safety cases:

   a. Overall management system description (essentially same for each rig) including objectives, functions involved, responsible parties, competencies, standards and procedures for specific areas such as Drilling and Well Control Operations and Alerts and Bulletins, and finally a description of required performance monitoring including audit and compliance and verification of HSE critical activities/task and equipment/systems.

   b. Rig-Specific description and supporting information including information on classification and design of the rig, detailed drilling, completion and Well Control systems, fire and explosion protection, evacuation and escape systems, and well testing.

   c. A risk management section, which includes information on crude oil under pressure and hydrocarbons in formation.

   d. Emergency Response Section detailing the policy, plans, control and command, training for emergency, and evacuation and escape.

   e. Performance Monitoring sections including periodic monitoring and analysis of any incidents, behavior based observations, audit and audit compliance, verification of HSE critical activities/tasks and equipment/systems.

2. A careful review and evaluation of Transocean’s Audit and Compliance Policies and Requirements documents that have been provided to the U.S. government agencies.
These documents are the basis for the mandatory rig audits that are conducted by Transocean’s corporate HSE audit group and the Process Safety Consultant will participate in one or more of such rig audits to evaluate the auditing effort relating to process safety related issues. These audits look for any non-compliance and in particular whether there are any major non-conformances/material deficiencies at the rigs.

3. **A careful review and evaluation of Transocean maintenance processes, requirements and tracking for Well Control equipment, in particular BOPs.** This review and evaluation will include the need to assess one or more BOP manufacturer’s recommendations for maintenance, requirements to use only OEM parts and related issues. That information will be evaluated along with Transocean practices and how those issues are internally reviewed and addressed within the Gulf of Mexico.

4. **A careful review of Transocean’s training and competency assessments for rig workers involved in process safety activities.** This evaluation will include the need to review in detail training and/or assessment standards developed by IADC, OPITO and any others as agreed to by Transocean and the Process Safety Consultant. The evaluation will include the Process Safety Consultant directly participating in process safety related courses and reviewing other relevant modules the Process Safety Consultant believes are important for the review.

The Process Safety Consultant will also attend the Q2 or Q3 2014 Transocean Offshore Drilling Ltd. HSE Committee and Board meetings to understand what information the Committee is already periodically receiving and obtain input regarding what information would be of assistance for their required process safety related evaluations.

In addition, through conducting the reviews as described above, if other areas to review are identified, the Process Safety Consultant, Transocean and the U.S. government agencies will in good faith discuss the possible expansion of the scope provided it is reasonable and consistent with the applicable language of the Consent Decree and Performance Plan.

It is intended that the Process Safety Consultant’s report will focus on a summary of the review and any observations, conclusions or opinions regarding Transocean’s process safety efforts. The report shall include at a minimum a detailed description of 1) the review process used; 2) the assessments, evaluations and conclusions made; and 3) the background and rationale for conclusions.

The intent of the report is to provide this important independent information to Transocean management and the Transocean Offshore Deepwater Drilling Inc. HSE Committee of the Board of Directors as part of their obligation to evaluate the risks and processes associated with process safety, specifically BOP testing and maintenance, training and Well Control. The report will not focus on recommendations for any improvements and Transocean will need to carefully determine appropriate steps for any required remedial plan to better understand the actual implications and help ensure the greatest possible positive impact.

In addition, as referenced above, if at any time while the Process Safety Consultant is conducting the review the Process Safety Consultant concludes that there are any “material deficiencies” in
Transocean's process safety relating to this Scope of Work, the Process Safety Consultant is to immediately report this conclusion in writing to Transocean, the TODDI HSE Committee and the U.S. government agencies. For purposes of this scope of work, the definition of material deficiency is the same definition used within Transocean's internal Audit and Compliance Manual for "major non-compliance": A deviation from requirements that pose a serious threat to 1) the safety of personnel; 2) the vessel; 3) the environment; or 4) indicates the lack of effective systemic implementation of a requirement.
Appendix E: Methodology and Scope

This Supplemental Report was prepared by Dr. Malcolm Sharples with Offshore: Risk & Technology Consulting Inc. and represents the PSC’s report as agreed upon in the Scope of Work, Appendix D. The PSC’s intent is to provide a comprehensive view of Transocean’s methods of assuring Process Safety and as such required an in-depth and well-considered review of the system of safety to prevent and/or mitigate results of a major accident event related to the requirements outlined in the Scope of Work. In some cases, an explanation of the background to the requirement is provided to ensure that the reader understands the basis of the issues and opinions.

The review activities used by the PSC to identify the method by which Transocean’s system of safety takes care of preventing a Process Safety accident or minimizing the consequences should it occur are below.

A thorough review of several Safety Cases and referenced safety management documents referred to in the Safety Cases. Ultimately, for the Supplemental Report, more than 190 documents were produced some with additional revisions as they became available. The review of written documentation was supplemented with examination of Management System internal audits, and external audits as well as real time reviews of Transocean databases (FOCUS, RMS, GMS, and HSE Toolbox). In addition, interviews with managers and crew members to confirm that the intended documented safety system was a reality for the rig crews/teams were conducted.

Over 220 industry standards and documents were carefully reviewed including API Stds and recommended practices, OPITO (safety) standards, International Marine Contractor's Association standards (marine and DP guidance), OGP Reports on BOPs, Competency and Process Safety, and IADC guidelines on Well Control training and competency. Additionally, the 18+ reports from the Macondo inquiries were reviewed together with many of the documents publicly available from the related investigations, books and trials. This review effort was done in order to ensure that the this PSC review considered any legitimate issues that had been identified from testimony or exhibits presented, which were in the subject areas. More than 40 industry papers/books were also reviewed including some on cultural and social psychology issues to do with crew activities. Industry databases (e.g., BSEE, USCG, OGP, etc.) on reported accidents were independently searched and data reviewed in order to ensure that any major incidents lessons learned, where causes were adequately determined and reported, had been recorded and acted upon.

Interviews were conducted with a wide range of personnel, and over a wide range of subjects related to Process Safety. A two-day Crew Briefing held by BHP was attended. A three-day intensive Maintenance Management course was attended. In both events the opportunity was taken to have crew interviews, discussions and evaluation. An in-depth enquiry session was with Maersk at their Houston Training Facility. Observations are provided in Appendix B.

The review did not find any material deficiencies in Transocean's drilling rigs' MAHRAs or its operational oversight of Well Control equipment, which might produce a Process Safety accident event.

Transocean’s efforts in developing a safety culture with an awareness of the social psychology programs developing a crew awareness of the concepts of Groupthink, Confirmation Bias, Normalization of Deviance and Situational Awareness is to be applauded as significant progress in Process Safety.
TRANSOCEAN’S COOPERATION AND TRANSPARENCY

Transocean’s senior management and all other Company employees engaged by the PSC, notably the crew, fully cooperated during the Supplemental Report review. This included responding to a large number of requests for information and follow-up information as the Supplemental Report progressed. A document trail was closely mapped and followed.

Transocean was also fully transparent regarding the information, documents, and disclosures of issues. In all cases, documents requested were supplied efficiently or made available for viewing. When requested, presentations were given and computer programs for items such as maintenance systems and incident reporting and investigations were demonstrated. The responses to all interrogations were satisfactory.

The PSC was provided full access to Transocean employees, as needed including subject matter experts for particular questions.
**NOMENCLATURE:**

<table>
<thead>
<tr>
<th>Abbreviation</th>
<th>Explanation</th>
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<tbody>
<tr>
<td>API</td>
<td>American Petroleum Institute</td>
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<tr>
<td>API RP</td>
<td>API Recommended Practice</td>
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<tr>
<td>API Std</td>
<td>API Standard</td>
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<tr>
<td>Blueprint Process</td>
<td>Structured Work Identification Strategy whereby a maintenance strategy is developed (particularly with multiple prior rig owners)</td>
</tr>
<tr>
<td>BOP</td>
<td>Blowout Preventer</td>
</tr>
<tr>
<td>BSEE</td>
<td>Bureau of Safety and Environmental Enforcement</td>
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<tr>
<td>BSR</td>
<td>Blind Shear Ram</td>
</tr>
<tr>
<td>CAMS</td>
<td>Competence Assessment Management System</td>
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<tr>
<td>CAP</td>
<td>Competency Assessment Program (OPITO certified)</td>
</tr>
<tr>
<td>CM</td>
<td>Corrective Maintenance</td>
</tr>
<tr>
<td>COMOPS</td>
<td>Combined Operations</td>
</tr>
<tr>
<td>COW Process</td>
<td>Control of work</td>
</tr>
<tr>
<td>DINC</td>
<td>Incident of Non-Compliance (BSEE term for non-conformance) assigned to a Drilling Contractor</td>
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<tr>
<td>DNV</td>
<td>Det Norske Veritas – a Classification Society with expertise in Safety Cases</td>
</tr>
<tr>
<td>DOC</td>
<td>Document of Compliance (ISM Code)</td>
</tr>
<tr>
<td>DOJ</td>
<td>Department of Justice</td>
</tr>
<tr>
<td>DP</td>
<td>Dynamic Positioning - system of holding position at a specific location</td>
</tr>
<tr>
<td>DPA</td>
<td>Designated Person Ashore</td>
</tr>
<tr>
<td>DP-CAP</td>
<td>Dynamic Positioning Competency Assessment Program</td>
</tr>
<tr>
<td>DPO</td>
<td>Dynamic Positioning Operator</td>
</tr>
<tr>
<td>Drill</td>
<td>Notation of DNV, which notes they have a certified drilling system</td>
</tr>
<tr>
<td>EDS</td>
<td>Emergency Disconnect System - shearing and releasing Lower Marine Riser (LMRP)</td>
</tr>
<tr>
<td>EPA</td>
<td>Environmental Protection Agency</td>
</tr>
<tr>
<td>ERP</td>
<td>Emergency Response Plan</td>
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<tr>
<td>Abbreviation</td>
<td>Explanation</td>
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<tr>
<td>ESD</td>
<td>Emergency Shutdown System (i.e. for engines and may not be automated)</td>
</tr>
<tr>
<td>FOCUS</td>
<td>Planning and tracking tool for corrective and improvement actions: Formulate an action plan, organize resources to carry out the plan, Communicate the action plan, Undertake the action, Summarize and capture lessons learned</td>
</tr>
<tr>
<td>GMS</td>
<td>Global Management System</td>
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<tr>
<td>GOM</td>
<td>Gulf of Mexico</td>
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<tr>
<td>HPHT</td>
<td>High Pressure High Temperature</td>
</tr>
<tr>
<td>HSE</td>
<td>Health, Safety and Environment</td>
</tr>
<tr>
<td>HSE Case</td>
<td>Synonym for the Safety Case (as used in this document)</td>
</tr>
<tr>
<td>HSE Toolbox</td>
<td>Procedures (usually electronic) for interfacing with crew before a job starts</td>
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<tr>
<td>IADC</td>
<td>International Association of Drilling Contractors</td>
</tr>
<tr>
<td>INC</td>
<td>Incident of Non-Compliance (BSEE term for non-conformance)</td>
</tr>
<tr>
<td>IMCA</td>
<td>International Marine Contractor’s Association</td>
</tr>
<tr>
<td>IMO MODU CODE</td>
<td>International Maritime Organization standards for Design and Construction of MODUs</td>
</tr>
<tr>
<td>Integrity Management</td>
<td>Another term for Process Safety</td>
</tr>
<tr>
<td>ISM Code</td>
<td>International Safety Management Code: The maritime code, as defined in 46 U.S.C. §3201(1), for the international standard for the safe management and operation of ships and for pollution prevention</td>
</tr>
<tr>
<td>KSA</td>
<td>Knowledge, Skill, and Ability Competencies (IADC Program)</td>
</tr>
<tr>
<td>Level 1 Documents</td>
<td>Executive Level (Corporate)</td>
</tr>
<tr>
<td>Level 2 Documents</td>
<td>Operational Hub Level</td>
</tr>
<tr>
<td>Level 3 Documents</td>
<td>Rig Specific</td>
</tr>
<tr>
<td>MAHRA</td>
<td>Major Accident Hazards Risk Assessment</td>
</tr>
<tr>
<td>MMA</td>
<td>Maintenance Management Audit</td>
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<tr>
<td>Abbreviation</td>
<td>Explanation</td>
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<tr>
<td>MMS</td>
<td>Minerals Management Service, Dept. of Interior - former name of BSEE</td>
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<tr>
<td>MSA</td>
<td>Management System Audit</td>
</tr>
<tr>
<td>MODU</td>
<td>Mobile Offshore Drilling Unit</td>
</tr>
<tr>
<td>Notation</td>
<td>An optional Classification society certification to include drilling equipment</td>
</tr>
<tr>
<td>NTL</td>
<td>Notice to Lessee - a requirement promulgated by BSEE in addition to the CFR requirement</td>
</tr>
<tr>
<td>OCS</td>
<td>Outer Continental Shelf</td>
</tr>
<tr>
<td>OEM</td>
<td>Original Equipment Manufacturer</td>
</tr>
<tr>
<td>OI Barrier Tool</td>
<td>OI Barrier Tool - used where an actual or the potential for an OI Event exists (not for normal use) Troubleshooting, Unplanned Maintenance or Unplanned or Unanticipated Events</td>
</tr>
<tr>
<td>OIM/Master</td>
<td>Offshore Installation Manager</td>
</tr>
<tr>
<td>OJT</td>
<td>On-the-Job Training</td>
</tr>
<tr>
<td>Operator</td>
<td>The person the lessee(s) (Oil Company/Operator) designates as having control or management of operations on the leased area</td>
</tr>
<tr>
<td>OPITO</td>
<td>Offshore Petroleum Industry Training Organization</td>
</tr>
<tr>
<td>PdM</td>
<td>Preventive Maintenance is a maintenance strategy based on inspection, component replacement and overhauling at a fixed interval regardless of condition at the time. Usually scheduled inspections are performed to assess the condition of an asset. This strategy aims to reduce the probability of failure or equipment degradation</td>
</tr>
<tr>
<td>PM</td>
<td>PdM is defined as a maintenance strategy based on the actual condition (health) of an asset as determined from non-invasive measurements and tests. PdM allows preventive and corrective actions to be optimized by avoiding traditional calendar or usage based related maintenance tasks. Condition of the equipment can be measured using condition monitoring, statistical process control, or equipment performance. PdM and Condition Based Maintenance (CBM) are used interchangeably. PdM drives us to understand the true condition of our equipment and helps us to identify proactive maintenance actions to be performed at a scheduled point in time when the maintenance activity is most cost effective and before the asset fails in service (doing the right maintenance at the right time)</td>
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<tr>
<td>Abbreviation</td>
<td>Explanation</td>
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<tr>
<td>PSC</td>
<td>Process Safety Consultant</td>
</tr>
<tr>
<td>RCM</td>
<td>Reliability Centered Maintenance - standard preventative maintenance triggered by predicting time to failure &amp; time for repair</td>
</tr>
<tr>
<td>Review</td>
<td>Capitalized Review - means the examination undertaken by the Process Safety Consultant - Follow-up Review in this document</td>
</tr>
<tr>
<td>Rig</td>
<td>Synonym for MODU</td>
</tr>
<tr>
<td>RMS</td>
<td>Rig Management System - a computer based Maintenance Program</td>
</tr>
<tr>
<td>ROPO</td>
<td>Register of Permitted Operations - synonymous with Summary of Operational Boundaries and SIMOPS as used in this Report</td>
</tr>
<tr>
<td>ROV</td>
<td>Remotely Operated Vehicle</td>
</tr>
<tr>
<td>RRP</td>
<td>Rig Recommended Practice - previously called Rig Specific Procedure, RSP, or when mandatory, MRSP</td>
</tr>
<tr>
<td>RSTC</td>
<td>Rig Safety and Training Coordinator</td>
</tr>
<tr>
<td>SEMS</td>
<td>Safety and Environmental Management System</td>
</tr>
<tr>
<td>SCA</td>
<td>Safety Critical Activities</td>
</tr>
<tr>
<td>SCE</td>
<td>Safety Critical Equipment or Element</td>
</tr>
<tr>
<td>SCS</td>
<td>Safety Critical System</td>
</tr>
<tr>
<td>SIMOPS</td>
<td>Simultaneous Operations-that can be carried out at the same time, and those that cannot (usually a chart); Summary of Operational Boundaries - synonymous with ROPO and SOOB as used in this Report</td>
</tr>
<tr>
<td>SMART</td>
<td>System Management Review Team Process - the means to communicate and implement change to the management system (represented in manuals and other documents) to corporate, division and field personnel</td>
</tr>
<tr>
<td>SMC</td>
<td>Safety Management Certificate - for a MODU for the ISM Code</td>
</tr>
<tr>
<td>SMS</td>
<td>Safety Management System synonymous with Safety and Environmental Management System as used in this Report</td>
</tr>
<tr>
<td>SOOB</td>
<td>Summary of Operational Boundaries - synonymous with ROPO and SIMOPS as used in this Report</td>
</tr>
<tr>
<td>START</td>
<td>START Conversations are used to observe to workplace practices and conditions in order to maintain and improve safe behavior</td>
</tr>
<tr>
<td>Abbreviation</td>
<td>Explanation</td>
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<tr>
<td>SV-DV</td>
<td>Self-Verification - Division Verification - a program to test specific knowledge of procedures on Transocean MODUs</td>
</tr>
<tr>
<td>TODDI</td>
<td>Transocean Offshore Deepwater Drilling Inc</td>
</tr>
<tr>
<td>TOFS</td>
<td>Time Out for Safety</td>
</tr>
<tr>
<td>TPRA</td>
<td>Task Planning and Risk Assessment</td>
</tr>
<tr>
<td>USCG</td>
<td>United States Coast Guard</td>
</tr>
<tr>
<td>UPS</td>
<td>Uninterruptible Power Supply (Battery)</td>
</tr>
<tr>
<td>UWA</td>
<td>Ultimate Work Authority - (30 C.F.R. § 250.1931)</td>
</tr>
<tr>
<td>WC</td>
<td>Well Control</td>
</tr>
<tr>
<td>WSOG</td>
<td>Well Specific Operating Guideline</td>
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</tbody>
</table>
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