Process Safety Assessment Final Report

Submitted to
The Bureau of Safety and Environmental Enforcement (BSEE)

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Executive Summary

A Safety and Environmental Management System (SEMS) is a nontraditional, performance-focused tool for integrating and managing oil and gas operations on the Outer Continental Shelf (OCS). It has been present on the OCS in some form since 1993 with the publishing of the American Petroleum Institute's (API) Recommended Practice (RP) 75; however, implementation of SEMS before 2010 was voluntary. After 2010, SEMS regulations were made mandatory under Code of Federal Regulations (CFR) Title 30, Part 250, Subpart S.

The goal of BSEE's SEMS program is to encourage the offshore oil and gas industry to adopt an approach to safety that looks beyond baseline compliance with regulations towards a safety culture that promotes knowledgeable leadership, widespread ownership and continuous improvement in safety and environmental protection. To foster continuous improvement, BSEE initiated an analysis of other process safety related industry standards, regulatory regimes and documents to identify useful concepts that can guide further improvements in the treatment of offshore process safety issues, either within Subpart S or within API Recommended Practice 75 which is incorporated by reference within the Subpart S regulation.

Process Safety is a blend of engineering and management skills focused on preventing catastrophic accidents associated with the use of chemicals and petroleum products.[1] Process safety focuses on prevention of fire, explosion resulting from the unintended hazardous chemical releases and which can have serious effects on the people, environment or the subject facility.

This report provides an overview of existing process safety industry standards and regulations, the methodology and findings of a comparative analysis of both the Subpart S regulation and the API RP 75 standard against process safety related standards and regulations, and recommendations for future rulemaking to improve the effectiveness of SEMS and the overall safety culture of oil and gas operations on the OCS. **Table E.1** provides a summary of the assessment findings and recommendations.

Table E.1: Summary of Findings

Key Elements of the Subpart S Regulation / API RP 75 Standard		API RP 750	API RP 754	API RP 14J	API 770	UK HSE	IADC MODU	ISO 31000	ISO IEC 31010	ISO 10418	OSHA	OGP 456
≠	No direct Comparison	●	Similar approach			REC	Recommendation					
(1)	General	●	REC	●	REC	●	●	REC	REC	●	●	REC
(2)	Safety and Environmental Information	●	●	●	REC	●	●	●	●	●	●	●
(3)	Hazards Analysis	●	●	●	REC	REC	REC	REC	●	●	●	●

[1] "Process Safety FAQs." American Institute of Chemical Engineers. http://www.aiche.org/ccps/about/process-safety-faqs#What%20is%20Process%20Safety.

Key Elements of the Subpart S Regulation / API RP 75 Standard		API RP 750	API RP 754	API RP 14J	API 770	UK HSE	IADC MODU	ISO 31000	ISO IEC 31010	ISO 10418	OSHA	OGP 456
≠	No direct Comparison	●	Similar approach			REC	Recommendation					
(4)	Management of Change	●	●	●	REC	●	●	≠	≠	≠	●	●
(5)	Operating Procedures	●	≠	●	REC	●	●	≠	≠	●	●	●
(6)	Safe Work Practices	●	≠	≠	≠	●	●	≠	≠	≠	●	●
(7)	Training	●	●	●	REC	≠	●	≠	≠	≠	●	●
(8)	Mechanical Integrity	●	●	●	≠	●	●	≠	≠	●	●	●
(9)	Pre-startup Review	●	●	●	≠	●	●	≠	≠	●	●	●
(10)	Emergency Response and Control	●	●	●	REC	●	●	≠	≠	●	●	●
(11)	Investigation of Incidents	●	●	≠	REC	●	●	≠	≠	≠	●	≠
(12)	Auditing	●	≠	≠	≠	●	●	≠	≠	≠	●	≠
(13)	Recordkeeping (Records and Documentation)	●	≠	≠	≠	●	●	≠	≠	●	≠	≠
(14)	Stop Work Authority (SWA)*	●	≠	≠	≠	≠	≠	≠	≠	≠	≠	≠
(15)	Ultimate Work Authority (UWA)*	●	≠	≠	≠	≠	≠	≠	≠	≠	≠	≠
(16)	Employee Participation Plan (EPP)*	●	≠	≠	≠	●	●	≠	≠	≠	●	≠
(17)	Reporting Unsafe Working Conditions*	●	●	≠	≠	≠	≠	≠	≠	≠	≠	≠

*Applies to Subpart S Analysis Only

The assessment revealed opportunities to strengthen the management system approach to preventing major process safety incidents by incorporating additional requirements or guidance within Subpart S or within API RP 75 which is incorporated by reference into the Subpart S regulation. Additional guidance and specificity on topics such as the consideration of human factors, the use of performance indicators, and the quantification of risk can reduce confusion and improve focus throughout the offshore industry. The following set of recommendations resulted from the process safety assessment.

1. Establish a framework for reporting leading and lagging indicators.
2. Provide guidance on implementation of barrier management strategies to improve the overall barrier management approach.
3. Adopt a comprehensive human factors standard and require qualitative or quantitative Human Reliability Analysis for each process or operation.

4. Incorporate components of the ALARP concept and risk tolerability into the SEMS regulations or API RP 75.
5. Incorporate barrier performance measurement guidance into the SEMS regulations or API RP 75.
6. Establish SEMS guidance for MODU owners and contractors.
7. Incorporate the risk management framework, process, and best practices described in ISO 31000:2009 into the current risk management approach.
8. Incorporate guidance on the selection and application of risk assessment techniques.
9. Provide additional guidance on active barrier management, measurement and maintenance.

These recommended improvements can be achieved by BSEE and the Offshore Oil & Gas Industry through multiple routes, one of which may include a modification directly to the regulation; however many of these improvements can be achieved by revising or adopting existing industry standards such as API RP 75.

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List of Acronyms

ALARP	As Low As Reasonably Practicable
ANPR	Advance Notice of Proposed Rule
API	American Petroleum Institute
ASTM	American Society for Testing and Materials
BOEMRE	Bureau of Ocean Energy Management, Regulation and Enforcement
BSEE	Bureau of Safety and Environmental Enforcement
CFR	Code of Federal Regulations
DCR	Design and Construction Regulations
EPP	Employee Participation Plan
GOM	Gulf of Mexico
HFE	Human Factors Engineering
HRA	Human Reliability Analysis
HSE	Health and Safety Executive
HSE	Health, Safety and Environmental
HSW	Health and Safety at Work
IADC	International Association of Drilling Contractors
ICA	Instrument Criticality Analysis
ISO	International Organization for Standardization
JSA	Job Safety Analysis
KPI	Key Performance Indicator
LOPC	Loss of Primary Containment
MMS	Minerals Management Service
MOA	Memorandum of Agreement
MODU	Mobile Offshore Drilling Unit
NPR	Notice of Proposed Rule

NRCMB	National Research Council’s Marine Board
OCS	Outer Continental Shelf
OGP	Oil & Gas Producers
OSCR	Offshore Safety Case Regulation
PDI	Process Design Information
PFEER	Prevention of Fire and Explosion, Emergency Response
PSE	Process Safety Event
PSM	Process Safety Management
RP	Recommended Practice
SEMP	Safety and Environmental Management Program
SEMS	Safety and Environmental Management System
SME	Subject Matter Expert
SWA	Stop Work Authority
U.K.	United Kingdom
USCG	United States Coast Guard
UWA	Ultimate Work Authority
VCA	Valve Criticality Analysis

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1. Introduction

The Bureau of Safety and Environmental Enforcement (BSEE) is responsible for the oversight of exploration, development, and production operations for oil and natural gas on the Outer Continental Shelf (OCS). BSEE's regulation and oversight of Federal offshore resources is intended to ensure that energy development on the OCS is done in a safe and environmentally responsible manner. The functions of BSEE include oil and gas permitting, facility inspections, regulations and standards development, safety research, data collection, technology assessments, field operations, incident investigation, environmental compliance and enforcement, oil spill prevention and readiness, oversight of production and development plans, and resource conservation efforts.

On October 15, 2010 BSEE issued regulations for all operators on the OCS to have a functioning Safety and Environmental Management System (SEMS) program in an effort to:

- focus on the influences that human error and poor organization have on accidents;
- foster continuous improvement;
- encourage the use of performance-based operating practices; and
- collaborate with industry in efforts that promote offshore worker safety and environmental protection.

The goal of BSEE's SEMS program is to encourage the offshore oil and gas industry to adopt an approach to safety that looks beyond baseline compliance with regulations towards a safety culture that promotes knowledgeable leadership, widespread ownership and continuous improvement in safety and environmental protection. The SEMS program is meant to be a tool through which companies actively manage and improve safety performance related to human behavior, organizational structure, leadership, standards, processes, and procedures – not simply a compilation of required documentation.[2]

SEMS has been present on the OCS in some form since 1993 with the publishing of the American Petroleum Institute's (API) Recommended Practice (RP) 75. The SEMS regulations were made mandatory in 2010 under Code of Federal Regulations (CFR) Title 30, Part 250, Subpart S. To foster continuous improvement, BSEE initiated an analysis of other process safety related industry standards, regulatory regimes and documents to identify useful concepts that can guide further improvements in the treatment of offshore process safety issues, either within Subpart S or within API Recommended Practice 75 which is incorporated by reference within the Subpart S regulation.

This report provides an overview of existing process safety industry standards and regulations, the methodology and findings of a comparative analysis of both the Subpart S regulation and the API RP 75 standard against process safety related standards and regulations, and recommendations for future rulemaking to improve the effectiveness of SEMS and the overall safety culture of oil and gas operations on the OCS.

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[2] Bureau of Safety and Environmental Enforcement, FY2016 Budget Justification

2. Background

On October 15, 2010, BSEE published the Final Rule for SEMS, in the Federal Register [30 CFR Part 250 Subpart S] – [75 FR 63610]. The original SEMS rule, also known as the Workplace Safety Rule, covered all offshore oil and gas operations in federal waters and made mandatory the previously voluntary practices in API RP 75. While many people believe that the SEMS regulations were developed in response to the BP oil spill and blowout incident in 2010, SEMS has its origins two decades before.

Figure 1 illustrates the progress made toward the SEMS program in the 1990s. In 1990, the National Research Council's Marine Board (NRCMB) found that the prescriptive approach to regulating offshore operations used by BSEE's predecessor agency, the Minerals Management Service (MMS), had forced industry into a compliance mentality. In response to NRCMB study, API developed RP 75 – Development of a Safety and Environmental Management Program (SEMP) for Outer Continental Shelf Operations and Facilities. One year later, in 1994, MMS published a Notice in the Federal Register that recognized API RP 75 as meeting the spirit of SEMS. In 1998, API RP 75 was updated to focus more on contract operations, including mobile offshore drilling units (MODUs).

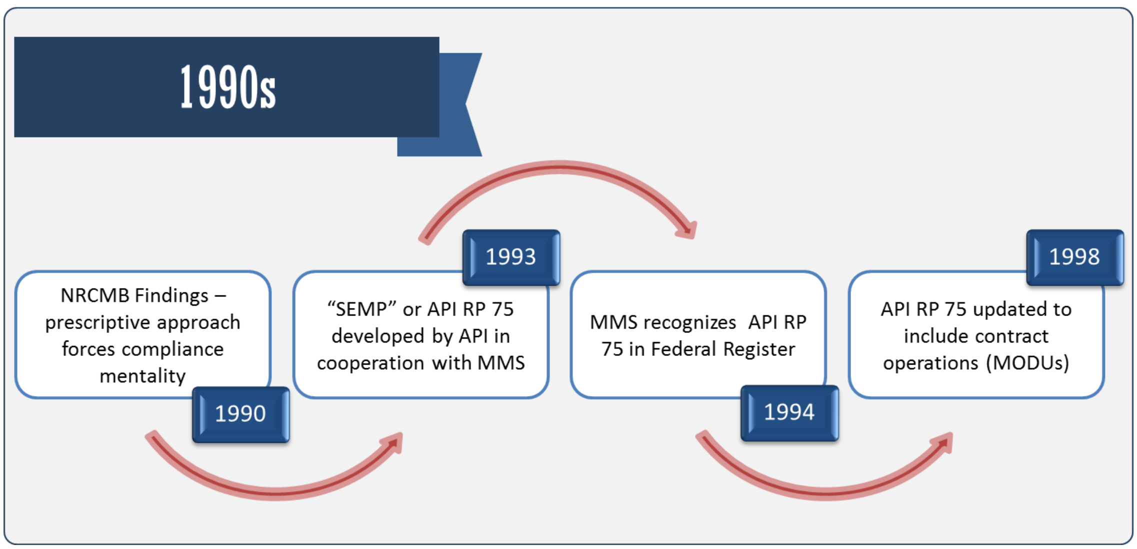

Figure 1: SEMS Timeline (1990s)

Figure 2 shows significant milestones towards the SEMS regulations during the 2000s. The current edition of the standard incorporated by reference into the BSEE Subpart S regulation is API RP 75, 3rd Edition, published in 2004 and reaffirmed in 2008. In 2006, MMS published an Advance Notice of Proposed Rulemaking (ANPR) in the Federal Register to seek comments on improving the regulatory approach to safety and environmental management. The comment and information gathering period lasted three years until June 2009 when MMS published a Notice of Proposed Rule (NPR) based on feedback from the 2006 ANPR. In addition to the NPR, MMS organized a public meeting in September 2009 to discuss the proposed rule with industry.

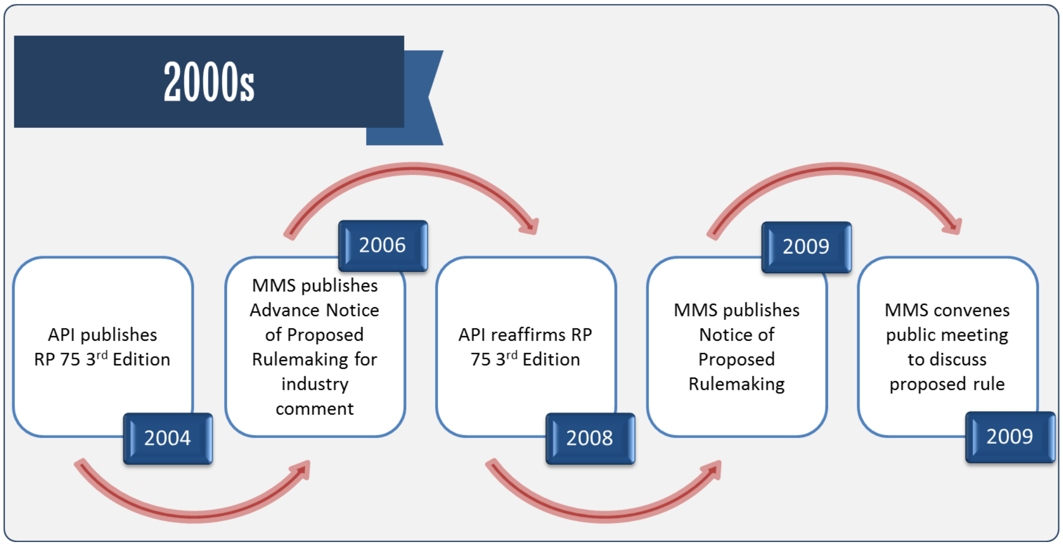

Figure 2: SEMS Timeline (2000s)

Following the BP oil spill and blowout incident in April 2010, the Bureau of Ocean Energy Management, Regulation and Enforcement (BOEMRE), formerly MMS, published the Final Rule for the SEMS program on October 15, 2010. Before BOEMRE was split and dissolved, the agency proposed revisions to the SEMS Rule in 2011. Based on the comments received from the Notice of Proposed Rulemaking published in the Federal Register on September 14, 2011, BSEE published the revised SEMS Rule, better known as SEMS II, on June 4, 2013. The SEMS II final rule enhances the original SEMS rule, providing greater protection by supplementing operators' SEMS programs with employee training, empowering field level personnel with safety management decisions and strengthening auditing procedures by requiring them to be completed by independent third parties. Since publication of the SEMS II Rule in 2013, BSEE strives to continuously improve the effectiveness of SEMS and the improvement of the overall safety culture of oil and gas operations on the OCS. **Figure 3** illustrates the continuing development of the SEMS regulations.

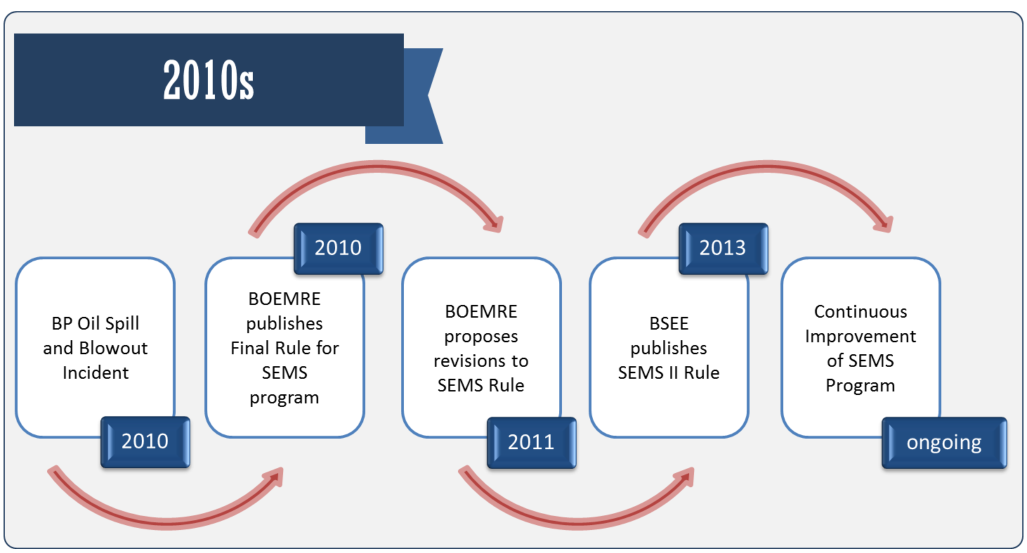

Figure 3: SEMS Timeline (2010s)

3. Assessment Methodology

The process safety assessment began with a review of the list of process safety documents provided by BSEE for analysis against BSEE Subpart S and API RP 75. The project team thoroughly reviewed each document and assigned a subject matter expert (SME) based on their area of expertise (e.g. risk analysis, hazard analysis, human factors) and existing knowledge of and involvement with the standard or regulation. In addition to those provided by BSEE, the team recommended other process safety related documents to include in the analysis such as API RP 14J (Recommended Practice for Design and Hazards Analysis for Offshore Production Facilities) and API 770 (A Managers Guide to Reducing Human Error; Improving Human Performance in the Process Industries).

SMEs were tasked with assessing whether each document contains essential process safety related information that is not addressed in the SEMS regulations or the API RP 75 standard. To support the comparative analysis, the team developed an assessment template, shown in **Figure 4** below. Each assessment included an analysis of direct comparisons, similarities, and gaps; a recommended action for BSEE; and a review of potential challenges or roadblocks for implementation. The Subpart S analysis was organized by the key elements of the BSEE SEMS Regulation, described in **Appendix A**. Similarly, the key elements of API RP 75 shown in **Appendix B** were used to conduct the comparative analysis.

BSEE Process Safety Assessment - API RP 75

Standard/Program	API RP 750
Full Title	API RP 750, Management of Process Hazards for Offshore Facilities (First Edition, 1990)
Reviewer	
Summary (scope, application, use, history)	

	API RP 75 Standard - Key Elements	RP 75 Element Key Points	Analysis (direct comparisons, similarities, gaps)	Recommended Action for BSEE	Implementation Challenges/Roadblocks
(1)	General	This recommended practice is intended to assist in			
(2)	Safety and Environmental information	The management program should require that a compilation			
(3)	Hazard Analysis	The management program should require that a hazards			
(4)	Management of Change	The management program should establish procedures to			
(5)	Operating Procedure	The management program should include requirements for			
(6)	Safe Work Practices	The management program should establish and implement			
(7)	Training	The management program should establish and implement			
(8)	Assurance of Quality and	The management program			

API RP 750 | API RP 754 | API RP 14J | API 770 | UK HSE | IADC MODUs | ISO 31000 | ISO 31010 | ISO 10418 | OGP | OSHA

Figure 4: Assessment Template

Table 1 on the following pages provides a summary of each process safety related standard or regulation analyzed during this study.

Table 1: Standard and Regulation Abstracts

Standard/Regulation	Abstract
BSEE SEMS regulation (Title 30, Part 250, Subpart S, §250.1900 - §250.1933)	The 30 CFR part 250, Subpart S, regulations for SEMS, describe the goal of the SEMS Program, aspects to be included in the SEMS program, management's general responsibilities, the safety and environmental information required, hazard analysis criteria, and the criteria for operating procedures that must be met by SEMS. It also includes the criteria that must be documented for safe work practices and contractor selection, training, mechanical integrity, pre-startup review, emergency response and control, investigation of incidents, and auditing requirements. The regulation also includes the parameters with which BSEE determines if the SEMS program is effective, recordkeeping and documentation requirements, and the procedures that must be included for reporting unsafe working conditions.[3]
API RP 75, Recommended Practice for Development of a Safety and Environmental Management Program for Offshore Operations and Facilities (Third Edition, May 2004, reaffirmed May 2008)	This RP is intended to assist in development of a management program designed to promote safety and environmental protection during the performance of offshore oil and gas and sulphur operations. This RP addresses the identification and management of safety hazards and environmental impacts in design, construction, start-up, operation, inspection, and maintenance, of new, existing, or modified drilling and production facilities. The objective of this RP is to form the basis for a SEMP. By developing a SEMP based on this RP, owners and operators will formulate policy and objectives concerning significant safety hazards and environmental impacts over which they can control and can be expected to have an influence. This standard recommends that each operator have a SEMP for their operations.[4]
API RP 750, Management of Process Hazards for Offshore Facilities (First Edition, 1990)	This RP is intended to assist in the management of process hazards by helping prevent the occurrence of, or minimize the consequences of, catastrophic releases of toxic or explosive materials. This RP addresses the management of process hazards in design, construction, start-up, operation, inspection, maintenance, and modification of facilities. It applies specifically to processes and facilities with a potential for catastrophic release. [5] This RP is intended for facilities that use, produce, process, or store the following substances: a) Flammable or explosive substances that are present in such quantity and condition that a sudden catastrophic release of more than 5 tons of gas or vapor can occur over a matter of minutes, based on credible failure scenarios and the properties of the materials involved.

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[3] "Title 30, Part 250, Subpart S – Safety and Environmental Management Systems (SEMS)." Code of Federal Regulations.

[4] "Recommended Practice for Development of a Safety and Environmental Management Program for Offshore Operations Facilities. API Recommended Practice 75." Third Edition. American Petroleum Institute. May 2004.

[5] "API RP 750: First Edition." Industry Standards & Regulations.

Standard/Regulation	Abstract
	b) Toxic substances that have a substance hazard index (SHI) greater than 5000 and that are present in amounts above a threshold quantity. This RP was developed for refineries, petrochemical operations, and major processing facilities.
API RP 754, Process Safety Performance Indicators for the Refining and Petrochemical Industries (First Edition, April 2010)	This RP identifies leading and lagging process safety indicators useful for driving performance improvement. As a framework for measuring activity, status or performance, this document classifies process safety indicators into four tiers of leading and lagging indicators. Tiers 1 and 2 are suitable for nationwide public reporting. Tiers 3 and 4 are intended for internal use at individual sites. This RP was developed for the refining and petrochemical industries, but may also be applicable to other industries with operating systems and processes where loss of containment has the potential to cause harm. [6] Performance indicators identified in this RP are based on the following guiding principles. [7] – Indicators should drive process safety performance improvement and learning. – Indicators should be relatively easy to implement and easily understood by all stakeholders (e.g. workers and the public). – Indicators should be statistically valid at one or more of the following levels: industry, company, and site. – Statistical validity requires a consistent definition, a minimum data set size, a normalization factor, and a relatively consistent reporting pool. – Indicators should be appropriate for industry, company, or site level benchmarking.

[6] "API RP 754: Process Safety Performance Indicators for the Refining and Petrochemical Industries," April 2010.

[7] "Fact Sheet Recommended Practice 754: Process Safety Indicators for the Refining and Petrochemical Industries." American Petroleum Institute. March 2010.

Standard/Regulation	Abstract
API RP 14J, Recommended Practice for Design and Hazards Analysis for Offshore Production Facilities	The purpose of this RP is to assemble into one document useful procedures and guidelines for planning, designing and arranging offshore production facilities; and performing a hazard analysis on open-type offshore platform facilities. [8] The document discusses several procedures that could be performed during a hazard analysis. It presents minimum requirements for process safety information and hazard analysis that can be used for satisfying the requirements of API RP 75. The concepts contained in this RP recognize that special hazard considerations exist for offshore production facilities. This RP is directed to those permanent or temporary installations associated with routine production operations. The guidelines presented should provide an acceptable level of safety when used in conjunction with referenced industry codes, practices or standards.
API 770: A Managers Guide to Reducing Human Errors; Improving Human Performance in the Process Industries	API 770 Publication: A Managers Guide to Reducing Human Errors; Improving Human Performance in the Process Industries (API-77001) is designed to equip managers with a basic understanding of the causes of human errors and to suggest ways for reducing human errors at individual facilities.[9] Published in 2001, API 770 is a standard written with the aim of giving managers from the middle to upper levels a basic understanding of human error. The guide is organized into four general steps. The first develops a glossary to clarify the jargon often used by professionals who study human error. The second identifies factors that shape human performance. The third suggests ways to improve performance and reduce errors. The fourth introduces human reliability analysis (HRA), a method for estimating the likelihood of human error. API 770 takes as its main motivation the axiom that human error contributes to most process industry accidents. It also assumes the need to understand how human error can be mitigated through human factors engineering (HFE).

[8] "Recommended Practice for Design and Hazards Analysis for Offshore Production Facilities. API Recommended Practice 14J (RP 14J) Second Edition, May 2001." American Petroleum Institute. May 2001.

[9] "A Manager's Guide to Reducing Human Errors, Improving Human Performance in the Process Industries." API Publication 770, March 2001. American Petroleum Institute.

Standard/Regulation	Abstract
United Kingdom Health and Safety Executive Safety Case Regulations (specifically sections relating to process safety)	The United Kingdom (U.K.) Health and Safety Executive (HSE) Offshore Installations Safety Case Regulations (OSCR) aim to reduce the risk from major accident hazards to the health and safety of the workforce employed on offshore installations, and in connected activities. A safety case is a document that gives confidence to both the duty holder and HSE that the duty holder has the ability and means to control major accident risks effectively. It provides an additional level of regulatory control compared to more prescriptive regulations such as: Offshore Installations Prevention of Fire and Explosion, and Emergency Response (PFEER) regulations, and the Offshore Installations and Wells Design and Construction Regulations (DCR), these are justified by major accident potential in offshore activities within scope. [10] The regulations implement the central recommendation of Lord Cullen's report on public inquiry on the Piper Alpha disaster. This recommendation states that the operator or owner of every offshore installation should be required to prepare a safety case and submit it to HSE for acceptance. [11] Of note, there is no difference between acceptance and approval for the U.K. HSE Safety Case. The OSCRs do not set standards for the control of major accident risks. These are set by PFEER, DCR and other regulations, as well as the Health and Safety at Work Act (HSW Act). A safety case demonstrates that the duty holder has arrangements in place which, if implemented, are capable of achieving compliance with these legal objectives. Safety cases are required for all installations operating, or to be operated, including: 1) new production installations to be established offshore (at early stage of design), 2) if a production installation is to be moved to a new location, and 3) if a non-production installation (e.g. MODU, flotels, floating storage units) is to be converted into a production installation. Non-production installations are required to have a safety case under Regulation 8 which requires every persons to co-operate with the operator or owner of an installation, among others, so far as is necessary to enable them to comply with all their legal responsibilities for health and safety, including their duties under the OSCR.[12]

[10] "A Guide to the Offshore Installations (Safety Case) Regulations 2005." Health and Safety Executive (HSE). 2006.
[11] "A Guide to the Offshore Installations (Safety Case) Regulations 2005." Health and Safety Executive (HSE). 2006.
[12] "A Guide to the Offshore Installations (Safety Case) Regulations 2005." Health and Safety Executive (HSE). 2006.

Standard/Regulation	Abstract
International Association of Drilling Contractors Health, Safety, and Environmental Case Guidelines for Mobile Offshore Drilling Units (MODUs) (version 3.4, Nov 1, 2011)	The International Association of Drilling Contractor (IADC) Health, Safety, and Environmental (HSE) Case Guidelines provide a framework for developing an integrated health, safety and environmental management system for use in reducing the risks associated with offshore and onshore drilling activities. The guidelines are intended to assist drilling contractors in preparing and reviewing HSE cases that should provide themselves and relevant international authorities with the assurances that their operations will comply with requirements and that they are being conducted within tolerable limits of safe operations.[13] The guidelines seek to identify and address specific coastal state regulatory requirements. While the guidelines offer advice on good practices and regulatory compliance, they are not an authoritative interpretation of each coastal state's regulatory requirements. Where questions of regulatory requirements are identified, the drilling contractor must confirm their application with the relevant Regulator. [14] An HSE Case has two primary purposes: 1. Demonstrate internal assurance within the drilling contractor's organization that its management system's risk reducing controls related to the HSE aspects of its operations meet senior management expectations. 2. Where applicable, demonstrate to the drilling contractor's external stakeholders that its management system's risk reducing controls meets their expectations. The HSE case demonstrates how a drilling contractor's organization applies a systematic risk management approach to maintain and improve HSE and operational performance. Developing and maintaining an HSE case provides continuous assurance that existing HSE risks are effectively managed and provides assurance that risks associated with changes to equipment, activities or locations, as well as systemic weaknesses identified by incident analyses and audits, will be effectively managed. [15]

[13] "Health Safety and Environment Case Guideline for Drilling Contractors." International Association of Drilling Contractors (IADC). Issue 3.2. October 3rd, 2006.
[14] "Health Safety and Environment Case Guideline for Drilling Contractors." International Association of Drilling Contractors (IADC). Issue 3.2. October 3rd, 2006.
[15] "Health Safety and Environment Case Guideline for Drilling Contractors." International Association of Drilling Contractors (IADC). Issue 3.2. October 3rd, 2006.

Standard/Regulation	Abstract
ISO 31000:2009, Risk management – Principles and guidelines	ISO 31000:2009 provides principles and general guidelines on risk management. This international standard is not specific to any industry or sector, and can be used by any public, private or community enterprise, association, group or individual. This standard can be applied throughout the life of an organization and to a wide range of activities, including strategies and decisions, operations, processes, functions, projects, products, services and assets. This standard establishes a number of principles that need to be satisfied to make risk management effective. ISO 31000:2009 describes the necessary components of the framework for managing risk and the way in which they interrelate in an iterative manner. ISO 31000:2009 also describes the risk management process, including the activities of communicating, consulting, establishing the context, and identifying, analyzing, evaluating, treating, monitoring and reviewing risk. [16]
ISO/IEC 31010:2009, Risk management – Risk assessment techniques	ISO 31010:2009 is a supporting standard for ISO 31000 and provides guidance on selection and utilization of risk assessment techniques. The application of a range of techniques is introduced, as well as the nature of the assessment and guidance to their applicability for certain situations. This standard does not deal specifically with safety. It is a generic risk management standard and is general in nature, so that it may give guidance across many industries and types of systems.[17]
ISO 10418 Basic Surface Safety Systems	ISO 10418 provides objectives, functional requirements and guidelines for techniques for the analysis, design and testing of surface process safety systems for offshore installations for the recovery of hydrocarbon resources. The basic concepts associated with the analysis and design of a process safety system for an offshore oil and gas production facility are described, together with examples of the application to typical (simple) process components. ISO 10418 is applicable to fixed offshore structures, floating production, storage and off-take systems for the petroleum and natural gas industries. This international standard is not applicable to mobile offshore units and subsea installations, although many of the principles contained in it may be used as guidance. [18]

[16] "ISO 31000:2009, Risk Management – Principles and guidelines." International Organization for Standardization. 2009.
[17] "ISO 31010:2009, Risk Management – Risk Assessment Techniques." International Organization for Standardization. 2009.
[18] "ISO 10418:2003, Petroleum and natural gas industries -- Offshore production installations -- Analysis, design, installation and testing of basic surface process safety systems." International Organization for Standardization. 2003.

Standard/Regulation	Abstract
OSHA Regulation 29 CFR 1910.119 – Process Safety Management of Highly Hazardous Chemicals	Section 119 of Part 1910 Subpart H, describes the process safety management (PSM) of highly hazardous chemicals in relation to Occupational Safety and Health Standards[19]. This section contains requirements for preventing or minimizing the consequences of catastrophic releases of toxic, reactive, flammable, or explosive chemicals. These releases may result in toxic, fire or explosion hazards. OSHA Standard Interpretations: Outer Continental Shelf lands--OSHA and the U.S. Coast Guard [1910.119] dated 02/02/1993, states the following; OSHA cannot enforce its regulations if the working conditions are already regulated by another agency (4(b)(1) of the OSH Act and 21(d) of OCSLA). The Department of the Interior regulates working conditions directly related to production platform activities and equipment, and the U.S. Coast Guard regulates production platform working conditions for safe access/egress, personal protective equipment, housekeeping, guarding of deck areas, lockout/tag out, lifesaving devices and equipment, lifeboats, firefighting equipment, fire extinguishers and systems, first-aid kits, emergency communications equipment, and commercial diving. In addition to the above statutory prescription, the PSM regulation does not apply to oil or gas well drilling or servicing operations (29 C.F.R. 1910.119(a)(2)(ii)). This exclusion would extend to those operations even if performed on an offshore platform. OSHA took this action because the agency has already undertaken rulemaking with regard to these activities (48 Federal Register 57202).
International Association of Oil & Gas Producers Report No. 456, Process Safety – Recommended Practice on Key Performance Indicators (November 2011)	The International Association of Oil & Gas Producers (OGP) Report No. 456, Process Safety – RP on Key Performance Indicators (November 2011), focuses on the prevention of the unplanned release which could result in a major incident via assets integrity management systems for new and existing upstream assets. It also includes preliminary guidance on monitoring and review, including how to establish lagging and leading key performance indicators (KPIs) to strengthen risk controls, or barriers, in order to prevent major incidents. A major incident is one that has resulted in multiple fatalities and/or serious damage, possibly beyond the asset itself. It is typically initiated by a hazardous release, but may also result from major structural failure or loss of stability causing serious damage to an asset.

[19] "Code of Federal Regulations (CFR) Title 29, Part No. 1910, Subpart: H, Standard No. 1910.119" Process Safety Management of Highly Hazardous Chemicals

Standard/Regulation	Abstract
	Development of KPIs is based on the principle that major incidents rarely result from a single cause, but rather by multiple failure effects, occurring coincidently and collectively, and resulting in an incident with severe consequences (Swiss cheese model). In order to prevent loss of primary containment (LOPC) events and mitigate their consequences, it is required to assess the quality of the barriers and strengthen those barriers that reflect weaknesses. For monitoring barrier performance within an asset integrity or process safety management system (e.g. SEMS), OGP recommends a four tier framework of process safety KPIs. The process includes recording of all untended LOPC events in order to establish leading and lagging KPIs for the barriers with proven weaknesses; and provide the basis for a stronger control with minimum defects. This is analogous to ensure that the 'holes in the cheese slices' shrink or disappear, greatly reducing the likelihood of their alignment. [20]

[20] "Process Safety – Recommended Practice on Key Performance Indicators. Report No. 456. November 2001." International Association of Oil & Gas Producers. November2011.

4. Summary of Findings

Table 2 provides a summary of the assessment findings and recommendations. For each element of the Subpart S regulation and the API RP 75 standard, the table indicates a similar approach described in the process safety related document (●); no direct comparison to the process safety related document (≠); or a recommendation for improving the treatment of offshore process safety issues (REC).

Table 2: Summary of Findings

Key Elements of the Subpart S Regulation / API RP 75 Standard		API RP 750	API RP 754	API RP 14J	API 770	UK HSE	IADC MODU	ISO 31000	ISO IEC 31010	ISO 10418	OSHA	OGP 456
≠	No direct Comparison	●	Similar approach			REC	Recommendation					
(1)	General	●	REC	●	REC	●	●	REC	REC	●	●	REC
(2)	Safety and Environmental Information	●	●	●	REC	●	●	●	●	●	●	●
(3)	Hazards Analysis	●	●	●	REC	REC	REC	REC	●	●	●	●
(4)	Management of Change	●	●	●	REC	●	●	≠	≠	≠	●	●
(5)	Operating Procedures	●	≠	●	REC	●	●	≠	≠	●	●	●
(6)	Safe Work Practices	●	≠	≠	≠	●	●	≠	≠	≠	●	●
(7)	Training	●	●	●	REC	≠	●	≠	≠	≠	●	●
(8)	Mechanical Integrity	●	●	●	≠	●	●	≠	≠	●	●	●
(9)	Pre-startup Review	●	●	●	≠	●	●	≠	≠	●	●	●
(10)	Emergency Response and Control	●	●	●	REC	●	●	≠	≠	●	●	●
(11)	Investigation of Incidents	●	●	≠	REC	●	●	≠	≠	≠	●	≠
(12)	Auditing	●	≠	≠	≠	●	●	≠	≠	≠	●	≠
(13)	Recordkeeping (Records and Documentation)	●	≠	≠	≠	●	●	≠	≠	●	≠	≠
(14)	Stop Work Authority (SWA)*	●	≠	≠	≠	≠	≠	≠	≠	≠	≠	≠
(15)	Ultimate Work Authority (UWA)*	●	≠	≠	≠	≠	≠	≠	≠	≠	≠	≠
(16)	Employee Participation Plan (EPP)*	●	≠	≠	≠	●	●	≠	≠	≠	●	≠
(17)	Reporting Unsafe Working Conditions*	●	●	≠	≠	≠	≠	≠	≠	≠	≠	≠

*Applies to Subpart S Analysis Only

API RP 75 is a legacy document from which the BSEE Subpart S regulation was developed; therefore, the recommendations identified in the Subpart S analysis are also applicable to API RP 75. Currently, the Subpart S regulation incorporates API RP 75, 3rd Edition into reference which includes all elements as provided in Subpart S except the following requirements introduced under SEMS II.

1. ***Job Safety Analysis (JSA)***—provides additional requirements for conducting a JSA.
2. ***Auditing***—requires that all SEMS audits be conducted by an audit service provider, accredited by a BSEE-approved accreditation body.
3. ***Stop Work Authority (SWA)*** — creates procedures that establish SWA and make responsible any and all personnel who witness an activity that is creating imminent risk or danger to stop work.
4. ***Ultimate Work Authority (UWA)***—clearly defines requirements establishing who has the UWA on the facility for operational safety and decision-making at any given time.
5. ***Employee Participation Plan (EPP)***—provides an environment that promotes participation by employees and management in order to eliminate or mitigate hazards on the OCS.
6. ***Reporting Unsafe Working Conditions***—empowers all personnel to report to BSEE possible violations of safety or environmental regulations and requirements and threats of danger.

Given the similarities between the two documents, the following subsections will include a discussion of the analysis and regulatory recommendations for Subpart S, and note where the recommendation is applicable to API RP 75.

4.1 API RP 750, Process Hazard Management on Offshore Facilities

API RP 750 emphasizes the management of process hazards through management systems addressing the following 11 areas:

1. Process safety information
2. Process hazards analysis
3. Management of change
4. Operating procedures
5. Safe work practices
6. Training
7. Assurance of the quality and mechanical integrity of critical equipment
8. Pre-startup safety review
9. Emergency response and control
10. Investigation of process-related incidents
11. Audit of process hazards management systems

API RP 750 includes criteria for process safety information; however, no gaps were identified compared to the current SEMS regulations. API RP 750 also includes criteria for updating Process Design Information (PDI), if the original PDI no longer exists with a process hazard analysis. The SEMS regulations take an identical approach with PDI as part of the hazard analysis element and record keeping element.

4.2 API RP 754, Process Safety Performance Indicators for the Refining and Petrochemical Industries

The purpose of this RP is to identify leading and lagging process safety indicators that are useful for driving performance improvement in the refining and petrochemical industries. These indicators can be used at individual facilities for the development of performance indicators, or for nationwide public reporting. A comprehensive leading and lagging indicators program provides useful information for driving improvement and reducing risks of major hazards by identifying the underlying causes and taking action to prevent recurrence.[21]

API RP 754 is informed by two key concepts from the process safety indicator pyramid, or accident pyramid introduced by H.W. Heinrich in 1931. First, safety accidents can be placed on a scale representing the level of consequence. Second, many precursor incidents with lesser consequences occur for each accident with greater consequences. Heinrich's model represents a predictive relationship between lower and higher consequence events. It is believed that a similar predictive relationship exists between lower and higher consequence process safety events (PSEs). Indicators that are predictive are considered leading indicators and may be used to identify a weakness that can be corrected before a higher consequence event occurs. API RP 754 organizes PSEs into four tiers. Tiers 1 and 2 are suitable for public reporting. Tier 3 and 4 indicators are intended for internal company use and for local (site) reporting.

Tier 1 Indicator – The count of Tier 1 PSEs is the most lagging performance indicator. It represents incidents with greater consequence resulting from actual losses of containment due to weaknesses in the barriers. When used in conjunction with lower tiers, it can provide a company with an assessment of process safety performance. A Tier 1 PSE is a LOPC with the greatest consequence.

Tier 2 Indicator – The count of Tier 2 PSEs represents LOPC events with a lesser consequence. Tier 2 PSEs, even those that have been contained by secondary systems, indicate barrier system weaknesses that may be potential precursors of future, more significant incidents. In that sense, Tier 2 PSEs can provide a company with opportunities for learning and improving process safety performance.

Tier 3 Indicator – A Tier 3 PSE typically represents a challenge to the barrier system that progressed along the path to harm, but is stopped short of a Tier 1 or Tier 2 LOPC consequences. Indicators at this level provide an additional opportunity to identify and correct weaknesses within the barrier system.

Tier 4 Indicator – Tier 4 indicators typically represent performance of individual components of the barrier system and are comprised of operating discipline and management system performance. Indicators at this level provide an opportunity to identify and correct isolated system weaknesses.

[21] Fact Sheet Recommended Practice 754: Process Safety Indicators for the Refining and Petrochemical Industries." American Petroleum Institute. March 2010.

Tier 4 indicators are indicative of process safety system weaknesses that may contribute to future Tier 1 or Tier 2 PSEs. In that sense, Tier 4 indicators may identify opportunities for both learning and system improvements.

Based on Heinrich's model, the foundation of API RP 754 is the principle that occurrence of any incident is dependent on multiple failures, rather than a single failure. Leading up to the incident is the collective mechanics of multiple barrier failures that ultimately result in the incident. In other words, barriers, that can protect the facility from a hazard, may have weaknesses or "holes." If these weaknesses align, the hazard passes through that gap and results in potential harm. ISO 17776 defines barriers as "measures which reduce the probability of realizing a hazard's potential for harm and which reduce its consequences." Barriers can be physical or non-physical (e.g. administrative, procedural). People can represent a barrier, and the control is dependent upon the action the person would take. For example, a watch stander is a barrier to an event such as collision.

To ensure barrier weaknesses do not exist and that barriers are available when needed, API RP 754 focuses on management of such barriers by implementing regular or periodic performance measurement based on the barrier criticality. Effective barrier management includes measuring the performance of each and every identified barrier in the organization's risk management plan. Effective management of performance indicators allows organizations to have a better understanding of the risk management system in place and an opportunity for the early detection of any unsafe conditions.

Recommendation:

Applicable to Subpart S and API RP 75

API RP 754 provides the framework for reporting PSEs for performance measurement. Measuring leading and lagging indicators allows both the regulatory agency and industry to learn from barrier weaknesses and effectively manage process safety through early detection. Currently, BSEE does not provide a framework for nationwide reporting of PSEs as part of SEMS. To take advantage of the lessons learned from the various PSEs throughout the offshore industry, it is recommended that future SEMS rulemaking, or enhancements to existing industry standards (e.g. API RP 75), establish a framework for reporting leading and lagging indicators. Developing a public reporting system for lagging and leading indicators would ensure consistent application of barriers to hazardous events and serve as a basis for quantifying the robustness of various barriers so that future process improvements can be promptly implemented.

Preservation of effective barriers is essential to the health of any safety management program to ensure that barriers are appropriate, robust, and can be maintained throughout their lifecycle. The development of a management verification strategy to measure barrier performance, such as periodic monitoring of the condition of the fire pumps, would strengthen the overall barrier management approach. In this regard, the Petroleum Safety Authority in Norway issued a comprehensive guidance on barrier management in 2013.[22] It is recommended that BSEE or API further investigate this guidance and consider the implementation of barrier management strategies as a valuable enhancement to API RP 75 or Subpart S.

[22] "Principles for barrier management in the petroleum industry." Petroleum Safety Authority. 2013

4.3 API RP 14J, Recommended Practice for Design and Hazards Analysis for Offshore Production Facilities

API RP 14J is incorporated by reference in 30 CFR 250.198 and details useful procedures and guidelines for planning, designing and arranging platform production facilities, and performing hazard analysis on open-type offshore production facilities. API RP 14J focuses on the general requirements for hazard analysis and addresses the following areas:

- Overview of the general principles of safe facilities design
- Basic facilities design concept
- Hazard mitigation and personnel evacuation
- Platform equipment arrangement
- Documentation to present process safety information required by API RP 75 and hazard analysis review
- Hazard analysis concepts and methods

While the document provides the reader with a framework to identify hazards and general guidance on management of hazards, it does not offer guidance on how to apply risk mitigations. For example, the standard discusses the use of fire and blast walls but offers no design guidance for the wall. API 14J provides input to the Subpart S element on Hazard Analysis and the checklists contained in API 14J are a good reference for offshore facility hazard assessments; however, no specific gaps were identified to guide further improvements in the treatment of offshore process safety issues.

4.4 API 770, A Manager's Guide to Reducing Human Errors Improving Human Performance in the Process Industries

API 770 is designed to equip managers with a basic understanding of the causes of human errors and to suggest ways for reducing human errors at individual facilities. API 770 takes as its main motivation the axiom that human error contributes to most process industry accidents. It also assumes the need to understand how human error can be mitigated through HFE.

The SEMS regulations represent a significant progression towards increased safety via decreased human error. However, the only information concerning HFE incorporated by reference via API RP 75 is stated as, "human factors may be considered in the design and implementation of the company SEMS program." This statement merely suggests HFE involvement at the convenience of the owner/operator and does not strongly encourage HFE. BSEE should actively encourage API to update the language of API RP 75 concerning human factors. Updating the language or noting that in this instance, 'may' should be taken to mean 'shall' will require SEMS programs to address human factors issues needed to help mitigate the human error that directly contributes to over three quarters of process industry accidents.

Recommendation:

Applicable to Subpart S and API RP 75

In addition to the suggested language revision provided in the section above, it is recommended that BSEE require qualitative or quantitative HRA, in accordance with API 770, Section 4, for each process or operation.

It is also recommended that BSEE adopt a comprehensive human factors standard, such as the American Society for Testing and Materials (ASTM) F1166, Standard Practice for Human Engineering Design for Marine Systems, Equipment, and Facilities, or equivalent. The adopted HFE standard should incorporate the following issues and analyses:

1. ***Valve Criticality Analysis (VCA) and Instrument Criticality Analysis (ICA)*** to identify the criticality of valves and instruments and to ensure that workers can visually and physically access the most critical in a safe and efficient manner. For example, unsafe access is shown when a worker has to stand on piping to operate a valve or when a worker cannot use a safe and effective body configuration to turn the wheel without mechanical interference from some other structure. In another real-world example, compromised visual access happens when gauges are mounted on the back side of a control panel because there is no room available on the front.
2. ***Material Handling Analysis*** to ensure that potential physical and chemical hazards presented by moving hardware are appropriately identified and mitigated through consideration of basic anatomical and biomechanical considerations.
3. ***Maintenance Task Analysis*** to clarify the nature of routine maintenance that will be required and to ensure safe procedures for conducting that work.
4. ***Alarm Management Strategy Analysis*** to increase usability of alarm systems by avoiding alarm flooding and sensory saturation of human perceptual systems. Other problems that can be identified and mitigated here include desensitization to alarm events that occur too frequently, poor discrimination between alarms within a sensory modality (e.g., vision, audition), and improper alarm points and locations.
5. ***Function Allocation Analysis*** to ensure that automated and non-automated functions are consistent and well-defined for the human operator. This analysis helps avoid dangerous automation biases towards over- or under-reliance on automatic systems.
6. ***Link Analysis*** to identify the most commonly used control points and the transitions between them. This analysis optimizes critical transitions between controls, which makes normal processes more efficient and emergency procedures more accurate under duress.
7. ***Escape, Evacuation, and Rescue Analysis*** to ensure that escape routes are identified, consistent, and well-marked. This analysis is important because it must be ensured that the escape, evacuation, and rescue plan does not impose secondary threats and hazards on workers fleeing from primary threats and hazards. Issues here include accommodation of typical worker anthropometry so as to eliminate potential obstructions during speeded egress, and

consideration of perceptual phenomena that occur under acute stress. An example is perceptual field narrowing, which could further inhibit recognition of inappropriately placed guides.

8. ***Procedure Analysis*** to confirm that nominal and emergency procedures exist and to ensure that they are clear, understandable, and accessible to relevant personnel. This type of analysis should be mandatory, especially when there is a deviation that requires management of change.

4.5 U.K. Health and Safety Executive Safety Case Regulations

U.K. HSE incorporates "performance-based" regulations for safety and environmental regulations. Operators are required to submit the safety case demonstrating that the risk to the facility is reduced to as low as reasonably practicable (ALARP). The ALARP concept is grounded in the principle that the residual risk after considering all possible safeguards should be as low as possible given the benefits achieved from implementation of any additional safeguard would be grossly disproportionate to cost. ALARP weighs the risk against the cost and complexity of further reducing the risk. This approach was taken to allow the operators, or company, to choose the best available technologies to ensure safe operation of the facility, instead of being restricted by prescriptive requirements. Some operators, such as those with European or U.K. roots, already utilize the concept of ALARP in their risk management strategies; however, it not required by present regulations. A safety case is built upon the following three principles:

1. Those who create risks are responsible for controlling those risks.
2. Safe operations are achieved by setting and achieving goals rather than by following prescriptive regulations.
3. All risks must be reduced such that they are below the threshold of acceptability, i.e., the risks to be eliminated or reduced to ALARP.

In judging compliance, HSE expects duty-holders to apply relevant good practice as a minimum. For new plant/installations/situations, this will mean the application of current good practice. For existing plant/installations/situations, this will mean the application of current good practice to the extent necessary to satisfy the relevant law.[23]

OSCR directs separate safety cases for production installations, non-production installations including MODUs, and conversion of non-production installation to a production installation (even temporarily). For combined operations, required notifications and the safety case need to be revised to address the changes for approval. The final dismantling of a fixed installation also requires a specific revision of the existing safety case to address the specific hazards and risks involved. The safety cases are live documents which will be updated and revised as necessary during the operational life of the installation. The safety case must be reviewed within five years of its acceptance or from the last review, or as directed by the authorities.

[23] "Assessing compliance with the law in individual cases and the use of good practice." U.K. HSE. June 2003. http://www.hse.gov.uk/risk/theory/alarp2.htm.

According to Subpart S, hazard analysis needs to be developed and implemented, and recommendations from the analysis need to be resolved and documented. Whereas, OSCR requires the safety case to demonstrate that major hazard risks are identified, evaluated, and reduced to ALARP, as well as compliant with relevant statutory provisions in place to manage subject risk. In practice the ALARP standard remains for acceptance, except where the law requires a stronger standard. This means that ALARP should not be used to avoid compliance with existing prescriptive requirements or regulations; rather, it should demonstrate that mitigation measures possess at least an equivalent or higher level of safety compared to prescriptive requirements.

Several methods shown in **Table 3**, both quantitative and qualitative, can be employed in order to demonstrate that a project has reduced risk to ALARP levels. The key, regardless of which method is selected, is to ensure that the measures proposed to reduce risk are employed unless the cost or complexity of the change is grossly disproportionate to the perceived risk level. One key difference between the concept of ALARP and prescriptive regulations that focus on previously deemed critical pieces of equipment is that ALARP regimes focus solely on hazard management and not on maximizing production or reducing schedule. The concept is dependent on performance standards that outline the requirements for safety critical equipment. The performance standards contain information to manage pieces of equipment that, in the event of a failure, could constitute a major accident event or would be relied upon to respond to a major accident event.

Table 3: ALARP Demonstration Methods

Qualitative	
Performance Data	Demonstrate that reliability of a control measure is appropriate.
Improvement Approach	Demonstrate relative improvements in performance based on modifications.
Judgment Approach	Present considered judgments as to the adequacy of control measures based on a cross section of stakeholders.
Practical Tests	Demonstrate control measures function effectively using simulations, function tests etc.
Comparison with Codes	Compare the design against recognized standards, codes of practice and guidelines.
Quantitative	
Hazard / Risk Criteria	Defines criteria that relate to risk reduction, assess performance quantitatively, compare against other facilities.
Assessment of Risks	Evaluate risks and costs and compare the merits of risk reduction options.
Technical Analysis	Evaluate control measures in technical terms by assessing strengths and weaknesses e.g. effectiveness, reliability, technical feasibility, compatibility, appropriateness of performance standards.

Recommendation:

Applicable to Subpart S and API RP 75

The concept of reducing risk to ALARP levels is what allows performance-based measures to be implemented effectively. Without it, end users of the SEMS regulations may have difficulty deciding which risk mitigation measures should be implemented and which ones are not practical to implement. Therefore, it is recommended that BSEE consider including components of ALARP in the SEMS regulations or API RP 75.

The subject of risk tolerability should also be included. In the case of qualitative assessment using a risk matrix, definitions of risk terms such as severe and minor can vary considerably leading to difficulty on the part of the reviewer when trying to evaluate the accuracy of the assessment. Standard definitions for each category used in the matrix should be provided or discussed in the regulations as well a recommended minimum size of the matrix (e.g. 4x4 vs 3x3).

Implementation of ALARP or a similar risk management principle requires the regulator to rely on the individual facility owner/operator to develop the ALARP levels and provide justification that their ALARP levels are appropriate and meet the criteria defined by that owner/operator. It should be noted that many large scale operators in the Gulf of Mexico (GOM) region already use the ALARP principle in their facility design.

4.6 IADC Health, Safety, and Environmental Case Guidelines for MODUs

IADC MODU guidelines were developed to assist drilling operators to comply with the various coastal state regulatory requirements. Adherence to guidelines does not imply adherence to respective regulatory requirements where the MODU is operating. It is the responsibility of the drilling contractor to confirm the applicability of their case documents with the regulator. The U.K. HSE safety case recognizes the IADC MODU guidelines as an acceptable way to present the safety case. IADC MODU guidelines are divided into six parts:

1. Introduction/External Stakeholder Expectations
2. Drilling Contractor's Management System
3. MODU Description and Supporting Information
4. Risk Management
5. Emergency Response
6. Performance Monitoring

Part 1 defines the external stakeholder HSE expectations to ensure that the drilling contractor's scope of operations are reduced to a tolerable level of risk. This expectation can include identification of senior management and their roles and responsibilities in management of HSE risk, case scope and arrangement, defined case responsibility, process for case review and updates, continuous improvement program, action item/recommendation management plan, compliance to regulatory requirements, environmental impact and aspect assessments, and commitment to operate MODU as per the arrangements defined in the HSE case.

Part 2 defines the HSE objective that must be met to demonstrate that HSE risks are reduced to a tolerable level. Part 3 describes the equipment and systems necessary to meet the HSE objectives as defined in Part 2. Part 4 includes risk management processes to ensure that risk associated with the drilling contractor's scope of work is reduced to a tolerable level. Any gaps identified during Part 4 should be addressed. Part 5 discusses the HSE objectives for emergency response of incidents to mitigate the consequences identified in Part 4 and associated measures to recover. Finally, Part 6 describes arrangements for performance measurement of controls/barriers identified in Part 4 to ensure that risk mitigation measures are maintained and available when required.

IADC MODU uses the ISO 17776 risk management process model, which includes process steps of hazard identification, risk assessment and consideration of risk tolerability, and identification of risk reduction measures. In addition to hazard analysis, IADC MODU emphasizes the importance of defining performance requirements of the barriers identified for high risk or major hazard events during the hazard analysis. Identifying the following performance requirements and monitoring the barriers allows early opportunity to ensure prevention of any near-miss events evolving into major hazard scenarios.

- Identify the critical tasks/activities required to ensure barriers are in-place, working effectively, and their integrity is maintained.
- Identify the resources and competencies required for the barrier to be implemented and effective.
- Identify where the barrier is referenced in the drilling contractor's management systems.
- Identify any factors that prevent such barriers from being defeated, removed from service or any reduction or elimination of their effectiveness.
- Identify any compensatory barriers and the associated activities, resources, competencies, and drilling contractor's management system references to address such barrier defeating factors.[24]

IADC MODU also contains the use of risk estimation, which includes the process of ranking identified hazards with respect to their impact to people, assets, the environment or any other area of concern (e.g. company reputation). Use of risk estimation provides a convenient structure to apply the drilling contractor's screening criteria (values, targets or performance standards) to evaluate or compare the significance of an identified hazard, event or associated risk and determine the tolerability. Tolerability means a willingness to operate with some risk in order to secure certain benefits and in the confidence that the risk is being properly controlled. There is no standard risk assessment matrix developed specifically for the drilling operators. It is the responsibility of the drilling operator to develop a risk matrix based on its own risk tolerability criteria.

Current Environment for Gulf of Mexico Drilling Contractors

The following paragraphs describe the current environment (requirements, industry practices, etc.) for drilling contractors in the GOM Region. Drilling contractors are expected to be familiar with the operator's SEMP and have safety and environmental policies and practices consistent with it. Typical practice in the GOM Region for drilling contractors is to follow any required risk assessments or related safety studies to meet classification society requirements or internal company requirements. API Standard 53, 4th edition (Blowout Prevention Equipment Systems for Drilling Wells) requires a documented risk assessment to be performed by the drilling contractor and operator jointly to identify

[24] "Health Safety and Environment Case Guideline for Drilling Contractors." International Association of Drilling Contractors (IADC). Issue 3.2. October 3rd, 2006.

ram placements and configurations including choke and kill lines, taking into account annular and large tubular(s) for well control management. This is a site specific assessment which implies that the blowout preventer stack configuration and arrangement needs to be re-assessed when the rig moves from one offshore well to another.

Within the GOM Region, drilling operators generally follow the SEMS guidelines for hazard identification and risk management processes. Multiple hazard analysis techniques can be applied to identify hazards associated with the drilling operations. Some of the widely used techniques used by drilling operators to identify hazards include:

- Hazard identification (HAZID)
- Preliminary hazard analysis (PHA)
- Job hazard analysis (JHA)
- Fault tree analysis (FTA)
- Event tree analysis (ETA)
- Hazard and operability analysis (HAZOP)
- Failure modes and effects analysis (FMEA)
- Failure modes and effects criticality analysis (FMECA)
- Quantitative Risk Assessment (QRA)
- Fire and Explosion Studies
- Emergency Escape and Rescue Analysis (EERA)
- Simultaneous operations study (SIMOPS)

Drilling contractors also follow the operator's risk management program to ensure compliance. It is imperative that drilling contractors develop bridging documents to ensure that their procedures and practices, including risk management, are in alignment with operators' practices. IADC indicates that when reviewing an HSE case with operators or other third-party companies, it is important to note that while the HSE case is a stand-alone document for the drilling contractor, it is intended to also provide a foundation to bridge or interface documents involving all parties. These bridging arrangements should address site specific and project-specific conditions and requirements, such as well intervention and response planning, allowable persons-on-board, and seabed limitations.

API Bulletin 97 (Well Construction Interface Document Guidelines) provides additional guidance on how to align the operator's SEMS with the drilling contractor's safe work practices. Currently, the API Bulletin 97 is not part of the BSEE regulation, but should be considered for incorporation into regulation to provide clear guidance on defining the responsibility between the lease owner/operator and the drilling contractor.

Recommendation:

Applicable to Subpart S and API RP 75

The majority of requirements from the IADC MODU HSE guidelines are covered across the various elements of the SEMS regulations, with the exception of performance measurement. For example, the mechanical integrity element of SEMS covers requirements regarding maintenance of equipment, which can either prevent or mitigate the hazard, but does not provide guidance on their performance measurement. IADC MODU emphasizes the importance of defining and monitoring performance requirements of barriers identified for high risk or major hazard events during the hazard analysis to allow early opportunity to ensure prevention of any near-miss events evolving into the major hazard scenarios. It is recommended that Subpart S or API RP 75 incorporate guidance on barrier performance measurement.

In addition to barrier performance requirements, it is recommended that BSEE establish SEMS guidance for MODU owners and contractors. Currently, MODU operations in the GOM Region fall under the oversight of the United States Coast Guard (USCG) and BSEE. The Memorandum of Agreement (MOA) OCS-08 between USCG and BSEE delegates responsibilities for MODUs between USCG and BSEE and indicates SEMS will be applicable to a MODU when it is attached to the seabed. However, the SEMS regulations do not require a MODU owner or contractor to develop a SEMS program because that responsibility resides with the leaseholder. It is recommended that BSEE consider referencing IADC guidance for drilling contractors. In lieu of incorporation by reference, given the shared jurisdiction of MODU operations, it is important that BSEE provide clear guidance for MODU contractors to ensure safe operations.

4.7 ISO 31000:2009, Risk management - Principles and guidelines

The risk management approach described in ISO 31000:2009 provides basic principles and guidelines for managing any form of risk in a systematic, structured and transparent manner and within any scope and context. ISO 31000:2009 addresses the necessary components of the risk management framework that supports the design, implementation, maintenance and improvement of risk management processes. ISO 31000:2009 also outlines the overall risk management process and the elements of risk assessment including risk identification, risk analysis and risk evaluation.

Risk assessment is part of risk management which provides a structured process that identifies sources of risk, areas of impact, events and their causes, and analyzes the risk in terms of consequence and probability before determining whether further treatment is required. A key component described in the risk assessment process in ISO 31000:2009 is risk evaluation. Risk evaluation is the process of comparing the results of risk analysis with risk criteria to determine whether the risk is acceptable or tolerable. Risk criteria, derived from standards, laws, policies and other requirements, provide a frame of reference against which the significance of a risk is evaluated.

Recommendation:
Applicable to Subpart S and API RP 75

It is recommended that the risk management approach in Subpart S incorporate the framework, process, and best practices described in ISO 31000:2009. It is also recommended that BSEE include the concept of risk evaluation and guidance on defining risk criteria in the SEMS regulations to provide a basis for decisions about whether risk treatment is needed, the most appropriate approach to be used to treat the risks, and the priority for treatment implementation.

4.8 ISO/ IEC 31010: 2009, Risk management - Risk assessment techniques

ISO 31010:2009 provides guidance on selection and application of systematic tools and techniques that can be used to perform a risk assessment or to assist with the risk assessment process. This standard provides a basis for the selection of different tools and techniques that may be appropriate in different contexts and varying degrees of depth and detail. ISO 31010:2009 provides details on where the particular study can be used, inputs required to conduct the study, methodology, outputs, strengths and limitations of the study.

Recommendation:
Applicable to Subpart S and API RP 75

ISO 31010:2009 provides detailed information on various best practices in selection and use of risk assessment techniques, many of which are currently used by the industry for identification and management of the risk. No significant gaps were identified between Subpart S and ISO 31010 as the standard is a guidance document on various tools and techniques that can used to perform the risk assessment; however, it is recommended that Subpart S or API RP 75 take into consideration and/or reference the information available regarding the selection and application of risk assessment techniques described in ISO 31010:2009.

4.9 ISO 10418, Petroleum and natural gas industries - Offshore production installations - Basic surface process safety systems

ISO 10418 provides objectives, functional requirements and guidelines for the analysis, design and testing of surface process safety systems for offshore installations. The basic concepts associated with the analysis and design of a process safety system for an offshore oil and gas production facility are described with examples of the application to typical (simple) process components.

ISO 10418 is applicable to fixed offshore structures, floating production, storage and off-take systems for the petroleum and natural gas industries. This standard is not applicable to mobile offshore units and subsea installations, although many of the principles contained in it may be used as guidance. This standard can be a useful resource for the analysis, design and testing of surface process safety systems; however, no gaps were identified specific to Subpart S or API RP 75.

4.10 OSHA 29 CFR 1910.119, Process safety management of highly hazardous chemicals

OSHA 29 CFR 1910.119, or OSHA PSM, provides requirements for preventing or minimizing the consequence of catastrophic releases of toxic, reactive, flammable or explosive chemicals. The regulation is applicable to facilities with processes that involve a chemical at or above the specified threshold quantities as specified by the regulation. OSHA PSM follows an identical approach as the SEMS regulations by defining the requirements according to the following elements.

- Employee Participation

- Process Safety Information
- Process Hazard Analysis
- Operating Procedures
- Training
- Contractors
- Mechanical Integrity
- Hot Work Permit
- Management of Change
- Incident Investigation
- Emergency Planning and Response
- Compliance Audits
- Trade Secrets

The majority of the OSHA requirements are reflected in applicable Subpart S elements. No significant gaps were identified during the assessment of OSHA 29 CFR 1910.199. Still, OSHA 29 CFR 1910.119 has been applied to the onshore process industry for many years and can be considered a mature regulation.

4.11 OGP Report No. 456, Process Safety – Recommended Practice on Key Performance Indicators

OGP Report No. 456 provides guidance on the identification of KPIs and how to use them to ensure that barriers identified for risk management are performing as needed. Subpart S emphasizes barrier management to prevent hazardous events and consequences. OGP emphasizes identifying the hazards and corresponding barriers and then establishing lagging and leading indicators as KPIs to strengthen risk controls, or barriers, in order to prevent major incidents. KPIs provide a constant reminder of asset integrity and an opportunity for early detection from near-misses and less severe events.

A good example of a lagging indicator on barrier weakness is the reporting of near miss events. Near misses include events with consequences that do not meet the company's criteria for recordable incidents, such as a spill of less than one barrel. Near misses also provide simple observations of an unsafe condition with no consequences. These are recognized as events which had the potential, in other slightly different circumstances, to result in recordable consequences. Near miss events provide both leading information on the likelihood of actual incidents as well as lagging information on barrier weaknesses.

Near miss data can contribute significantly to continuous improvement of asset integrity and process safety, whether used to identify barrier weaknesses or as a warning of a potential catastrophe.[25] At the time of this report, BSEE is working with the Bureau of Transportation Statistics to develop an initiative

[25] "Process Safety – Recommended Practice on Key Performance Indicators. Report No. 456. November 2001." International Association of Oil & Gas Producers. November 2011.

aimed at collecting and analyzing near miss data to capture essential information about accident precursors and potential hazards associated with offshore operations. This approach will augment existing safety programs and be oriented towards gathering previously difficult-to-obtain information on safety incidents. The system will have voluntary reporting by both industry and federal personnel, and will ensure confidentiality for those individuals who report near misses. BSEE's near-miss reporting system, SafeOCS, was formally launched on May 5, 2015 with the activation of the program's reporting line. The program's official website is anticipated for launch in June 2015.

The lack of an incident for an extended period of time does not equate to a safe working environment; rather, this period of time may be contributing to a minor issue evolving to a major issue. Use of KPIs allows operators to identify small issues early with an opportunity to mitigate the risk. OGP's six step approach to identify critical barriers and select the KPIs is outlined below.

1. Ensure management ownership and establish implementation team
2. Establish industry Tier 1 and Tier 2 KPIs to assess company performance*
3. Confirm critical process and integrity barrier to prevent major incidents
4. Select Tier 3 and Tier 4 KPIs to monitor critical barriers at facilities*
5. Collect quality data, analyze performance and use to set improvement actions
6. Regularly review critical barriers, actions, performance and KPI effectiveness

* Section 4.2 provides information on Tiers 1 through 4

Recommendation:

Applicable to Subpart S and API RP 75

To continue to improve Subpart S as a performance-based regulation, the inclusion of a barrier performance measurement approach is recommended. SEMS provides a framework to identify the barrier, but does not provide clear guidance on how to maintain the barrier and measure its performance. While 30 CFR part 250, Subpart D – Oil and Gas Drilling Operations provides guidance on design, maintenance and inspection requirements for critical equipment during oil and gas drilling operation, it does not provide guidance on measurement of the factors that can contribute to the reduction in the effectiveness of barrier. Barriers become weak or degrade over time if they are not maintained. Maintenance and regular inspection required by the Mechanical Integrity element of Subpart S are good practices to ensure that barriers are maintained; however, this practice involves gaps between periodic inspections and lacks continuous oversight. In addition to the existing guidance on barrier management with Subpart S, it is recommended that BSEE incorporate an approach for barrier measurement and maintenance, including criteria for performance measurement using KPIs for active management of barriers.

5. Recommendations

Table 4 provides the list of recommendations identified during the comparative analysis of Subpart S and API RP 75 against other process safety related industry standards and regulations.

Table 4: Recommendations

#	Recommendation	Source	Type
1	***Establish a framework for reporting leading and lagging indicators.*** API RP 754 provides the framework for reporting PSEs for performance measurement. Measuring leading and lagging indicators allows both the regulatory agency and industry to learn from barrier weaknesses and effectively manage process safety through early detection. Currently, BSEE does not provide a framework for nationwide reporting of PSEs as part of SEMS. To take advantage of the lessons learned from the various PSEs throughout the offshore industry, it is recommended that future SEMS rulemaking, or enhancements to existing industry standards (e.g. API RP 75), establish a framework for reporting leading and lagging indicators. Developing a public reporting system for lagging and leading indicators would ensure consistent application of barriers to hazardous events and serve as a basis for quantifying the robustness of various barriers so that future process improvements can be promptly implemented.	API 754	Guidance/ rulemaking
2	***Provide guidance on implementation of barrier management strategies to improve the overall barrier management approach.*** Preservation of effective barriers is essential to the health of any safety management program to ensure that barriers are appropriate, robust, and can be maintained throughout their lifecycle. The development of a management verification strategy to measure barrier performance, such as periodic monitoring of the condition of the fire pumps, would strengthen the overall barrier management approach. In this regard, the Petroleum Safety Authority in Norway issued a comprehensive guidance on barrier management in 2013. It is recommended that BSEE or API further investigate this guidance and consider the implementation of barrier management strategies as a valuable enhancement to API RP 75 or Subpart S.	API 754	Guidance
3	***Adopt a comprehensive human factors standard and require qualitative or quantitative HRA for each process or operation.*** In addition to updating the HFE language in API RP 75, it is recommended that BSEE require qualitative or quantitative HRA, in accordance with API 770, Section 4, for each process or operation. It is also recommended that BSEE adopt a comprehensive human factors standard, such as the American Society for Testing and Materials (ASTM) F1166, Standard Practice for Human Engineering Design for Marine Systems, Equipment, and Facilities, or equivalent. The adopted HFE standard should incorporate the following issues and analyses: 1. Valve Criticality Analysis and Instrument Criticality Analysis 2. Material Handling Analysis	API 770	Guidance/ Implementation

#	Recommendation	Source	Type
	3. Maintenance Task Analysis 4. Alarm Management Strategy Analysis 5. Function Allocation Analysis 6. Link Analysis 7. Escape, Evacuation, and Rescue Analysis 8. Procedure Analysis		
4	***Incorporate components of the ALARP concept and risk tolerability in the SEMS regulations or API RP 75.*** The concept of reducing risk to ALARP levels is what allows performance-based measures to be implemented effectively. Without it, end users of the SEMS regulations may have difficulty deciding which risk mitigation measures should be implemented and which ones are not practical to implement. Therefore, it is recommended that BSEE consider including a discussion of ALARP in the SEMS regulations or API RP 75. The subject of risk tolerability should also be included. In the case of qualitative assessment using a risk matrix, definitions of risk terms such as severe and minor can vary considerably leading to difficulty on the part of the reviewer when trying to evaluate the accuracy of the assessment. Standard definitions for each category used in the matrix should be provided or discussed in the regulations as well a recommended minimum size of the matrix.	UK HSE	Guidance
5	***Incorporate barrier performance measurement guidance into the SEMS regulations or API RP 75.*** The majority of requirements from the IADC MODU HSE guidelines are covered across the various elements of the SEMS regulations, with the exception of performance measurement. For example, the mechanical integrity element of SEMS covers requirements regarding maintenance of equipment, which can either prevent or mitigate the hazard, but does not provide guidance on their performance measurement. IADC MODU emphasizes the importance of defining and monitoring performance requirements of barriers identified for high risk or major hazard events during the hazard analysis to allow early opportunity to ensure prevention of any near-miss events evolving into the major hazard scenarios. It is recommended that Subpart S or API RP 75 incorporate guidance on barrier performance measurement.	IADC MODU	Guidance/ rulemaking
6	***Establish SEMS guidance for MODU owners and contractors.*** Currently, MODU operations in the GOM Region fall under the oversight of the United States Coast Guard (USCG) and BSEE. The Memorandum of Agreement (MOA) OCS-08 between USCG and BSEE delegates responsibilities for MODUs between USCG and BSEE and indicates SEMS will be applicable to a MODU when it is attached to the seabed. However, the SEMS regulations do not require a MODU owner or contractor to develop a SEMS program because that responsibility resides with the leaseholder. It is recommended that BSEE consider referencing IADC guidance for drilling contractors. In lieu of incorporation by reference, given the shared jurisdiction of MODU operations, it is important that BSEE provide clear guidance for MODU contractors to ensure safe operations.	IADC MODU	Guidance/ rulemaking

#	Recommendation	Source	Type
7	***Incorporate the risk management framework, process, and best practices described in ISO 31000:2009 into the current risk management approach.*** It is recommended that the risk management approach in Subpart S incorporate the framework, process, and best practices described in ISO 31000:2009. It is also recommended that BSEE include the concept of risk evaluation and guidance on defining risk criteria in the SEMS regulations to provide a basis for decisions about whether risk treatment is needed, the most appropriate approach to be used to treat the risks, and the priority for treatment implementation.	ISO 31000:2009	Guidance/ rulemaking
8	***Incorporate guidance on the selection and application of risk assessment techniques described in ISO 31010:2009.*** ISO 31010:2009 provides detailed information on various best practices in selection and use of risk assessment techniques, many of which are currently used by the industry for identification and management of the risk. No significant gaps were identified between Subpart S and ISO 31010 as the standard is a guidance document on various tools and techniques that can used to perform the risk assessment; however, it is recommended that Subpart S or API RP 75 take into consideration and/or reference the information available regarding the selection and application of risk assessment techniques described in ISO 31010:2009.	ISO 31010:2009	Reference/ rulemaking
9	***Provide additional guidance on active barrier management, measurement and maintenance.*** To continue to improve Subpart S as a performance-based regulation, the inclusion of a barrier performance measurement approach is recommended. SEMS provides a framework to identify the barrier, but does not provide clear guidance on how to maintain the barrier and measure its performance. Barriers become weak or degrade over time if they are not maintained. Maintenance and regular inspection required by the Mechanical Integrity element of Subpart S are good practices to ensure that barriers are maintained; however, this practice involves gaps between periodic inspections and lacks continuous oversight. In addition to the existing guidance on barrier management with Subpart S, it is recommended that BSEE incorporate an approach for barrier measurement and maintenance, including criteria for performance measurement using KPIs for active management of barriers.	OGP 456	Guidance

Appendix A – Subpart S Key Elements

Table 5: Subpart S Key Elements

BSEE Subpart S Key Element	Description
General (see § 250.1909)	You must require that the program elements discussed in API RP 75 and in this subpart are properly documented and are available at the field and office locations. You are responsible for the development, support, continued improvement, and overall success of your SEMS program. Specifically you must: a) Establish goals and performance measures, demand accountability for implementation, and provide necessary resources for carrying out an effective SEMS program. b) Appoint management representatives who are responsible for establishing, implementing and maintaining an effective SEMS program. c) Designate specific management representatives who are responsible for reporting to management on the performance of the SEMS program. d) At intervals specified in the SEMS program and at least annually, review the SEMS program to determine if it continues to be suitable, adequate and effective (by addressing the possible need for changes to policy, objectives, and other elements of the program in light of program audit results, changing circumstances and the commitment to continual improvement) and document the observations, conclusions and recommendations of that review. e) Develop and endorse a written description of your safety and environmental policies and organizational structure that define responsibilities, authorities, and lines of communication required to implement the SEMS program. f) Utilize personnel with expertise in identifying safety hazards, environmental impacts, optimizing operations, developing safe work practices, developing training programs and investigating incidents. g) Ensure that facilities are designed, constructed, maintained, monitored, and operated in a manner compatible with applicable industry codes, consensus standards, and generally accepted practice as well as in compliance with all applicable governmental regulations. h) Ensure that management of safety hazards and environmental impacts is an integral part of the design, construction, maintenance, operation, and monitoring of each facility. i) Ensure that suitably trained and qualified personnel are employed to carry out all aspects of the SEMS program. j) Ensure that the SEMS program is maintained and kept up to date by means of periodic audits to ensure effective performance.

BSEE Subpart S Key Element	Description
Safety and Environmental Information (see § 250.1910)	You must require that SEMS program safety and environmental information be developed and maintained for any facility that is subject to the SEMS program. SEMS program safety and environmental information must include: a) information that provides the basis for implementing all SEMS program elements, including the requirements of hazard analysis (§ 250.1911); b) process design information including, as appropriate, a simplified process flow diagram and acceptable upper and lower limits, where applicable, for items such as temperature, pressure, flow and composition; and c) mechanical design information including, as appropriate, piping and instrument diagrams; electrical area classifications; equipment arrangement drawings; design basis of the relief system; description of alarm, shutdown, and interlock systems; description of well control systems; and design basis for passive and active fire protection features and systems and emergency evacuation procedures.
Hazards Analysis (see § 250.1911)	Hazards Analysis needs to be developed and implemented for all of the facilities with documentation for the life of the facility. Hazard analysis to include hazards of operation, previous incident, control technology, safety and health effects on employees, impact on human and environment. Need to be performed by competent personnel and recommendations from the analysis need to be resolved and documented. Similar analysis can be applied to simple and nearly identical facilities with site specific deviations documented.
Management of Change (see § 250.1912)	Requires written MOC procedure for modification related to equipment, operating procedures, personnel changes, materials and operating conditions. Not Applicable for replacement in kind. MOC procedures must include: technical basis for change, impact of the change on safety, health and the coastal and marine environments, time period for change, personnel communication. If a management of change results in a change in the operating procedures of you SEMS program, such changes must be documented and dated.
Operating Procedures (see § 250.1913)	Requires written operating procedures for conducting safe and environmentally sound activities for each operation addressed in SEMS program. Operating procedure should address personnel responsible for operating areas, initial startup, normal operations, all emergency operations, normal shutdown, startup following a turnaround, bypassing and flagging out of service equipment, safety and environmental consequence for deviation from operating limits and mitigate steps to avoid deviations, chemical properties and associated hazards, protection against personnel exposure to chemicals via PPE, control technology, raw materials and associated quality control, hazardous chemical inventory control, impact to human and marine as identified in hazards analysis. Operating procedures must be accessible to all employees. Periodic update of operating procedures.

BSEE Subpart S Key Element	Description
Safe Work Practices (see § 250.1914)	Establish and implement safe work practices to minimize risks associated with operations, maintenance, modification activities and the handling of materials and substances that could affect safety or the environment. Document contractor selection criteria and requires evaluation of contractor's safety records and environmental performance. Ensure contractor has their own written safe work practices. Must document an agreement between contractor and company on appropriate contractor safety and environmental policies and practices before the start of the work. Domestic service contractor (e.g. janitorial, food and beverage etc.) is not part of these requirements.
Training (see § 250.1915)	Must establish and implement a training program so that all personnel are trained in accordance with their duties and responsibilities to work safely and are aware of potential environmental impacts. Training must address SEMS elements 250.1913,14,18,30,31,32,33, and how to recognize and identify hazards, and how to construct and implement JSAs (250.1911). Must document instructors' qualifications. Must address: a) Initial training for the basic well-being of personnel and protection of the environment, and ensure that persons assigned to operate and maintain the facility possess the required knowledge and skills to carry out their duties and responsibilities, including startup and shutdown. b) Periodic training to maintain understanding of, and adherence to, the current operating procedures, using periodic drills, to verify adequate retention of the required knowledge and skills. c) Communication requirements to ensure that personnel will be informed of and trained as outlines in the section whenever a change is made in any of the areas in your SEMS program that impacts their ability to properly understand and perform their duties and responsibilities. d) How you will verify that the contractors are trained in the work practices necessary to understand and perform their jobs in a safe and environmentally sound manner in accordance with all provisions of this section.
Mechanical Integrity (Assurance of Quality and Mechanical Integrity of Critical Equipment) (see § 250.1916)	Must develop and implement written procedures that provide instructions to ensure the mechanical integrity and safe operation of equipment through inspection, testing, and quality assurance. Mechanical integrity program must encompass all equipment and systems used to prevent or mitigate uncontrolled releases of hydrocarbons, toxic substances, or other materials that may cause environmental or safety consequences. Procedures must address the following: a) The design, procurement, fabrication, installation, calibration, and maintenance of your equipment and systems in accordance with the manufacturer's design and material specifications.

BSEE Subpart S Key Element	Description
	b) The training of each employee involved in maintaining your equipment and systems so that your employees can implement your mechanical integrity program. c) The frequency of inspections and tests of your equipment and systems. The frequency of inspections and tests must be in accordance with BSEE regulations and meet the manufacturer's recommendations. Inspections and tests can be performed more frequently if determined to be necessary by prior operating experience. d) The documentation of each inspection and test that has been performed on your equipment and systems. This documentation must identify the date of the inspection or test; include the name and position, and the signature of the person who performed the inspection or test; include the serial number or other identifier of the equipment on which the inspection or test was performed; include a description of the inspection or test performed; and the results of the inspection test. e) The correction of deficiencies associated with equipment and systems that are outside the manufacturer's recommended limits. Such corrections must be made before further use of the equipment and system. f) The installation of new equipment and constructing systems. The procedures must address the application for which they will be used. g) The modification of existing equipment and systems. The procedures must ensure that they are modified for the application for which they will be used. h) The verification that inspections and tests are being performed. The procedures must be appropriate to ensure that equipment and systems are installed consistent with design specifications and the manufacturer's instructions. i) The assurance that maintenance materials, spare parts, and equipment are suitable for the applications for which they will be used.
Pre-startup Review (see § 250.1917)	Commissioning process must include a pre-startup safety and environmental review for new and significantly modified facilities that are subject to this subpart to confirm that the following criteria are met: a) Construction and equipment are in accordance with applicable specifications. b) Safety, environmental, operating, maintenance, and emergency procedures are in place and are adequate. c) Safety and environmental information is current. d) Hazards analysis recommendations have been implemented as appropriate. e) Training of operating personnel has been completed. f) Programs to address management of change and other elements of this subpart are in place. g) Safe work practices are in place.

BSEE Subpart S Key Element	Description
Emergency Response and Control (see § 250.1918)	Must require that emergency response and control plans are in place and are ready for immediate implementation. These plans must be validated by drills carried out in accordance with a schedule defined by the SEMS training program (§ 250.1915). The SEMS emergency response and control plans must include: a) Emergency Action Plan that assigns authority and responsibility to the appropriate qualified person(s) at a facility for initiating effective emergency response and control, addressing emergency reporting and response requirements, and complying with all applicable governmental regulations; b) Emergency Control Center(s) designated for each facility with access to the Emergency Action Plans, oil spill contingency plan, and other safety and environmental information (§ 250.1910); and c) Training and Drills incorporating emergency response and evacuation procedures conducted periodically for all personnel (including contractor's personnel), as required by the SEMS training program (§ 250.1915). Drills must be based on realistic scenarios conducted periodically to exercise elements contained in the facility or area emergency action plan. An analysis and critique of each drill must be conducted to identify and correct weaknesses.
Investigation of Incidents (see § 250.1919)	Must establish procedures for investigation of all incidents with serious safety or environmental consequences and require investigation of incidents that are determined by facility management or BSEE to have possessed the potential for serious safety or environmental consequences. Incident investigations must be initiated as promptly as possible, with due regard for the necessity of securing the incident scene and protecting people and the environment. Incident investigations must be conducted by personnel knowledgeable in the process involved, investigation techniques, and other specialties that are relevant or necessary. a) The investigation of an incident must address the following: b) (1) The nature of the incident; (2) the factors (human or other) that contributed to the initiation of the incident and its escalation/control; and (3) Recommended changes identified as a result of the investigation. c) A corrective action program must be established based on the findings of the investigation in order to analyze incidents for common root causes. The corrective action program must: (1) Retain the findings of investigations for use in the next hazard analysis update or audit; (2) Determine and document the response to each finding to ensure that corrective actions are completed; and (3) Implement a system whereby conclusions of investigations are distributed to similar facilities and appropriate personnel within their organization.
Auditing (Audit of	Your SEMS program must be audited by an accredited ASP according to the requirements of this subpart and API RP 75, Section 12

BSEE Subpart S Key Element	Description
Safety and Environmental Management Program Elements) (see § 250.1920)	(incorporated by reference as specified in § 250.198). The audit process must also meet or exceed the criteria in Sections 9.1 through 9.8 of Requirements for Third-party SEMS Auditing and Certification of Deepwater Operations COS–2–03 (incorporated by reference as specified in § 250.198) or its equivalent.
Recordkeeping (Records and Documentation) and additional BSEE requirements (see § 250.1928)	Your SEMS program procedures must ensure that records and documents are maintained for a period of 6 years, except as provided below. You must document and keep all SEMS audits for 6 years and make them available to BSEE upon request. You must maintain a copy of all SEMS program documents at an onshore location.
Stop Work Authority (SWA) (see § 250.1930)	Your SWA procedures must ensure the capability to immediately stop work that is creating imminent risk or danger. These procedures must grant all personnel the responsibility and authority, without fear of reprisal, to stop work or decline to perform an assigned task when an imminent risk or danger exists. Imminent risk or danger means any condition, activity, or practice in the workplace that could reasonably be expected to cause 1) death or serious physical harm; or 2) significant environmental harm.
Ultimate Work Authority (UWA) (see § 250.1931)	Your SEMS program must have a process to identify the individual with the UWA on your facility(ies). You must designate this individual taking into account all applicable USCG regulations that deal with designating a person in charge of an OCS facility. Your SEMS program must clearly define who is in charge at all times. In the event that multiple facilities, including a MODU, are attached and working together or in close proximity to one another to perform an OCS operation, your SEMS program must identify the individual with the UWA over the entire operation, including all facilities.
Employee Participation Plan (EPP) (see § 250.1932)	Your management must consult with their employees on the development, implementation, and modification of your SEMS program. Your management must develop a written plan of action regarding how your appropriate employees, in both your offices and those working on offshore facilities, will participate in your SEMS program development and implementation. Your management must ensure that employees have access to sections of your SEMS program that are relevant to their jobs.
Reporting Unsafe Working Conditions (see § 250.1933).	Your SEMS program must include procedures for all personnel to report unsafe working conditions in accordance with § 250.193. These procedures must take into account applicable USCG reporting requirements for unsafe working conditions. You must post a notice at the place of employment in a visible location frequently visited by personnel that contains the reporting information in § 250.193.

Appendix B – API RP 75 Key Elements

Table 6: API RP 75 Key Elements

API RP 75 Key Element	Description
General	This RP is intended to assist in development of a management program designed to promote safety and environmental protection during the performance of offshore oil and gas and sulphur operations. This RP addresses the identification and management of safety hazards and environmental impacts in design, construction, start-up, operation, inspection, and maintenance, of new, existing, or modified drilling and production facilities. The program elements described herein address the following 11 areas: a) Safety and environmental information (Section 2) b) Hazards analysis (Section 3) c) Management of change (Section 4) d) Operating procedures (Section 5) e) Safe work practices (Section 6) f) Training (Section 7) g) Assurance of quality and mechanical integrity of critical equipment (Section 8) h) Pre-startup review (Section 9) i) Emergency response and control (Section 10) j) Investigation of incidents (Section 11) k) Audit of safety and environmental management program elements (Section 12) l) Documentation and record keeping (Section 13)
Safety and Environmental information	The management program should require that a compilation of safety and environmental information be developed and maintained for any facility subject to this RP. This information will provide the basis for implementing succeeding program elements. The process design information should include, as appropriate, a simplified process flow diagram and acceptable upper and lower limits, where applicable, for items such as temperature, pressure, flow and composition. Where process design material and energy balances are available, these should be included. API RP 14J contains guidance as to the process design information required for offshore production facilities. On a mobile offshore unit (MOU), API RP 14J is only applicable to a production processing system.

API RP 75 Key Element	Description
	Where the original process design information no longer exists, information may be developed in conjunction with a hazards analysis in sufficient detail to support the analysis. The mechanical design information should include, as appropriate, piping and instrument diagrams, electrical area classifications, equipment arrangement drawings, design basis of the relief system, description of alarm, shutdown, and interlock systems, description of well control systems, and design basis for passive and active fire protection features and systems and emergency evacuation procedures. If applicable, information on materials of construction, equipment and piping specifications, corrosion detection and prevention systems, and design codes, regulations, and standard practices employed may also be included. API RP 14J contains guidance as to the mechanical design information recommended for offshore production facilities. Note: On an MOU, API RP 14J is only applicable to a production processing system. Where the original mechanical design information no longer exists, suitability of equipment design for intended use should be verified and documented. This may be done on the basis of engineering analysis or documentation of successful prior operating experience. Design and installation of new facilities and major modifications should include consideration of human factors. ASTM F1166-95, Standard Practice for Human Engineering Design for Marine Systems, Equipment, and Facilities, is a related resource.
Hazard Analysis	The management program should require that a hazards analysis be performed for any facility subject to this RP. The purpose of this analysis is to identify, evaluate, and, where unacceptable, reduce the likelihood and/ or minimize the consequences of uncontrolled releases and other safety or environmental incidents. Human factors should be considered in this analysis. The hazards analyses for existing facilities should be performed in order of priority. The following factors (not necessarily in prioritized order) may be considered when establishing priority ranking for performing hazards analyses: a) Areas with continuous offshore population, such as living quarters on major platforms, and platform clusters or complexes. b) Inventory and flow rate of flammable, toxic, or other materials that may constitute a safety hazard or cause a significant environmental impact. c) Locations involving simultaneous operations such as producing while drilling, or producing while constructing above or below the water line. d) Facilities that remove natural gas liquids or handle hydrogen sulfide. e) Facilities with severe operating conditions, such as high pressures, highly corrosive fluids, or conditions such as abnormal sand production or high flow rates that may cause severe erosion or corrosion. f) Facilities in proximity to areas the operator considers to be environmentally sensitive areas.

API RP 75 Key Element	Description
	In performing a hazards analysis on a new or modified facility, special consideration should be given to the following: a) Previous experience with a similar facility. b) Design circumstances, such as changes in the design team or the design itself, after the project is underway. c) Unusual facility location, design or configuration, equipment arrangement, or emergency response considerations. d) Any findings that need to be brought to resolution before startup or that require immediate attention should be clearly identified. e) Operating procedures and practices, including simultaneous operations guidelines. Management should establish a program for updating hazards analyses to verify that the most recent hazards analysis reflects the current process. Hazards analyses should be reviewed periodically and updated as appropriate, with typical review intervals ranging between 5 years for high-priority facilities and 10 years for low-priority facilities. The hazards analyses should be performed by a person(s) knowledgeable in engineering, operations, design, process, safety, environmental, and other specialties as appropriate. At least one person should be proficient in the hazards analysis methodologies being employed. If only one person performs the hazard analysis, that person should not have participated in the original design of or modifications to the facility. The management program should require that the findings of a hazards analysis are presented in a written report. This report should describe the hazards that have been identified and recommended steps to be taken to mitigate them. Qualitative assessments of the severity of the findings may be made as appropriate. The management program should require the communication of all identified hazards and follow-up actions to the appropriate personnel.
Management of Change	The management program should establish procedures to identify and control hazards associated with change and maintain the accuracy of safety information. A facility is subject to continual change to increase efficiency, improve operability and safety, accommodate technical innovation, and implement mechanical improvements. On occasion, temporary repairs, connections, bypasses, or other modifications may be made out of operating necessity. Any of these changes can introduce new hazards or compromise the safeguards built into the original design. Care must be taken to understand the process, facility, and personnel safety and environmental implications of any changes. Although some changes may be minor with little likelihood of compromising safety or environmental protection, all changes may have the potential for disruption, injury, or business loss. Change in facilities arises whenever the process or mechanical design, as described in Section 2, is altered. Change in facilities may also occur as a result of changes in produced fluids, process additives, product specifications, byproducts or waste products, design inventories, instrumentation and control systems, or materials of construction.

API RP 75 Key Element	Description
Operating Procedure	The management program should include requirements for written facility operating procedures designed to enhance efficient, safe, and environmentally sound operations. Within a given company the designs of several offshore facilities may differ only in the size and/or number of equipment items present. Consequently, standard operating procedures may apply to multiple facilities. By their very nature, operating procedures directly address human factors issues associated with the interaction between facilities and personnel. The human factors associated with format, content, and intended use should be considered to minimize the likelihood of procedural error. When changes are made in facilities, operating procedures should be reviewed as part of the management of change procedure described in Section 4. In addition, operating procedures should be reviewed periodically to verify that they reflect current and actual operating practices. The frequency of the review should correspond to the degree of hazard presented. Review of and changes to the procedures should be documented and communicated to appropriate personnel.
Safe Work Practices	The management program should establish and implement safe work practices. These practices should be designed to minimize the risks associated with operating, maintenance, and modification activities and the handling of materials and substances that could affect safety or the environment. Human factors should be considered in the development of safe work practices. These safe work practices will normally apply to multiple locations and will normally be in written form (safety manual, safety standards, work rules, etc.). For some locations, site-specific work practices may be appropriate. The program should provide guidelines for selection and performance evaluation of contractors. Contractors should have their own written safe work practices. Contractors may adopt appropriate sections of the operator's safety and environmental management program. Regardless, an operator and contractor should agree on appropriate contractor's safety and environmental policies and practices before the contractor begins work at the operator's facilities. Safe work practices for all personnel, including contractors, should provide for the safe conduct of operating, maintenance, and modification activities, including simultaneous operations. Specifically, safe work practices should cover: a) Opening of pressurized or energized equipment or piping. b) Lockout and tagout of electrical and mechanical energy sources. c) Hot work and other work involving ignition sources. d) Confined space entry. e) Crane operations. Materials specifications, inventories, separation, confinement, and handling of toxic or hazardous materials that can affect safety and environmental protection should be determined, documented, and communicated to appropriate personnel.

API RP 75 Key Element	Description
	When selecting contractors, operators should obtain and evaluate information regarding a contractor's safety and environmental management policies and practices, and performance thereunder, and the contractor's procedures for selecting subcontractors.
Training	The management program should establish and implement training programs so that all personnel are trained to work safely and are aware of environmental considerations offshore, in accordance with their duties and responsibilities. Training should address the operating procedures described in Section 5, the safe work practices recommended in Section 6, and the emergency response and control measures recommended in Section 10. Any change in facilities that requires new or modification of existing operating procedures per Section 5 may require training for the safe implementation of those procedures. Training should be provided by qualified instructors and documented. INITIAL TRAINING - Due to the nature of offshore operations, certain training elements should be provided for the basic well-being of personnel and protection of the environment. PERIODIC TRAINING - Refresher training should be provided to maintain understanding of and adherence to the current operating procedures. Procedures should be established, such as periodic drills, to verify adequate retention of the required knowledge and skills. The management program should require that whenever a change is made in the procedures recommended in Sections 5, 6, or 10, personnel will be trained in or otherwise informed of the change before they are expected to operate the facility. Contractors should train their personnel in the work practices necessary to perform their jobs in a safe and environmentally sound manner. The training provided to contract personnel should include applicable site-specific safety and environmental procedures and rules pertaining to the facility and the applicable provisions of emergency action plans. This paragraph applies to contractors performing operating duties, maintenance or repair, turnaround, major renovation, or specialty work at the facility.
Assurance of Quality and Mechanical integrity of critical equipment	The management program should require that procedures are in place and implemented so that critical equipment for any facility subject to this RP is designed, fabricated, installed, tested, inspected, monitored, and maintained in a manner consistent with appropriate service requirements, manufacturer's recommendations, or industry standards. Contractors should have programs in place to address their own critical equipment. Human factors should be considered, particularly regarding equipment accessibility for operation, maintenance and testing. The overall quality assurance strategy to require conformance to specifications/requirements should be developed at the beginning of the project and become a part of the overall project execution plan and maintenance program. The quality assurance strategy should carry over into the operating and maintenance procedures and management of change.
Pre- Start up Review	The management program should require that the commissioning process include a pre-startup safety and environmental review for new and significantly modified facilities that are subject to this RP to confirm that the following criteria are met:

API RP 75 Key Element	Description
	a) Construction and equipment are in accordance with specifications. b) Safety, environmental, operating, maintenance, and emergency procedures are in place and are adequate. c) Safety and environmental information is current. d) Hazards analysis recommendations have been considered, addressed, and implemented as appropriate. e) Training of operating personnel has been completed. f) Programs to address management of change and other elements of this publication are in place. g) Safe work practices are in place.
Emergency Response and Control	The management program should require that emergency response and control plans are in place and are ready for immediate implementation. These plans should be validated by drills carried out to a schedule defined by the management program. The drills should address the readiness of personnel and their interaction with equipment. Written action plans should be established to assign authority to the appropriate qualified person(s) at a facility for initiating effective emergency response and control. These plans should also address emergency reporting and response requirements and comply with all applicable governmental regulations. Training incorporating emergency response and evacuation procedures should be conducted periodically for all personnel (including contractor's personnel), as required by the management program. Drills based on realistic scenarios should also be conducted periodically to exercise elements contained in the facility or area emergency action plan. An analysis and critique of each drill should be conducted to identify and correct weaknesses, as appropriate.
Investigation of Incidents	The management program should establish procedures for investigation of all incidents with serious safety or environmental consequences. The program should also require investigation of incidents that are determined by facility management to have possessed the potential for serious safety or environmental consequences. Incident investigations should be initiated as promptly as possible, considering the necessity of securing the incident scene and protecting people and the environment.
Audit of Safety and Environmental management program elements	The operators (and contractors with SEMPs) should establish and maintain an audit program and procedures for the periodic audit of the safety and environmental management program in order to determine if the program elements have been properly implemented and maintained and to provide information on the results of the audit to management. The audit program and procedures should cover: a) The activities and areas to be considered in audits b) The frequency of audits

API RP 75 Key Element	Description
	c) The audit team d) How audits will be conducted e) Audit Reporting
Records and Documentation	Management program should be established to ensure that records and documents are maintained in a manner sufficient to implement the management system. Records or documentation may be in either paper or electronic form. The safety and environmental management program documentation does not have to be retained in a separate file or binder, but can be integrated into the operator's filing or document control system. All records and documentation should be dated (with dates of revision) and readily identifiable. Audit requirements in Section 12 should be considered when formatting, distributing and filing the records and documentation related to the safety and environmental management plan.