Paradigm Shift in the Regulatory Application of Safety Management Systems to Offshore Facilities

Steven T. Maher, PE CSP Risk Management Professionals www.RMPCorp.com <u>Steve.Maher@RMPCorp.com</u> 877/532-0806

<u>Co-Authors</u> George D. Long Ramine S. Cromartie Risk Management Professionals

<u>Review & Input</u> Ian S. Sutton – Sutton Technical Books Mark R. Steinhilber – California State Lands Commission

> Rev. 0 Prepared for 7th Global Congress on Process Safety Chicago, Illinois March 13-16, 2011

Paradigm Shift in the Regulatory Application of Safety Management Systems to Offshore Facilities

Steven T. Maher, PE CSP George D. Long Ramine S. Cromartie Risk Management Professionals

> Ian S. Sutton Sutton Technical Books

Mark R. Steinhilber California State Lands Commission

Keywords: Offshore, BSEE, SEMS, Safety & Environmental Management System, 30 CFR Part 250, Center for Offshore Safety, I3P Audits

Abstract

The April 2010 Deepwater Horizon tragedy and release from the Macondo Well resulted in a reexamination of the existing regulatory framework, significant modifications to the structure and function of key regulatory agencies, and the application of new Safety Management System requirements to offshore facilities in United States waters. Late-2010 witnessed the evolution of both prescriptive and performance-based regulations designed to address the direct and underlying causes of this tragedy. The objective of this paper is to briefly review these new regulatory requirements and illustrate how they are related to the application of other Safety Management Systems, for both offshore and onshore facilities. The common themes, objectives, and overlaps of specific onshore and offshore Safety Management System elements was examined, and tips on how these overlaps can be used to more effectively (and sensibly) implement these programs is discussed. This paper also outlined successful Safety Management System programs that are being applied by various state agencies to onshore and offshore coastal facilities, and derived lessons-learned from these programs that may assist in the implementation of related federal programs.

1. Introduction

The year 2010 began with the United States government and the public generally supporting the petroleum industry and further expansion and drilling in the Gulf of Mexico (GoM). In the aftermath of the Deepwater Horizon accident that resulted in 11 lives lost, 17 injuries, and more than 4 million barrels of oil released into the GoM, a widespread loss of confidence and reversal of support in the oil industry set the stage for substantive business and regulatory changes. Table 1.1 identifies some of the key events that transpired in the wake of the Macondo Well release.

One of the outcomes of these events was the formulation of regulatory requirements for the development of a Safety Environmental & System Management (SEMS) for offshore facilities. Describing the history and driving forces behind the development of "performance-based" safety regulations for onshore and offshore facilities, their correlation to SEMS, and practical implementation of SEMS are the key objectives of this paper.



2. Offshore Drilling/Production/Transportation Risks and Regulations

2.1 Types of Risks

Personal Safety (often referred to as "Occupational Safety") and Process Safety characterize two general categories of risk. Both types of risk can result in potential harm to individuals, but the most significant differences are in how they are best controlled and regulated:



Personal Safety:

- Consequence Measures Lost Time Injury (LTI)
- Key Controls Design, Personal Protective Equipment (PPE), Job Activity Attentiveness
- Regulatory Mechanisms Readily Addressed by "Prescriptive" Safety Requirements

Process Safety:

- Consequence Measures Injuries, Financial, Environmental
- Key Controls (Safety) Management Systems
- Regulatory Mechanisms "Performance-Based" Safety Requirements



It is important to make three fundamental observations associated with these types of risks:

- Indicators of potential personal safety risks are typically direct, e.g., LTI; whereas, indicators for process safety risks are typically indirect, e.g., a mechanical failure that results in no direct injuries or "near misses" that if it had not been discovered or corrected in time, could have resulted in a release or injury.
- Different types of risks can require very different approaches to regulation.
- Addressing one type of risk does not necessarily address the second type, e.g., lowering the incidence of "slips, trips, and falls" does not directly lower the potential for a major process accident.



Spinning Disk (Dynamic) Model

2.2 Prescriptive vs. Performance-Based Regulations

When dealing with process safety, one of the realities of accident prevention is that rarely are there simple, single precursors. Simple, single precursors have typically been addressed through design or operating procedures, leaving multiple events, or failures that coincide, the primary cause of process safety incidents. A typical analogy is that of swiss cheese^[27] or a spinning disk, where:

Protective "Barriers'

Swiss Cheese (Static) Model

- Hazards are contained by multiple protective barriers.
- Barriers may have weaknesses or "holes."
- When holes align, the hazard passes
- FIGURE 2.3 Swiss Cheese and Spinning Disk Models for Accident Causes

through the barriers resulting in the potential accident.

- Barriers may be physically engineered containment or behavioral controls dependent upon people.
- Holes can be latent, incipient, or actively opened by people.

Prescriptive Regulations specifically state what actions and requirements must be met in order to achieve compliance, and they are concerned with what has to be done to manage the control of risks.



Goal/Performance-Based Regulations specify the outcome required, but leave the method of achieving this to the implementer. Goals or targets to be met in such regulations are often qualified by "reasonable practicability," and thus demand, from both the regulator and the duty holder, a correlation between action to risk and of cost to benefit.

Although there is definitely a place for prescriptive requirements, the advantages of performance-based regulations include:

- Performance-Based Regulations can better adapt to best practices and innovative technology.
- Performance-Based Regulations can be more cost-effective the company can utilize the tools, resources, and management systems that are already in place rather than "reinvent the wheel."
- Prescriptive Regulations can be reduced to a "tick in the box" approach and are often unable to reflect the most up-to-date practices.
- With Prescriptive Regulations, implementers focus on achieving compliance, rather than focusing on effectiveness.
- With a Performance-Based approach, the duty holder must demonstrate that they have managed all the risks through a coherent and compelling safety argument.

The past two decades have seen a general evolution of safety programs toward performancebased regulation. However, prescriptive requirements are often needed to define the metrics for performance-based safety, so both control mechanisms can be important.

3. Offshore Facility Process Safety Regulations

3.1 Driving Forces for Offshore Process Safety Regulations

The December 2, 1984 Methyl Isocyanate (MIC) release from the Union Carbide Bhopal Facility is considered a pivotal event in catalyzing Safety Management System (SMS) approaches to control process safety. Referencing the analogies in Figure 2.3, the MIC release resulted from the concurrent alignment of several "holes," and the magnitude of the tragedy (3928 fatalities and over 100,000 permanent injuries are estimated)^[20], drew the attention of industry, the public, and the regulatory community to the dire potential consequences associated with process safety events. Industry was quick to realize the significance of the event, with respect to the need to create and implement SMS mechanisms at highly-hazardous facilities, and the importance of developing mechanisms to control process safety.

The American Institute of Chemical Engineers (AIChE) founded the Center for Chemical Process Safety (CCPS) in 1985, recognizing that the most effective mechanism for addressing process safety was not the application of additional prescriptive mechanisms, or by addressing any specific action, but by effecting changes in the way business is done (i.e., safety culture and management systems). CCPS Guidebooks are currently considered key references in conveying





the technologies needed for process safety, and the very first guidebook ("Guidelines for Technical Management of Chemical Process Safety"[1]) published in 1987 was designed to address this pressing need. Shortly thereafter, the American Petroleum Institute (API) distilled its version of Safety Management Systems and issued Recommended Practice 750, "Management of Process Hazards"[2] in 1990. Although each document has details that are different, the following are key observations:

- All segments of industry correctly identified Safety Management Systems as the primary and most effective mechanism for addressing core issues associated with process safety incidents.
- Industry was the first to promote the application of Safety Management Systems for chemical and petroleum facilities.
- Although some of the implementation details differed between these two documents, and also differed from the current implementation details of OSHA's Process Safety Management (PSM) requirements (29 CFR 1910.119) and EPA's Risk Management Program (RMP) requirements (40 CFR Part 68), <u>the same key Safety Management System elements identified in the 1980s are a core part of PSM, RMP, and SEMS today</u>.

Figure 3.1 also identifies key events that precipitated from the 1984 Bhopal tragedy: promulgation of 29 CFR 1910.119 in 1992 and 40 CFR Part 68 in 1996. Although



implementation of the voluntary CCPS and API guidelines would have achieved the same objectives, without the existence of specific regulatory requirements, implementation of voluntary guidelines would be uneven, and only practiced by the more conscientious companies, which may have to sacrifice short-term competitiveness for long-term business viability (sometimes a "tough sell" to management). Therefore, uniform regulatory requirements for safety programs are generally necessary to ensure that companies that are demonstrating responsibility by addressing safety are not competitively disadvantaged by doing so.

3.2 Pre-2010 Offshore Facility Process Safety Regulations

As with onshore facility PSM/RMP requirements, the catalyst for a paradigm shift in the offshore regulatory process toward Safety Management Systems was a terrible tragedy – the 1988 Piper Alpha accident (Figure 3.2). Similar to Bhopal, there was an undesirable alignment of "holes" in the barriers of protection that resulted in the loss of 167 lives.

In reviewing the offshore industry response and regulatory outcome of the Piper Alpha tragedy, there are more similarities than differences when compared to Bhopal:

• The Offshore Industry responded

first with company-specific evaluations and optimization of their Platform Safety Shutdown Systems (PSSDS),^[15] and creation of guidelines for the development of a Safety and Environmental Management Program

(SEMP) for offshore facilities.

- The Offshore Industry guidelines focused on Safety Management Systems, with the same core elements as PSM/RMP.
- U.S. regulations did not directly follow, possibly a reflection of Piper Alpha's location in the North Sea and a lower percentage of expensive, deepwater platforms in the Gulf of Mexico. Although regulations for the development of a Safety and Environmental Management System (SEMS) were drafted, they were never finalized. The one exception was California. Just as California enacted state-specific requirements for onshore facilities (Risk Management and Prevention Programs, RMPP) that predated the







KE 5.2 – Tiper Alpha Tragedy

promulgation of RMP at the federal level, California's State Lands Commission created an audit program to evaluate platform safety in state waters that would augment the regulatory inspection regime. The audit program actively included an assessment of the use of SEMP that included site visits, document review, and 15-20 interviews. Use of SEMP was considered good industry practice and therefore highly encouraged. Working with each operating company to conduct the SEMP portion of the audit, each operating company was provided a confidential report that identified gap-closing opportunities. Since its initiation, Offshore Facility Operators have been observed to implement SEMP with definitive improvement in both personal safety and process safety that included reduced oil spill incidents and volumes.

The key regulatory outcome for offshore facilities in UK waters was the requirement for the creation of a Safety Case. These requirements were promulgated in 1992, updated in 2005 (See Figure 3.1), and essentially required "A documented body of evidence that provides a convincing and valid argument that a system is adequately safe for a given application in a given environment"^[4]. As well as being required, a key driver for the creation of a Safety Case is for the owner to satisfy to themselves that the facility is safe. The original 1992 requirements included:^[4]

- Fire Risk Analysis
- Assessment of the risk of ingress of smoke or gas into the accommodation
- Review of the ability of emergency systems to withstand severe accident conditions
- Evacuation, escape, and rescue analysis

The 2005 Safety Case updates focused on:^[7]

- Early design notification
- Thorough and fundamental review of safety cases at least every five years
- Removal of safety case resubmittal requirements (although still auditable)
- Licenses to ensure Operators are capable of fulfilling their legal responsibilities for safety

Although quite a bit more extensive than PSM, RMP, SEMP, and the early SEMS concepts, Safety Cases remain a Safety Management System / performance-based regulatory approach, and as such represents a continuation of that same evolution of the regulatory paradigm from prescriptive to performance-based.

A contrast of the depth of Safety Cases requirements to the SEMP Guideline and the early SEMS Regulatory concepts is depicted in Figure 3.3, and this is the status as we entered the year 2010.





3.3 2010 Offshore Facility Process Safety Regulations

As for onshore facility PSM/RMP requirements and for offshore Safety Cases, the catalyst for a paradigm shift in the United States offshore regulatory process toward Safety Management

Systems was a terrible tragedy – the 2010 Deepwater Horizon accident (Figure 3.4).

The progression of U.S. Offshore Facility regulatory development closely patterned the events following the 1984 Bhopal and 1988 Piper Alpha tragedies for U.S. onshore facilities and UK offshore facilities, respectively:

 Industry had already created a framework for the application of a Safety Management Systems approach – SEMP – for offshore facilities.



- U.S. regulations for an abbreviated Safety and Environmental Management System (SEMS) requirement had already been drafted in 2006 (see Figure 3.1); however, the lack of impetus had resulted in a deprioritization of its deployment prior to 2010. In 2010, the nearby location of the Deepwater Horizon accident in the Gulf of Mexico, the fatalities, the significant environmental impact (accentuated due to the depth of the Macondo Well release and the extended duration of the event), as well as the economic impact resulted in a "perfect storm" of events that could not result in any outcome other than the requirement for full implementation of the previous SEMP guidelines, as part of SEMS regulations (30 CFR Part 250, see Figure 3.1).
- Although no regulation can guarantee that accidents will not occur, a SMS framework was considered the best solution, with the core elements analogous to PSM/RMP.
- SMS is a proven approach, and there are many more similarities than differences between PSM, RMP, and SEMS (see Section 6).



Figure 3.5 shows the range of offshore facility SMS regulations and guidelines that are currently (2012) in effect. The thrust of SEMS in 2010 was an eventuality of the Deepwater Horizon event. Given the similarity in all SMS applications and in SMS being a recognized solution for



providing a management framework for safety, the promulgation of 30 CFR Part 250 was seemingly inevitable, and it also parallels the evolutionary trend in offshore facility regulations toward performance-based systems. Even so, SEMS applications are in the early-stages and evolving, and there are likely to be changes as industry moves forward with SMS applications.

4. Tandem Evolution of Technology and Offshore Facility Process Safety Applications

4.1 Pacing the Evolution of Technology, Risk, and Regulation

As well as industrial accidents driving the evolution of safety regulations; new technologies, increased process pressures, the quest for deeper offshore facilities, and more hazardous

conditions also inevitably drive changes in regulatory approaches toward Safety Management Systems. Figure 4.1 illustrates the cyclic interdependency of technology, risk, and regulation.

4.2 Offshore Protection Systems Evolution and Risk Assessment of High Consequence Events

One key responsibility of the facility risk manager is to understand the scenarios/conditions that contribute to risk and to appropriately prioritize safety efforts. Figure 4.2 illustrates the general use of risk analysis to characterize risk and prioritize management activities, all part of the general risk management framework.



Safety system technologies and risk analysis technologies are constantly changing. The latter

part of the twentieth century saw a dramatic evolution in electronics control/protection and system technologies. Whereas early offshore facilities used primarily analog devices that were susceptible to single failures, the revolution in electronics allowed for much more flexibility in control/protection system architecture. providing higher systems with reliability architectures that promoted high degrees of effectiveness. Figure 4.3 illustrates this revolution in technology and the spectrum of control/protection systems, applied to offshore facilities.



In response to this revolution, many offshore facility designers sought to optimize the design of control/protection features using these new technologies. One such example was the 1989

Offshore Platform Safety Shut-Down System Effectiveness Study^[15]. This effort reviewed a wide range of protection system architectures for three general classes of offshore platforms:

- Type 3 Production Platforms Stratfjord
- Type 2 Production Platforms GoM
- Type 1 Production Platforms Nigeria



Of the dominant risk contributors identified (End-Devices, Actuation Signals, & Simple Logic Processing Units (LPU)), the LPU vulnerabilities were readily addressed with the evolution of microprocessors, driven by the commercial IT market. As sensor technologies became more reliable (and more affordable), voting logic and sensor monitoring were able to greatly improve the reliability of the actuation signals used for protection loops. End-devices were a bit more challenging;

however. improvements in subsystem architecture and application of redundancy to the subsystems needed to ensure that enddevices can perform their protective function have greatly improved end-device reliability. Together these improvements have resulted in significant gains in protection loop reliability.



Figure 4.4 illustrates the tandem evolution of protection system design architecture and analysis techniques as offshore facility risk became greater.



4.3 Benefits of a Risk-Based Regulatory Framework

Safety system reliability/effectiveness is certainly critical for events that could have large personnel consequences, large environmental consequences, or large impacts on ports/harbors/shipping. Referring to Figures 4.1 & 4.2, it is clear that the elements involved in safely managing facility operation must keep pace with each other as designs and applications evolve. I.e.:

- If Event Consequences increase and the Acceptable Risk Threshold is to be kept constant, then
 - Scenario Likelihood must decrease
- If Event Consequences increase and the Acceptable Risk Threshold is to migrate lower over time, then
 - Scenario Likelihood must decrease even further

As Offshore Facilities operate in deeper waters, at higher pressures, and in more extreme environments; we push the limits of engineering, requiring higher pedigree safety systems to manage the increased potential for risk. These higher pedigree safety systems allow us to push engineering limits even further. This cycle (see Figure 4.1) mandates the application of the more complex design standards and analytical tools, discussed above, to ensure that safety systems provide the necessary reliability.

Thus, to be able to take advantage of the improvements associated with the rapid evolution of protection system design, the application of Safety Management Systems, performance-based standards, and a risk-based regulatory framework can provide an environment for technology to advance, while avoiding the limitations and impediments associated with prescriptive standards.

5. Offshore Facility Regulatory Entities

The previous sections addressed the evolution of SEMS regulations, driven by high-profile offshore facility tragedies, along with the implementation of analogous onshore facility SMS requirements. These SEMS requirements apply primarily to the jurisdiction of what is now the Bureau of Safety and Environmental Enforcement (BSEE), which was announced on January 19, 2011 and formed on October 1, 2011 as part of the split that separated BSEE from the Bureau of Ocean Energy Management (BOEM). The agencies that have jurisdiction over the various

offshore facilities are the result of several pivotal decisions regarding the governing of offshore facilities:

> • 1892 opinion in Illinois Central Railroad v. Illinois [146 U.S. 387], the U.S. Supreme Court declared that the "Sovereign Lands" of a





state are held in trust by the State for all present and future generations, and that such land may not be sold for development incompatible with uses covered by the Public Trust Doctrine.

- The Submerged Lands Act was established in 1953 which gives the States jurisdiction over natural resources out to 3 nautical miles (3.45 miles), with the exception of Texas and the west coast of Florida, which is 9 nautical miles.
- The United States Exclusive Economic Zone was established in 1983 and claims rights to all waters up to 200 nautical miles from the coastline for the United States.

Other agencies have jurisdiction over offshore facilities, and Tables 5.1 and 5.2 provide a summary reference of the different agencies involved, their jurisdictions, and the SMS-related regulatory requirements that they have promulgated.

TABLE 5.1 – State SMS Governing Regulations			
	Agency	Regulation/Guideline	
Texas (9 Nautical Miles)	Texas Railroad Commission	Primarily Design & Operating Requirements, but no Explicit SMS	
California (3 Nautical Miles)	California State Lands Commission (Certified Unified Program Agencies may have some overlapping jurisdiction for some Onshore Facilities)	California Public Resources Code (PRC) 6103, 6108, 6216, 6301, 6873 (d), CCR, Title 2, Div 3, Chapter 1, Articles 1-11. PRC 8757 (a) provide the basis for SMS inspections, audits, & enforcement	
Louisiana (3 Nautical Miles)	Department of Environmental Quality / Department of Natural Resources	Primarily Design & Operating Requirements, but no Explicit SMS	
Alaska (3 Nautical Miles)	Alaska Oil and Gas Conservation Commission	Primarily Design & Operating Requirements, but no Explicit SMS	

TABLE 5.2 – Federal SMS Governing Regulations		
Agency	Regulation/Guideline	
BSEE (Outer Continental Shelf)	SEMS	
EPA RMP (OCS, State Waters, and Onshore)	Offshore Facilities and Onshore Production Facilities Typically Exempt - However, "General Duty Clause" can be Evoked in Some Cases	
OSHA PSM (State Waters and Onshore)	Offshore Facilities and Onshore Production Facilities Typically Exempt - However, "General Duty Clause" can be Evoked in Some Cases	
Coast Guard (OCS, State Waters, and Onshore)	Primarily Equipment Functionality, Design, & Operability, but no Explicit SMS	



Offshore facility Safety Management System regulations had not been previously considered necessary by the majority of the agencies responsible for regulating offshore facility safety. A notable exception was the California State Lands Commission, which had a basis for SMS inspections, audits, and enforcement, driven in part by the 1969 release from Platform A off the coast of Santa Barbara. BSEE now (2012) has adopted a SMS approach as part of its SEMS requirements, so it is likely that this same evolution will occur with the various other offshore regulatory agencies. Although offshore facilities in state waters have a lower inherent environmental risk associated with a well blowout, the similar worker risks, the proximity of the release to the shore, and potential for more significant impacts on harbors, shipping, and fishing grounds can place a high importance on facilities in state waters. So, with agencies overseeing state waters deciding whether the risks warrant the application of SEMS, or a similar SMS approach, companies operating offshore facilities that are outside the jurisdiction of BSEE will need to evaluate the acceptability of not implementing SEMS.

6. Comparison of SEMS to Other SMS

Although the overall offshore facility regulatory environment is dynamic and a moving target (even SEMS is likely to continue to evolve as applications to Offshore Facilities progress), 30 CFR Part 250 is "on the books," with near-term implementation deadlines (see Table 6.1). Table 6.1 also identifies in red, recent/anticipated events that may affect the implementation of SEMS. Section 6 focuses on the key SEMS elements, and more important, summarizes the similarities and differences with other SMS requirements, for reasons that will be explained.

6.1 Key SEMS Elements

Figure 6.1 identifies the key elements of SEMS. Several characteristics are worth noting:

- SEMS represents a continuity with other Safety Management System core elements, and as such, it mostly overlaps with the core elements that were put forth by the 1987 CCPS Guidebook^[1], API RP 750^[2], API RP 75^[6], PSM^[3], and RMP^[5].
- These are proven strategies that represent the best expert consensus for management of safety at

TABLE 6.1 TIMELINE OF KEY EVENTS/DEADLINES POST-SEMS
15Nov10 – Effective Date of 30 CFR Part 250
14Sep11 – Proposed Revisions to SEMS
15Nov11 – SEMS Deadline for Initial Implementation of SEMS Elements, Including Completion of Hazards Analysis
2011 – API's Establishment of the Center for Offshore Safety (COS)
2012 – COS Development of SEMS Audit Guidelines and Auditor Qualifications Criteria
15Nov13 – SEMS Deadline for Completion of Audits (SEMS Revisions may provide additional guidance for implementation of Independent Third-Party Audits)

high risk industrial applications, and as such represent the continuation of an evolution of safety regulatory programs for process facilities.



- The elements in red in Figure 6.1 are those that were highlighted as the core elements in the 2006 SEMS rule proposed by the Minerals Management Service (MMS). Of significance:
 - These 4 elements are considered some of the generally more important SMS elements throughout the universe of SMS regulations, e.g., PSM and RMP.
 - These 4 elements represent a continuity between the 2006 SEMS proposed rule and the 2010 SEMS final rule.



• The elements in orange (Audits, Employee Participation, and Contractor Safety) are expected to change or be added as part of the anticipated revisions to the SEMS Program requirements^[32].

6.2 Similarities with Other Safety Management Systems

As mentioned above, there are more similarities than differences between the various SMS

regulations and guidelines. The fact that the core elements of the 1987 CCPS "Guidelines for Technical Management Safety"^[1], of Chemical Process assembled by the chemical process industry, overlap significantly with the requirements, 2010 SEMS after thousands of industry and regulatory professionals have been involved in applications of PSM and RMP is not a coincidence. The fact that root causes of most major process safety accidents (onshore/offshore, chemical/petroleum) point to gaps in SMS elements is not a coincidence. It points to:



• Safety Management System approaches (e.g., PSM, RMP, SEMS) representing reasonable best practices for management of process safety at highly hazardous facilities.



• Recognizing that there are many other risk/safety analysis techniques/methodologies and management approaches, there is still a lot of work to be done to implement basic SMS applications.

Figure 6.2 illustrates the overlap between some of the mainstream SMS approaches, and Table 6.1 provides a roadmap and regulatory references for the various elements. Note that the color-coding of Table 6.1 is synchronized with Figure 6.1.

TABLE 6.1 – SMS Program Overlap Compliance Matrix			
SECTION	API RP 75 / 30 CFR Part 250	OSHA (29 CFR)	EPA (40 CFR)
Safety & Environmental Information	2 / 250.1910	1910.119 (d)	68.65
Hazards Analysis	3 / 250.1911	1910.119 (e)	68.67
Management of Change	4 / 250.1912	1910.119 (l)	68.75
Operating Procedures	5 / 250.1913	1910.119 (f)	68.69
Safe Work Practices	6 / 250.1914	1910.119 (h,k)	68.85/87
Training	7 / 250.1915	1910.119 (g)	68.71
Assurance of Quality & Mechanical Integrity of Critical Equipment	8 / 250.1916	1910.119 (j)	68.73
Pre-Startup Review	9 / 250.1917	1910.119 (i)	68.77
Emergency Response & Control	10 / 250.1918	1910.119 (n)	68.95
Investigation of Incidents	11 / 250.1919	1910.119 (m)	68.81
Audit of SEMS/SEMP Elements	12 / 250.1920, 24, 25	1910.119 (o)	68.79
Records & Documentation	13 / 250.1928		
Employee Participation	/ 250.1932	1910.119 (c)	
Contractor Safety	Various	1910.119 (h)	68.87

6.3 Key Differences Between Select SMS Programs

Although similar in approach and concept for the technical management of process safety, in the creation of SEMS, BSEE infused several elements to address problems in the implementation of related SMS programs, and also several characteristics that facilitate its application to the broad spectrum of offshore facilities. Table 6.2 is offered as a reference to highlight some of these key differences. Correlation of these different programs is also addressed in Section 7.



TADLE 0.2 – Matrix of Key Differences Detween Select SMS Trograms				
SECTION	SEMS	EPA (40 CFR) & OSHA (29 CFR)		
Safety & Environmental Information	 Minimal Differences in Requirements – The SEI collection for every factorized by the needs of Hazards Analysis and other SEMS elements), but the core elements for most facilities (summarized below for emphasis): Process Flow Diagram (PFD) Piping & Instrumentation Diagram (P&ID) Acceptable Upper and Lower Limits of Process Variables Electrical Area Classifications Equipment Arrangement Drawings Relief System Design Bases Alarm, Shutdown, and Interlock System Descriptions Well Control System Descriptions Fire Protection Feature Design Bases Emergency Evacuation Procedures Material & Energy Balances (if available) Conformance of Mechanical Design to Applicable Codes & Standard Materials of Construction 	ility is unique (and e following form the ds		
Hazards Analysis	Initial HA and update at 3-year intervals starting on the second year after initial SEMS program completion	Initial and revalidation every 5-years		
	reflects the nature of operations for many Offshore Facilities.			
Management of Change	Minimal Differences in Requirements – SEMP documentation does, however, provide more details on typical types of changes, which might apply to Offshore Facilities.			
Operating Procedures	Review at the conclusion of specified periods and as often as necessary (frequency should correspond to the degree of hazard).	Annual recertification		
	Procedures must include job title and reporting relationship of responsible individuals.			
	Emergency operations, specific to offshore facilities, are identified.			
	Operating modes associated with bypassing out-of-service equipment must be specifically addressed.			
	Operating procedures must include impacts to the human and marine environment identified though the hazards analysis.			
	Procedure changes must be communicated to potentially-affected personnel.			
Safe Work Practices	 Minimal Differences in Requirements – SEMS generally puts additional Contractor Safety on the Offshore Operator. In addition: Operator must ensure that Contractors have their own written safe w however, Contractors may adopt appropriate sections of the Operato The clear definition of responsibilities and Contractor programs must 	responsibility for ork practices; r's SEMS Program. t be created before		

CIVIC D

Т

DID

2

D:ff

TABLE 6.2 – Matrix of Key Differences Between Select SMS Programs			
SECTION	SEMS	EPA (40 CFR) & OSHA (29 CFR)	
	the Contractor begins work at the Operator's facilities.Description of applicable Contractor duties is more complete.Inclusion of Contractor information on Form MMS-131 is specified		
Training	SEMS does not specify a training frequency, but does suggest the use of drills as an element of the training program.Via SEMP, SEMS references a number of API Recommended Practices to support initial training and additional details on initial training scope.	Refresher training every three years	
	 SEMS requires documentation of instructor qualifications. SEMS specifies that training must address and communications to affected personnel must be made for changes to: Operating Procedures (Section 250.1913) Safe Work Practices (Section 250.1914) Emergency Response and Control (Section 250.1918) 		
Assurance of Quality & Mechanical Integrity of Critical Equipment	 Minimal Differences in Requirements – Some additional emphasis point Consistency with manufacturer's design & material specifications Training of maintenance personnel to ensure that they can properly mechanical Integrity Program Frequencies of tests and inspections to be consistent with BSEE reg Modifications to equipment/systems to address their new application 	s for SEMS include: implement the ulations n	
Pre-Startup Review	Minimal Differences in Requirements – Some additional emphasis points for SEMS include ensuring that safety and environmental information is current.		
Emergency Response & Control	Documentation update requirements are not specified; however, there are clear requirements for: • Development of an Emergency Action Plan • Assignment of Designated Emergency Control Center(s) • Conducting Training and Drills	Annual Emergency Action/Response Plan update is considered best practice.	
Investigation of Incidents	Initiate the Incident Investigation as promptly as possible.Retain findings for use in the next hazards analysis update.Correlate the investigation findings and corrective actions to specific root cause(s).Distribute relevant findings to similar facilities, as well as other affected personnel.	Initiate the Incident Investigation as promptly as possible, but not later than 48 hours following the incident. Retain Incident Investigation reports for five years.	
Audit of SEMS/SEMP	3-year intervals starting on the second year after initial SEMS program completion	Triennial Audits	



TABLE 6.2 – Matrix of Key Differences Between Select SMS Programs			
SECTION	SEMS	EPA (40 CFR) & OSHA (29 CFR)	
Elements	Audit Plan to be submitted to BSEE at least 30 days before the audit Audit Report to be submitted to BSEE within 30 days of the audit completion date – At the same time, the Offshore Operator is required to submit a plan for addressing deficiencies identified within the audit. Requirement for review independent of the program, which avoids conflicts of interest – An entire section (250.1926) of 30 CFR Part 250 is dedicated to auditor qualifications. The anticipated revisions to SEMS Program Requirements ^[32] are expected to provide additional auditor training details and a requirement for an Independent Third-Party (I3P) Audit.	The two most recent compliance audits must be retained.	
Records & Documentation	 A copy of SEMS Program documents to be kept at an onshore location. Records to be kept orderly, readily identifiable, retrievable and legible, and include the date of any and all revisions. To be kept for 6 years: General Records Audits To be kept for 2 years: JSA Records (and on-site for 30 days) MOC Documentation Injury/Illness Log Documentation Contractor Safety Policy/Procedure Evaluations 	In addition to RMP/PSM element specific requirements, supporting documentation must be kept for 5 years.	
Employee Participation	 The anticipated revisions to SEMS Program Requirements^[32] are expected to result in Minimal Differences in Requirements – Employee Participation requirements include: Management consultation with employees on program development A written plan of action Operator and Contractor employee access to SEMS Program If requested, providing a copy of the Employee Participation Program to BSEE and making one available during an audit 		
Contractor Safety	 In general, Gulf of Mexico Offshore Facilities involve more direct, and extensive, involvement of Contractors. Thus, Contractor Safety responsibilities are woven into practically every element of SEMS, and includes the key actions required of PSM and RMP, as well as: 30 CFR Part 250.1915 – Training Verification for "the implementation of JSAs (§ 250.1911), operating procedures (§ 250.1913), safe work practices (§ 250.1914), emergency response and control measures (§ 250.1918), stop work authority (§ 250.1930), ultimate work authority (§ 250.1931), employee participation program (§ 250.1932), and the reporting unsafe of work conditions (§ 250.1933)" 30 CFR Part 250.1930 – Allowing "Stop Work Authority" 30 CFR Part 250.1932 – Involvement in SEMS Program Participation 30 CFR Part 250.1933 – Reporting of Unsafe Work Conditions 		

7. Organizing an Effective SEMS Program

The evolution of U.S. offshore facility safety programs into Safety Management Systems is occurring, and although SEMS requirements are likely to continue to undergo some change, the core elements are analogous to the other SMS best practices and are here to stay. At this point, Safety Case requirements for U.S. offshore facilities seem as if they will be pushed further into the future, but even with the current SEMS deadlines, for some facilities there is much to do in a very short period of time.

Fortunately, since the bulk of SMS elements are common with other loss prevention programs (e.g., PSM, RMP) (see Table 6.1), offshore facility operators that also have other business units that organize RMP or PSM Programs for onshore facilities can tap into these resources, technology, and expertise to effectively address SEMS requirements. In addition to your internal company resources, there are a number of courses (e.g., PetroSkills, Ref. 30), free webinars (e.g., Ref. 22), LinkedIn Sites, and professional guidance (e.g., Ref. 29) that are available to help in the formulation of a SEMS Program. Keep in mind that SEMS is a performance-based regulation, making every program unique. Thus, direct and peer-review involvement by all the stakeholders, as the program is being developed, is essential.

More than for onshore facilities, Offshore Operators will have to make use of twenty-first century information management and digital communications technologies to address some of the unique challenges they face in creating and managing SEMS:

- Much of the design, operations, and program information, and the individuals responsible for implementation, are at locations remote to the offshore facility being managed.
- These same responsible individuals are likely to be addressing SEMS for multiple offshore facilities, many with similar characteristics.
- The need to have a core repository for current information, and sharing it with multiple locations and groups (e.g., Contractors play a more critical role for SEMS Program applications), is more acute for offshore facilities.
- Web-based applications and extensive use of the internet/intranet communications can facilitate SEMS application.

An organized approach that makes good use of existing personnel resources, and software technologies^[24] that are able to efficiently create, document, and manage a SEMS Program, can make the objectives stated in 30 CFR Part 250 achievable. Most facilities have been starting with a gathering of available information and initiating an independent (via consultant or using resources from another business unit) gap analysis to develop a prioritized action plan. Once identified, any gaps in the following elements can be readily addressed by focused tasks (note that References 22, 28, 29, and 31 are key technical resources for the implementation of the SEMS Program and associated elements):

- Safety & Environmental Information
- Hazards Analysis



- Operating Procedures
- Assurance of Quality & Mechanical Integrity of Critical Equipment
- Emergency Response & Control
- Audit of SEMS/SEMP Elements
- Contractor Safety

It is likely that several SEMS elements can be readily addressed via a convergence with program elements that may be in-effect for other business units within your organization. The following typically represent minor incremental efforts if your company already has functional Safety Management System Programs in-place:

- Management of Change
- Safe Work Practices (There will also be some aspects specific to your business unit's operations)
- Training (There will also be some aspects specific to your business unit's operations)
- Pre-Startup Review
- Investigation of Incidents
- Employee Participation

8. References

- [1] CCPS "Guidelines for Technical Management of Chemical Process Safety," 1987.
- [2] API RP 750, First Edition "Management of Process Hazards," 1990.
- [3] PSM 29 CFR 1910.119, "Process Safety Management (PSM) of Highly Hazardous Chemicals, Explosives and Blasting Agents," 1992.
- [4] UK Safety Case Offshore Installations (Safety Case) Regulations 1992.
- [5] RMP 40 CFR Part 68, "Risk Management Programs (RMP) for Chemical Accidental Release Prevention," 1996.
- [6] API RP 75, Third Edition "Development of a Safety and Environmental Management Program for Offshore Operations and Facilities," 2004
- [7] UK SC Update "Statutory Instrument 2005 No. 3117, The Offshore Installations (Safety Case) Regulations 2005."
- [8] SEMS Concept 22May06 Federal Register Title 30, Code of Federal Regulations (CFR) Part 250 "Oil and Gas and Sulphur Operations in the Outer Continental Shelf (OCS) – Safety and Environmental Management Systems," 2006.
- [9] SEMS Proposed Rule 17Jun09 Federal Register "Safety and Environmental Management Systems for Outer Continental Shelf Oil and Gas Operations," 2009.
- [10] MODU HSE Case International Association of Drilling Contractors "Health, Safety and Environmental Case Guidelines for Mobile Offshore Drilling Units," May 2009.
- [11] API RP 14B, Fourth Edition "Design, Installation, Repair and Operation of Subsurface Safety Valve Systems."
- [12] API RP 14C, Seventh Edition "Analysis, Design, Installation, and Testing of Basic Surface Safety Systems for Offshore Production Platforms."
- [13] API RP 14J, Second Edition "Design and Hazards Analysis for Offshore Production Facilities."
- [14] California Code of Regulations (CCR) sections 1900-2954, (1998) published in handbook form as California State Lands Commission, Mineral Resources Management Division Regulations.



- [15] "Offshore Platform Safety Shutdown System Effectiveness," Safety Developments in the Offshore Oil and Gas Industry, Institution of Mechanical Engineers, Glasgow, Scotland, April 1991.
- [16] SEMS Final Rule 15Oct10 Federal Register Title 30, Code of Federal Regulations (CFR) Part 250 "Oil and Gas and Sulphur Operations in the Outer Continental Shelf – Safety and Environmental Management Systems," 2010.
- [17] Shaefer, Scott D. (1988, Sept.), "Safety Assessment of Management Systems." Paper presented at <u>Prevention First '98 Symposium</u> sponsored by the California State Lands Commission, Long Beach, CA.
- [18] Bishop, Peter and Robin Bloomfield, "A Methodology for Safety Case Development (1998)," presented the Safety-Critical Systems Symposium, Birmingham, UK, February 1998.
- [19] http://www.whitehouse.gov/the-press-office/remarks-president-energy-security-andrews-air-force-base-3312010
- [20] http://en.wikipedia.org/wiki/Bhopal_disaster
- [21] www.BSEE.gov Bureau of Safety & Environmental Enforcement
- [22] www.RMPCorp.com/Recordings.html –Offshore Facility SEMS Webinar Series
- [23] www.SEMSResource.com Links to SEMS Information
- [24] www.SEMS-Solution.com Broad-Spectrum SEMS Compliance Software Package
- [25] www.OilSpillCommission.gov/ National Commission on the BP Deepwater Horizon Oil Spill and Offshore Drilling
- [26] www.API.org American Petroleum Institute Publications & Recommended Practices
- [27] Broadribb, M. P.; Boyle, B.; Tanzi, S. J., "Cheddar or Swiss? How strong are your barriers?," **Process** Safety Progress 2009, *28*, 367-372.
- [28] www.CenterForOffshoreSafety.org Center for Offshore Safety
- [29] www.STB07.com Publications that include "The SEMS Report" periodical, as well as various reference books
- [30] www.PetroSkills.com Safety & Environmental Management System (SEMS) Training
- [31] www.AIChE.org/CCPS The Center for Chemical Process Safety offers guidebooks on nearly all Process Safety topics.
- [32] Proposed Revisions to SEMS 14Nov11 Federal Register Title 30, Code of Federal Regulations (CFR) Part 250 – "Oil and Gas and Sulphur Operations in the Outer Continental Shelf – Revisions to Safety and Environmental Management Systems," 2011.

