

Offshore Facility Process Safety Systems Overview (SEMS – A New Paradigm)

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Key Topics

- 2010 Update – Offshore Facility Federal SMS Regulatory Framework
- Safety Management Systems & Regulatory Overlap
- Key SEMS/SEMP Elements
- Lessons Learned from Safety Management Systems Applications
- Offshore Protection Systems Evolution & Risk of High Consequence Events
- Regulatory Dynamics & Available SMS Resources Within Your Company
- Questions?

2010 Update – Offshore Facility Federal SMS Regulatory Framework


- **1991, 1993, 2004** – SEMP Proposed & Evolved into API RP 75
- **2006/2009** – SEMS Concept / Proposed Rule
- **2010 – May 19** – MMS Restructuring Order 3299
- **2010 – May 27** – DOI Brief to the President
- **2010 – May 30** – Six-Month Moratorium on Deepwater (>500') Drilling
- **2010 – June 8** – DOI Directive to Shallow Water (<500') Drilling Operators
- **2010 – June 18** – DOI Directive on Blowout Prevention Requirements
- **2010 – June 22** – Preliminary Injunction of May 30 Moratorium
- **2010 – June** – MMS Organization Transformation to BOEMRE (Bureau of Ocean Energy Management, Regulation, and Enforcement), with Appointment of Michael R. Bromwich
- **2010 – July 12** – Suspension of Deepwater Drilling Until As Late as November 30, 2010
- **2010 – Aug 04** – Macondo Well Static Kill Achieved – Following July 15 termination of oil flow directly into the GOM

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2010 Update – Offshore Facility Federal SMS Regulatory Framework

- **2010 – Aug 04 – Sep 13** – BOEMRE Public Forums in New Orleans, Mobile, Pensacola, Santa Barbara, Anchorage, Houston, Biloxi, and Lafayette
- **2010 – Sep 05-12** – Macondo Well BOP Recovered and Transported to NASA Michoud Facility for Analysis
- **2010 – Sep 08** – BP Released Investigation Report
- **2010 – Sep 08** – DOI Released Offshore Safety Board Report
- **2010 – Sep 19** – Final Kill of Macondo Well
- **2010 – Sep 30** – BOEMRE Press Release
 - Drilling Safety Rule (“drilling operations on the OCS”)
 - Workplace Safety Rule (“operations in Federal waters”)
- **2010 – Oct 12** – Decision to Resume Drilling
- **2010 – Oct 15** – 30 CFR Part 250 – “Oil and Gas and Sulphur Operations in the Outer Continental Shelf – Safety and Environmental Management Systems; Final Rule” published in FR

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Today's Focus = Workplace Safety Rule

- **Safety & Environmental Management System (SEMS)** (30 CFR Part 250)
 - **Focus** – API RP 75 (2004) – “Recommended Practice for Development of a Safety and Environmental Management Program for Offshore Operations and Facilities” (SEMP)
 - **Applicability** – “... all OCS oil and gas and sulphur operations and the facilities under BOEMRE jurisdiction including drilling, production, construction, well workover, well completion, well servicing, and DOI pipeline activities.”
 - **Timeline** – Rule effective on November 15, 2010, with a SEMS Program to be in effect by November 15, 2011.
 - **Audits** – “An independent third-party or your designated and qualified personnel must conduct all SEMS audits;” “Audit documentation must be submitted to BOEMRE”

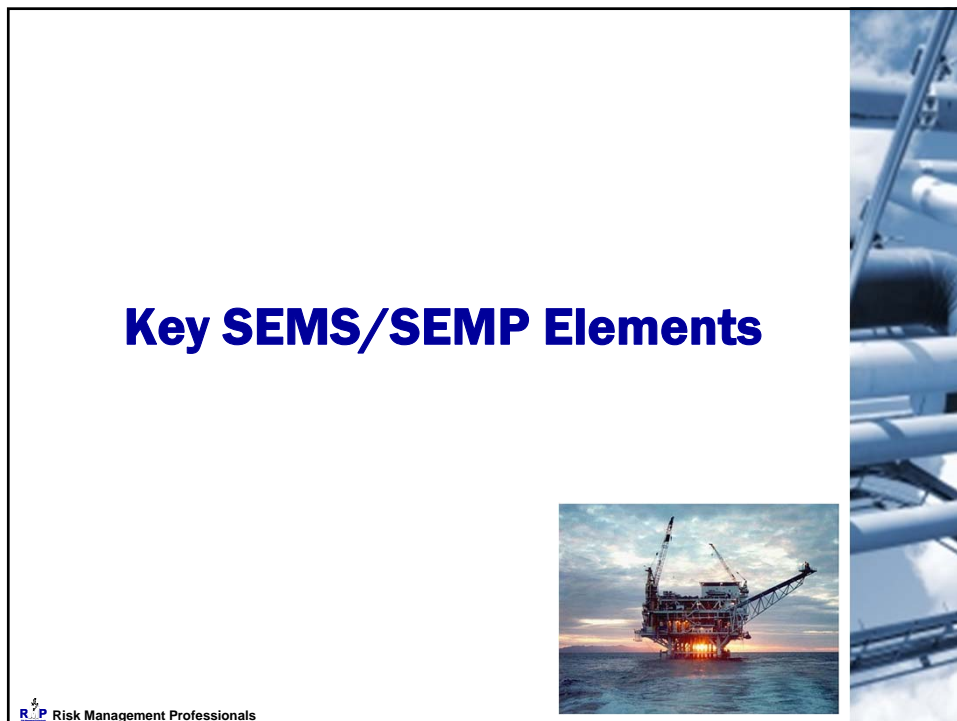
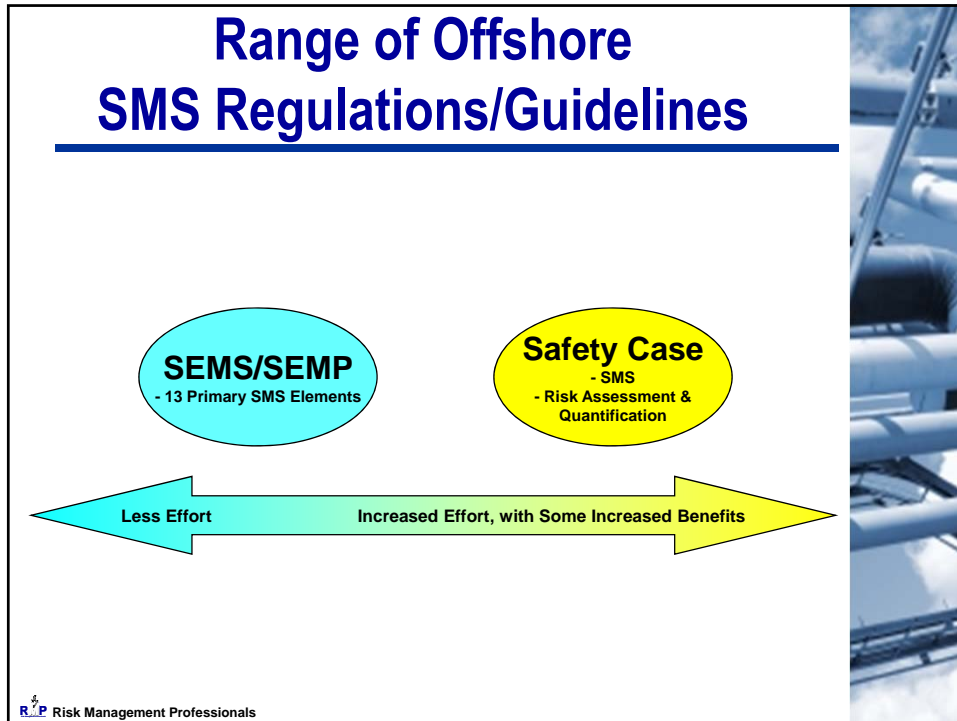
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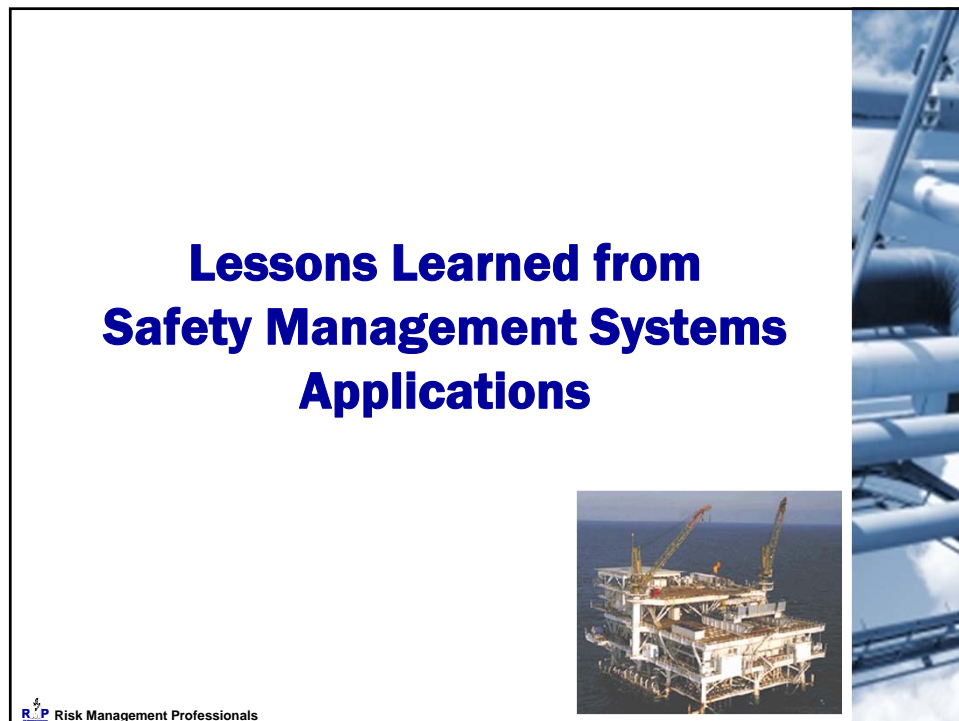
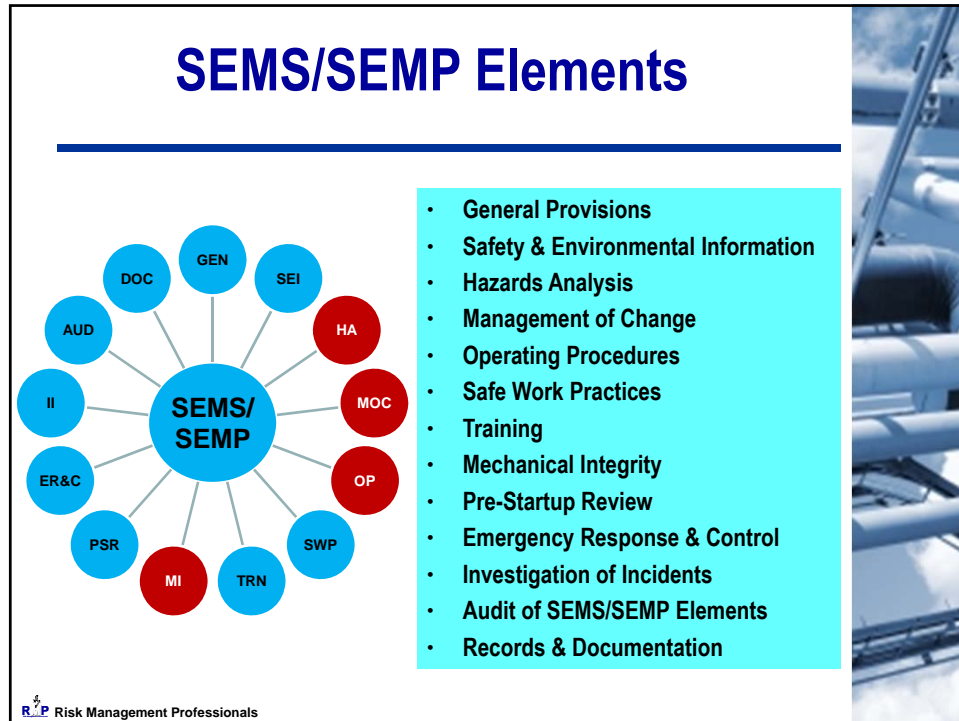


Safety Management Systems & Regulatory Overlap



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Key Program Upkeep Requirements

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SEMS Key Periodic Requirements

- **Every Three Years (Triennial)**
 - Refresher Training (Period Unspecified)
 - Audit of SEMS Elements (3-year intervals, starting on the second year after initial SEMS program completion)
 - Hazards Analysis (same interval as Audit of SEMS Elements)
- **Annual**
 - Operating Procedures (Frequency Based on Degree of Hazard)
 - Emergency Action Plan (Period Unspecified)

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SEMS Key Periodic Requirements

- **Non-Specific**
 - Safety & Environmental Information
 - MOC
 - Safe Work Practices
 - Mechanical Integrity
 - Pre-Startup Review
 - Incident Investigation
- **Non-Incidental Changes in Design or Operation !!**

Common Program Deficiencies

Common Deficiencies

- **Safety & Environmental Information (SEI)**
 - Process Flow Diagrams (PFDs) or Piping & Instrumentation Diagrams (P&IDs) are missing, not current, or not complete
 - SEI not properly filed, managed, or available
 - Relief system design or design basis not documented
 - Electrical area classifications not documented



Common Deficiencies

- **Hazards Analysis (HA)**
 - Five/Ten-year updates not done on-time
 - Recommendations not closed or closure not documented
 - Human factors not addressed in report
 - Accepted approach (e.g., API RP 14J) not used, or not used correctly
 - Inconsistent consideration of scenarios and risk-ranking
- **Management of Change (MOC)**
 - MOC Procedure not current or used
 - SEMS documentation not updated to reflect a change



Common Deficiencies

- **Operating Procedures (OP)**
 - Procedure outdated or periodic review not performed
 - Written procedures not synchronized with Operator actions
 - Key phases of operation not listed
 - Emergency shutdown procedure job assignments not clear
 - Temporary operations not included
 - Acceptable alarm setpoint range not documented



Common Deficiencies

- **Safe Work Practices (SWP)**
 - Employees not trained nor knowledgeable of the procedures
 - Safe work practices (e.g., LO/TO, HWP, Confined-Space Entry, Line Breaking) not followed (employees or contractors)
 - Activities are not documented and records kept on file



Common Deficiencies

- **Training (TRN)**

- Documentation that demonstrates that training has been performed is not available
- Personal protective equipment (PPE) procedures and training documentation not available or procedures not followed
- Training records do not indicate the means used to verify that the employee understood the training
- Training does not encompass maintenance procedures

Common Deficiencies

- **Mechanical Integrity (MI)**

- Written procedures related to the ongoing integrity of the process not available, not complete, or not implemented
- Inspections/maintenance are not occurring or inspection/maintenance frequency is not consistent with industry standards or best practices
- Equipment deficiencies not corrected in a safe or timely manner
- Facility relies on a Contractor and does not have a written preventive maintenance schedule that it is committed to
- MI activity NOT DOCUMENTED!!

Common Deficiencies

- **Pre-Startup Review (PSR)**
 - Written procedures do not exist
 - Pre-Startup Review documentation is not completed or kept on file following implementation of the MOC procedure
 - Documentation is not completed, and signed-off, until after start-up

Common Deficiencies

- **Emergency Response & Control (ER&C)**
 - EAP – Not up-to-date
 - EAP – Phone numbers outdated
 - EAP – Usability
 - EAP – Periodic review not performed
 - Training
 - Physicals and fit testing
 - Emergency response equipment

Common Deficiencies

- **Investigation of Incidents (II)**
 - Incident investigations not done correctly
 - Lack of follow-through on recommendations
 - Findings not shared with affected employees
 - Incident investigation is not promptly initiated
 - No investigation or documentation of “near-misses”



Examples of “Near Misses”

- That liquid isn’t supposed to be in that tank. Oops, forgot that valve hidden beneath the deck plate.
- Relief valves relieving is not meant to be normal practice. A relief valve is not a pressure regulator, and this is a deviation from the design intent.
- ESD or BOP actuation is not a preferred normal shutdown mechanism.
- Fouling of equipment or repeated premature failure of controls and devices



Common Deficiencies

- **Audit of SEMS/SEMP Elements (AUD)**
 - Lack of follow-through on recommendations
 - Audit not completed by periodic deadline
 - Audit of program, but not supporting documentation

Most common program-wide deficiency:
ADDRESSING RECOMMENDATIONS

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Recommendation Follow-through Tips

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Recommendation Follow-through

- Assign an individual responsible for following up on the recommendation.
- Assign a target completion date to each and every recommendation.
- Document the actions taken for addressing the recommendation, label it as "CLOSED," and document the date of completion.
- Even if the facility performs all of the actions of their recommendations (i.e., installing sensors, labeling piping, etc.), if the documentation that originally stated the recommendation(s) is not updated; **it is a deficiency**.

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Recommendation Follow-through

Generally-Accepted Bases for Declining Recommendations

– Document, in writing and based upon adequate evidence, that one or more of the following conditions are true:

- 1) The analysis upon which the recommendation is based contains factual errors.
- 2) The recommendation is not necessary to protect the health and safety of employees and contractors.
- 3) An alternative measure would provide a sufficient level of protection.
- 4) The recommendation is infeasible.

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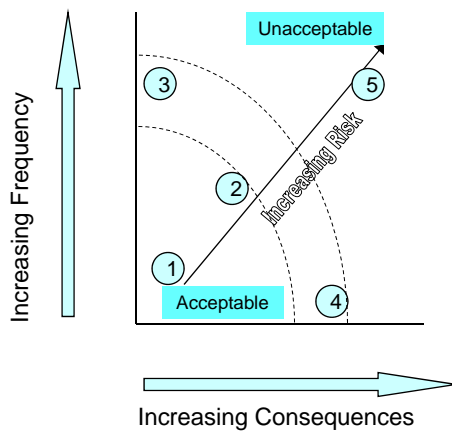


Offshore Protection Systems Evolution & Risk of High Consequence Events



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Focusing on the Objective (The “Big Picture”)



- **RISK =
PROBABILITY *
CONSEQUENCES**

- Probability =
Likelihood of
Occurrence
- Consequences =
Effects of
Occurrence

- For Engineered
Systems:

- $\text{Risk} = \sum P_i * C_i$

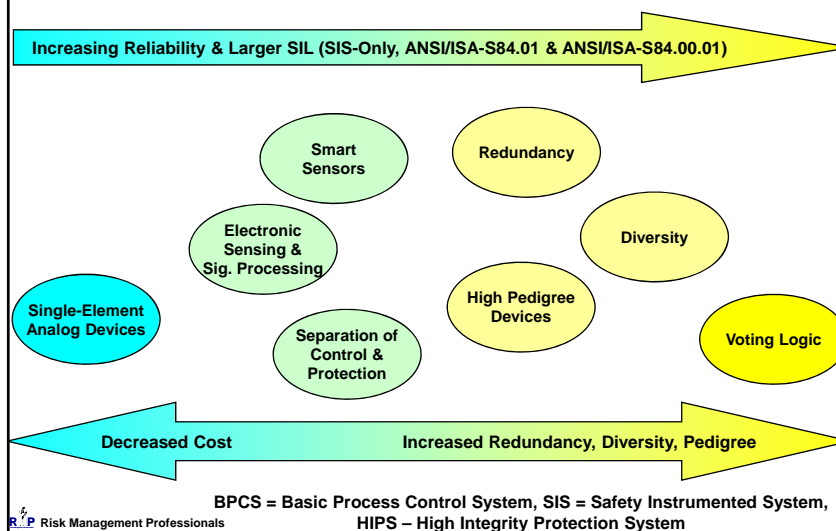
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Implications – Protection System Design

- Reminder:
 - If Risk is to be kept constant and Consequences increase, then
 - **Scenario Likelihood must decrease**
 - If Risk is to migrate lower over time & Consequences increase, then
 - **Scenario Likelihood must decrease even further**
- Protection system design and reliability is an integral part of maintaining risk below the acceptance threshold.
- What does this mean for safety system reliability for events involving ... ?
 - Large personnel consequences
 - Large environmental consequences
 - Large impacts on ports/harbors/shipping

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Control/Protection System Spectrum – BPCS & SIS/HIPS

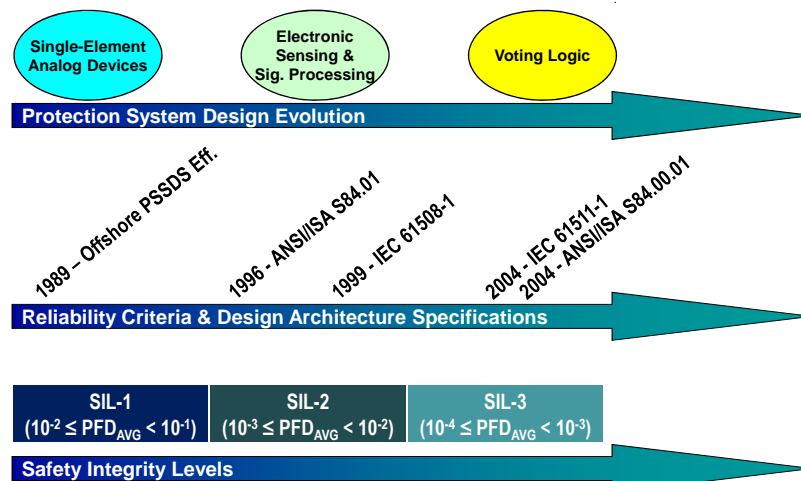


1990 Platform Safety Shut-Down System Effectiveness Study

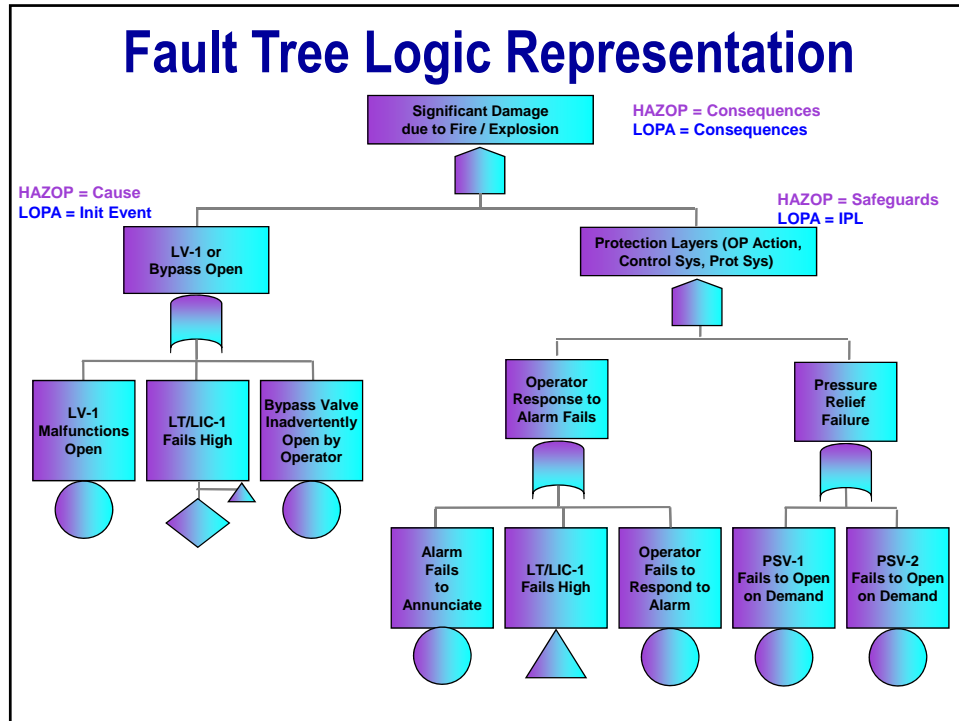
- **Scope**
 - Type 3 Production Platforms – Stratfjord
 - Type 2 Production Platforms – GOM
 - Type 1 Production Platforms – Nigeria
- **Protection System Types** – Wide Range:
 - Pneumatic
 - Electronic
- **Findings – Dominant Risk Contributors**
 - End-Devices
 - Actuation Signals
 - Simple Logic Processing Units

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Tandem Advances in Protection System Design Architectures & Analysis



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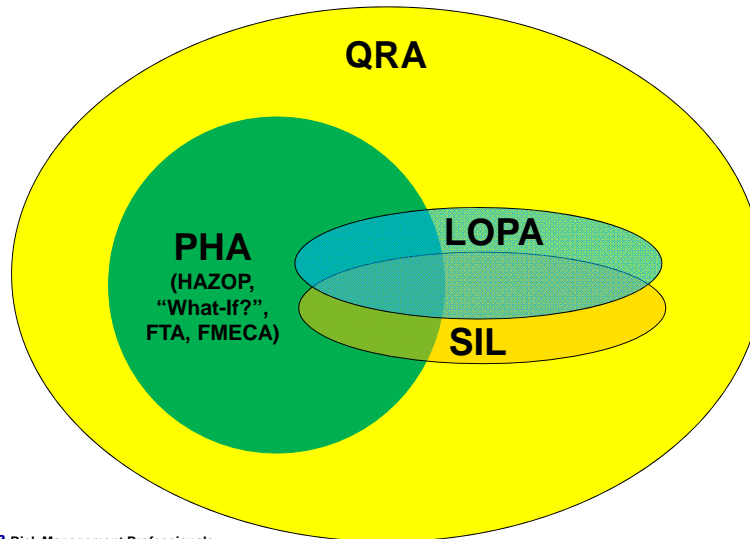


LOPA Ratio Calculation

- LOPA is a subset of the QRA Framework; however, it has its own set of acronyms and terminology to focus the analysis:
 - IC – Initiating Cause (i.e., Initiating Event)
 - ICL – Initiating Cause Likelihood (Frequency)
 - IPL – Independent Protection Layer
 - PFD – Probability of Failure on Demand
 - TF – Target Frequency
 - VF – Vulnerability Factor – Conditional Modifiers

$$LOPA\ Ratio\ (Safety) = \frac{TF_{Safety}}{ICL * PFD_1 * PFD_2 * PFD_3... * VFi * VFp}$$

Overlap Between Key Analysis Tools



Implications – Prescriptive Standards

- Reminder:
 - If Risk is to be kept constant and Consequences increase, then
 - **Scenario Likelihood must decrease**
 - If Risk is to migrate lower over time & Consequences increase, then
 - **Scenario Likelihood must decrease even further**
- What might this mean to ... ?
 - Recommended Practices & Design Guidelines
 - Redundancy
 - Diversity
 - Acceptable Design Configurations
 - Protection System Reliability
 - Mechanical Integrity
- **Limitations of Prescriptive Standards**

Regulatory Dynamics & Available SMS Resources Within Your Company

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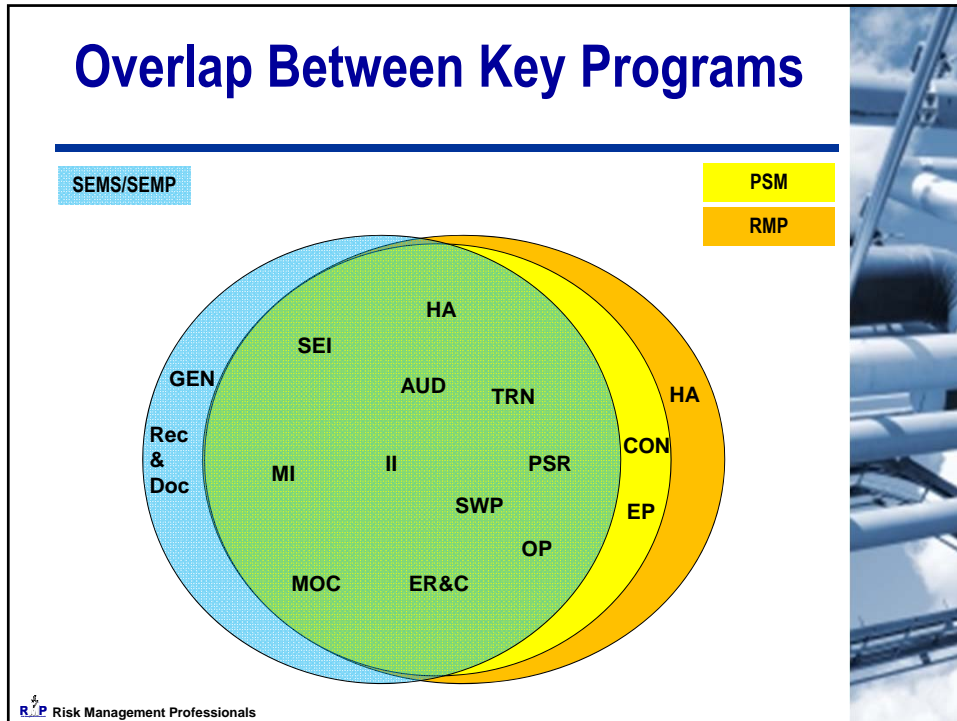


Business Issues in the Application of Safety Management Systems

- The bulk of SMS elements are common to other loss prevention programs (e.g., PSM, RMP) (see next page for comparison with SEMS elements).
- Offshore Facility Companies that also operate Onshore Facilities **already have the infrastructure and expertise to implement Offshore SMS efficiently.**

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SMS Program Overlap Compliance Matrix

Section	API (RP 75)	OSHA (29 CFR)	EPA (40 CFR)
Safety & Environmental Information	2	1910.119 (d)	68.65
Hazards Analysis	3	1910.119 (e)	68.67
Management of Change	4	1910.119 (l)	68.75
Operating Procedures	5	1910.119 (f)	68.69
Safe Work Practices	6	1910.119 (h,k)	68.85/87
Training	7	1910.119 (g)	68.71
Assurance of Quality & Mechanical Integrity of Critical Equipment	8	1910.119 (j)	68.73
Pre-Startup Review	9	1910.119 (i)	68.77
Emergency Response & Control	10	1910.119 (n)	68.95
Investigation of Incidents	11	1910.119 (m)	68.81
Audit of SEMS/SEMP Elements	12	1910.119 (o)	68.79
Records & Documentation	13	---	---

Recommended Strategies for SMS Implementation

- Recognize the Broad Spectrum of Activities Encompassed by SEMS
- Carefully Document If Exceeding Regulatory Requirements
- Integration & Minimize Duplication
 - Similar Objectives for all Performance-Based SMS Requirements
 - Use Program Overlaps to Minimize Duplication
 - Work Towards a Unified Program
- Start Simple
 - Weave Existing Elements into New Programs
 - “Gap Analysis” of Result
 - As Necessary, Update & Enhance Completeness of Existing Analyses
- **Don’t Wait** – Resources and the Cooperation of Multiple Departments/Organizations may be Required

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Recent Webinars in Offshore Facility Process Safety Series

- **July 22, 2010** – Offshore Facility Process Safety Overview (Risk Management Professionals + Guest Speaker, Mark Steinhilber)
- **September 14, 2010** – Effective Creation & Appropriate Application of Safety Cases (Risk Management Professionals + Guest Speaker, Ian Sutton)
- **October 14, 2010** – Offshore Facility Process Safety Systems Overview (SEMS – A New Paradigm)
- **November 18, 2010** – SEMS Update and HAZOP Study, LOPA, & SIL Assessment Integration Made Easy

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- 2) 1990 – API RP 750, First Edition – “Management of Process Hazards”
- 3) 1992 – PSM – 29 CFR 1910.119, “Process Safety Management (PSM) of Highly Hazardous Chemicals, Explosives and Blasting Agents”
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- 5) 1996 – RMP – 40 CFR Part 68, “Risk Management Programs (RMP) for Chemical Accidental Release Prevention”
- 6) 2004 – API RP 75, Third Edition – “Development of a Safety and Environmental Management Program for Offshore Operations and Facilities”
- 7) 2005 – UK SC Update – “Statutory Instrument 2005 No. 3117, The Offshore Installations (Safety Case) Regulations 2005”
- 8) 2006 – SEMS Concept – 22May06 Federal Register – Title 30, Code of Federal Regulations (CFR) Part 250 – “Oil and Gas and Sulphur in the Outer Continental Shelf (OCS) – Safety and Environmental Management Systems”
- 9) 2009 – SEMS Proposed Rule – 17Jun09 Federal Register – “Safety and Environmental Management Systems for Outer Continental Shelf Oil and Gas Operations”
- 10) 2009 – 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”

References

- 13) API RP 14J, Second Edition – “Design and Hazards Analysis for Offshore Production Facilities”
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Questions?

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