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Operational Sustainability, LLC®

Process Safety Solutions

Consulting
Services

Manage Risk.
Enhance Compliance.
Boost Profitability.



Operational excellence for the petrochemical, oil & gas, manufacturing, mining and utility industries.

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Operational Sustainability, LLC®

Succeeding in today's complex, highly-regulated industries depends on how well your company manages operational risk. Operational Sustainability, LLC® (OS) delivers world-class consulting services plus our industry-leading cloud-based, mobile-enabled software to enable your company to realize and achieve operational excellence. With an average of more than 30 years of industry experience, our advisors design Process Safety Management (PSM) solutions tailored to your company's needs.

Our Approach: PSM Consulting Services

PSM is a program comprised of multiple management systems designed to prevent toxic releases, fires, and explosions in the process industries. These management systems can appear highly divergent, but as shown in Figure 1, there are many interrelationships. OS provides industry experts with an average of 30 years of experience in process safety that are not only technically competent, but also approach projects with these key interrelationships in mind. In other words, we understand that each management system output becomes the input for another system and must be properly prepared to prevent rework later on. An example is a PSM recommendation designed so that it can be moved to an action tracking system immediately – without the need for remedial edits to include information required by the action tracker but not present in the PSM recommendation. Another example is assuring that necessary Layers of Protection Analysis (LOPA) safeguards required by a PHA are managed to the appropriate level by designating their status in Maintenance Software, on any relevant P&IDs, and controlling any changes via Management of Change (MOC). It is not uncommon for audits to reveal that a LOPA required critical alarm has been changed or removed because an inadequate management system didn't prevent that change.

To ensure OS meets client expectations, we begin each consulting engagement with a predetermined set of commitments including:

- Technical correctness in all aspects
- Thoroughness of process and reporting
- Auditability
- Clearly defined client expectations
- Understanding of regulatory requirements
- Appropriate design of output

OS assures quality from project inception through to project close out by delivering quick and appropriate responses to client needs in an environment of open communication. We are also very sensitive to costs. Everything from travel planning to hours billed will be accomplished as economically as possible and with your prior approval.



Figure 1 – Interrelated PSM Components



Hot Work / Safe Work Practice

Safe Work Practices is a process designed to prevent process safety incidents by thoroughly evaluating work procedures during the planning stages and authorizing work to proceed when risk is minimal.

Safe Work Practice is specifically designated by regulatory agencies for these situations:

- Lockout / Tagout
- Confined space entry
- Hot work
- Opening process equipment
- Piping / Line breaking
- Control over entrance
- Permits (general work, excavation, crane basket, etc.)
- Fall Prevention
- Underground electrical lines
- Unplugging lines and equipment
- Pressure Testing of Equipment
- Combustible and Flammable liquid containers
- Equipment Cleaning Requirements
- Temporary bypass of Interlocks

Regulations do not limit Safe Work Practices to only these activities, and they do imply the possible need for other activities to be covered under Safe Work Practices procedures. The documentation in Safe Work Practices provides evidence that the hazards were acknowledged, analyzed, resolved, and controls were in place to ensure risk is minimized. OS has Safe Work Practices Standards and Procedures and can help evaluate and implement your Safe Work Practices System to help ensure employees and contractors identify safety hazards, implement proper safety procedures, and coordinate their work with others.



General PSM / RMP Services

OS can review and/or develop written PSM / RMP programs for all element of PSM including policy statements, programs, and standards. Other related activities that we perform include:

- Process Safety Culture Assessment
- Gap Assessment
- Individual Element Auditing
- General PSM / RMP Consulting
- Resolution of PSM Gap / Audit Findings

Consulting Services By PSM Element

Process Hazard Analysis (PHA)

Process Hazard Analysis (PHA) is a blanket term for a collection of specific qualitative methodologies designed to identify and control process hazards associated with highly hazardous chemicals. In most cases the motivation for PHA is regulatory with OSHA PSM CFR 1910.119 and EPA RMP 40 CFR 68 being the primary drivers. Often facilities specify requirements for PHAs that exceed OSHA / EPA in order to satisfy internal rules or other regulations such DOT, state, or local requirements. Whatever your needs, OS will tailor the study to meet your requirements. OS offers extensive knowledge of current and proposed process safety regulations and assures that facilitators are kept current on all regulations and the specific requirements of each client. In addition, our facilitators utilize industry best practices as part of our overall quality management approach. The OS collective résumé includes the successful completion of hundreds of PHAs in the following industries: refining, petrochemical, oil & gas, specialty chemical, pharmaceutical, agricultural, and power generation.

OS can assist you in all types of PHAs including high level preliminary hazard reviews, Front End Engineering Design (FEED) high level reviews, initial PHAs, redo of an Existing PHA, and revalidations. We can also assist you in determining what PHA type or methodology is most appropriate. For example, a revalidation often turns into a more complex undertaking than doing a new study if a significant number of MOC forms have not been completed and/or the initial study quality is poor. If your initial PHA study was completed in the mid-90s and subsequent studies have all been revalidations, it may be advisable to consider a new study. Many companies are now taking that approach since studies completed during that time often do not provide the same quality as current studies.

Our consultants are proficient in leading PHAs using common and consensus methodologies including:

- What-If
- What-If / Checklist
- HAZID
- Hazard and Operability (HAZOP)
- Layers of Protection Analysis (LOPA) Semi-Quantitative
- Failure Mode and Effects Analysis (FMEA)
- HAZOP and LOPA combined
- HAZOP and SIL combined

OS is proficient in using qualitative methods as a screening tool to identify high risk and/or high severity hazard scenarios and then applying LOPA for a more exact analysis of the adequacy of the safeguards in place. This hybrid methodology capitalizes on the strengths of both the qualitative (relative speed) and semi-quantitative (verification of safeguards) methods that together can quickly identify and thoroughly analyze the major hazards.



FACILITY SITING

PSM / RMP regulations require PHAs to address facility siting. This concept is basically the spatial relationship between the process equipment and occupied buildings / adjacent equipment / units / off-site receptors. If occupied buildings are properly designed for blast resistance or are located far enough away from the process there may be no findings. However, if for example a control room is not sealed and is not maintained under positive pressure then toxic and/or flammables can enter the control room and potentially injure personnel and/or damage controls. Facility Siting is a blanket term that generally covers two separate evaluations conducted for PSM covered facilities:

1. An assessment of fire / explosion and toxic chemical impacts to occupied buildings, process equipment, adjacent units and any off-site receptors.
2. During the PHA a checklist is completed to identify process specific concerns including:
 - Occupied Building Hazards (windows, unreinforced masonry, unsealed conduit)
 - Vulnerable Control Rooms
 - Process Equipment Spacing Issues
 - Unit Spacing Issues — allowing an incident to possibly propagate from one unit to adjacent units
 - Emergency Response Deficiencies

OS provides the following facility siting services:

- Facility Siting Unit / Facility Spatial Assessment
- Occupied Building Survey
- Facility Siting Checklists for PHAs
- Gap Analysis / Audit of Existing Practices

HUMAN FACTORS

PSM / RMP regulations require PHAs to address human factors. Humans are involved in every aspect of the process life cycle from conceiving the idea to operating and maintaining an existing unit, so there are many opportunities for human failure and/or human error to result in undesired outcomes.

- Improperly specified materials may not be identified until there is a leak
- Reduction in staff to make a process economically viable may result in the loss of the entire unit if the existing staff can't respond to an upset condition
- The process may be perfectly designed but there is a failure to fabricate a unique component per specifications

Since the safeguard mindset is generally geared toward equipment protection, there may be little thought given to protection from human failures. While significant evolution in developing state-of-the-art safeguards to protect the process from itself has occurred, major human failure induced process-safety incidents still occur at roughly the same rate now as they did 20 years ago.

OS provides the following human factors services:

- Human Factors Control Room Assessment
- Human Factors Field Surveys
- Human Factors Checklists for PHAs
- Gap Analysis / Audit of Existing Practices



Process Safety Information (PSI)

PSI is often the first element addressed by a facility. This is because updated, valid PSI is required to conduct a quality PHA.

OS provides the following PSI services:

- PSI Compilation
- PSI Adequacy Assessment
- PSI Management Systems including electronic solutions
- PSI Development (PFDs, P&IDs, Electrical Classification Drawings, Process Chemistry, Maximum Intended Inventory, etc.)
- Safe Upper and Lower Limits (Safe Operating Envelopes) and Consequences of Deviation
- Facility Siting Studies / Assessments
- Relief System Design and/or Design Basis Review (e.g., API-520/521, ASME) including DIERS method.
- 3rd Party Review of Relief Systems and Guidelines

Operating Procedures

OS can assist you in developing or revising operating procedures that meet all OSHA PSM and EPA RMP requirements. We provide technical writers to work with your subject matter experts to accurately document procedures per current best practices and your internal preferences. The following are specific services we provide:

- Operating Procedures Development / Revision
- Operating Procedures Audit (per OSHA / EPA)
- Operating Procedures Testing (Is the written procedure actually carried out in the field?)

Training and Competency

OS has extensive experience in developing training and competency programs for industry leaders. We provide the following services:

- Written training / competency programs
- Specific training materials development for all aspects of PSM:
 - General PSM for Operators / Maintenance Techs / Instrument Techs
 - Specific PHA Roles for Managers / Engineers / Operators
- Training delivery for all PSM elements
- Operator training / Certification programs including Tests & Verification of Critical Tasks

Please call for the entire catalog available.

Mechanical Integrity (MI)

MI is a vast program that itself is often more complex than all the other PSM elements combined for a given facility. The bottom line is that MI is intended to prevent equipment from failing in a way that causes a release of highly hazardous chemicals. This can be anything from a piping leak to a pump failing to operate and all manner of things in between. MI must be managed with a lifecycle philosophy where an owner / operator designs, fabricates, builds, commissions, operates, maintains, and decommissions correctly. Therefore, MI is much more than just maintenance and includes diverse activities from monitoring rotating equipment to conducting non-destructive wall thickness measures on a pressure vessel.



OS has extensive experience developing and implementing MI programs for the process industries:

- Risk Based Inspection (RBI) Programs
- Preventative Maintenance Programs
- Corrosion Monitoring Programs
- Identification of PSM Covered Processes and Equipment
- Identification of Applicable Codes and Standards
- Positive Material Identification (PMI) Programs
- Equipment Corrective Action Programs
- Quality Assurance of New Equipment
- Quality Control of MRO Equipment and Spare Parts
- Maintenance Training Procedures
- Equipment Deficiencies Management Program
- Reliability Engineering Program
- Testing and Inspection Program and Plans
- Maintenance Procedures

Incident Investigation

OS can assist you in developing an incident investigation program that meets the requirements of PSM and RMP. We recommend that PSM Incidents and Near-Misses be investigated at a minimum using a Root Cause Analysis (RCA) or similar methodology in order to prevent recurrence. PSM investigation requirements are similar to standard investigation protocol.

However, there are some major differences:

1. The investigation must be initiated within 48 hours
2. There must be a system to promptly address investigation findings
3. The Incident Report shall be retained for 5 years

Management of Change (MOC)

Changes to processes are necessary and are done routinely with the intent to increase production, reduce cost, and improve safety. However, any change can have unintended consequences that pose significant hazards when not properly evaluated. For example, increased throughput at a refinery may result in a facility flare system that is undersized. Even simple changes can threaten process safety if not properly reviewed. Another aspect of MOC that is difficult to establish is Organizational Change. This is a regulatory requirement absent from many MOC portfolios. Reviewing all changes that aren't Replacements-in-Kind (RIK), along with personnel changes may seem arduous, but it doesn't have to be. OS can assist in developing a MOC program that is fully functional, complete, and streamlined so that the impact is minimal and acceptable.

OS specializes in the following MOC activities:

- Existing Program Gap Analysis / Assessment / Best Practices
- MOC Written Programs
- MOC Forms / Checklists Development
- Organizational Change Program Development
- Technical Content for MOC Programs

Pre-Startup Safety Review (PSSR)

PSSR helps to ensure that design specifications, procedures, required PHAs, and employee training are in place and adequate prior to introducing highly hazardous chemicals to a chemical process. A series of checklists are often used to assure that the equipment and materials specified are



actually used, bolts are tightened, and all other operational readiness tasks are complete prior to startup. MOC and PSSR are related and may be part of the same procedure.

OS specializes in the following PSSR activities:

- Existing Program Gap Analysis / Assessment / Best Practices
- PSSR Written Programs
- PSSR Forms / Checklists Development

Contractor Safety

Contractors performing maintenance or repair, turnaround, major renovation, or specialty work on or adjacent to a covered process must be evaluated per their safety programs and performance prior to servicing any Process Safety Critical equipment. The employer must inform the contractor of site hazards and applicable provisions of the emergency response program. This safety performance screening is commonly referred to as a Contractor Prequalification Program.

OS provides the following related services:

- Existing Program Gap Analysis / Assessment / Best Practices
- Contractor Prequalification Written Program

Compliance Audits

PSM / RMP requires compliance audits be conducted every three (3) years. OS will assist you in determining if you meet the requirements of OSHA PSM and EPA RMP. Since these are performance based standards, anything documented in your PSM policies / procedures as to how you will comply is binding. The audit scope encompasses all PSM elements and consists of reviewing relevant documents, management and employee interviews, and other methods to test the effectiveness of each program.

OS provides the following related services:

- Provide PSM Compliance Audit Team Leader
- Provide PSM Compliance Audit Team Member
- Address PSM Compliance Audit Findings
- Pre-PSM Compliance Audit Gap Analysis

Additional Elements

OS can also help you develop written programs for the following elements:

- Employee Participation
- Emergency Response
- Trade Secrets



Figure 2 – OS Process Safety Elements

Also available is the OS Process Safety Technical Content set that incorporates the **14 Process Safety elements**, helping organizations address key Process Safety challenges in a systemic, repeatable way.

- Employee Participation
- Process Safety Information
- Process Hazards Analysis (PHA)
- Operating Procedures
- Training
- Contractors
- Pre-Startup Safety Review (PSSR)
- Mechanical Integrity
- Hot Work Permit
- Management of Change (MOC)
- Incident Investigation
- Emergency Planning and Response
- Compliance Audits
- Trade Secrets

14 Key Elements of Process Safety



- Compliance Audits Standard
- Compliance Audits Procedure
- Compliance Audits Standard Field Guide
- Compliance Audits Procedure Field Guide
- Contractor Safety Standard
- Contractor Safety Standard Field Guide
- Corrective and Preventative Action Policy
- Emergency Response and Planning Standard
- Employee Participation Standard
- Employee Participation Standard Field Guide
- Incident Investigation Standard
- Incident Investigation Procedure
- Incident Investigation Standard Field Guide
- Incident Investigation Procedure Field Guide
- Management of Change Standard
- Management of Change Procedure
- Management of Change Procedure Field Guide
- Management of Organizational Change Standard

- Management of Organizational Change Procedure
- Management of Organizational Change Procedure Field Guide
- Mechanical Integrity Standards and Procedures including QA / QC
- Operating Procedure Standard
- Operating Procedures Standard Field Guide
- Pre-Startup Safety Review Standard
- Pre-Startup Safety Review Procedure
- Pre-Startup Safety Review Procedure Field Guide
- Process Hazards Analysis Standard
- Process Safety Information Standard
- Process Safety Information Field Guide
- Process Safety Management Field Guide
- Safe Work Practices Standard
- Safe Work Practices Standard Field Guide
- Safe Work Permitting Field Guide
- Trade Secrets
- Training Standard
- Training Standard Field Guide



Operational Sustainability, LLC[®]
Driving Operational Excellence[™]



Workforce



Assets



Operations



Compliance



Capital Projects

Operational Sustainability, LLC[®] makes operational excellence simple.

Succeeding in today's complex, highly-regulated industries depends on how well your company manages **operational risk** and enables **operational discipline**. Our world-class advisory services and our industry-leading cloud-based, mobile-enabled software work together to enable your company to realize **operational excellence** and **sustained operational integrity**. We identify and help you solve any issues to move to a real-time, mobilized risk-aware culture. With an average of more than 25 years of industry experience each, our advisors can design a solution tailored to your company's culture and needs.

Learn how Operational Sustainability can advise, train, and guide your workforce with the most comprehensive and effective **operational excellence** software and consulting services available today. See our full slate of free webinars, white papers, detailed module information, and scheduled workshops online at www.DrivingOE.com.

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