



Newly Responsible for Process Safety Management (PSM) at a Facility

*How do you know where to spend your time
to get the highest return per hour?*

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How do you know where to spend your time to get the highest return per hour?

Written by: Dustin Smith, P.E.

This paper is intended for individuals that work in a PSM covered facility, are new to PSM, and now responsible for compliance to regulatory or company guidelines, generally the PSM Manager. Where should you spend your time? Outside of learning all about process safety, you will be expected to further your facilities' PSM program. There are so many places to spend your time, so what yields the largest payoffs? Checking or auditing the existing PSM Program is the best way to understand what is working and what is not working. Combine that knowledge with an understanding of where negative events are most likely to occur (*typically regulatory actions or incidents*) and a new PSM Manager will be able to focus his or her efforts. This focus will allow you to find the site's programs that are least effective and have the highest potential of leading to a negative event.

Negative Events:

The Process Safety Management Act was intended to reduce industrial accidents and subsequently increase worker safety (Per the Background information listed in the Preamble to the PSM Standard). Thus, for anyone in charge of a facilities PSM program, eliminating loss of containment process incidents is Priority #1. The sites management will also want the manager of this program to ensure compliance with the PSM Standard. Thus, for the purposes of this page we will assume that the manager wants to eliminate both items which are collectively referred to in this paper as Negative Events.

Regulatory Citations

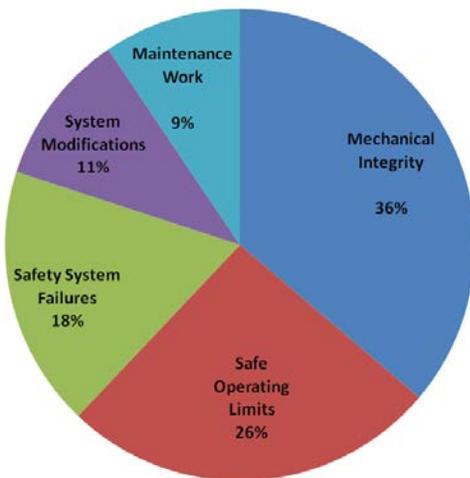
The following is a recreation of a summary information from a presentation that Mr. Mike Marshall with OSHA gave describing the Refinery and Chemical NEPs in 2012 at the USW Health, Safety & Environment Conference. He documents the results from the earlier Refinery NEP Audit (2007-2011) and the later Chemical NEP Audits (2009- and on-going at the time this was written). The five PSM Elements with the most citations are all the same for both audits (with the order of Process Hazard Analysis and Operating Procedures swapped) and comprised 80% of the citations. A PSM Manager that focuses on these five elements will get the most results for their time invested. The OSHA NEP citations are summarized from the Refinery NEP and Chemical NEP are summarized below:

Element	Description	Refinery NEP	Percent	Chem NEP
j	Mechanical Integrity	198	19.5%	#1 (23.2%)
d	Process Safety Information	177	17.4%	#2 (20.9%)
f	Operating Procedures	174	17.1%	#4 (14.0%)
e	Process Hazard Analysis	168	16.5%	#3 (15.8%)
l	Management of Change	92	9.0%	#5 (5.5%)
m	Incident Investigation	68	6.7%	#10 (2.6%)
h	Contractors	44	4.3%	#8 (3.4%)
o	Compliance Audits	41	4.0%	#6 (4.5%)
g	Training	29	2.9%	#7 (3.8%)
n	Emergency Planning and Response	14	1.4%	#11 (1.8%)
c	Employee Participation	12	1.2%	#9(2.8%)

Thus 4 out of 5 OSHA NEP citations are for five PSM Elements (Mechanical Integrity, Process Safety Information, Process Hazard Analysis, Operating Procedures and/or Management of Change). Thus, someone new to management PSM should look at these five elements first and then move onto the other elements.

Typical PSM Incidents

The other Negative Event defined here is a loss of containment related to process safety. The following is a chart based on data is adapted from the results presented in Appendix 1 of “What Went Wrong” By Trevor Kletz based on work by I. M. Duguid that categorized ~500 industrial accidents in late 1998. A quick review of these items versus the PSM Elements will provide the newly minted PSM manager some interesting insights.



1. *Mechanical Integrity* is the top item in both lists. Regulators are citing industry for the item that causes the most loss of containment incidents. **Focus efforts here!**
2. Exceeding *Safe Operating Limits* is the second item in the graph on industrial accidents. This is covered in Operating Procedures (top 5 in the citation list). One of Mr. Marshall's slides calls this section out specifically as 245 citations (~3% off all refinery NEP citations), but this is a latent reason for many of the other citations (e.g. setting a relief device set pressure to high).

The remaining industrial incidents (Maintenance Work, System Modification and Safety System Failures) are all requirements that are in the top 5 citation lists above. Thus, a PSM manager that focuses on the PSM Elements that are resulting in the highest citation rate will also work to improve the facility safety as there is good overlap between those citation and incident history.

How to Audit the Top 5 PSM Elements:

Now that PSM Elements are identified that target areas that are expected to give the most reduction in *Negative Events*, what specifically does the PSM Manager do? The PSM manager is usually not directly responsible for implementing and maintaining work and documentation associated with these PSM elements, but is individual that the facility designates as responsible to ensure that PSM is being implemented. Therefore, the PSM Manager should audit or check the implementation of these five elements. The rest of this article provides the information to develop a detailed action plan to verify the implementation status at a facility. Recommendations are included to develop a report to substantiate results that will go a long way to assist in changing actions and improving facility overall facility safety.

Prior to reading any further it is assumed that the PSM Manager will use this information to Audit existing PSM programs. The information provided here is very valuable as a initiation into these PSM elements but is by no means thorough enough to implement a PSM Program. Mechanical Integrity, for example, has multiple API Standards and Recommended Practices dedicated to setting up and monitoring the integrity of process equipment. This information spans thousands of pages and is by no means the only source of knowledge for MI. It is impractical for a new PSM Manager to review the all of the material on all of the elements prior to diving in. Thus, this article, a roadmap to learn via trial by fire while still providing value to the facility.

Mechanical Integrity (MI) - This is the key PSM Element for Negative Events and thus the first area to investigate. In general, the mechanical integrity program is set up to ensure that the equipment installed in the facility is still operational and/or fit for service. There are many different types of Mechanical Integrity Programs that could be implemented (RBI, thickness inspections, fit for service evaluations, function testing, etc.). Different equipment types (fixed equipment, rotating equipment, relief devices, instrumentation, shut-downs, etc.) usually have different inspection programs and may be inspected by different groups at the facility. In general, all equipment needs at least a program and the goal of each program can be boiled down to the following:

- *Inspection Interval* - Each item that should be inspected needs to be assigned an inspection interval. To verify this portion of the MI Program, the PSM Manager should be able to sample a portion of each type of equipment and verify the inspection interval, last inspection date and when the next inspection is due.
- *Inspection Criteria* - Each equipment that should be inspected should have the criteria by which it passes the inspection. Fixed equipment should have minimum thickness listed for each of the various inspection points. Relief devices should be verified to be operate. Shutdown systems have as part of their design the criteria for testing documented.
- *Inspection Deficiencies* - Any deficiencies identified from the review of the inspection intervals or inspections criteria should be reviewed with the appropriate owners and action items should be handled per the requirements for action items. Failure to follow through on this item was 3.7% of the Chemical Plant NEP citations.

An audit should note any overdue inspections and/or equipment items without inspection intervals, if any requirements for passing the inspection were missed (e.g. an inspection thickness was lower than required) and systemic failures to capture and resolve deficiencies. Additionally, if a backlog in the action item tracking system that is unacceptable by the facilities standards is noticed it should be noted.

Process Safety Information (PSI) - In general, the requirement for process safety information is required to ensure that the site has the ability to ensure that the equipment is designed appropriately for the service and can perform the other requirements of the PSM Standard (e.g. PHAs, MOCs, incident investigations, per the PSM Preamble). Mr. Marshall's presentation to the USW in 2012 also gave a breakdown of the PSI specific citations from the both NEPs. Since this article is to focus the efforts of PSM Managers to reduce Negative Events, the focus will be on the PSI items referenced by the OSHA presentation.

- *Compliance w/ RAGAGEP* - These items are basically action items from engineering reports that show equipment is not installed per a code or standard. The examples given are:
 1. Relief devices set above the equipment limits (e.g. MAWP)
 2. Isolation valves underneath relief devices not car-sealed or locked open
 3. Relief devices undersized
 4. Flare Knockout drums undersized
 5. Personnel Trailers in areas with excessive potential overpressure
 6. Control room buildings not alarmed for positive air pressure

While a new PSM manager may not be technically equipped to identify and resolve equipment deficiencies, he or she can find items like these by reviewing the engineering studies performed in the past few years and ensuring that all action items from these studies have been appropriately handled/resolved.

14% of the Refinery NEP and 11% of the Chemical NEP Findings were related to Action Items and how they were incorrectly tracked or not resolved. This paper is time tested and gives the basics on how to appropriately handled/resolve PSM Action Items.

- *P&ID missing / Incorrect* - Auditing P&IDs as a new PSM manager is a little trickier and time intensive. Three ways that I have found in the past to verify if P&IDs are accurate are as follows:
 1. Walk 'em Down - Perhaps the simplest way is to take a set to the unit and walk down a few sheets to see what discrepancies are found. An audit could include a summary of the findings and a copy of the red-lined drawings should be queued for updates.
 2. Verify MOCs - Take a listing of MOCs that are known to affect changes that should show up on the P&IDs (e.g. installation of a new condensate pot) and ensure that the P&IDs reflect the changes. ensure that that the changes from the project are shown on the official facility P&IDs.

3. Inspection Drawing Cross Check - In many facilities there will be separate inspection drawings that show the layout of the facility. A check of the inspection drawings against the P&IDs can provide an area of difference that indicates one of the two drawings is incorrect.

From experience, the best method for a new PSM Manager is to check the MOCs to identify areas of change and then field verify these changes and note any discrepancies, a combination of 1 and 2.

- *Relief System Design & Design Basis* - This one may be the most difficult for a new PSM Manager to review. In general, the best way to ensure that the PSV Documentation is correct is to ensure that it has been changing with MOCs, has the minimum requirements and has someone responsible for updates. Further verifications should include that for all pressure containing equipment (vessels, drums, towers, heat exchangers, etc.), there is:
 1. A listing of multiple overpressure scenarios with a narrative as to the cause and applicability of the scenario
 2. Each applicable overpressure scenario is quantified as to a rate that will be required to prevent overpressure, and that for each quantified overpressure scenario has a relief device that is sized and installed correctly.
 3. Each disposal system should have a study that identifies multiple global overpressure scenarios (big fires, power failures, partial power failures, instrument air failure, etc) and that the equipment in the flare is adequately designed (headers, knockout drums, flare stacks and tips).

In addition, verify that any deficiencies identified have been resolved (per the first item on the list).

An audit report would include systemic failures to capture and resolve deficiencies or a backlog in the action item tracking system that is unacceptable by the facilities standards. Include a summary of the P&ID review findings and a copy of the red-lined P&IDs should be queued for verification and updates. Describe systemic failures to document relief device design basis fully and note deficiencies not resolved or captured in the action item tracking system.

Operating Procedures - In general, the requirement for operating procedures is to ensure that the individuals operating the facility have predetermined directions on how to control the process under all phases of operation. Like many other elements of PSM, Operating procedures are extremely complex and difficult to develop, but with a few tips someone new to the PSM Manager role can audit the procedures to ensure that the basic content is covered:

- *Procedures Contain All Operating Phases* - Open up and skim through the procedures to ensure that they contain all of the operating phases listed in the PSM Standard (Initial Start-up, Normal Operations, Temporary Operations, Emergency Operation and Shutdown, Normal Shutdown, and subsequent startups).
- *Deviations* - Ensure that the operating procedure list the operating limits, what happens if the limits are exceeded (Consequence of Deviation), and how to bring the process back under control or when to shutdown and who can shut the process down.
- *Health & Safety Considerations* - The procedures should describe the chemical hazards, control measures and mitigation requirements for releases. If applicable, discuss any unique safety hazard, if the specification/requirements for the raw materials and the control of hazardous chemical inventory levels.
- *Annual Certification* - Ensure that the operating procedures are reviewed for accuracy and certified annually. Per Mr. Marshall's presentation, 2.4% of the Chemical NEP findings were related to annual certification of operating procedures.

An audit report would include systemic failures to meet the minimum content requirements in the PSM Standard and note if procedures are not being certified annually.

Process Hazard Analysis (PHA) - Based on Mr. Marshall's presentation, there are three area's that PHA citations were issued in the Chemical NEP (Refinery NEP information was not as detailed for PHAs)

- *PHA Findings and Recommendations* - While a new PSM manager may not be technically equipped to resolve or refute PHA Findings/Recommendations, he or she can ensure that all PHA Findings/Recommendations have been appropriately handled/resolved. Do you notice the running theme?
- *PHA Performance* - 2.2% of the citations were based because PHAs were not performed either initially or every five years as required. It is very easy to ensure that PHAs are scheduled and performed on time.
- *PHA Quality* - This one requires more effort, but many sources exist that provide checklists and basic PHA content framework to ensure completeness. Get one of these sources, take a class or somehow otherwise get educated to ensure that you as a facilities PSM Manager can ensure proper PHA quality.

An audit report would include systemic failures to perform the PHAs on the required schedule, meet minimum content requirements or handle the action items.

Management of Change (MOC) - Based on Mr. Marshall's Report, ~4% of citations were for not having a MOC program developed and implemented at the site. Over twenty years into the PSM standard this feels like a bitter pill for someone in the safety field. Tie that back to Mr. Kletz's work that more than about one in nine loss of containment incident where caused by poor management of change and this is an area for a new PSM Manager to verify hard and fast. Unfortunately, there is not a cookie cutter approach to audit an MOC System. Here is how Smith & Burgess Consultants do it for our customers:

- *PSI P&ID Review* - Previously we discussed walking down a set of P&IDs and noting discrepancies. If we assume that at some point in the past the P&IDs were correct, then all discrepancies are changes. Working with operations or other individuals knowledgeable with the facilities history, find the MOC for the changes that caused the P&ID Discrepancy.
- *Project Review* - Print out a list of projects or go to the Project Engineering department and find a set of projects that impacted the facility. Review these projects and if the facility was changed, ensure that there is a MOC, PSSR, and all PSI has been updated. PSI includes P&IDs, PFDs, Relief Systems Design Data, Electrical Area Classifications, One-Line Diagrams, etc. In addition to the PSI, the Mechanical Integrity data needs to have been updated, check the Inspection isometrics, equipment inspection records and other related equipment.

An audit report would include systemic failures to perform the MOCs or propagate the changes through the other required PSM documentation.

Conclusion (What's Next)

Working through these audit recommendations, a new PSM manager can diligently find the PSM Elements where improvements will reduce the facilities risk of a Negative Event. Working through this audit process will also familiarize the PSM Manager with many of the elements of the PSM Standard and the who's and how's of the implementation at their facility. The information gained from this analysis will prove useful in the education of the PSM Manager and help describe the status to other stakeholders. The end of this effort however is just the beginning of the improvement process. The completion of this audit process will give the facility a reasonable understanding of the issues associated with the five PSM Elements reviewed. Directing focus on specific areas that need to be corrected to continually improve overall safety. Implementing that roadmap is a discussion for another day.