The Obvious-to-Obscure Process Safety Checklist for Plant Engineers

Mr. John T. Perez, P.E.
Cognascents Consulting Group, Inc.
11777-A Katy Fwy Ste 438
Houston, TX 77079
USA
john.perez@cognascents.com

Prepared for Presentation at
American Institute of Chemical Engineers
2011 Spring Meeting
7th Global Congress on Process Safety
Chicago, Illinois
March 13-16, 2011

UNPUBLISHED

The Obvious-to-Obscure Process Safety Checklist for Plant Engineers

Mr. John T. Perez, P.E.
Cognascents Consulting Group, Inc.
11777-A Katy Fwy Ste 438
Houston, TX 77079
john.perez@cognascents.com

Keywords: Process Safety Management (PSM), Management of Change (MOC), Process Hazards Analysis (PHA), Human Factors (HF), Mechanical Integrity (MI).

Abstract

The recent process safety performance of the energy industry has led to scrutiny of industry and company-specific process safety standards, guidelines, and best practices. Several elements of process safety focus directly on the knowledge-base and experience of a facility's workforce. Plant engineers are required to participate in and lead various elements of a facility's process safety management program (e.g. management of change reviews, process hazards analyses, and mechanical integrity program implementation). Although plant engineers have an undergraduate degree in their technical field of choice, few have any formal training or recognized credential in the field of process safety. Furthermore, few companies have implemented a formal competency assessment and technical authorization program. Without such training and competency verification requirements, the author contend that a greater likelihood exists for human error in the administration of a facility's process safety program.

This paper provides a safe operating window for engineers of all experience levels on process safety protocols and pitfalls. The advice and information shared in this paper are direct learnings from assignments as a plant engineer, technical consultant, and business owner. The content is divided into the following four categories:

1. The Obvious - information, knowledge, and responsibilities conveyed through schooling and company's technical onboarding process.
2. The Potentially Obvious - information, knowledge, and responsibilities conveyed through training from entry-level to mid-level engineer.
3. The Potentially Obscure - information, knowledge, and responsibilities conveyed through training from mid-level to senior-level engineer.
4. The Obscure - information, knowledge, and responsibilities conveyed through advanced/expert training, application, and experience.

The target audience for this paper includes plant managers, business unit managers, project managers, plant engineers, EH&S managers, PSM coordinators, and operators; however, anyone involved with plant operations and/or service delivery to the energy industry may benefit from this paper.

1. Process Safety Is Under Fire, Again

I have worked in the energy industry for fourteen years. I have seen many changes, but I have also seen many things remain the same. I have heard people in companies across the energy spectrum argue whether the industry has improved overall with respect to process safety. I do not believe that enough information is available for review to answer the question definitively; however, I am hopeful that current benchmarking and reporting initiatives will take root and soon provide this valuable information. Unfortunately for now, the lack of information is a problem because it leaves the industry unarmed to critics and regulators.

It is December 2010 as I write this paper and process safety (along with other significant business functions) is under fire at the highest levels of the nation. Incidents like BP's Texas City explosion on 23 March 2005, Tesoro's Anacortes fire on 02 April 2010, and BP's Macondo blowout on 20 April 2010 continue to draw the spotlight to the ugly reality of risk in the energy industry. When people die or get hurt, the risk component to the industry merits examination and mitigation. During such examinations, accurate and accessible information is paramount to defining and understanding the true problem. Without information, society (as do engineers) tends to err on the conservative end of the risk scale. Erring on the conservative end can impose unnecessary cost in the form of regulations, protocol, time, and/or money.

During times of extreme scrutiny and examination, I often observe that a massive fact-finding exercise is performed – interviews are conducted, page after page of reports are read and catalogued, and surveys are administered and analyzed. As indicated above, the point of this exercise is to build a defense (or offense depending on which side you sit on) in the form of information to be used at a congressional hearing or trial or investigative hearing. Millions and millions of dollars are collectively spent by the involved parties to ensure superior preparation for reactive assessments and resolutions of serious incidents. The end goal is to try to prevent the same event from occurring again in the future.

The current process safety fever will subside at some point. But how do we improve the reality and perception of process safety within the energy industry and keep it away from the firing squad? The answer is simple and I hate singing an old tune that we all know. Prevent all incidents.

So, how do we prevent all incidents?

2. Constant Application of Deep and Broad Knowledge by Every Responsible Entity for Every Resource is Vital to Process Safety Excellence

The above macrocosmic presentation of process safety's delicate relationship with society can be distilled down to a microcosmic parallel at the asset level (i.e. platform, gathering/distribution system, refinery, plant, and station). After a significant incident occurs at a facility, an incident investigation is typically performed. The investigation requires a massive fact-finding exercise – interviews are conducted, experts are consulted, page after page of reports and inspections are read and catalogued, and data is downloaded from the control system. The point of this exercise is to gather information that can be used to figure out what happened, how it happened, why it happened, and how to keep it from happening again. Many dollars are spent to ensure superior preparation for reactive assessment and resolution of the incident. Does this sound familiar? I assert that there would not be a process safety macrocosm to scrutinize, if the integrity of the process safety microcosm was kept uncompromised.

Preserving the integrity of process safety at the microcosmic level requires constant application of broad and deep knowledge by each entity (i.e. individuals, organizations, and cultures) responsible for the performance of a resource (i.e. individuals, cultures, physical assets). Failure to accomplish this simply-stated directive is the core problem plaguing the process safety component of the industry.

Constant application of knowledge requires continuous presence and monitoring to afford proactive solutions. Platforms, refineries, and plants are typically operated 24/7 with multiple shifts ensuring continuous supervision. While many operators and technicians have mastered the technical elements of their job, it is unclear how many have dedicated the time necessary to be considered an expert in any one field. The same can be said for many engineers. So while constant presence may exist, constant application of knowledge necessary to ensure process safety excellence is typically not realized.

The depth of knowledge required to ensure process safety excellence is overwhelming to say the least. Recognized and Generally Accepted Good Engineering Practices (RAGAGEP) have ballooned to a body of knowledge that nobody can master. Process safety knowledge includes a wide horizontal axis of subject matter including leadership, process knowledge, human factors, risk analysis, pressure relief design, mechanical integrity, process control, unit operations, process safety protocols, operating procedures, standards, codes, regulations, and the list goes on. The vertical axis is as deep or deeper with topics and sub-topics detailing each subject matter.

Rare is the scenario where one entity is solely responsible for all facets of production and process safety administration. The more common scenario involves multiple individuals and/or organizations, each with a portion of responsibility for production and process safety administration. The problem with multiple layers of responsibility is that overall responsibility and, more importantly, accountability are diluted and more susceptible to marginalization. Another problem with multiple entities interacting to deliver process safety excellence is that each entity carries and brings a unique set of experiences. Experience is good when it is available to impart wisdom and knowledge. Experience is useless when it is not around. A larger problem is not knowing what has NOT been experienced.

The last component to process safety excellence is the resource base. Remember: process safety excellence results from constant application of broad and deep knowledge by each entity responsible for the performance of a resource. A facility's resource base includes the people, the work processes, the physical assets, and the intangible assets (e.g. culture). Once again, it is unreasonable to expect anyone to claim mastery and expertise over an entire resource base. Leading an organization to achieve process safety excellence is a very different skillset from executing PHAs or MOCs. Achieving recognition as a pressure relief analysis expert takes years, as does recognition in the fields of mechanical integrity, risk analysis, or process design.

Despite all of the above, plant engineers are required to participate every day in and lead various elements of a facility's process safety management program (e.g. management of change reviews, process hazards analyses, and mechanical integrity program implementation). Although most plant engineers have an undergraduate degree in their technical field of choice, few have any formal training or recognized credentials in the field of process safety. Furthermore, from my observation it appears as though few companies have implemented a formal competency assessment and technical authorization program. Without such training and competency verification requirements, I contend that a greater likelihood exists for human error in the administration of a facility's process safety program.

Unless a change is made it is unrealistic to believe that process safety excellence can be achieved. The change must directly address and mitigate the concerns regarding constant application of broad and deep knowledge by each entity responsible for the performance of a resource.

3. The Resurgence of the Checklist

Have you ever heard of Atul Gawande? His recent book, The Checklist Manifesto: How To Get Things Right, has sparked a resurgence of sorts for the age-old tool of making a list of actions/items necessary to perform a task the right way and the same way, every time. While doing research in the medical industry to better understand why clusters of excellence exist, he observed that many high-performing teams or organizations effectively used checklists.[1]

I know some of you are saying to yourselves, "Really, a checklist? This is your plan for process safety excellence?"

No, the checklist is not my plan. *Effective use of effective checklists* is my big "Aha" for you.

Most of us already incorporate checklists into our lives. Walkarounds are typically performed during each shift to check on critical assets. These walkarounds typically require operators or technicians to document their observations on a checklist. Many work processes for technical and business functions are driven or at least accompanied by a checklist. Failure to use a checklist is not the problem. *Failure to effectively use an effective checklist is the problem.*

The remainder of this paper offers suggestions for effective use and construction of checklists for safe operations by engineers of all experience levels.

4. Effective Use and Construction of Checklists

The following guidelines for construction of effective checklists have been consolidated from the sources cited in the References section of this paper.[1,2,3] I have attempted to incorporate my additions into the referenced body of knowledge on checklist development.

1. In determining the checklist's ***purpose***, one should ensure the following:
   a. The checklist is focused on a specific task;
   b. The checklist addresses a critical task of a complex system/problem;
   c. The checklist addresses a task that cannot be verified any other way and therefore is not vulnerable to marginalization.
2. A checklist's ***development*** should address and optimize the following elements:
   a. Checklist objectives should:
      i. Be accurate, clear, and concise;
      ii. Be located at the front of the checklist for quick and easy access;
      iii. Provide the who, what, when, where, and how of the checklist;
   b. Checklist ***content*** and ***format*** should:
      i. Prominently display the creation and revision date;
      ii. Be complete and technically correct;
      iii. Use precise terms and verbs consistently;
      iv. Spell out acronyms upon first-time usage;
      v. Use common/basic words and language;
      vi. Limit each checklist item to one activity;
      vii. Fit on one page with fewer than ten items per break in workflow;
      viii. Minimize the use of color;
      ix. Use easy-to-read font in a large-enough size for the entire user pool;
   c. Checklist ***structure*** should ensure:
      i. Similar tasks are grouped together;
      ii. Order of execution is addressed;
      iii. Visual breaks and textual devices are used appropriately;
      iv. Critical words, such as "not", are underlined;
      v. Communication queues are clearly defined and evident;
   d. Visual content should:
      i. Be located on the left side of the page with corresponding text to the right;
      ii. Serve an obvious purpose and contain only essential information.
3. The ***testing*** and ***validation*** of a checklist should ensure the following:
   a. Testing should be done one person at a time by future users;
   b. No help should be provided during testing;
   c. Testing and revising should continue until future users can use the checklist as intended on their own;

d. Testing should occur under normal and abnormal conditions – day and night, routine and non-routine operations, new and experienced users;
e. Checklist should be completed in a reasonable amount of time specific to purpose and task;
f. Prior to official use a continuous monitoring and improvement plan should be established.

Additional details for some of the above guidelines are provided in the papers cited in the References section. The above guidelines are by no means exhaustive and are meant to promote additional examination and understanding of effective checklist construction principles.

5. The Obvious-to-Obscure Process Safety Checklist

In line with the guidelines from Gawande, Stufflebeam, and Bichelmeyer, I offer the following advice and information. These guidelines are also direct learnings from assignments as a plant engineer, technical consultant, and business owner with respect to process safety protocols and pitfalls. The content is divided into the following four categories:

1. The Obvious - information, knowledge, and responsibilities conveyed through schooling and company's technical onboarding process.
2. The Potentially Obvious - information, knowledge, and responsibilities conveyed through training from entry-level to mid-level engineer.
3. The Potentially Obscure - information, knowledge, and responsibilities conveyed through training from mid-level to senior-level engineer/manager.
4. The Obscure - information, knowledge, and responsibilities conveyed through advanced/expert training, application, and experience.

Some of the below guidelines are designed to serve as prompts for reflective pauses rather than physical actions. The intended audience is anyone that falls within the scope of preserving the integrity of process safety. Some sections may apply more to young engineers and others to seasoned experts. The goal is to ensure that all of the below guidelines are considered when developing and executing checklists, especially checklists that impact the process safety integrity of a system.

5.1 The Obvious

The Obvious section of the checklist should include information, knowledge, and responsibilities conveyed through schooling and an organization's technical onboarding process. Obvious elements should include:

1. Standards and guidelines;
2. Processes and protocols;
3. Process safety information;
4. Operating procedures.

The above items do not have to be memorized, but an engineer should ask, read, and become familiar with all of the above items.

In addition, an engineer is expected to enter the professional ranks with a fundamental understanding of technical principles corresponding to their field of study. More importantly, an engineer is expected to arrive with the capability to problem-solve and think independently. They should be able to independently ask and answer obvious questions, such as:

1. Do I understand the process?
2. Do I understand how this piece of equipment works?
3. What real-time information can I check myself?

5.2 The Potentially Obvious

The Potentially Obvious section of the checklist should include information, knowledge, and responsibilities conveyed through training from an entry-level to mid-level engineer. A good way to think about Potentially Obvious elements is to consider your expectations or the organization's expectations of what someone should know a handful of years after entering the professional ranks. Potentially Obvious elements should include:

1. Moral courage – Who is responsible for blowing the whistle and slamming on the brakes?
2. Experience and history – What has happened in the past and where is the historical information for review?
3. Organizational wisdom – Who are the experts and how do I reach them?

5.3 The Potentially Obscure

The Potentially Obscure section of the checklist should include information, knowledge, and responsibilities conveyed through training from mid-level engineer to senior-level engineer/manager. We are now getting into the vulnerable area of the checklist where expectations of knowledge mastery are less defined. By this time in someone's career, it is expected that they operate fairly independently with little or no direction. Because of this expectation, the openness and security to ask "dumb" questions are not available. Potentially Obscure elements should include:

1. Leadership and accountability consolidation – Who is ultimately responsible and accountable for the overall effort?
2. Experience level of individuals and group responsible for process safety functions – Do we have the right people working on this?
3. Scope – Are we trying to do too much here?
4. Self-awareness prompt – Am I the best person to be leading this effort? Am I falling prey to any cognitive biases?

5.4 The Obscure

The Obscure section of the checklist should include information, knowledge, and responsibilities conveyed through advanced/expert training, application, and experience. Obscure elements are:

1. Experience and expertise biases – Who has different experiences than me? How do I know the expert is truly an expert? Have their credentials been vetted for the specific task at hand?
2. Expert bias – Who will challenge my thought process?
3. Cultural check – What is the pulse/morale of the unit or plant?
4. Big picture pause – What current or recent activity can impact multiple systems?
5. Persuasion and influence monitoring – Are people listening to me? If not, how do I make my need important to those I need help from?
6. In the moment evaluation – Are others in the moment? Are they being competent and experienced right now?
7. Self-awareness test – Am I leading by example? Am I living process safety? Have I made it part of my everyday job by integrating it into everything I do? Process safety is not 50% of the job or time – it is 100% of the job all the time … in and out of the plant.

6. Conclusion

Our industry continues to suffer fatal incidents. Process safety is under intense domestic scrutiny. Prevention on a microcosmic level is the first step to accomplishing macrocosmic process safety excellence. Assuring process safety integrity on the microcosmic level requires constant application of broad and deep knowledge by each entity (i.e. individuals, organizations, and cultures) responsible for the performance of a resource (i.e. individuals, cultures, physical assets). Failure to accomplish this simply-stated directive is the core problem plaguing the process safety component of the industry. The effective use of effective checklists is one measure that can be taken to realize process safety excellence. Checklist effectiveness includes modifying the typical approach to checklist development and content. Obvious elements should direct; however, Obscure elements should query. While many may believe that process safety checklists are prevalent in our industry, at the time of writing this paper (December 2010) my submitted abstract showed up on the first page of Google's search results for "process safety checklist". So I conclude that we are either not sharing our checklists publicly or we are not creating them – both of these problems must be remedied to achieve process safety excellence.

7. References

[1] Gawande, A. The Checklist Manifesto: How To Get Things Right. Picador, 175 Fifth Avenue, New York, N.Y. 10010. Copyright 2009: First edition.

[2] Stufflebeam, D. L. "Guidelines for Developing Evaluation Checklists: The Checklists Development Checklist." July 2000. http://www.wmich.edu/evalctr/archive_checklists/guidelines_cdc.pdf. Accessed 24 December 2010.

[3] Bichelmeyer, B. A. "Checklist for Formatting Checklists." 04 October 2003. http://www.wmich.edu/evalctr/archive_checklists/cfc.pdf. Accessed 05 January 2011.