

## Thinking in Outcomes - Maintaining Focus on What Process Safety Delivers in Risk Management

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**Abstract:** Establishing clear and shared delivery statements for each key aspect of process safety management helps to focus attention on what the system is intended to achieve in terms of risk management. Currently, most organisations simply describe and document the process and requirements within systems such as Management of Change and Permit to Work without first considering the purpose of these controls. Details on process safety management system outcomes have not been previously published.

This paper sets out a hierarchical rationale of process safety outcomes for all aspects of process safety management. Establishing clear and shared delivery statements for each key aspect helps to focus attention on what the system is intended to achieve in terms of risk management. Currently, most organisations simply describe and document the process and requirements within systems such as Management of Change and Permit to Work without first considering the purpose of these controls.

Being clear on the purpose and intended safety outcome of each element of a process safety management system is important because once systems and procedures are designed and implemented adherence to them soon starts to drift and people naturally deviate from the original arrangements. Having a well described and communicated 'success statement' underpinning such systems will help focus attention on the purpose of the control measures for those responsible for operating within the system and for those managing adherence to the procedure. This approach will also help identify where systems have started to falter before a catastrophic failure and therefore, offer an opportunity to rectify the situation.

### Divergent Views

In my experience, most people within an organisation have quite divergent views on why a process safety risk management system exists and what the intended outcome or purpose of that system is. For older plant, the original design intent or logic may have been long forgotten. The challenge within process safety is to manage risks which are not immediately apparent to those involved and for which the consequences of a failure in risk management and a resultant major accident are well beyond most people's experience and perception. Equally, therefore trying to secure compliance with control measures designed to protect against such opaque risks is made much more difficult.

We now appreciate that process safety technical risks are generally well managed and the use of automation and fail safe control systems have greatly enhanced risk reduction in the process industries. The remaining global challenge is improving human reliability and performance. I have often repeated the statement that 'people do safety and people also are equally adept at un-doing safety'. Therefore, clear and meaningful risk communication remains vital to reduce the opportunity for human error. Understanding why systems and procedures are necessary rather than slavishly being told to follow a procedure underpins commitment and adherence to safe operations. The prime example of a lack of knowledge and understanding in process safety management systems I have encountered over the years are in complex procedures such as permit to work, plant change/ modification and risk assessment. Few non-safety professionals when asked, can coherently explain what such systems are for, what they deliver and which aspects are key to ensuring safe outcomes.

Describing the outcomes of process safety management systems helps everyone to have a shared understanding of the reason why such systems and components are needed and what is delivered by the system or component. In turn, this makes it more likely that people will adhere to and maintain the systems as they know what they are for and why such controls are needed. Further benefits are that faults and problems will be more readily discovered, reported and rectified with process performance maintained.

### Life Cycle Approach

This paper follows a life cycle approach, Figure 1, to setting process safety outcomes running from plant design, construction, commissioning, operation, maintenance, modification and decommissioning. For each stage a clear set of outcome statements are suggested. From these sub-ordinate outcome statements are developed for each key component of a safety management system.

In the opinion of the author clear outcome or purpose statements should be incorporated into Major Accident Prevention Policy statements required under the EC Seveso Directive and should be part of an operator's documented Safety Management System under Article 8<sup>1</sup>.

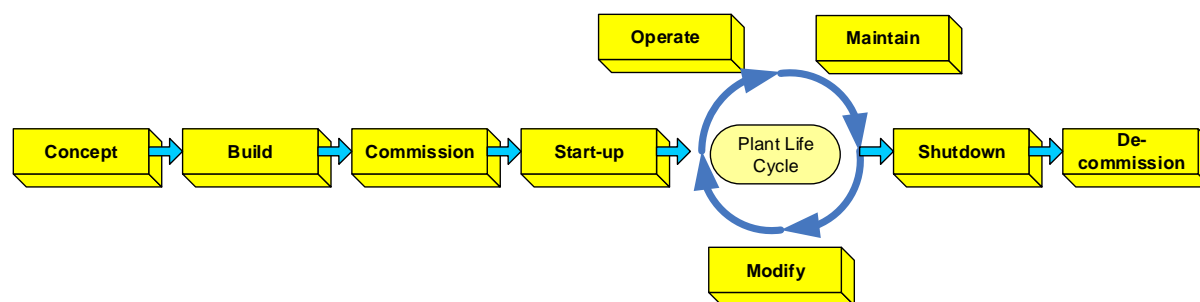


Figure 1: Process Safety Management System Lifecycle

## Process Safety Management System - Outcomes

Most newcomers to the concepts and principles of process safety management have little or no clear idea about what a process safety management system does or is needed beyond a vague concept of control of the risk of a major accident – whatever that might be? When asked to describe why such systems are needed or even how such systems work most non- safety professionals struggle to provide a coherent explanation. US OSHA, in 1993 described Process Safety Management as ‘*a set of interrelated approaches to managing hazards associated with the process industries and is intended to reduce the frequency and severity of incidents resulting from releases of chemicals and other energy sources*’. This definition struggles with the phrase ‘process industries’ as this is not entirely clear but otherwise, it is quite succinct.

This leads on to several subordinate outcomes as against an overall aim of preventing a major accident and limiting the consequences should one occur, these are:

- To ensure containment of hazardous substances, stored energy at all times such hazards are present within an establishment:

and, if this is achieved then the following outcomes will also occur:

- Protection of the health and safety of those who may be affected by a major accident,
- Protection of the environment,
- Protection of the assets of the business, and
- Protection of business reputation and maintenance of trust with stakeholders.

These outcomes should be considered and be delivered through every stage of the plant lifecycle from the process concept design, through building of the plant and equipment, commissioning, operation, maintenance, modification and de-commissioning.

A process safety management system is there more than a list of elements or sections in a PSM guidance document and should provide a systematic approach to achieve the designated outcomes for each critical stage. Furthermore, process safety management is a continuous activity to be sustained until the risks are no longer present.

## Lifecycle stage outcomes

Looking at each of the life cycle stages the outcomes of an effective **design concept** is that:

- The design is capable of ensuring the safe containment of hazardous substances, stored energy under all foreseeable operating conditions. The design should ensure the process is intrinsically safe and fail-safe in the event of an emergency. These outcomes should be maintained during:
  - Start up,
  - Operation,
  - Shut-down,
  - Emergency shut down, and
  - Maintenance operations.

The outcomes of an effective **plant build** are:

- The plant is built to the design specification, and
- Post-design changes are HAZOP’d and PIDs are updated prior to commissioning.

The outcomes of **plant commissioning** are:

- The Design concept and safety systems are checked, proved and validated,

- Problems / snags recorded and resolved,
- Post-design changes HAZOP'd,
- Post-design changes recorded / PIDs updated,
- Operational parameters are validated, and
- Operational procedures reviewed and validated.

The outcomes of an effective **operational control** are:

- The plant / process is operated within the designated safe parameters,
- Sufficient process condition safety margins are maintained,
- Effective operational information on plant status is available,
- Suitable warning & alarms of process deviations are provided,
- Operations do not adversely degrade assets or containment,
- Safe start-up and shutdown is facilitated,
- Defects and incidents are captured and reviewed.

The outcomes of **asset management and maintenance** are:

- Operation performance, including instruments, sensors, alarms and actuators is maintained within optimised parameters,
- Degradation processes are understood, detected and rectified, and
- Defects are detected and rectified.

The outcomes of **plant / process modification** are:

- Operational control is not degraded,
- Plant integrity is not degraded,
- Control systems and instrument function is maintained, and
- Information & PIDs updated to reflect the changes.

The outcomes for **plant / process decommissioning** are that:

- Containment of hazardous substance or stored energy is maintained whilst such materials remain present,
- Removal of stock inventories and substances does not increase the risk of a major hazard,
- The final state of the plant, equipment and location is as safe as it was before the inventory of hazardous material was introduced, and
- Those handling waste and scrap materials are fully aware of the risk of contamination to people and the environment and how to dispose or recycle substances safely.

## **Outcomes of other elements of a Process Safety Management System**

Continuing with the theme that each element of a process safety management system should have a clear outcome statement which is understood and shared by all staff and contractors within a company, listed below are some suggested outcomes for the remaining elements of a process safety management system.

### **Leadership and Governance**

The outcome of effective leadership and governance for process safety is that all senior managers, board members and executives have a shared understanding of the major hazard risks created by their enterprise(s) and that they have up to date and comprehensive intelligence on the status of the management of those risks. The key outcome is that the executive and board make business decisions based on the full awareness of the risks and that they set the direction and strategy to maintain control of these risks.

### **Resources and Accountability**

The outcome here is that suitable and sufficient funding and resources (people and expertise) are provided to support the onward management of process safety risks and the implementation of identified improvements to risk management. The secondary outcome is that staff (at all levels) understand their role and function in the prevention of major accidents and that they are held accountable, through performance appraisals, for the delivery of those functions.

## **Hazard Identification and Risk Assessment**

I find this fundamental area of process safety management causes most confusion to non-safety professionals. The commonly held view is that hazard identification and risk assessment is a means in itself and hence once undertaken risks will be controlled. The next common mis-conception is that risk assessment is to justify what already exists or is planned and somehow scientifically specify (usually down to a unrealistic mathematical accuracy) the probability of a major accident or incident occurring. Whilst these are not incorrect they are secondary outcomes to the primary aim which is to provide an opportunity to decide whether the controls to be applied to a hazard are sufficient (in quantity and effectiveness) to reduce to acceptable level the likelihood of a failure in control giving rise to a catastrophic incident.

## **Management of Hazardous Substances Inventory**

The clear outcomes here are that there is accurate information on the type, quantity and hazard classification of all hazardous substances present within a facility. Further outcomes are that hazardous substances are stored, handled and processed in a way that reduces the risk of a primary or secondary loss of containment and that the correct emergency action can be taken in the event of an incident based on the information held.

## **Competence Management**

This is another aspect of process safety management which causes confusion in terms of its outcome. Many people think of competence as a process rather than an outcome. The clear purpose of a competence management system is that those involved in (process) safety critical tasks have the right level of knowledge, skill and experience to enable to perform a required task without compromising safety and giving rise to a major incident. There many different means and activities required to achieve this outcome but the purpose remains the same in all circumstances.

## **Risk Communication**

Risk communication should be about the recipients of the communication rather than the communicator and the outcome for process safety management is that those who need to know or understand about aspects of risk control are provided with that information in a way that enables them to understand and act in the way intended. This outcome can be readily checked by asking those involved in key tasks or activities to explain the hazards, the potential harm(s) and the measures required to prevent a major accident.

## **Permit to Work**

As mentioned above, this is one of the most difficult aspects of process safety for non-professionals to understand clearly. Many people again confuse process with outcome and consider that the physical permit to work provides protection against harm or that the completion of the permit form provides this protection. However, the key outcome of a permit to work system is that designated high-hazard work / activities are only undertaken when authorised by a designated competent person and that the safety precautions specified by that person are adopted prior to and during the work activity.

## **Plant Change / Modification**

This control measure is similar to Permit-to-Work in that it causes considerable confusion and is frequently not followed where required. This is often down to a poorly understood scope of what should fall within the remit of a 'change' but also because the process dominates over the outcome due to complexity and lack of understanding about the systems purpose. The primary outcome of a plant change system is that modification or changes to processes, controls or procedures are only undertaken once they have been authorised by a competent person and that competence is directly related to an ability to determine whether the proposed change will have a detrimental impact on the management of process safety risks.

## **Control of Contractors**

The outcome of the arrangements to manage the work of third party contractors is to ensure that they work in a way which does not compromise the integrity of plant and processes holding hazardous substances. In other words that, contractors fully adhere to safe systems of work and fully understand the hazards present and the measures necessary to prevent a major accident. It's tempting to set the outcome as 'that contractors work equally safely as company employees' but this assumes that company employees always work as safely as possible. Like many of the outcome statements presented in this paper the ultimate aim is to improve risk communication and understanding by everyone working at a major hazard facility.

## **Operational Procedures**

Documented safe operational procedures are the corner stone of effective risk management and yet this proves to be one of the most difficult aspects of process safety to control. This because there are mixed outcomes. The primary purpose or outcome of an operational procedure is to communicate in clear and unambiguous terms what actions are needed to control risk within the context of the work being undertaken. So once again, it's the recipient who is more important than the author when it comes to the format and content. A secondary and less critical outcome is to form a written record to demonstrate compliance with a legal code or good practice guideline. However, this latter outcome often seems to dominate the first which is all about effective risk communication.

## **Emergency Arrangements**

The outcome of effective emergency arrangements is less harm is caused to people and the environment in the event of a major accident or serious process safety incident than would have been the case if such arrangements did not exist or were ineffective. A subordinate outcome that contributes to this is that the plant and process is safely shut down and any loss of hazardous substances are safely contained on site and in a condition which minuses the risk of a secondary event such as fire or explosion.

## **Measuring and Monitoring**

The outcome of a measuring and monitoring system is that the current status of process safety risk control and mitigation systems is fully determined and information provided in a timely way to allow early intervention for systems where performance has deteriorated beyond an acceptable level. This outcome covers not just technical control and mitigation systems but also information on human performance of critical tasks (by both employees and third party contractors).

## **Performance Review**

An effective performance review takes data from performance measurement and indicates areas of acceptable and sub-standard performance in process safety risk management in a way that enables corrective actions to be planned and implemented and other improvements determined.

## **Improvement Planning**

The outcome of effective improvement planning is that actions and changes required to restore or improve risk management are identified, prioritised and resourced so that they can be effectively implemented in a timely manner.

## **Conclusions**

This paper explains a way of thinking about process safety management that determines the outcome of risk control measures ahead of the actual detail of how the outcome is to be achieved. The author is not aware of such outcome statements having been published elsewhere. These descriptors can be adapted and modified to suit the local circumstances within different organisations as they are not meant to be absolute definitions. The aim of describing process safety outcomes to assist risk communication within an organisation where the concepts of process safety management are not familiar to all involved in risk management or in conducting process safety critical tasks. It is strongly recommended that all major hazard enterprises encompass this approach within their documented process safety management system and, where required by the Seveso Directive<sup>1</sup> within the documented Major Accident Prevention Policy.

The benefits of adopting these outcome statements is that it secures a shared understanding of why control measures are necessary and what the individual components of a process safety management system actually deliver. This can be routinely communicated in tool box talks and safety briefings and readily tested by discussing the outcomes with those directly involved in hazardous activities.

Once described these statements can be used to monitor and measure whether the system outcomes are actually being delivered by the use of lagging key performance indicators for each individual component.

## **References**

1. European Commission, Directive 2012/18/EU, Seveso-III