ACHIEVE CONTINUOUS SAFETY IMPROVEMENT

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Carolyn W. Merritt, Chairman and CEO, U.S. Chemical Safety Board, on the Release of the BP Refineries Independent Safety Review Panel Report stated:

> "The panel's findings present a landmark opportunity for the boards of directors and executives of oil and chemical companies throughout the world to re-examine their own safety cultures and ask whether they are sufficiently investing in the people, procedures, and equipment that will make their workplaces safe from catastrophic accidents. This is an opportunity for review and reform on a worldwide scale. "

Finding the Balance

Balancing safety and production goals can be a tenuous, delicate and complex act. It is undeniable that safety and production are compatible. It is indisputable that investments in safety yield long-term benefits. However, these benefits are not as obvious nor do they produce the rapid results associated with production investments, which generally have a high certainty of providing a measurable, positive effect within a short time frame.

For protection and safety, many of the benefits are less tangible. When successful, the instrumented protective system (IPS) is blamed for a process outage; when it fails, it is blamed for the incident. The hazard and risk analysis describes the hazardous event prevented by the operation of each instrumented protective function (IPF). When an IPF operates as required, the IPF should be given credit for the event avoided by its successful operation, including potential fatalities, injuries, environmental releases, equipment damage, and financial losses. Also, the IPF should be credited when its fault tolerant design prevents a safe IPF equipment failure from taking spurious action on the process.

Figure 1 provides a summary of the decision making process, illustrating how available resources must be allocated across safety and production goals. Decision makers often have defensive filters which affect the receipt and interpretation of information (Reason 1990). Today's business climate puts pressure on personnel in a variety of forms, such as production forecasts, budget cuts, resource reductions, or colleague retirement.

In the absence of a strong safety culture, production and budget pressure can result in a culture of denial where the decision maker's defensive filter refuses to acknowledge any evidence that does not support production or budget plans. Risk assessment can become skewed, with credible safety recommendations and concerns being dismissed without appropriate consideration. Erroneous assumptions concerning equipment and procedure robustness lead to complacency and an acceptance of increased risk. Often, this is done in the absence of dependable documentation, information, and data, or a rigorous mechanical integrity program.

Good engineering practices should be applied in preventing process safety incidents. Internal practices should be benchmarked against those of market sector peers or other process industry companies. Periodic gap analysis should be conducted to determine if existing equipment is designed, maintained, inspected, tested, and operated in a safe manner. Based on observed performance and benchmarking information, action plans for improvement should be developed and implemented.

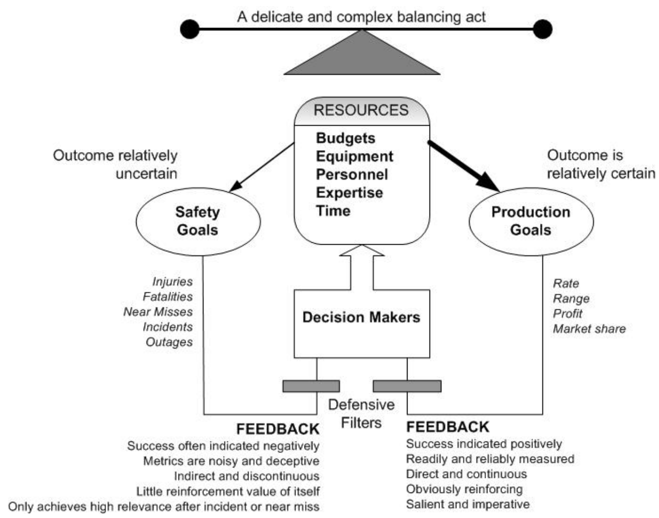

Figure 1. Overview Illustrating the Complexity of the Decision Making Process. (adapted from Reason 1990)

Understanding History

A series of catastrophic chemical incidents occurred during the 1970s and 1980s. These incidents are so legendary that they are often referenced by city only: Flixborough (1974), Seveso (1976), Mexico City (1984), and Bhopal (1984). They were catastrophic incidents that awakened the world to chemical industry risk. These incidents are summarized in Lee's Loss Prevention in the Process Industry.

The first process safety regulations were issued in Europe in the 1970s in direct response to the impact on the communities of Flixborough and Seveso. Nearly a decade later, the tragedy caused by the Mexico City explosion and the Bhopal chemical release resulted in process safety regulations being issued in the United States and many other countries. Industrial societies responded worldwide by publishing numerous codes, standards, and practices on a variety of process safety topics.

Unless you understand history you are doomed to repeat it. Despite these incidents occurring more than three decades ago, the errors and root causes for these incidents still exist today. Trevor Kletz discussed this problem in his book, Lessons from Disaster: How organizations have no memory and accidents recur (Kletz 1993). He presents numerous cases where an incident occurs and is repeated just a few years later. Kletz finds that organizations have poor memory due to many factors, such as insufficient failure investigation, inadequate communication and distribution of investigation findings, lack of information retention and little training concerning previous events.

A safety culture does not rely on balance sheet improvements to justify IPSs. It understands that the potential for incidents is an inherent part of the process design and that, without focused effort, incidents invariably occur.

Benchmarking Current Status

The owner/operator should understand how internal practices compare with recognized and generally accepted good engineering practices. This is often referred to as benchmarking and establishes the owner/operator's position with regard to industrial and market peers. This is often the most painful part of the continuous improvement process, as it tends to shed light on the shortfalls and inadequacies of the protective management system as a whole.

Some owner/operators will likely find that their design and management philosophy is out of alignment with various aspects of good engineering practices. When unacceptable risk is identified, an action plan should be established with short-term and long-term measures sufficient to reduce the risk below the owner/operator risk criteria. It is well proven that investments to improve safety and reliability of the process operation yield long-term economic returns.

Defining Gaps

An increasing number of owner/operators are finding themselves operating within a regulatory framework which often does not provide prescriptive requirements. Instead, the requirements are a moving target based on the somewhat fuzzy concept of "good engineering practice." Keeping up and complying with the basic requirements concerning process safety and IPSs can seem taxing enough. How does an owner/operator move forward with continuous improvement when it seems that even the immediate goals are a moving target? To some, it may seem challenging enough just to maintain the status quo; let alone to embrace more changes.

Continuous improvement operates on the principle that finding failures and errors is the beginning of a learning process. Minimizing their reoccurrence requires an understanding of how these failures or errors developed. Continuous improvement, as well as the application of good engineering practice, should be viewed as an on-going process rather than an endpoint. Work processes, information, resources, and skills should be analyzed periodically to identify weaknesses that limit performance and to recommend improvements, as necessary. Information systems, whether computerized or manual, should provide personnel with up-to-date information in a format that is easy to understand. Information should be revision controlled, yet accessible.

Many factors affect IPF performance expectations and the designs used to attain them, such as the economy, market trends, and technology, along with legal and political issues. A strong safety culture expects ownership and accountability for safe and reliable performance of the process equipment over its life. Management should support periodic evaluation of the existing equipment to determine that it is designed, maintained, inspected, tested, and operating in a safe manner.

Changes in operability, functionality, reliability, or maintainability expectations may require the implementation of different design/or management practices. Proof test, failure investigation, alarm, trip, and audit reports, etc. provide valuable insight into personnel and management system performance. Operating excellence requires that the root causes of unacceptable process reliability and equipment performance be identified and resolved. Improving equipment mechanical integrity requires a culture that values maintenance.

A need for improvement may be identified through various management system activities. Continuous improvement processes should include periodic examination of overall available information to identify, trend, and correct systematic problems. A gap analysis should be performed to compare the observed IPS performance to the expected performance. The gap analysis should determine that:

- Equipment is operating according to design intent,
- Safety, operating, maintenance, and emergency procedures are appropriate for competency and risk reduction expectations,
- Hazard and risk analysis or management of change recommendations are addressed in a timely manner, and
- Training of personnel is adequate for current work expectations.

Significant issues may be identified during the analysis. Management system failures are often reflected in multiple performance metrics. Systemic problems may be identified, such as poor adherence to policies, procedures, and practices or insufficient inspection and preventive maintenance. If IPS equipment is not maintained, it is likely that other equipment is suffering from the same inadequate maintenance. The cumulative maintenance deviations, whether intentional or unintentional, may cause a breakdown of multiple protection layers.

Team effort is often needed to evaluate IPS requirements and performance. Some organizations establish a formal structure where identified personnel participate as site representatives on a core team. The core team evaluates changes in the good engineering practices and makes recommendations for modifying internal practices.

Whenever work processes are modified, a shift in emphasis often leads to changes in the way team members perceive the process, its associated risks, various protection layers and IPSs. This shift may result in recommendations for additional risk reduction or IPS. These recommendations and other continuous improvement efforts complete the lifecycle, moving the process toward safer and more reliable operation.

Determining Path Forward

The key aspect of continuous improvement is charting the course to achieve it. Over time, various options will be presented to upgrade hardware, software, or human interface systems. Proposed changes should be reviewed using a management of change process to identify how the change affects other functions or systems. Areas for improvement should be addressed with an action plan, which typically prioritizes recommendations based on consequence severity and risk gap.

Action plans should define objectives, milestones, and timelines. Action plans should be periodically assessed to determine whether there is a need to accelerate the schedule or broaden its objectives. For example, a planned IPS upgrade may be accelerated when the manufacturer withdraws support for critical equipment. To be successful, action plans should be communicated to affected personnel so they understand and commit to them.

Implementing upgrades aimed at improving long-term operational effectiveness takes time to complete, depending on the complexity and degree of change involved. As the IPS is changed, operating plans and targets should consider any additional risk borne by the process during the transition. Once the design basis changes are underway, the operating and mechanical integrity basis should be reviewed and needed revisions implemented.

There are many barriers to improvement, including:

- Poor data integrity and quality,
- Poor information availability and consistency,
- Lack of broad understanding of facts and procedures,
- Poor or missing internal practices and procedures,
- Poorly understood compliance expectations,
- Inadequate revision control or notification of changes, and
- Lack of comprehensive training on data, information, procedures, and practices.

To overcome these barriers, personnel must be provided with more than just another initiative or mandate for change. Continuous improvement must be part of an organization's culture, beginning at the highest management level and continuing to the front-line operator. A continuous improvement culture requires that all personnel understand the importance of following approved practices and procedures. Personnel should feel that safe and reliable operation is an institutional value and that they won't lose their jobs or be held back for speaking out. Front-line personnel must believe that continuous improvement is supported by all levels of management. Everyone should understand that employment is conditional on safe work performance.

To succeed, personnel must be aware of the potential risk and be committed to do what is necessary to maintain and continuously improve operational and mechanical integrity. The path forward encompasses many detailed tasks, but generally includes the following:

- Assign responsibility and hold personnel accountable,
- Audit to ensure practices and procedures are followed,
- Question norms and reduce risk further when practical,
- Integrate business and process safety goals,
- Track performance, address bad actors, and celebrate success, and
- Learn and remember.

A Corporate Responsibility

Carolyn W. Merritt (2007) stated, "Corporate leadership at the highest level is accountable for the safe operation of facilities that use hazardous chemicals. Safety culture is created at the top, and when it fails there, it fails workers far down the line."

An organization's culture is ultimately driven by what management indicates is important; what is measured; and what is rewarded. Safe operation can only be sustained where it is recognized that the direct costs of an incident represent the tip of an iceberg. Hidden from view are the indirect costs and long-term business damages resulting from unsafe operations. When the true cost of an incident is understood, it becomes very clear that being cost effective is much more than simply today's budget. Success requires that personnel believe that investment in reducing risk further is encouraged and rewarded. Market leaders recognize that this investment provides benefits that far outweigh its costs. Operating excellence seeks to prevent incidents, because it is good for business and it is the right thing to do.

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