Putting the spotlight on pipeline safety

Mike Poland, Life Cycle Engineering, USA, explains methods of managing pipeline risk within the energy value chain.

With the release of ANSI/AP RP 1173, Pipeline Safety Management Systems in July this year, the corporate responsibility for managing the safety of complex processes is once again highlighted. A key component to this recommended practice and recent international standards, such as ISO 55001:2014, Asset management – Management systems – Requirements, is the focus on stakeholder engagement in communicating risk identification and risk management.

Pipeline safety in the US came into federal focus on 17 December 2002 when President George W. Bush signed The Pipeline Safety Improvement Act of 2002 into law. This law increased safety requirements for the operation of the nation’s pipelines, and mandated extensive public awareness/education programmes on the existence of pipelines and...
pipeline safety. The government’s concern for this topic was more recently elevated by the Congressional Research Service’s release of ‘Keeping America’s Pipe Safe and Secure: Key Issues for Congress’ on 9 January 2013. The report highlights pipeline accidents in Marshall, Michigan; San Bruno, California; Allentown, Pennsylvania; and Laurel, Montana, and how these events have heightened congressional concern about pipeline risks. Implementation of management systems to identify and mitigate risk to an organisation’s internal and external stakeholders is now widely recognised as both a legal and ethical requirement.

**Exemplar accident events**

The following events were highlighted in the Congressional report and further detailed in both Pipelines and Hazardous Materials Safety Administration and National Transportation Safety Board.

**Marshall**

In July of 2010, a 30 in. dia. pipeline owned and operated by Enbridge Incorporated ruptured in a

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**Figure 1.** Common framework of the management system standard.

**Figure 2.** Relationships between the risk management principles, framework and process.
wetland in Marshall, Michigan. The rupture occurred during the last stages of a planned shutdown and was not discovered or addressed for over 17 hours. During the time lapse, 843,444 gal. of crude oil was released. Clean-up efforts approached US$800 million, and more than 300 people reported symptoms consistent with crude oil exposure. Deficient integrity management procedures, inadequate training of control centre personnel, and insufficient public awareness and education were identified as key contributors to the failure.

Allentown
On 9 February 2011 in Allentown, Pennsylvania, a gas line owned and operated by UGI Utilities leaked and resulted in an explosion. As a result of the explosion and ensuing fire, five people lost their lives, three people required in-patient hospitalisation, and eight homes were destroyed. The estimated property damage from the rupture exceeded US$2.5 million.

Laurel
In Laurel, Montana, on 1 July 2011, a failure occurred on ExxonMobil’s 12 in. dia. Silvertip Pipeline, resulting in the release of approximately 1500 bbls of crude oil into the Yellowstone River. The cause of the release was determined to be a severed pipeline near the south shore of the Yellowstone River that occurred after a prolonged period of high runoff and flooding. The estimated property damage was US$135 million, along with a financial impact to ExxonMobil of US$760,391 to reimburse State agencies’ costs regarding the discharge and a penalty of US$1.6 million. Debris caught on the pipe over time increased the stresses until ultimately the critical stress of the pipe was exceeded. Procedural, training and emergency response deficiencies were highlighted as contributors to the extent of the loss.

San Bruno
California regulators imposed US$14 billion in penalties against Pacific Gas & Electric for a 2010 gas pipeline explosion that killed eight people in San Bruno. The company could face additional fines of more than US$1 billion if convicted of the federal charges, which are separate from the financial penalties that the state administrative judges weighed. Natural gas continued to flow from the pipeline for nearly two hours after the initial explosion—fueling the intense fire, hindering emergency response, and increasing fire damage. The long duration of flowing gas was due to delays in the closing of manually operated valves by the pipeline operator, and may have been exacerbated by inadequate employee training in valve closure procedures.

Risk management
Several key documents provide a solid framework for developing a management system to identify and manage risk.

ISO/IEC Directives, Part 1, Annex SL – Proposals for management system standards
ISO/IEC Directives, Part 1, Annex SL contains the framework for all management systems going forward and includes 10 common elements that are assembled in a Deming ‘plan-do-check-act’ continuous improvement process (Figure 1). These elements are:

- Scope.
- Normative references.
- Terms and conditions.
- Context of the organisation.
- Leadership.
- Planning.
- Support.
- Operation.
- Performance evaluation.
- Improvement.

All ISO management system standards going forward will be created using this format.

OSHA 1910.119, Process safety management of highly hazardous chemicals
A process safety management programme is divided into 14 elements and defined in OSHA 1910.119. These elements are:

- Process safety information.
- Process hazard analysis.
- Operating procedures.
- Training.
- Contractors.
- Mechanical integrity.
- Hot work.
- Management of change.
- Incident investigation.
- Compliance audits.
- Trade secrets.
- Employee participation.
- Pre-startup safety review.
- Emergency planning and response.
Mechanical integrity is a critical component of a process safety management system as well as pipeline safety management systems and transmission and distribution integrity management programmes.

**ISO 31000:2009, Risk management – Principles and guidelines**

The ISO 31000:2009 international standard provides generic guidelines and is not intended to promote uniformity of risk management across organisations. It states that the design and implementation of risk management plans and frameworks will need to take into account the varying needs of a specific organisation, its particular objectives, context, structure, operations, processes, functions, projects, products, services, or assets and specific practices employed.

It is the intent of this standard to be used to harmonise risk management processes in existing and future standards. It provides a common approach in support of standards dealing with specific risks and/or sectors, and does not replace those standards. Figure 2 provides a visual depiction of the standard and the integration of principles, framework and processes that establish a risk management system.


The ISO/IEC 31010:2009 risk management includes the application of logical and systematic methods for:

- Communicating and consulting throughout this process.
- Establishing the context for identifying, analysing, evaluating, treating risk associated with any activity, process, function or product.
- Monitoring and reviewing risks.
- Reporting and recording the results appropriately.

Risk assessment is an element of risk management, which provides a structured process that identifies how objectives may be affected, and analyses the risk in terms of consequences and their probabilities before deciding on whether further treatment is required. Risk assessment attempts to answer the following fundamental questions:

- What can happen and why (by risk identification)?
- What are the consequences?
- What is the probability of their future occurrence?
- Are there any factors that mitigate the consequence of the risk or that reduce the probability of the risk?

One of the benefits of this international standard is the comparison of risk assessment techniques, which includes both the types of techniques used and the factors influencing selection of risk assessment techniques.

**Creating a plan and a system**

In an application of the common elements of ISO 55001 in developing a system, the governance can be created for managing corporate assets like pipelines. Once this is complete, the business processes, capabilities and metrics can be optimised to align with this governance to reduce risk and create value through the execution of asset management plans throughout the lifecycle. This transcends the technical requirements and includes the human behaviors and motivators. The final component is to strive for continuous improvement.

**Governance**

Top management must demonstrate leadership and commitment with respect to the asset management system by ensuring that an asset management policy, asset management strategy and asset management objectives are established and are compatible with the organisational objectives. One of those objectives is the safe operation of pipelines within an organisation’s asset portfolio. This and other asset management objectives are developed from the engagement with stakeholders who shape the organisation’s expectations and requirements.

**Planning**

When planning how to achieve its asset management objectives, the organisation shall determine and document:

- The method and criteria for decision making and prioritising of the activities and resources to achieve its asset management plan(s) and asset management objectives.
- The processes and methods to be employed in managing its assets over their lifecycles.
- What will be done?
- What resources will be required?
- Who will be responsible?
- When it will be completed?
- How the results will be evaluated?
- The appropriate time horizons for the asset management plans.
- The financial and non-financial implications of the asset management plans.
- The review period for the asset management plans.
- Actions to address risks and opportunities associated with managing the assets, taking into account how these risks and opportunities can change with time, by establishing processes for:
  - Identification of risks and opportunities.
Assessment of risks and opportunities.

Determining the significance of assets in achieving asset management objectives.

Implementation of the appropriate treatment (and monitoring) of risks and opportunities.

The organisation must ensure that its asset management related risks are considered in the organisation’s risk management approach, including contingency planning. The application of principles, framework, and processes contained within ISO 31000 should be used to develop the risk management approach.

System elements
API 1173 provides the key elements of a pipeline safety management system. These 10 elements may not appear distinctly in a single document but should be identifiable in a clear and mandated process within the organisation’s procedures:

Leadership and management commitment.
Stakeholder engagement.
Risk management.
Operational controls.
Incident investigation, evaluation, and lessons learned.
Safety assurance.
Management review and continuous improvement.
Emergency preparedness and response.
Competence, awareness and training.
Documentation and record keeping.

This recommended practice provides organisations with safety management system requirements that, when applied, provide a framework to reveal and manage risk, promote a learning environment, and continuously improve pipeline safety and integrity. It also provides a comprehensive framework and defines the elements needed to identify and address safety for a pipeline’s lifecycle. The individual elements, when executed as deliberate, routine, and intentional processes, are designed to result in improved communication and co-ordination, which yield a cohesive system and a stronger safety culture.

Conclusion
Management system requirements like ISO 55000, ISO 31000, and API 1173 identify what is to be done. The details associated with implementation and maintenance of the requirements are left up to the individual organisations. Adopting and implementing a management system using elements and requirements described herein will provide a plan-do-check-act continuous improvement system and the foundation for planning data collection and analysis, selecting and prioritising threats or causes, and implementing any changes. This system must also promote behaviors that reduce risk. Leaders, managers, and employees acting to make safety performance and risk reduction decisions over time will improve pipeline safety, thereby strengthening the safety culture of an organisation.

Bibliography

Does your asset management system comply with new safety, risk and asset management standards?

We know you place a high priority on mechanical integrity, safety and regulatory compliance. Managing risk can be particularly challenging when you’re faced with aging assets and an aging workforce. Life Cycle Engineering can help you:

- Apply an asset management framework to reveal and manage risk for the life cycle of your assets
- Implement asset management best practices to comply with OSHA regulations, ISO 31000 and 55000, and API 1173
- Create a learning environment and build technical competencies that will yield a stronger safety culture

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