An Overview of the Process Safety Leadership Group Final Report

The Process Safety Leadership Group (PSLG) final report represents the full and final guidance for the twenty five recommendations in the Major Incident Investigation Boards (MIIB) design and operation of fuel storage sites report. This article describes the development process adopted by the PSLG, and key features of its final report.

Introduction

The explosions and fires at the Buncefield oil storage depot near Hemel Hempstead in the early hours of Sunday 11th December 2005, triggered a fundamental review by the oil industry and regulators of large scale petrol (gasoline?) storage.

In January 2006, work began by the Buncefield Major Incident Investigation Board (MIIB) to determine the causes of the Buncefield incident. The MIIB developed a series of recommendations for industry and the Competent Authority (CA – Health and Safety Executive, Environment Agency and Scottish Environmental Protection Agency), which, once implemented, would greatly reduce the risk of a similar incident in the future.

Three reports[1] were produced, *Design and operation of fuel storage sites*, *Emergency preparedness for, response to, and recovery from incidents* and *Land use planning and the control of societal risk around major hazards*. The purpose of this article is describe the history, working methodology, and the key outputs of the Process Safety Leadership Group (PSLG), established to address the twenty five recommendations of the MIIB's *Design and operation of fuel storage sites* report.

History of the Process Safety Leadership Group

In the spring of 2006, the MIIB published three progress reports, *What went wrong at Buncefield*, describing the probable causes of the incident. Rather than wait for the MIIB to develop and complete its recommendations, the industry and the joint competent authorities decided to work in parallel with the MIIB, to produce a quicker response and earlier implementation of key recommendations. Industry and the CA formed the Buncefield Standards Task Group (BSTG) in the summer of 2006 to complete this work, producing a final report[2], including expected implementation timescales, in the summer of 2007. Meanwhile the MIIB produced the *Design and Operations of fuel storage sites* report in spring 2007.

The PSLG was then formed to take forward the BSTG work and to ensure all twenty five recommendations of the MIIB's *Design and operation of fuel storage sites* report were comprehensively addressed, most notably in the areas of high reliability organisations, culture, and leadership.

Working Methodology

The PSLG (and the BSTG before it) took a radical approach to the development of the guidance necessary to tackle the MIIB's recommendations. Typically such a response was developed in

isolation by either the CA, industry or through specialist consultants – the PSLG took a holistic approach, forming working groups consisting of the CA, industry, trade unions, and other expert organisations (such as the Energy Institute), thus ensuring the development of effective, practical guidance supported by all involved parties.

Seven working groups where established, under the supervision of a steering group:

Work Group 1, human factors

Work Group 2, scope – the products to which the guidance should apply

Work Group 3, control and instrumentation

Work Group 4, secondary and tertiary containment

Work Group 5, emergency arrangements

Work Group 6, mechanical integrity

Work Group 7, co-ordination (of work groups 1 to 6)

Many of these working groups followed on from, and included key members of the BSTG working groups, and sought to complete the work started by the BSTG.

The PSLG consolidated the completed guidance from each of these working groups, and that produced by the BSTG – providing a comprehensive and complete response to all twenty five of the MIIB's original recommendations. The final report[3] was published to coincide with the fourth anniversary of Buncefield, on the 11th December 2009.

Scope and Application

Of most importance to industry, is how and to what the guidance within the PSLG report should be applied. Whilst it is clear that the priority should focus on storage tanks similar to those at Buncefield (referenced as *in-scope*), how should it be applied *practically* to existing installations, and to what extent should it be used for other types of installations and products?

Great care was taken to address these issues, and the following flowchart (which can also be found in the PSLG report) clearly summarises the application of the guidance to existing establishments subject to the Control of Major Accident Hazards Regulations (COMAH).

INSERT IMAGE: Figure 1 Compliance at existing COMAH establishments.doc

Figure 1 – Compliance at existing COMAH establishments

The PSLG makes it clear that for in-scope tanks, meeting the provisions of its final report in full, will, in the majority of cases, mean that a duty holder meets the requirements of COMAH regulation 4, to take all measures necessary to prevent major accidents and limit their consequences to people and the environment, so far as is reasonably practicable. For existing operations, where meeting the provisions in full is not considered reasonably practicable, the degree of compliance necessary, or

indeed the appropriateness of alternative methods to achieve it, is subject to agreement between the duty holder and the CA.

Key Actions

The PSLG report is structured such that it aligns closely with the MIIB's *Design and operation of fuel storage sites* report, thus ensuring clear guidance against individual recommendations. There are six parts to consider:

Part 1, systematic assessment of safety integrity level requirements

Part 2, protecting against loss of primary containment using high integrity systems

Part 3, engineering against loss of primary containment

Part 4, engineering against loss of secondary containment

Part 5, operating with high reliability organisations

Part 6, delivering high performance through culture and leadership

The structure of the report follows the various mechanisms for the protection against loss of containment from a storage tank - risk assessment to determine the necessary safety integrity level of an overfill protection system, the design of the overfill protection system, engineering primary (tank), secondary (bund) and tertiary (additional barriers) containment systems, and finally, defining good practice in terms of process safety management in the design, operation and maintenance of these mechanisms.

The following provides a brief narrative on each of these topics, and highlights some of the key requirements identified in the guidance. Reference should be made to the full text of the PSLG report for a comprehensive definition of requirements.

Systematic assessment of safety integrity levels

In determining the need for an overfill protection system, it is essential that an appropriate risk assessment technique is used, and used correctly, to determine the required Safety Integrity Level (SIL) for that system.

The PSLG report recommends that before overfill protection systems are installed, the target SIL should be determined using a technique such as Layer of Protection Analysis (LOPA), Risk Graph or Fault Tree. Furthermore, duty holders should review risk assessments for existing installations to take account of new knowledge and development in standards.

Detailed guidance is provided on the application of LOPA, aiming to ensure a consistent approach to risk assessment is taken throughout the industry sector. Recognising this is not the only technique available, much of the guidance can equally be applied to other methods.

Protecting against the loss of primary containment using high integrity systems

The design of high integrity systems involves many different factors – equipment selection and the architecture of the safety instrumented system, the safety lifecycle used to develop, operate and maintain that system, and defining a tanks capacity, allowing identification of normal, alarm and overfill levels.

In designing, operating and maintaining a safety instrumented system, the PSLG report refers to BS EN 61511 - *Functional safety. Safety instrumented systems for the process industry sector*[4] as the standard to be adopted. However whilst BS EN 61511 may be applied in full to new safety instrumented systems, the PSLG is mindful as to the extent that it may reasonably be applied to existing systems, systems which may well have been designed prior to the standard – in these instances, and where the cost of implementing BS EN 61511 in full can be demonstrated to be grossly disproportionate, the standard should be met so far as is reasonably practicable, with due diligence given to key factors such as demonstrable independence, suitability and evidence of prior use of this existing equipment. It is worth noting that both the UK Petroleum Industry Association (UKPIA) and Tank Storage Association (TSA), have made a commitment on behalf of their respective members to install a minimum of SIL1 automatic overfill protection systems on all in-scope tanks.

Important guidance is also provided on how to define the appropriate setpoints for tank capacity, allowing both operators (during normal operation), and process control and safety instrumented systems (when normal operating levels are exceeded) sufficient time to react to stop the flow into the tank.

Engineering against loss of primary containment

Failure of an overfill protection system places reliance on the tank to avoid uncontrolled loss of primary containment. Ensuring a tanks integrity is a combination of its initial design, and periodic internal and external inspections.

For new build tanks, the PSLG recognised that BS EN 1405[5] and API 650[6] provided in depth guidance on design and construction elements for vertical cylindrical tanks, but further recommended that single bottomed designs where preferable as these more fully supported inspection arrangements ensuring tank integrity. Double bottomed designs may still be acceptable, provided robust integrity management arrangements are in place.

For existing tanks, and to ensure the continued integrity of new build tanks, EEMUA 183[7] and API 653[8] provide relevant good practice in terms of tank integrity management – internal and external inspections, and the competency requirements of inspectors. Once again the PSLG did not seek to replace, but instead recommend this existing guidance.

Engineering against loss of secondary containment

Guidance on secondary and tertiary containment measures are defined in the CA's *Containment Policy*[9], which sets out the measures that industry needs to achieve in order to protect both people and the environment from harm. The role of the PSLG report is to add further clarity to the containment policy, specifically in the areas of bund lining systems, penetrating pipework and expansion joints.

Bunding provides the means for secondary containment of hazardous substances, should failure of the primary containment measure (tank) occur. The PSLG report provides in-depth discussion on various aspects of bund design, including bund lining system options, the design of pipe penetrations and expansion joints, and bund capacity calculations for both new and existing builds.

Tertiary containment refers to the measures in place to minimise the consequences of failure of both primary and secondary containment measures. The PSLG recommends that duty holders carry out a risk assessment to determine the extent of the requirement for tertiary containment.

Operating with high reliability organisations

Whilst the physical hardware and systems associated with preventing a loss of containment is an essential part of process safety, their full benefit can only be realised when human and organisational factors involved in their design, use and maintenance is also considered.

Critical factors involve whether or not personnel involved at all levels of an organisation, from operators to mangers, understand fully what their roles and responsibilities are, and whether they have the necessary competency to carry out those activities. The PSLG identifies the need to clearly define these aspects within an organisation, and provides guidance on the tools and techniques necessary to support them – for example, control room design, alarm management, management of change and communication processes (including those necessary for inter-site transfers).

Measuring the success of process safety management systems is also considered, and the PSLG recommends the adoption of both leading and lagging process safety performance indictors to assess how effectively risks are being controlled.

Delivering high performance through culture and leadership

Hardware and management systems aim to manage risk directly, but there is also a strong need to proactively work towards excellence in process safety, encouraging continuous improvement within the industry sector through learning from ourselves and from others.

In addressing the need for high performance, the PSLG published the *Principles of Process Safety Leadership*, promoting the improvement of process safety from board level – a commitment to actively manage process safety, engage with the workforce, monitor performance and share best practice and learn from relevant incidents from across industry sectors.

Several initiatives have been launched by trade associations to tackle these challenges, including UKPIA's Process Safety Leadership Commitment adopted in April 2008. A process safety forum (represented by the UKPIA, TSA, Oil and Gas UK, Chemical Industries Association and the Nuclear Industry Association) has also been established to collectively review incidents and share lessons and good practice.

Implementation

The original BSTG report set implementation timescales for the recommendations that it had addressed, where appropriate. The completion of this work is now drawing to an end.

The PSLG aimed to fill the gaps left by the BSTG - industry is now in the process of performing a detailed gap analysis (for in-scope tanks) against each of these new and amended requirements, identifying where additional work is required. Following this period of gap analysis, work will be prioritised on a risk basis and implementation timescales agreed locally with the CA.

Conclusion

The PSLG report provides full and comprehensive guidance necessary to address the twenty five recommendations from the MIIB's *Design and operations of fuel storage sites* report. Whilst its application directly affects operators of fuel storage sites, it may also provide valuable guidance to other industry sectors, both when designing new installations, or maintaining existing equipment. The cooperative process adopted by the PSLG ensures that the guidance is balanced and pragmatic, and supports the adoption of this methodology for any future work.

References

1. The Buncefield Incident 11 December 2005 – The final report of the Major Incident Investigation Board. ISBN 978-0-7176-6318-7
2. Safety and environmental standards for fuel storage sites – Buncefield Standards Task Group (BSTG) Final report
3. Safety and environmental standards for fuel storage sites – Process Safety Leadership Group (PSLG) Final report. ISBN 978-0-7176-6386-6
4. BS EN 61511 - Functional safety. Safety instrumented systems for the process industry sector
5. BS EN 14015:2004 – Specification for the design and manufacture of site built, vertical, cylindrical, flat bottomed, above ground, welded, steel tanks for the storage of liquids at ambient temperature and above – British Standards Institution
6. API 650 – Welded tanks for oil storage – American Petroleum Institute 2009
7. EEMUA 159 – Environmental risk assessments of bulk liquid storage facilities – Engineering Equipment Materials Users Association
8. API 653 - Tank inspection, repair, alteration, and reconstruction - American Petroleum Institute 2009
9. COMAH Competent Authority policy on containment of bulk hazardous liquids at COMAH establishments