



CONTEMPORARY ISSUES IN PROCESS HAZARD ANALYSIS

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Process Hazard Analysis (PHA), a regulatory requirement under OSHA 29 CFR 1910.119(e), is a collection of methodologies to address process hazards. Societal and technological changes impact sources, intensity, and frequency of hazards. For instance, digital controls and smart instruments have reduced maintenance requirements inherent with the analog instruments. It is reasonable to state that digital controls, in general, reduce maintenance related hazards of the analog systems. However, as may be anticipated, they present a different set of safety issues. Similarly, changes in today's industrial workforce present hazards which are different from those present a decade or so ago. Thus, although PHA methodologies remain essentially unchanged, their emphasis on sources and intensities of hazards changes. Proper consideration of societal and technological changes ("soft" and "hard" issues) will help ensure that a PHA identifies and addresses hazards effectively. This paper discusses a number of contemporary issues that significantly impact the nature and intensities of hazards:

- Business Volatility
- Process Instrumentation, Control, and Safety Systems
- Database Management
- Process Developments
- Changing Workforce
- Security and Infrastructure
- Regulatory Issues

Business Volatility: In some sense, business climate always keeps changing. However, recent trends in mergers, acquisitions, divestitures, and globalization tend to enhance business volatility. However, what does business volatility have to do with PHA? Well, business changes could impact safety in numerous ways. For instance, assume that company A shares its flare with companies B and C. Further assume that company A, because of changing market environment, has to change its operations frequently. This will affect flare operations. If proper safeguards are not incorporated into design and/or administrative procedures, a mishap at the company A could jeopardize safety at other plants. Sometimes, cost-cutting measures in response to market pressures may be a detriment to a company's safety, health, and environmental efforts. PHA should ensure that adequate and robust administrative and control safeguards (engineering safeguards) are in place to minimize occurrence and spread of unsafe events. As refineries and chemical plants change feed stocks, previously non-existent hazards could become crucially



important. Although Management Of Change (MOC) is intended to address hazards before ANY change is implemented, in practice however, there is often time pressure to complete MOC as quickly as possible. PHA should ensure an on-going and robust MOC is in place. An effective PHA would thoroughly consider potential impact on safety from business changes.

Process Instrumentation, Control and Safety Systems: Process controls and instruments have their own life cycles; birth, growth, maturation, and decline, and obsolescence. Pneumatic systems were followed by electrical systems and then digital systems. Today, most instruments are smart (digital systems with self-diagnostics and communication capabilities) with fieldbus/protocols (e.g., HART) as a means of data communication. Digitization has practically eliminated inherent problems of pneumatics and electrical systems (drift of analog instruments, problems with the quality of air supply, signal accuracy and others) and enhanced safety in a number of ways including substantially reduced maintenance, early detection of problems, and implementation of complex safety functions. Some Foundation fieldbus transmitters can even detect plugged impulse lines, a common problem in some applications. Despite all these benefits, smart instruments are not totally immune to the problems that can impair safety. For instance, using instruments outside their turndown ratio (operating range), lack of regular maintenance, and improper applications could lead to unsafe situations. Wireless devices are gaining popularity in recent years. However, their applications in safety-critical applications should be approached with considerable caution since these devices are still in the relatively early stages of development. This is not to suggest that new technologies should not be applied. In fact, it is the newer technologies such as smart instruments and communication protocols that have contributed to improved safety in recent years. Recently, several organizations are pursuing the certifications of their safety instrumented systems. These third-party certifications, based on IEC 61511 (also ANSI/ISA 84.01), are helpful in ensuring safe operation and high reliability through the life of an instrument and control loops.

Database Management: A typical PHA generates wealth of information regarding hazards and recommended corrective actions. Today, a number of software packages are available which enhance auditable documentation, analysis and availability of data (e.g., search and sort functions). These packages contain multiple functionalities such as data check, data encryption, statistical analyses and graphing, and some others. The packages are also amenable to Web implementation. Consider the following:

- *Try to avoid creating islands of information. PHA is a part of safety, which in turn is a part of Health, Safety Security, and Environmental (HSSE) group. It may be worth making PHA database as a part of the HSSE database. Since these are IT-intensive (Information Technology) activities, close coordination with the IT group is obviously helpful and even mandatory!*



- *It should be easily accessible by authorized people at various locations and should have safeguards to prevent deliberate or inadvertent data modification.*
- *Before implementing or incorporating PHA database as a part of the HSSE database system, consider making a “dry run” to debug.*

Process Developments: As may be expected, different processes pose different hazards. In a sense, PHA is an assessment of hazards presented by a process and therefore it is always an issue. The reasoning behind considering *Process Developments* as an issue is that as new processes are developed, PHA should take into consideration that workers have scant experience with the new process and this may lead to unsafe events. Conversely, projects that involve technologies that are already in use by the company, may, generally, pose less risk. This issue of *Process Developments* may also be called “*Uncharted territory.*”

Changing Workforce: Continual craft and safety training of workers is almost always assumed for a PHA. i.e. it is assumed that an organization has mechanisms to train its workers. The type of training should keep pace with the changes in technology as well as changes in the composition of the workforce. For instance, a company with heavy turnover of workers will face different training challenge than a company with relatively stable workforce. Outsourcing (contractors) and their workforce also impact safety. With the digitization of the instrument and control systems, older technicians may need to be retrained in maintenance of the digital instruments. On the other hand, younger employees may need additional training in plant operations and troubleshooting. PHA should ensure that training of the employees and contractors is in alignment with the composition of the workforce and technology.

Security and Infrastructure: Subsequent to 9/11 tragedy, a number of organizations including American Chemical Council (ACC) and The Center for Chemical Process Safety (CCPS) have developed guidelines for identifying and evaluating a plant’s security vulnerabilities. Department of Homeland Security (DHS) has promulgated standards for the chemical facility anti-terrorism measures (6 CFR 27) which became effective on June 8, 2007. The facilities which handle one or more chemicals on the Chemicals Of Interest List (6 CFR 27; Appendix A) above the threshold or screening quantities are covered by the regulation. A number of chemical companies have conducted Security and Vulnerability Analysis (SVA) of their sites and developed Site Security Plans (SSP). Briefly, SVA entails a review of the chemicals and processes and avenues by which these chemicals can fall into the hands of groups intent on causing large scale catastrophe or supply disruptions. In parallel with the chemical security, cyber security has also received considerable attention. A number of vulnerabilities exist including, but not limited to, corrupted software and data files, viruses, worms, denial-of-service, and Trojan horses. Just as in PHA, risks and consequences are prioritized so that mitigation measures can be developed. Additionally SVA , just as in



PHA, may also involve Quantitative Risk Assessment (QRA). The focus of SVA or cyber security should be on practical and cost-effective systems which will prevent mishaps or minimize their consequence (fault tolerance). In view of substantial amount of specialized work involved in cyber security assessment and SVA, many companies perform these analyses independent of PHA. For small projects which don't involve SVA, it would be worth to include at least a qualitative vulnerabilities assessment as a part of PHA.

Regulatory Issues: Compliance with the existing health, safety, and environmental regulations is an integral part of a PHA. Focus areas of regulations change in response to local and global events and public demands. For instance, based on accumulated data and comments from some individuals, OSHA promulgated new standard on exposure limits of hexavalent chromium (PEL at 5 microgram / m³) in 2006. Previous exposure limit was much higher (100 microgram/ m³). Similarly, Highly Reactive VOC (HRVOC) regulations from Texas Commission on Environmental Quality (TCEQ) are examples of shift focus of regulations. A PHA has to ensure the project is in compliance with federal, state, and local regulations. This would include equipment design, compliance testing where applicable, sampling, record keeping, and reporting. As we discussed earlier, databases should be designed to facilitate compliance with health, safety, and environmental regulations (e.g., include appropriate forms for the regulations, Quality Assurance and Controls (QA/QC), and report generation).

In sum, the bottom line of a PHA is to consider impact of contemporary issues on health, safety, security, and environment and implement changes in an auditable and cost-effective manner.

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