Use a Comprehensive Database to Better Manage Process Safety

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You may be using previous incident data to sharpen safety practices in your plant. But — is your database large enough to be meaningful and is it being used to its fullest extent?

Significant process incidents have long captured the attention of the media, the general public, and, in particular, stakeholders involved in the chemical process industries (CPI). Apart from the shock impact, such incidents create an awareness of some of the events that can happen when safety systems break down.

Within the safety community, an external loss is often met with a sigh of relief that it did not occur on home turf. On the other hand, there may be the recognition that a similar event could occur locally under slightly different conditions. If pursued further, an analysis of a loss at another company's plant may pave the road toward making necessary improvements to facilities, procedures, and programs at other sites. Proactively, learnings from external incidents can help to educate today's workforce so that previous losses are not repeated. Analysis of external incidents is not a substitute for effective process safety management; it is a valuable enhancement that can minimize the company's likelihood of experiencing significant loss.

An external incident database provides the leverage for influencing change and improvements at a local plant site. Senior management tends to focus on the business objectives of running a plant. Any significant incident will undermine those objectives. The challenge for process safety management today is to help educate tomorrow's leaders. A database of incident case studies can provide a platform for this.

A key requirement for any useful database is accurate data. The CPI must come to terms with its need for standardized reporting of all accidents and near misses. Root causes should not be speculated on, but should be based on a logical reconciliation with established management practices. Some companies might have to spend considerable effort to develop this analysis capability.

Larger databases offer advantages

The larger the database — the more data it contains — the more can be learned by studying it. One way to establish this is by participating in an industry-wide database.

Access to such a database offers several advantages over a single company's efforts to correlate accident data. The reported exposure is at least an order of magnitude higher than that for even the largest single-company compendium. Within a facility's or even an entire company's incident history, there may not be very many incidents from which to choose for review. With an industry database, there is a much larger pool of incidents, and a better chance of having useful incident data to share.

The Center for Chemical Process Safety (CCPS) offers a participative database of process safety incidents as just described. Established in 1997, the Process Safety Incident Database (PSID) captures key learnings associated with incidents and near misses. The PSID has 25 member companies that submit data and share in the cost of maintaining the information.

Incidents in the CCPS PSID can be analyzed using a combination of created lists and generated reports based on them. Lists are a collection of incidents extracted from the database that meet the query search criteria of the user. List management allows the user to develop a filing system of incidents. Amassing such incidents and reporting the key features that enable users to obtain focused information from what will eventually be a very large database.

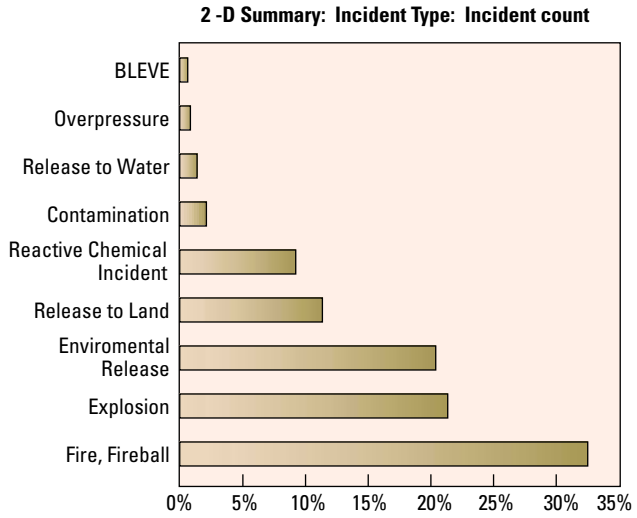

Figure 1. The most common types of incidents are found via a 2-D summary report.

The method used here can be applied to a company's database, but on a smaller scale. Whatever the size of the database you have, you can still draw some inferences, or, hopefully, conclusions from it that can be applied to increase safety at your plant.

Finding the critical areas

In analyzing data, a key ability is to create two-dimensional (2-D) cross-plots of data. Each data field is supported by a prescriptive pick list used to catalog incidents into a number of headings. Creating a 2-D report can enable the user to prioritize efforts. This report should focus on one field (*e.g.*, chemicals, incident type, phase of operation, equipment, etc.) and give the incident counts associated with that field in either as a table or graphic. Figure 1 is a graphic example based on type of incidents using actual PSID data.

This figure shows that roughly one-third of reported incidents were due to fires or fireballs — the largest single category. This certainly looks like the major safety incident in many plants. Using such data, the engineer would want to investigate further to see under what circumstances these fires occurred.

Figure 2 is an analysis of the data by type of incident. It shows that most of the fires occurred during normal operation. This suggests that even a mature plant might improve its operating practices and investigate these data further. Upon so doing, inadequate operator training and unreliable control instrumentation were found to be the leading causes of these serious incidents. Thus, such a stepwise analysis can ferret out the major reasons why certain types of incidents happen, and pave the way toward making changes in equipment or operating procedures that can eliminate the potential for such mishaps. This is how we can actually learn from experience.

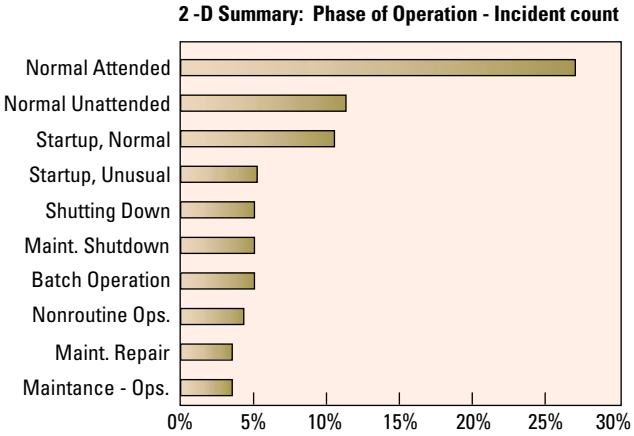

Figure 2. Analysis of phase of operation during which the incident occurred.

Identifying potential problem areas

Still, in even performing such an analysis more information needs to be revealed. The most obvious question is: Where in the plant did these incidents take place?

This requires a cross-tab analysis of the data. Using the list developed for incidents involving fire and comparing the "phase of operation" with the "initiating equipment," one can quickly analyze such a matrix for potential problem areas. The results from the PSID identified "fired equipment," specifically fired heaters, as the problem area. If one examines the immediate cause of fired heater incidents, the largest single factors are related to design and operations (Figure 3).

In response to these findings, at least one company has initiated a special audit of its fired heater operations and intends to rewrite its operating procedures and offer refresher training for its operators. The adequacy of control systems during normal and upset conditions is also being examined in this audit.

Other uses of databases

The simplest application for a database is the use of whole-incident reports. These enable the user to quickly focus on a specific category of loss or type of equipment failure and access all of the relevant incidents. By reading through the complete history of each incident including the description of the process, the incident itself, the causes, the contributing factors, and the remedial actions, it is possible to gain considerable insight into what happened and what was later done to prevent a recurrence. Lessons learned and extracted from each case study can be conveniently captioned, so that this information may be directly communicated to users. If your database is comprehensive enough, this may be possible. This task is facilitated by a multi-company database such as the PSID.

A comprehensive database can support the following activities:

- Process hazard analyses (PHAs)
- Mechanical integrity improvements

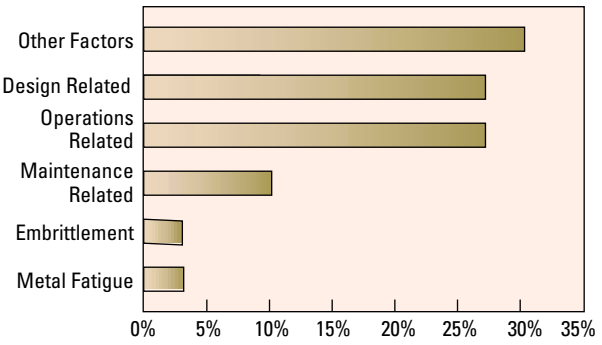

Figure 3. Design and operations are the key causes of fired-heater incidents.

- High-risk procedures and activities
- Safety alerts
- Operator and engineer training
- Emergency planning and scenario development
- New chemical screening.

Benefits can be derived from using whole-incident reports to support PHA studies. Prior to embarking on a hazard and operability study (HAZOP), the sponsor or facilitator can check out the system and highlight key areas of concern.

If, for example, compressor operation represents such a concern, whole-incident reports involving these machines can be distributed and reviewed with participants. In a similar manner, causal trends for compressors can be reviewed.

OSHA requires learnings from past company incidents to be incorporated into PHA studies. However, the use of a comprehensive database can take this initiative one step further. Consideration of previous incidents from industry as a whole can make PHAs more comprehensive and valuable. Along the same lines, a pool of incidents can be used during the initial stages of a project; the database can be queried and incident information found and used during the preliminary PHA.

Risk assessment

Accident investigation provides another useful application for a comprehensive database. Formal investigation should involve a risk assessment of an operation to ensure that it is safe to continue. This requires careful consideration of other things that could go wrong. It is also necessary to understand how the actual incident compares to what might have occurred under somewhat different circumstances. These questions require a broad perspective that is enhanced by an easy-to-access database. In the past several years, external investigations of large-scale industrial accidents have cited failure to learn from previous incidents as a leading contributor.

One member company is using the PSID as an enhancement to its ongoing programs in abnormal situation management (ASM). Figure 2 shows that less than 40% of incidents with fired heaters occurred during normal operation. Some of the items in the figure are clearly associated with abnormal situations, but others may require a detailed analysis of the individual incidents to determine which fit into the company's definition of abnormal.

This company conducts ASM training exercises for its operating teams and uses the database to heighten awareness of what has happened to others. The firm is particularly concerned about situations that require radio communications to operating personnel in remote control rooms that may be considerably far from field operating personnel. Hence, the company is interested in the subsets of incidents that list communications as a contributing factor.

A comprehensive database can support technical and operator training. While task-specific skills still form the basis of most training, lessons learned on a broader scale can help to illustrate the consequences of not following a proper process safety management program. These lessons can take the form of complete case studies or stand-alone findings from completed accident reports.

A comprehensive database — whether it contains company-wide information or involves data from numerous companies, as is the PSID — can help influence firms to take action early before similar trends or incidents appear at a local site. In today's fast-paced environment, equipment is pushed to higher levels of capacity and online running is approaching 100% in some cases. Operating personnel may be less familiar with start-up protocols than they once were. Managers and supervisors often lack direct field experience to make the best decisions. Many plants have cut down the numbers of persons in field operations. Mergers and acquisitions have created a culture void in the experience that once prevailed in our high-tech industries. Since the majority of large-scale incidents have occurred previously at other locations, it would seem logical that to teach today's workforce about the lessons learned from previous incidents would pay big dividends. This is the main thrust of a large incident database.

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If your company is interested in finding out more about the PSID you can reference the following website: www.aiche.org/ccps/perd.htm. CEP

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