Sitewide Safety Analysis

By Andrew Sears, Safety Manager

EPA inspection

- There were two drums of 1,2-dichloroethane found that had their tops loose, which led to the potential for fugitive emissions.
- Two vat filters had inadequate fume extraction.
- A wash bottle of acetone was left next to the sink in the Quality Control laboratory, which could have dripped acetone into the wastewater.

Safety concepts

- Eliminating vulnerability by substituting safer materials
- Reducing vulnerability by curtailing high volume storage
- Reducing vulnerability by expanding buffer zones and relocating facilities or neighbors
- Enhancing safety through add-on barriers to discharge
- Enhancing security through barriers to access

Safety considerations

- Location
  - plant: things are predictable and controlled, but if things go wrong there are more fatalities and damage
  - lab: tends to do more dangerous things, but at a smaller, manageable scale with little risk for injury
  - storage area: very little happening, but should be checked for leaks or unexpected decomposition
- Safe operations – need to have safe operating procedures in place
  - Chemical processes: if there is a dangerous step, have a supervisor check to ensure it was carried out correctly.
  - Lab checks: a lab person tests a mixture to make sure it is fine before the next step.

Safety considerations (cont.)

- Personal protective equipment – make sure all staff are wearing appropriate protective gear such as goggles, face shields, gloves, and air suits.
- Safe systems and policies – having the engineers do a formal handover to the production staff when repairs or changes are done. For example, check to make sure there are no potential sparks or naked flames near flammable materials.

Proposal

- I propose that Acme Chemical introduces a Hazard and Operability study (HAZOP) for all new processes.
- Existing processes can also be reviewed as time allows.

What is a HAZOP?

- A structured and systematic examination of a planned or existing process or operation in order to identify and evaluate problems that may represent risks to personnel or equipment, or prevent efficient operation.
- It is a qualitative technique based on guide-words and is carried out by a multi-disciplinary team during a set of meetings.
- This technique originated in 1963 at the Heavy Organic Chemicals division of ICI, then a major British and international chemical company.

Outline

- The HAZOP method refers to processes for which design information is available. This usually includes a process flow diagram, which is usually examined in small sections. For each of these a design *Intention* is specified.
- The HAZOP team then determines the possible *Deviations* from each intention, feasible *Causes* and likely *Consequences*.
- Only then can it be decided whether existing, designed safeguards are sufficient, or whether additional actions are necessary in order to reduce risk to an acceptable level.

Parameters & guide words

- The key feature of HAZOP is to select appropriate parameters which apply to the design intention.
- These parameters are general words such as Flow, Temperature, Pressure, and Composition (there are several others).
- To identify deviations from the design intention, a set of Guide Words are applied to each parameter for each section of the process.
- The current standard Guide Words are no (or not), more, less, as well as, part of, reverse, other than, early, late, before, and after.

Parameters & guide words (cont.)

- These last four guide words are only applied to batch or sequential operations.
- The parameters and guide words are then combined, such as LESS PRESSURE, NO FLOW, or MORE TEMPERATURE.
- If the combination is meaningful, then it is a potential deviation.
- After the causes and effects of any potential hazards have been established, the system being studied can then be modified to improve its safety.

The HAZOP team

- Study leader (or chairman) – experienced in HAZOP but not directly involved in the design, to ensure that the method is followed carefully
- Recorder (secretary, scribe) – ensures that problems are documented and recommendations passed on
- Designer – explains any design details or provides further information
- User – considers the method in use and question its operability and the effect of deviations
- Specialist – someone with relevant technical knowledge
- Maintainer – someone concerned with maintenance of the process

Example

- Suppose that in our Acme Chemical Company plant, there is a pipe that is intended to transport 2.3 kg/s of 96% sulfuric acid at 20°C and a pressure of 2 bar from a pump to a heat exchanger.
- This heat exchanger is intended to heat this amount of sulfuric acid from 20°C to 80°C.
- Variations in parameters such as flow, temperature, pressure, and composition could be deviations from the design intention.
- For instance, a guide word – parameter combo such as “less composition” would indicate that there is less than 96% sulfuric acid.