6.1 PROCESS HAZARD ANALYSIS

Process hazard analysis is the cornerstone of the OSHA standard. The standard goes on to say that the employer may choose from one or more of the following safety analysis methodologies as a process hazard analysis:

- What-if
- Checklist
- What-if/checklist
- Hazard and operability (HAZOP) study
- Failure mode and effects analysis (FMEA)
- Fault tree analysis
- An appropriate equivalent methodology

The remainder of this chapter will discuss HAZOP and what-if techniques in detail and illustrate specific examples of how they are applied. Chapter 7 will address fault tree analysis and Chapter 8 will discuss failure modes effects and criticality analysis. An excellent reference manual for these techniques is the *Guidelines for Hazard Evaluation Procedures*, published by the American Institute for Chemical Engineers' CCPS (2008).

6.2 HAZOP

A *hazard and operability* (HAZOP) study is a *systematic group approach to identify process hazards and inefficiencies in a system.* A team of engineers methodically analyzes a system and, through the use of guide words, asks how the process could deviate from its intended operation and what the effects would be. The group divides the system into nodes and, using the preestablished guide words (no flow, less flow, high temperature, etc.), ponders the questions of what could occur if the process deviated in some fashion. In other words, a HAZOP is a somewhat controlled *technical brainstorming session.*

The HAZOP is an extremely useful tool in *making sense* of highly complex process flows. The advantage of working in a group is that with the synergy of the individuals, more creativity is applied to identifying possible hazard scenarios. Of course, the HAZOP can be used at any phase of system or plant development; however, the design has to be somewhat mature to truly take advantage of the HAZOP's powers. This does not mean that you cannot perform a HAZOP on a preliminary design that is still not fully defined; HAZOPs are also great for looking at the effects of a modification to an existing design or operations.

The HAZOP is the primary method used in the petrochemical industry to identify, control, and document hazards. The HAZOP report is one of the pieces of information you have available to demonstrate your compliance to OSHA or other government inspectors.

Once you decide that you wish to conduct a HAZOP study, you must

1. Define objectives and scope
2. Select the HAZOP team