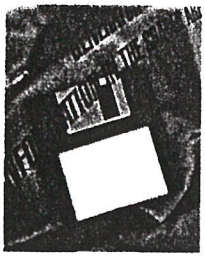


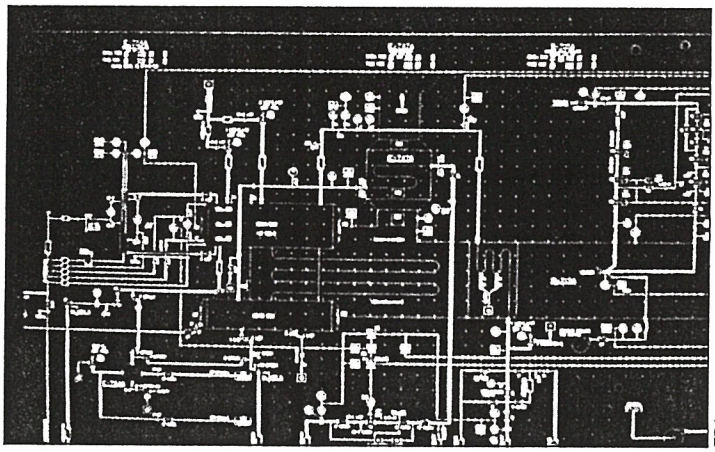


# Linking databases to plant drawings saves time and money in process hazard analyses

By Cindy Lancaster

PART OF OSHA REGULATION *29 CFR 1910.119* requires process hazards analyses (PHAs) to be performed for certain chemical operations. A PHA — also known as a hazardous operations analysis, or HAZOP — is an organized, systematic effort to identify and analyze the significance of potential hazards associated with processing or handling highly hazardous chemicals.

The problem is, most chemical and petrochemical plants have been designed using manual drafting methods. In many cases, these paper drawings are deteriorating with age, and their information is outdated. Thus, many companies updating their drawings to satisfy PHA requirements are converting to computer-aided plant engineering methods.



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*PC-based programs are available that allow plants to become "self-documenting" by linking technical databases and plant drawings in a computerized format.*

The latest generation of PC-based, computer-aided plant engineering systems links information databases and adds them to drawings in minimal time. This method creates a "self-documenting plant," and saves time when performing the PHA and generating other safety- or efficiency-related information. While the computer-aided capability has been available for years on mainframe computers, only recently has it migrated to the more cost-effective PC level.

**The analysis process.** The purpose of the PHA is to provide information that will assist employers and employees in improving safety and reducing the consequences of unwanted or unplanned releases of hazardous chemicals. Selecting a methodology is influenced by several factors, including the size and complexity of the process, how long the facility has been operating, and the number of changes made to the plant.

An analysis team typically includes a technically skilled manager to lead and review the project; a process engineer to resolve technical issues; a secretary or scribe to record the results of the review; and operations or other employees to provide qualified, on-the-spot operating expertise. The team leader must be impartial and know how to properly implement PHA methodology during the evaluation.

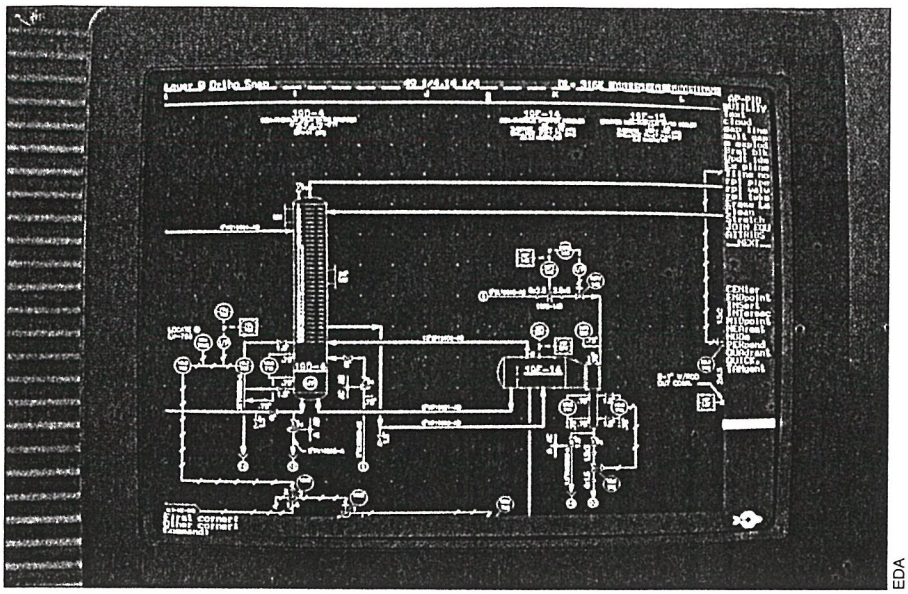
Before conducting the review, a company must compile a range of recorded process safety information, including toxicity levels and permissible exposure limits. Information pertaining to the technology of the process must include a simplified process flow diagram, process chemistry, maximum intended inventory, and safe upper and lower limits for such items as pressure temperatures, and flow and compositions.

The review usually begins with an analysis of the facility's basic process design under normal operating conditions. The team goes through the process, step by step, and considers the effects of deviations in pressure, temperature, flow rate, composition and more. For example, what happens if a process normally running at 100 psi is suddenly increased to 500 psi? All pieces of equipment involved in the process are examined to determine whether they can handle the changed conditions. Provisions for alerting plant operators of new conditions and shutting down the process also are considered.

A review often identifies possible safety enhancements. Here, the team must make recommendations to correct any problems. The results of each PHA include a detailed analysis of process unit safety conditions and a series of recommendations for improvements to help keep potentially dangerous events from occurring.

Collecting and maintaining the data required to perform the PHA is one of the most critical issues. The team should not waste large amounts of time digging through filing cabinets or drawers of paper drawings. Thus, the first step in the data collection process usually involves developing some sort of database that will enable clerical personnel to enter necessary information for quick access by the PHA team. Computer-aided plant engineering systems that link non-graphic information, such as the operating specifications required for a PHA, allows the piping and instrument diagram drawing to serve as a guide for the analysis. Storing non-graphic data in the drawing also saves a tremendous amount of time when generating reports. Virtually any type of operating information or specifications can be extracted from the database by using a simple query.

In some cases, developers of the engineering software can become consultants, setting up the necessary graphics and database conventions to handle a PHA or other documentation needs. The developer/con-



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*Piping and instrument diagrams developed on PCs can help guide process hazards analyses.*

sultant, along with the safety management team, first determines the nature of the relevant information for the facility. Next, the consultant proposes a set of graphics standards and database structure to handle the situation. Once the standards and structure have been approved, the developer customizes the software to operate according to the standards.

**Examples.** Occasionally, the software developer and consultant teaches drafters and clerical personnel how to maintain the new standards. In one petrochemical plant example, database attribute fields included tag number and description, design conditions, operating conditions, vessel inventory, vessel orientation, and maximum and minimum pressure, temperature and liquid level. Graphic conventions included such items as text styles, numbering systems, legend and symbol sheets, tagging, and valve flow elements. All required information for the PHA was included so the process could be carried out quickly after the data had been entered. Reports for meeting further regulatory requirements could be generated automatically.

Another instance of using computer-aided plant engineering technology to streamline the PHA process involves The UNO-VEN Co. (Arlington Heights, Ill.), which owns and operates a refinery in northern Illinois. The major portion of the UNO-VEN refinery was built in 1970 using manual drafting techniques. Before beginning the its PHA initiative, UNO-VEN converted its aging and cumbersome plant drawings to computer-aided design (CAD) format. The company incorporated PHA-required information, such as operating conditions and equipment ratings, into the drawing using new PC-based plant engineering systems.

Employees determined the required information and the desired procedures and format for the company's PHAs. Staff then modified the database to store information for meeting the company's PHA procedures and user prompts for data entry. Libraries of symbols also were modified to match the UNO-VEN's style requirements.

UNO-VEN employees are well underway in converting manual drawings to CAD and performing PHAs. The company expects to complete the analyses within the regulatory time frame.

A third example involves Unocal Corp. (Los Angeles), the largest chemical producer in Alaska and the largest ammonia producer in western North America. To comply with corporate policy changes, a hazardous operations analysis had to be performed at Unocal's Chemical and Minerals complex in Kenai, Alaska. The Kenai plant was originally designed in the mid- and late-1960s using paper drawings. Since many drawings were out-of-date and had to be redone, Unocal resolved to convert them to CAD.

It became clear to Unocal officials that the process of entering each of the approximately 130 paper drawings — some of which were 15 feet long — and creating associated equipment lists would take an inordinate amount of time using a conventional CAD system. Officials decided to use piping design software to keep track of piping connectivity with other lines, equipment and drawings. Important non-graphic data, such as construction material, design pressures and temperatures, were counted.

With the project about 50 percent complete, it is apparent that Unocal's method will cut conversion time considerably, compared to conventional CAD procedures. Since users merely have to point at a certain part of the drawing to access non-graphic data, substantial additional savings are expected. ▼

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