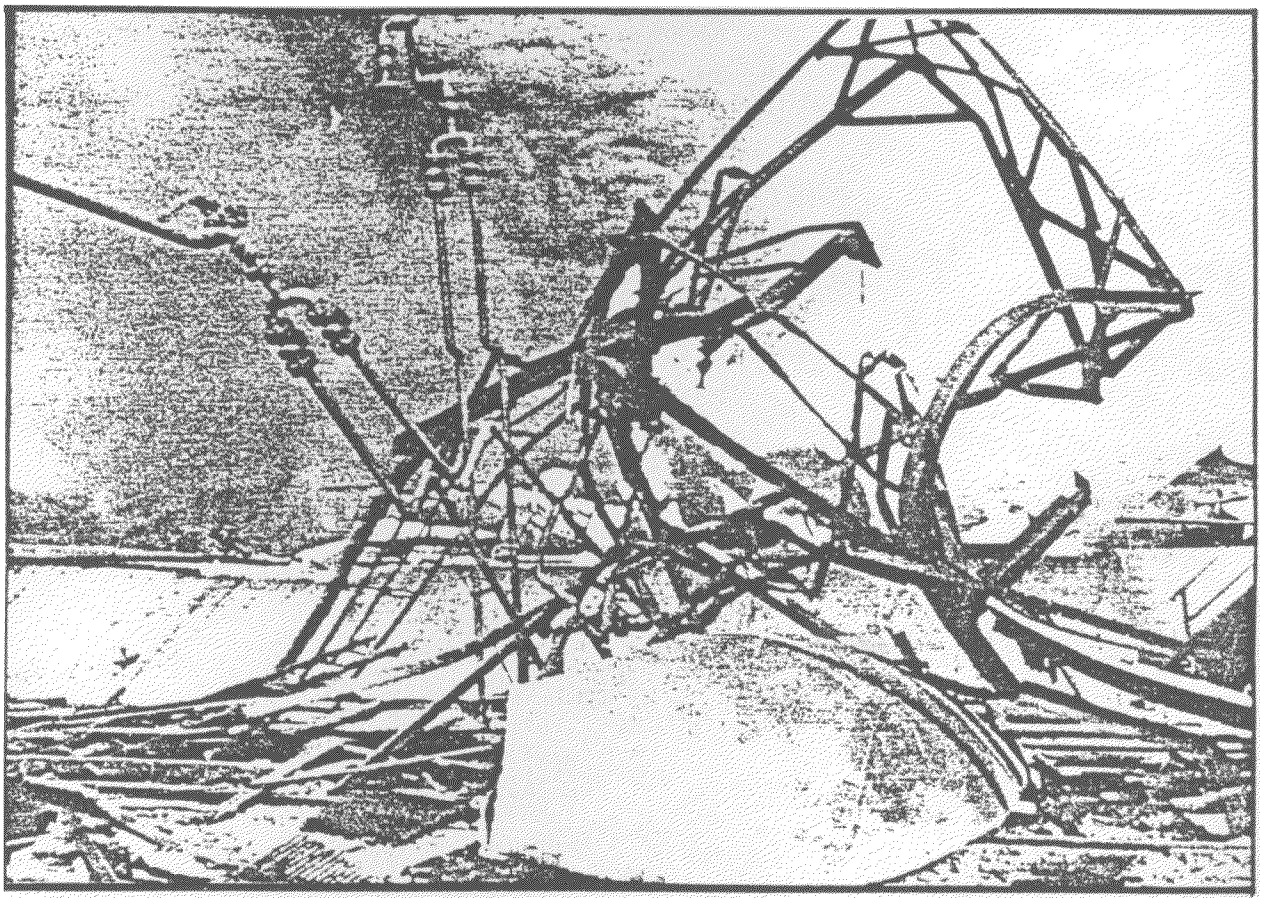
Chapter 7

Hazard And Operability Studies (HAZOP)



7. HAZARD AND OPERABILITY STUDIES (HAZOP)

8.1 Background

The results of an hazard assessment, as described in previous sections, may show that a more detailed safety study is required of a particular section of the plant which presents a significant hazard to operators and/or the surrounding community. For this purpose, a HAZOP study may be required to identify systematically the possible ways in which the system could fail. The studies are carried out by a team including the principal design engineers, HAZOP chairman and an external HAZOP expert.

7.2 HAZOP Method

HAZOP involves the scrutiny of a large number of possible deviations from normal operationing conditions, which are generated by applying guide words such as MORE, LESS, REVERSE etc., to each of the parameters describing conditions in each component or pipeline in the plant. Often there is no realistic cause, or the effects are unimportant (e.g. REVERSE temperature is meaningless, LOW pressure, unless a vaccuum might be created, may not be harmful) such cases can be quickly passed over. Sometimes, the causes are credible and the effects are significant either for the correct functioning of the process or for safety and possibly both. In such cases, there may be a need for design changes to eliminate the identified cause, or alternatively a more detailed reliability study may be recommended, to determine whether the probability of the event is high enough to justify action. The team may assess the consequences and probability subjectively as 'large' or 'small' and rank the actions accordingly.

At the stage described above, major changes to the design may be made relatively cheaply, whereas a detailed HAZOP takes place after the design has been frozen. The third type of HAZOP is to consider plant alterations that may be made during service. This type of HAZOP provides a formal method of ensuring that any such alterations cannot contribute to excessive hazards. Usually, a coarse HAZOP is applied just before the design has been completed.

The objectives and the method of HAZOP Studies are:

- To identify those areas of the design which may possess a significant hazard potential
- To identify and study features of the design which influence the probability of a hazardous incidents occurring
- To familiarise the study team with the design information available
- To ensure that a systematic study is made of the areas of significant hazard potential
- To identify pertinent design information not currently available to the team
- To provide a mechanism for feedback to the client of the study team's detailed comments.

The method of study is as follows:

(i) Identification of drawings relating to equipment containing hazardous materials, based on the drawing list and on a brief examination of the drawings themselves.

(ii) Study of the selected drawings following a simplified HAZOP checklist. A line-by-line study is not normally attempted, but in most cases attention is concentrated on vessels and major equipment items. The checklist contains such questions as 'how can the vessel be over pressured?', 'what happens on low or high level?' etc.

(iii) The results of the study are recorded as a set of comments to be followed up. Some require further investigation or calculation whereas other are passed to the project design team as recommendations for design change.

(iv) HAZOPS are recorded in a fixed format although the format varies from study to study.

HAZOP methods, as practised to date, are only applicable to process hazards but there is no doubt that it could be developed to apply to structures, management procedures and many other systems that relate to safety. This would, however, probably involve the development of new guide words.

The technique can be laborious but the efficiency of the study team increases rapidly with experience, as trivial cases can be more quickly identified and resolved. It is unwise, however, to take too many short-cuts because this undermines the main advantage of the method, which is its thoroughness and comprehensiveness in failure case identification.

7.3 Further Information

For further reading, the analyst is referred to the booklet "A Guide to Hazard and Operability Studies" published by the Chemical Industries Association (1977) and Roach and Lees (1981). Other systematic hazard assessment techniques are being used by the chemical industry which are well presented in the U.S.A Chemical Manufacturers Association Publication "Process Safety Management" (1985).