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**Questions**

1. briefly discuss hazard operability technique
2. state the significance of hazop technique
3. with the aid of a block diagram, list the components of hazard operability

**Answers**

A HAZOP (Hazard and Operability) study identifies hazards and operability problems in a process plant. It is a tool for the identification of hazards due to process parameter deviations. The concept involves investigating how the plant might deviate from the design intent. HAZOP is based on the principle that several experts with different backgrounds can interact and identify more problems when working together than when working separately and combining their results. Although the HAZOP study was developed to supplement experience-based practices when a new design or technology is involved, its use has expanded to almost all phases of a plant's life. The “Guide-Word” HAZOP is the most well-known of the HAZOPs; however, several specializations of this basic method have been developed

 The HAZOP concept is to review the plant in a series of meetings, during which a multidisciplinary team methodically “brainstorms” the plant design, following the structure provided by the guide words and the team leader's experience.

 The primary advantage of this brainstorming is that it stimulates creativity and generates ideas. This creativity results from the interaction of the team and their diverse backgrounds. Consequently the process requires that all team members participate (quantity breeds quality in this case), and team members must refrain from criticizing each other to the point that members hesitate to suggest ideas.

The team focuses on specific points of the design (called "study nodes"), one at a time. At each of these study nodes, deviations in the process parameters are examined using the guide words. The guide words are used to ensure that the design is explored in every conceivable way. Thus the team must identify a fairly large number of deviations, each of which must then be considered so that their potential causes and consequences can be identified.

The success or failure of a HAZOP study depends on several factors, to name a few:

* The completeness and accuracy of drawings and other data used as a basis for the study
* The technical skills and insights of the team
* The ability of the team to use the approach as an aid to their imagination in visualizing deviations, causes, and consequences
* The ability of the team to concentrate on the more serious hazards which are identified.

In the process of identifying problems during a HAZOP study, if a solution becomes apparent, it is recorded as part of the HAZOP result; however, care was taken to avoid trying to find solutions which are not so apparent, because the prime objective for the HAZOP is problem identification.

**Significance of hazop technique**

HAZOP study deals with the identification of hazards due to process parameter deviations. When a failure occurs due to deviations, it may take the process outside of its normal operating ranges. In general, there are several layers of protection measures in a plant in response to a process deviation. The basic process controls, alarms, safety valves, operator supervision etc. are the typical protection measures against any harmful consequences due to deviation of process parameters as shown below:

* Process equipments are designed for process operating limits.
* Basic process controls, alarms and operators are adjusted to process deviations.
* Presence of Critical Alarms along with Speedy Response of Operators.
* Safety Interlock System/Emergency Shut Down at operating limits.
* Relief Systems that activate at equipment design limits.
* Mitigation systems that contain the effects of incident.
* Plant emergency response to control the effects of incidents (On-site Control Arrangement).
* Emergency response to protect the public from the effects of an incident (Offsite Control Arrangement).

OMPO

**Components of hazard operability**

* 1. *Study Nodes* - The locations (on piping and instrumentation drawings and procedures) at which the process parameters are investigated for deviations.
	2. *Intention* - The intention defines how the plant is expected to operate in the absence of deviations at the study nodes. This can take a number of forms and can either be descriptive or diagrammatic; e.g., flow-heets, line diagrams, P&IDs.
	3. *Deviations* - These are departures from the intention which are discovered by systematically applying the guide words (e.g., "more pressure").
	4. *Causes* - These are the reasons why deviations might occur. Once a deviation has been shown to have a credible cause, it can be treated as a meaningful deviation. These causes can be hardware failures, human errors, an unanticipated process state (e.g., change of composition), external disruptions (e.g., loss of power), etc.
	5. *Consequences* - These are the results of the deviations should they occur (e.g., release of toxic materials). Trivial consequences, relative to the study objective, are dropped.
	6. *Guide Words* - These are simple words which are used to qualify or quantify the intention in order to guide and stimulate the brainstorming process and so discover deviations. The guide words shown in Table 1 are the ones most often used in a HAZOP; some organizations have made this list specific to their operations, to guide the team more quickly to the areas where they have previously found problems. Each guide word is applied to the process variables at the point in the plant (study node) which is being examined. These guide words are applicable to both the more general parameters (e.g., react, transfer) and the more specific parameters (e.g., pressure, temperature).

**Table 1: HAZOP Guide Words and Meanings**

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| **Guide Words** | **Meaning** |
| No | Negation of the Design Intent |
| Less | Quantitative Decrease |
| More | Quantitative Increase |
| Part Of | Qualitative Decrease |
| As Well As | Qualitative Increase |
| Reverse | Logical Opposite of the Intent |
| Other Than | Complete Substitution |