
HAZOP Hazard & Operability studies



Mitsui Sumitomo Insurance Group

What is HAZOP? (Hazard & Operability)

A systematic review of the design & operation of a system to identify the potential for accidental releases of hazardous material, or operability problems. (Potential accident scenarios)

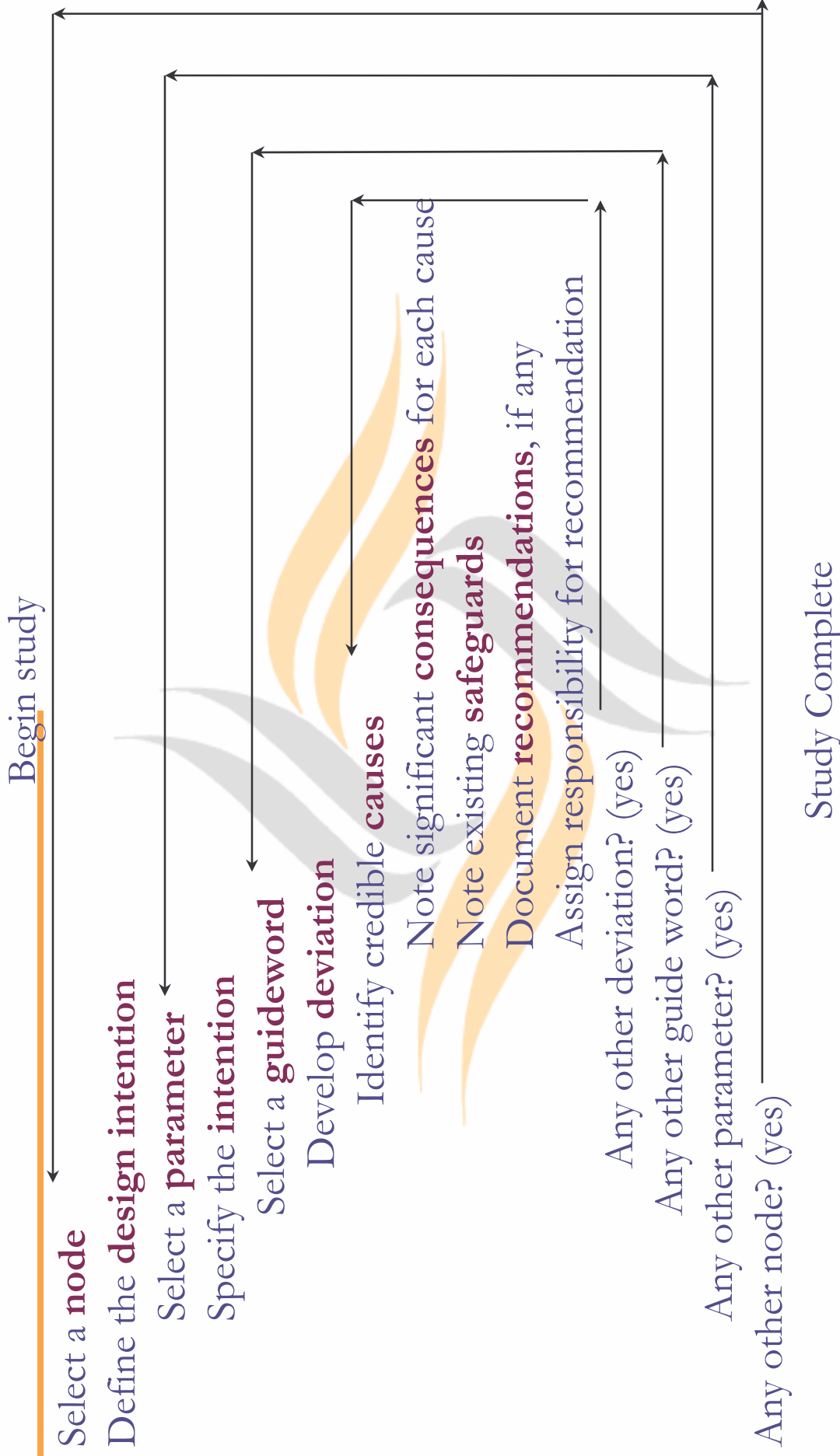
Based on the premise that :

- A hazard is not realized if the process is always operated within its design intent
- Creative input of a team is better than of an individual
- Item can be applied, independent of process technologies

When HAZOP Should Be Done?

- Drawing board
- Construction
- Only during process modifications
- Whenever accident occurs

HAZOP Process



Node

A node is a location on a process diagram (usually P&ID's) at which process parameters are investigated for deviations. Nodes are points where the process parameters have an identified design intent.

Nodes are usually pipe sections or vessels.

Plant components (e.g..., pumps, compressors, exchangers) are found within nodes

P&ID Classification	No.Of Equipemnets	No.Of Pipe lines	No.of Interlocks
Simple	1 to 4	1 to 9	<2
Standard	5 to 6	10 to 20	2 to 4
Complex	>6	>30	>10
Very Complex	>6	>30	>10

Parameter

A parameter is an aspect of the process that describes it physically, chemically, or in terms of what is happening.

Parameters are usually classified as specific or general.

- Specific parameters are those that describe aspects of the process.
- General parameters are those that describe aspects of design intent remaining after the specific parameters have been removed

Common Parameters

Specific	General
Flow	Addition, Reaction
Temperature	Maintenance, Testing
Pressure	Instrumentation
Composition	Sampling, Relief
Phase	Corrosion / Erosion
Level	Safety



Guide Words

Guide words are simple words or phrases used to qualify or quantify the intention and associated parameters in order to discover deviations.

There are seven standard guide words.

Standard Guide Words

Guide Word

No

More

Less

As Well As

Part of

Reverse

Other Than

Meaning

Negation of the design intent

Quantitative increase

Quantitative decrease

Qualitative increase

Qualitative decrease

Logical opposite of the intent

Complete Substitution



In addition to the seven standard guide words, the following auxiliary guide words may be considered :

- **How ?** How is the step to be accomplished ? Are adequate facilities provided to allow the operator to perform the step as specified ?
- **Why ?** Is the step or operation really needed ?
- **When ?** Is timing of the step or operation important ?
- **Where ?** Is it important where the step is performed ?

And so on _____

Intention

The intention defines how the system is expected to operate at the nodes. It thus provides a point of reference for developing deviations.

Deviations

Deviations are departures from the design intention that are discovered by systematically applying the guidewords to each parameter at each node.

E.g. “more” + “temperature” = “higher temperature”

HAZOP - Model Worksheet

Name of the company :

Node :

Parameter :

Intention :

Guide word	Deviation	Causes	Probability	Hazards	Operability Problems	Recommendations
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HAZOP - Hazard Vs Operability

Relative Percentage : Operability to Hazard

Status of Plant	Operability Problem Identified (%)	Hazards Identified (%)
New	60	40
Existing	70	30

Team Composition

Team Leader

Team Members

Engineers

Scientists

Operators

Project Engineering

Process

Control

Corrosion



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HAZOP Summary

- (a) Prior screening of units using available quantification technique
- (b) Inclusion of probability factors into the selection of nodes
- (c) Focusing on critical parameters to identify hazardous outcome
- (d) Separation of Hazard and Operability problems
- (e) Realistic assessment of time factor in the HAZOP study
- (f) To draw up a practical follow-up action plan

HAZOP-Limitations

- Failure of a cooling pump causes - Temperature to raise in a reactor.
- HAZOP-Safeguards-Backup pump, quench, rupture disk etc.
- It stops there-What if Rupture disk works- Contents released into atmosphere
- Quenching works-loss of material-Cleanup cost

HAZOP-LIMITATIONS

- Backup pump works- Repair cost of primary pump?
- Batch operations-Change of Sequence
 - Suitable for automated or semi automated
- Application Stage
- Accuracy of P&I Diagrams
- A component in Risk Analysis Technique
 - Semi-Quantification Technique

Should be combined with other Quantification Techniques like FTA, and Consequence Analysis to complete risk assessment.

- Hazard vs. Operability problems
- Team Composition
- Probability and likelihood of hazards
- Time factor
- Management Response to recommendations/Follow up