Hazard and Operability Study

ELEMENT 6

Definitions

- A **hazard analysis** is a process used to assess risk.
- The results of a hazard analysis is the identification of unacceptable risks and the selection of means of controlling or eliminating them.

Hazard and Operability Analysis (HAZOP) is a structured and systematic technique for system examination and risk management.

In particular, HAZOP is often used as a. technique for identifying potential hazards in a system and identifying operability problems.

HAZOP analysis is typically conducted by a team of experts from various disciplines, including engineering process design, operations, maintenance, and safety

HAZOP

- Definition: A **hazard and operability study** (HAZOP) is a structured and systematic examination of a planned or existing process or operation in order to identify and evaluate problems that may represent risks to personnel or equipment, or prevent efficient operation.
- A HAZOP is a qualitative technique based on guide-words and is carried out by a multi-disciplinary team (HAZOP team) during a set of meetings.

HAZOP History

- The technique originated in the Heavy Organic Chemicals Division of ICI, which was then a major British and international chemical company. The history has been described by Trevor Kletz[3][5] who was the company's safety advisor from 1968 to 1982.
- In 1963 a team of 3 people met for 3 days a week for 4 months to study the design of a new Phenol plant. They started with a technique called *critical examination* which asked for alternatives, but changed this to look for **deviations**. The method was further refined within the company, under the name *operability studies*, and became the third stage of its hazard analysis procedure (the first two being done at the conceptual and specification stages) when the first detailed design was produced.

HAZOP Process

- A process flow diagram is examined in small sections, such as individual items of equipment or pipes between them. For each of these a design *Intention* is specified.
- The Hazop team then determines what are the possible significant *Deviations* from each intention, feasible *Causes* and likely *Consequences*. It can then be decided whether existing, designed safeguards are sufficient, or whether additional actions are necessary to reduce risk to an acceptable level.

HAZOP Team

Name	Alternative	Role
Study leader	Chairman	someone experienced in Hazop but not directly involved in the design, to ensure that the method is followed carefully
Recorder	Secretary or scribe	to ensure that problems are documented and recommendations passed on
Designer	(or representative of the team which has designed the process)	To explain any design details or provide further information
User	(or representative of those who will use it)	To consider it in use and question its operability, and the effect of deviations
Specialist	(or specialists)	someone with relevant technical knowledge
Maintainer	(if appropriate)	someone concerned with maintenance of the process.

What you are in for.

- When Hazop meetings were recorded by hand they were generally scheduled for three to four hours per day. For a medium-sized chemical plant where the total number of items to be considered is 1200 (items of equipment and pipes or other transfers between them) about 40 such meetings would be needed.

Appropriate Parameters

- The key feature is to select appropriate **parameters** which apply to the design intention.
  - Flow, Temperature, Pressure, Composition
  - In a chemical plant, a pipe may have the intention to transport 2.3 kg/s of 96% sulfuric acid at 20°C and a pressure of 2 bar from a pump to a heat exchanger.
- Deviations from the design Intention using Guide Words

Guide Words

Guide Word	Meaning
NO OR NOT	Complete negation of the design intent
MORE	Quantitative increase
LESS	Quantitative decrease
AS WELL AS	Qualitative modification/increase
PART OF	Qualitative modification/decrease
REVERSE	Logical opposite of the design intent
OTHER THAN	Complete substitution
EARLY	Relative to the clock time
LATE	Relative to the clock time
BEFORE	Relating to order or sequence
AFTER	Relating to order or sequence

Early, late, Before, After - applied to batch or sequential operations

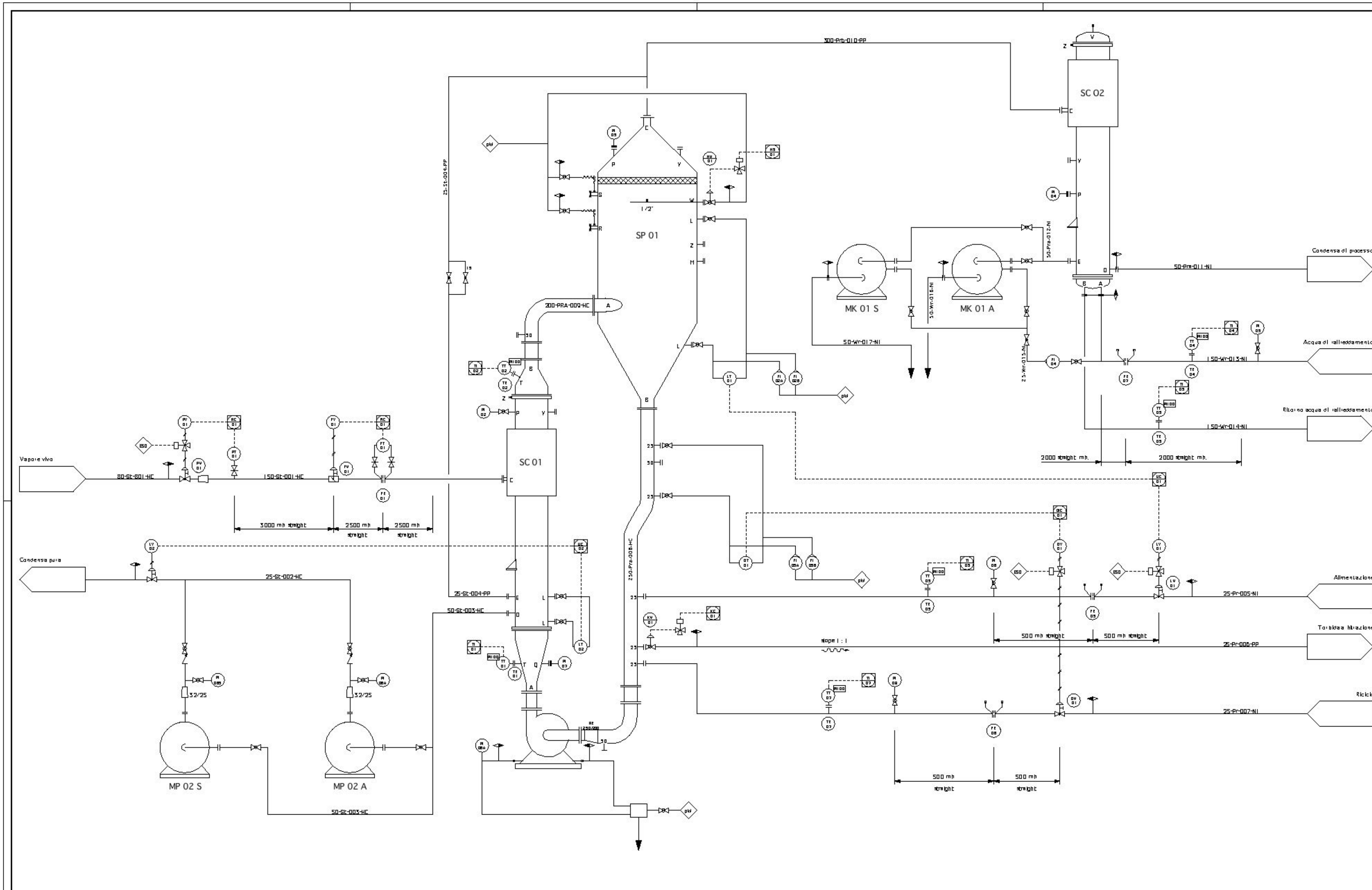
Guide Word – Parameter Pairs

Parameter / Guide Word	More	Less	None	Reverse	As well as	Part of	Other than
Flow	high flow	low flow	no flow	reverse flow	deviating concentration	contamination	deviating material
Pressure	high pressure	low pressure	vacuum		delta-p		explosion
Temperature	high temperature	low temperature					
Level	high level	low level	no level		different level		
Time	too long / too late	too short / too soon	sequence step skipped	backwards	missing actions	extra actions	wrong time
Agitation	fast mixing	slow mixing	no mixing				
Reaction	fast reaction / runaway	slow reaction	no reaction				unwanted reaction
Start-up / Shut-down	too fast	too slow			actions missed		wrong recipe
Draining / Venting	too long	too short	none		deviating pressure	wrong timing	
Inertising	high pressure	low pressure	none			contamination	wrong material
Utility failure (instrument air, power)			failure				
DCS failure			failure				
Maintenance			none				
Vibrations	too low	too high	none				wrong frequency

Process HAZOP worksheet

Hazards and Operability Review						
Project Name:			Date:		Page of	
Process :						
Section:			Ref. Drawing:			
Item	Study node	Process Parameter	Deviations (guide words)	Possible causes	Possible consequences	Action Required

Guide Word	Deviation	Causes	Consequences	Action
Less	Less flow of cooling water	Pipe blockage	Temperature of process fluid remains constant	High Temperature Alarm
More	More cooling flow	Failure of cooling water valve	Temperature of process fluid decrease	Low Temperature Alarm
More of	More pressure on tube side	Failure of process fluid valve	Bursting of tube	Install high pressure alarm
Contamination	Contamination of process fluid line	Leakage of tube and cooling water goes in	Contamination of process fluid	Proper maintainance and operator alert
Corrosion	Corrosion of tube	Hardness of cooling water	Less cooling and crack of tube	Proper maintainence



300-Prb-010-PP
SC 02
SP 01
SC 01
MK 01 S
MK 01 A
MP 02 S
MP 02 A
Condensa di processo
50-Pra-011-NI
Acqua di raffreddamento
150-Wr-013-NI
Ritorno acqua di raffreddamento
150-Wr-014-NI
2000 straight min.
Vapore vivo
80-St-001-HC
150-St-001-HC
3000 mh straight
2500 mh straight
Condensa pura
25-St-002-HC
25-St-004-PP
50-St-003-HC
200-PRA-009-HC
250-Pra-008-HC
50-Wr-017-NI
50-Pra-012-NI
Alimentazione
25-Pr-005-NI
Torbida a filtrazione
25-Pr-006-PP
slope 1 : 1
Riciclo
25-Pr-007-NI
500 mh straight
32/25

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Alistair Chemicals

Cristallizzatore NaCl in NaClO
Schema meccanico

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