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HT-E - Practical HAZOPS for Engineers and Technicians

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Short Description

Practical HAZOPS for Engineers and Technicians This manual covers the techniques of hazard and operability studies that are widely used in industry for the identification of potential hazards in process plant operations. In recent years HAZOP methods have been extended to searching for hazards in operational procedures and in many other fields including electronic controls and emergency planning procedures.

Description

Practical HAZOPS for Engineers and Technicians This manual covers the techniques of hazard and operability studies that are widely used in industry for the identification of potential hazards in process plant operations. In recent years HAZOP methods have been extended to searching for hazards in operational procedures and in many other fields including electronic controls and emergency planning procedures.

HAZOP can be adapted to a wide range of applications to seek out operational failure modes and possible harm to persons, environment or assets. This manual details the relationship (and differences) between HAZOP and other risk management techniques such as HAZID, hazard analysis, FMEA and fault tree

analysis. It explains the concepts of the Safety Integrity Levels (SIL) of instrumented systems and how these are specified in association with Hazard studies and risk assessments.

In process plant design it includes the identification and effect of failures in process control systems and SCADA systems. An example of CHAZOP (Control System HAZOP) is discussed that considers hazards arising from failures in control systems. Hazard studies interact closely with process design and safety engineering solutions in the critical stages of engineering projects. Understanding these interactions assists engineers and technicians to plan their work efficiently and to contribute effectively to the reduction of risks in the workplace.

This manual shows how information flow from HAZOP supports safety management throughout the life cycle of the plant. The HAZOP techniques and safety system practices described are based on the latest international practices including the guidelines in IEC 61822 for HAZOP studies.

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1 Introduction

1.1 General information

The HAZOP technique is widely recognized as the most effective method currently available for satisfying two basic requirements. The first is checking a new design for safety and operability problems whilst the piping and instrumentation diagram (P&ID) is being developed and finalized. The second is the identification of latent safety and operability problems in existing plant, which have yet to be revealed during operations.

The HAZOP technique is very powerful in terms of its ability to identify the potential for incidents. It is, however, a significant consumer of resources and needs to be an integral part of a project development activity. For this reason our training course begins by outlining the context of HAZOP studies within the legal

and project frameworks that it serves.

HAZOP has developed over a number of years and there are a number of ways in which it is applied. This manual describes a typical approach to the technique, which is generally supported by well-established guide manuals and by an IEC standard. It has been prepared for two purposes:

- To be support material for a HAZOP training programme, which provides an insight into the technique for engineers new to HAZOP and gives more experienced people the opportunity for practice at an advanced level.
- To be a handbook for HAZOP facilitators when they carry out workshop studies and need to promote in their team an awareness of how the technique will be applied.

The successful practice of the technique is very dependent on the skills of the facilitator or HAZOP team leader. This manual identifies the leader's tasks and provides a first level of training in those duties. HAZOP leadership skills are largely based on the subsequent experience to be gained by the leader whilst making good use of the best available advice and guidance.

Both those who will participate in workshops, either as facilitator or team member, and those who will be recipients of workshop reports are encouraged to participate in this training to learn the behaviors necessary to contribute and respond optimally in the performance of a HAZOP workshop.

1.2 Workshop outline

The general plan of the workshop is to first build up an understanding of why HAZOP studies are done and how to conduct HAZOP studies. The workshop then highlights the tasks of the team leader and offers guidance on how these tasks can be performed. The workshop also outlines the principles of risk assessment and risk reduction and closes with a special section on safety instrumentation and the principles of SIL determination.

The best way to achieve competency in HAZOP is to practice the techniques in small study groups. The workshop provides practical exercises using simplified examples and these are intended for small groups of 3 or 4. Specimen answers are provided but the study groups may find additional items to note based on their own ideas or experiences. The key point here is that a HAZOP study must promote freethinking by the team members around each issue so that most possible problems can be identified. At the same time, the team leader must impose enough discipline to keep the study moving along without wasting time on

issues that are of no consequence.

This workshop includes some outline training in methods of assessing hazards in terms of their likelihood and consequences. Such methods are broadly called Hazard Analysis or “HAZAN”. The long-established writer on chemical industry hazards, Trevor Kletz, advises that we must be careful to distinguish between HAZOP and HAZID methods, which search for possible hazards, and HAZAN, which evaluates known hazards for risk levels. Kletz uses the following diagram to explain the differences and we include it here as Figure 1.1 with acknowledgements.

Figure 1.1

Differences between HAZOP and HAZAN

Please note that there is a glossary of abbreviations and terms placed at the beginning of the manual for help with the jargon and acronyms that inevitably

arise from a technical subject.

Here is brief review of the path of study for the workshop:

Chapter 2 briefly describes what HAZOP is and why it is done so that we can get started with the concepts in mind.

Chapter 3 describes the background of plant safety and project needs that influence the timing and conduct of a HAZOP study. It also shows how HAZOP is part of a family of hazard studies that are used for a typical project from concept to final delivery and throughout its continuing life.

Chapter 4 provides an introduction to the overall HAZOP study method to allow you to become familiar with the general techniques as simply and as quickly as possible. It may be that you have already experienced this level of participation in HAZOPs but it should be helpful to refresh your understanding of the whole procedure in one package of notes.

Chapter 5 describes the HAZOP examination phase in more detail to build up competency in the techniques of structuring the study into nodes and in the application of guidewords and deviations to the operations being studied. This chapter also expands training in procedural HAZOPS, which are applied to a sequence of operations or procedures.

Chapter 6 then considers the role of the HAZOP team leader or facilitator and provides guidance on those duties including the reporting phase and on the problems of managing the study sessions. The leader’s tasks can be most clearly seen once you have experienced some typical HAZOP study sessions and even when trying out the practical exercises.

Chapter 7 introduces the concepts of risk assessment and risk reduction and shows how these are related to the provision of safeguards, particularly using safety-instrumented systems. HAZOP study teams often call for instrumented trip and alarm solutions to unacceptable risk and therefore an understanding of risk reduction methods and Safety Integrity Levels (SILs) is helpful, particularly for the HAZOP team leader.

Chapter 8 introduces some methods of hazard analysis including failure mode and effects analysis (FMEA) and fault tree analysis (FTA). These are supporting tools that help with the understanding of the logic of failure modes and are used for the quantification of hazard rates once the possibility of hazard has been detected by the HAZOP stage.

Appendices are provided after Chapter 8. These contain useful references, guidewords and tables supporting HAZOP workshops.

Practical exercises are described at the back of the manual followed by some specimen answers.

1.3 Reference sources

The HAZOP techniques described in this manual are based on the recommendations, terminologies and procedures described in 3 widely accepted sources. These are:

1. **HAZOP and HAZAN:**Notes on the identification and assessment of hazards. By Trevor Kletz, published by I ChemE.
2. **HAZOP Guide to Best Practice**published jointly by The Chemical Industries Association (UK), I ChemE and the European Process Safety Centre (EPSC). References in our text to “The EPSC Guide” are references to this book.
3. **IEC 61882: HAZOP Guidance**: This IEC engineering standard provides a well defined set of procedures and terminologies for HAZOP and our training manual closely follows these as a definitive version.

Material for this course have also been sourced from previous and existing IDC Training Manuals, in particular:

- Training notes from earlier IDC HAZOP workshops have been integrated into this edition and IDC Technologies acknowledges with thanks the contribution of Max Barrie for much of the core material on HAZOP workshop techniques.
- **Practical HAZOPS, Trips and Alarms:**IDC Technologies’ training manual that combines training in hazard studies with training in safety instrumented systems. Substantial material from this source has been adopted for this manual where we have more focus on the core training in HAZOP methods.

Further details on obtaining the above publications are to be found in Appendix 1.