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Hazard and operability studies (HAZOP studies) – Application guide

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CONTENTS

FOREWORD.....	4
INTRODUCTION.....	2
1 Scope.....	8
2 Normative references	8
3 Terms, definitions and abbreviations	8
3.1 Terms and definitions	8
3.2 Abbreviations	11
4 Principles Key features of HAZOP.....	11
4.1 Overview General	11
4.2 Principles of examination.....	12
4.3 Design representation	14
4.3.1 General	14
4.3.2 Design requirements and design intent	14
5 Applications of HAZOP	15
5.1 General.....	15
5.2 Relation to other analysis tools.....	16
5.3 HAZOP study limitations.....	16
5.4 Hazard Risk identification studies during different system life cycle phases stages.....	17
5.4.1 Concept and definition phase stage.....	17
5.4.2 Design and development phase Development stage	17
5.4.3 Manufacturing and installation phase Realization stage	17
5.4.4 Operation and maintenance phase Utilization stage	17
5.4.5 Decommissioning or disposal phase Enhancement stage	18
5.4.6 Retirement stage.....	18
6 The HAZOP study procedure	18
6.1 General.....	18
6.2 Definitions.....	20
6.2.1 Initiate the study	20
6.2.2 Define scope and objectives	20
6.2.3 Define roles and responsibilities	21
6.3 Preparation work	22
6.3.1 General Plan the study.....	22
6.3.2 Design description Collect data and documentation	23
6.3.3 Establish guide words and deviations	24
6.4 Examination	25
6.4.1 Structure the examination	25
6.4.2 Perform the examination	25
6.5 Documentation and follow up.....	28
6.5.1 General	28
6.5.2 Styles Establish method of recording	29
6.5.3 Output of the study.....	29
6.5.4 Reporting requirements Record information	30
6.5.5 Sign off the documentation	30
6.5.6 Follow-up and responsibilities	30

7 Audit	
Annex A (informative) Methods of reporting recording	32
A.1 Reporting Recording options	32
A.2 HAZOP worksheet	32
A.3 Marked-up representation	33
A.4 HAZOP study report	33
Annex B (informative) Examples of HAZOP studies	34
B.1 General	34
B.2 Introductory example	34
B.3 Procedures	39
B.4 Automatic train protection system	42
B.4.1 General	42
B.4.2 Application	42
B.5 Example involving emergency planning	45
B.6 Oil vaporizer	
B.6 Piezo valve control system	49
B.7 HAZOP of a train stabling yard horn procedure	58
Bibliography	69
Figure 1 – The HAZOP study procedure	20
Figure 2 – Flow chart of the HAZOP examination procedure – Element Property first sequence	27
Figure 3 – Flow chart of the HAZOP examination procedure – Guide word first sequence	28
Figure B.1 – Simple flow sheet	35
Figure B.2 – Train-carried ATP equipment	42
Figure B.3 – Piezo valve control system	49
Figure B.4 – Oil vaporizer	
Table 1 – Example of basic guide words and their generic meanings	13
Table 2 – Example of guide words relating to clock time and order or sequence	13
Table 3 – Examples of deviations and their associated guide words	24
Table B.1 – Properties of the system under examination	35
Table B.2 – Example HAZOP worksheet for introductory example	36
Table B.3 – Example HAZOP worksheet for procedures example	40
Table B.4 – Example HAZOP worksheet for automatic train protection system	43
Table B.5 – Example HAZOP worksheet for emergency planning	46
Table B.6 – Example HAZOP worksheet for oil vaporizer	
Table B.6 – System design intent	50
Table B.7 – Example HAZOP worksheet for piezo valve control system	51
Table B.8 – Operational breakdown matrix for train stabling yard horn procedure	60
Table B.9 – Example HAZOP worksheet for train stabling yard horn procedure	54

INTERNATIONAL ELECTROTECHNICAL COMMISSION

**HAZARD AND OPERABILITY STUDIES (HAZOP STUDIES) –
APPLICATION GUIDE****FOREWORD**

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International Standard IEC 61882 has been prepared by IEC technical committee 56: Dependability.

This second edition cancels and replaces the first edition published in 2001. This edition constitutes a technical revision.

This edition includes the following significant technical changes with respect to the previous edition:

- a) clarification of terminology as well as alignment with terms and definitions within ISO 31000:2009 and ISO Guide 73:2009;
- b) addition of an improved case study of a procedural HAZOP.

The text of this standard is based on the following documents:

FDIS	Report on voting
56/1653/FDIS	56/1666/RVD

Full information on the voting for the approval of this standard can be found in the report on voting indicated in the above table.

This publication has been drafted in accordance with the ISO/IEC Directives, Part 2.

The committee has decided that the contents of this publication will remain unchanged until the stability date indicated on the IEC website under "<http://webstore.iec.ch>" in the data related to the specific publication. At this date, the publication will be

- reconfirmed,
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IMPORTANT – The “colour inside” logo on the cover page of this publication indicates that it contains colours which are considered to be useful for the correct understanding of its contents. Users should therefore print this publication using a colour printer.

INTRODUCTION

This standard describes the principles for and ~~procedures of~~ approach to guide word-driven risk identification. Historically this approach to risk identification has been called a hazard and operability study or HAZOP study for short. This is a structured and systematic technique for examining a defined system, with the objectives of:

- identifying ~~potential hazards~~ risks associated with the operation and maintenance of the system. The hazards or other risk sources involved ~~may~~ can include both those essentially relevant only to the immediate area of the system and those with a much wider sphere of influence, for example some environmental hazards;
- identifying potential operability problems with the system and in particular identifying causes of operational disturbances and production deviations likely to lead to non-conforming products.

An important benefit of HAZOP studies is that the resulting knowledge, obtained by identifying ~~potential hazards~~ risks and operability problems in a structured and systematic manner, is of great assistance in determining appropriate remedial measures.

A characteristic feature of a HAZOP study is the examination session during which a multi-disciplinary team under the guidance of a study leader systematically examines all relevant parts of a design or system. It identifies deviations from the system design intent utilizing a set of guide words. The technique aims to stimulate the imagination of participants in a systematic way to identify ~~hazards~~ risks and operability problems. A HAZOP study should be seen as an enhancement to sound design using experience-based approaches such as codes of practice rather than a substitute for such approaches.

Historically, HAZOP and similar studies were described as hazard identification as their primary purpose is to test in a systematic way whether hazards are present and, if so, understand both how they could result in adverse consequences and how such consequences could be avoided through process redesign. ISO 31000:2009 defines risk as the effect of uncertainty on objectives, with a note that an effect is a deviation from the expected. Therefore HAZOP studies, which consider deviations from the expected, their causes and their effect on objectives in the context of process design, are now correctly characterized as powerful risk identification tools.

There are many different tools and techniques available for the identification of ~~potential hazards and operability problems~~ risks, ranging from checklists, ~~fault~~ failure modes and effects analysis (FMEA), ~~Fault Tree Analysis (FTA)~~ to HAZOP. Some techniques, such as checklists and what-if/analysis, can be used early in the system life cycle when little information is available, or in later phases if a less detailed analysis is needed. HAZOP studies require more detail regarding the systems under consideration, but produce more comprehensive information on ~~hazards~~ risks and ~~errors~~ weaknesses in the system design.

The term HAZOP is sometimes associated, in a generic sense, with some other hazard identification techniques (e.g. checklist HAZOP, HAZOP 1 or 2, knowledge-based HAZOP). The use of the term with such techniques is considered to be inappropriate and is specifically excluded from this document.

Before commencing a HAZOP study, it should be confirmed that it is the most appropriate technique (either individually or in combination with other techniques) for the task in hand. In making this judgment, consideration should be given to the purpose of the study, the possible severity of any consequences, the appropriate level of detail, the availability of relevant data and resources and the needs of decision-makers.

This standard has been developed to provide guidance across many industries and types of system. There are more specific standards and guides within some industries, notably the process industries where the technique originated, which establish preferred methods of application for these industries. For details see the bibliography at the end of this standard.

HAZARD AND OPERABILITY STUDIES (HAZOP STUDIES) – APPLICATION GUIDE

1 Scope

This International Standard provides a guide for HAZOP studies of systems using guide words. It gives guidance on application of the technique and on the HAZOP study procedure, including definition, preparation, examination sessions and resulting documentation and follow-up.

Documentation examples, as well as a broad set of examples encompassing various industries applications, illustrating HAZOP studies are also provided.

2 Normative references

The following documents, in whole or in part, are normatively referenced in this document and are indispensable for its application. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

IEC 60050-192, *International electrotechnical vocabulary – Part 192: Dependability* (available at <http://www.electropedia.org>)

~~IEC 60300-3-9, *Dependability management – Part 3: Application guide – Section 9: Risk analysis of technological systems*~~

~~IEC 60812, *Analysis techniques for system reliability – Procedure for failure mode and effects analysis (FMEA)*~~

~~IEC 61025, *Fault tree analysis (FTA)*~~

~~IEC 61160, *Formal design review*~~

INTERNATIONAL STANDARD

NORME INTERNATIONALE

Hazard and operability studies (HAZOP studies) – Application guide

Études de danger et d'exploitabilité (études HAZOP) – Guide d'application

CONTENTS

FOREWORD.....	4
INTRODUCTION.....	6
1 Scope.....	7
2 Normative references	7
3 Terms, definitions and abbreviations	7
3.1 Terms and definitions	7
3.2 Abbreviations	9
4 Key features of HAZOP.....	10
4.1 General.....	10
4.2 Principles of examination.....	11
4.3 Design representation	12
4.3.1 General	12
4.3.2 Design requirements and design intent	13
5 Applications of HAZOP	13
5.1 General.....	13
5.2 Relation to other analysis tools.....	14
5.3 HAZOP study limitations.....	14
5.4 Risk identification studies during different system life cycle stages.....	15
5.4.1 Concept stage.....	15
5.4.2 Development stage	15
5.4.3 Realization stage	15
5.4.4 Utilization stage	15
5.4.5 Enhancement stage	16
5.4.6 Retirement stage.....	16
6 The HAZOP study procedure	16
6.1 General.....	16
6.2 Definitions.....	17
6.2.1 Initiate the study	17
6.2.2 Define scope and objectives	17
6.2.3 Define roles and responsibilities	18
6.3 Preparation	19
6.3.1 Plan the study.....	19
6.3.2 Collect data and documentation	20
6.3.3 Establish guide words and deviations	20
6.4 Examination	21
6.4.1 Structure the examination	21
6.4.2 Perform the examination	22
6.5 Documentation and follow up.....	24
6.5.1 General	24
6.5.2 Establish method of recording	25
6.5.3 Output of the study.....	25
6.5.4 Record information.....	25
6.5.5 Sign off the documentation.....	26
6.5.6 Follow-up and responsibilities	26
Annex A (informative) Methods of recording	27

A.1	Recording options	27
A.2	HAZOP worksheet.....	27
A.3	Marked-up representation.....	28
A.4	HAZOP study report	28
Annex B (informative)	Examples of HAZOP studies	29
B.1	General.....	29
B.2	Introductory example.....	29
B.3	Procedures	34
B.4	Automatic train protection system	37
B.4.1	General	37
B.4.2	Application.....	37
B.5	Example involving emergency planning.....	40
B.6	Piezo valve control system	44
B.7	HAZOP of a train stabling yard horn procedure	48
Bibliography		59
Figure 1	The HAZOP study procedure	17
Figure 2	Flow chart of the HAZOP examination procedure – Property first sequence	23
Figure 3	Flow chart of the HAZOP examination procedure – Guide word first sequence.....	24
Figure B.1	Simple flow sheet.....	30
Figure B.2	Train-carried ATP equipment.....	37
Figure B.3	Piezo valve control system	44
Table 1	Example of basic guide words and their generic meanings	11
Table 2	Example of guide words relating to clock time and order or sequence	12
Table 3	Examples of deviations and their associated guide words.....	21
Table B.1	Properties of the system under examination.....	30
Table B.2	Example HAZOP worksheet for introductory example	31
Table B.3	Example HAZOP worksheet for procedures example	35
Table B.4	Example HAZOP worksheet for automatic train protection system	38
Table B.5	Example HAZOP worksheet for emergency planning	41
Table B.6	System design intent	45
Table B.7	Example HAZOP worksheet for piezo valve control system.....	46
Table B.8	Operational breakdown matrix for train stabling yard horn procedure	50
Table B.9	Example HAZOP worksheet for train stabling yard horn procedure	53

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SOMMAIRE

AVANT-PROPOS.....	62
INTRODUCTION.....	64
1 Domaine d'application.....	66
2 Références normatives.....	66
3 Termes, définitions et abréviations.....	66
3.1 Termes et définitions.....	66
3.2 Abréviations.....	69
4 Principales caractéristiques de HAZOP.....	69
4.1 Généralités.....	69
4.2 Principes de l'examen.....	70
4.3 Plan de conception.....	72
4.3.1 Généralités.....	72
4.3.2 Exigences de conception et intention de conception.....	72
5 Applications de HAZOP.....	73
5.1 Généralités.....	73
5.2 Relation avec d'autres outils d'analyse.....	74
5.3 Limites de l'étude HAZOP.....	74
5.4 Etudes d'identification des risques durant les différentes phases du cycle de vie du système.....	75
5.4.1 Phase de conception.....	75
5.4.2 Phase de développement.....	75
5.4.3 Phase de réalisation.....	75
5.4.4 Phase d'utilisation.....	75
5.4.5 Phase d'amélioration.....	75
5.4.6 Phase de mise hors service.....	76
6 Procédure de l'étude HAZOP.....	76
6.1 Généralités.....	76
6.2 Définitions.....	77
6.2.1 Lancer l'étude.....	77
6.2.2 Définir le domaine d'application et les objectifs.....	77
6.2.3 Définir les rôles et les responsabilités.....	77
6.3 Préparation.....	79
6.3.1 Planifier l'étude.....	79
6.3.2 Recueillir les données et la documentation.....	79
6.3.3 Déterminer les mots-guides et les écarts.....	80
6.4 Examen.....	81
6.4.1 Structurer l'examen.....	81
6.4.2 Réaliser l'examen.....	82
6.5 Documentation et suivi.....	85
6.5.1 Généralités.....	85
6.5.2 Déterminer la méthode de compte rendu.....	85
6.5.3 Résultats de l'étude.....	85
6.5.4 Enregistrer les informations.....	86
6.5.5 Agrément de la documentation.....	86
6.5.6 Suivi et responsabilités.....	86

Annexe A (informative) Méthodes de compte rendu	87
A.1 Options de compte rendu	87
A.2 Tableau HAZOP	87
A.3 Plan annoté	88
A.4 Rapport d'étude HAZOP	88
Annexe B (informative) Exemples d'études HAZOP	89
B.1 Généralités	89
B.2 Exemple introductif	89
B.3 Procédures	94
B.4 Système de protection automatique des trains	97
B.4.1 Généralités	97
B.4.2 Application	97
B.5 Exemple avec planification en cas d'urgence	101
B.6 Système de commande de vanne piézoélectrique	106
B.7 HAZOP pour une procédure d'avertisseur sonore dans une aire de stationnement de trains	111
Bibliographie	123
Figure 1 – Déroulement d'une étude HAZOP	76
Figure 2 – Organigramme de la procédure de l'examen HAZOP – Séquence propriété d'abord	83
Figure 3 – Organigramme de la procédure d'examen HAZOP – Séquence mot-guide d'abord	84
Figure B.1 – Schéma de circulation simple	90
Figure B.2 – Equipement ATP embarqué	98
Figure B.3 – Système de commande de vanne piézoélectrique	106
Tableau 1 – Exemple de mots-guides fondamentaux et de leurs significations génériques	71
Tableau 2 – Exemple de mots-guides relatifs à l'heure et à un ordre ou une séquence	71
Tableau 3 – Exemples d'écarts et mots-guides associés	81
Tableau B.1 – Propriétés du système soumis à l'examen	90
Tableau B.2 – Exemple de tableau HAZOP pour un exemple introductif	91
Tableau B.3 – Exemple de tableau HAZOP pour les procédures	95
Tableau B.4 – Exemple de tableau HAZOP pour un système de protection automatique des trains	99
Tableau B.5 – Exemple de tableau HAZOP pour une planification en cas d'urgence	102
Tableau B.6 – Intention de conception du système	108
Tableau B.7 – Exemple de tableau HAZOP pour un système de commande de vanne piézoélectrique	109
Tableau B.8 – Matrice de décomposition fonctionnelle pour une procédure d'avertisseur sonore dans une aire de stationnement de trains	113
Tableau B.9 – Exemple de tableau HAZOP pour une procédure d'avertisseur sonore dans une aire de stationnement de trains	116

COMMISSION ÉLECTROTECHNIQUE INTERNATIONALE

ÉTUDES DE DANGER ET D'EXPLOITABILITÉ (ÉTUDES HAZOP) – GUIDE D'APPLICATION

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La Norme internationale IEC 61882 a été établie par le comité d'études 56 de l'IEC: Sûreté de fonctionnement.

Cette deuxième édition annule et remplace la première édition parue en 2001. Cette édition constitue une révision technique.

Cette édition inclut les modifications techniques majeures suivantes par rapport à l'édition précédente:

- a) terminologie clarifiée, et alignement sur les termes et définitions de l'ISO 31000:2009 et du Guide ISO 73:2009;
- b) ajout d'une étude de cas améliorée d'un HAZOP de procédure.

Le texte de cette norme est issu des documents suivants:

FDIS	Rapport de vote
56/1653/FDIS	56/1666/RVD

Le rapport de vote indiqué dans le tableau ci-dessus donne toute information sur le vote ayant abouti à l'approbation de cette norme.

Cette publication a été rédigée selon les Directives ISO/IEC, Partie 2.

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- reconduite,
- supprimée,
- remplacée par une édition révisée, ou
- amendée.

INTRODUCTION

La présente norme décrit les principes et l'approche relatifs à l'identification des risques à partir de mots-guides. Historiquement, cette approche de l'identification des risques a été appelée étude de danger et d'exploitabilité ou, par abréviation, étude HAZOP. Il s'agit d'une technique structurée et systématique appliquée à l'examen d'un système défini en vue:

- d'identifier les risques liés à l'exploitation et à la maintenance du système. Les phénomènes dangereux ou les autres sources de risque peuvent comprendre à la fois ceux qui se présentent seulement à proximité immédiate du système et ceux qui ont des effets plus étendus, par exemple certains phénomènes dangereux environnementaux;
- d'identifier les problèmes potentiels d'exploitabilité posés par le système et, en particulier, les causes des perturbations d'exploitation et des écarts dans la production susceptibles d'entraîner la fabrication de produits non conformes.

Un avantage important des études HAZOP est que la connaissance qu'elles apportent, en identifiant de manière structurée et systématique les risques et les problèmes d'exploitabilité, s'avère d'une grande utilité pour déterminer les mesures à prendre.

Une des caractéristiques d'une étude HAZOP est la session d'examen durant laquelle une équipe multidisciplinaire dirigée par un chef d'étude examine systématiquement toutes les parties d'une conception ou d'un système concernées par l'étude. Elle identifie les écarts par rapport à l'intention de conception du système, en utilisant un ensemble de mots-guides. La technique vise à stimuler de manière systématique l'imagination des participants pour les aider à identifier les risques et les problèmes d'exploitabilité. Il convient de considérer une étude HAZOP comme une amélioration d'une conception juste, utilisant des approches basées sur l'expérience, telles que les règles de bon usage, plutôt qu'un succédané de ces approches.

Historiquement, les études HAZOP et assimilées étaient présentées comme une identification des phénomènes dangereux dont l'objectif premier est de soumettre à l'essai de manière systématique la présence de phénomènes dangereux et, le cas échéant, de comprendre à la fois comment ils pourraient provoquer des conséquences négatives et comment une nouvelle conception du processus pourrait les éviter. L'ISO 31000:2009 définit le risque comme l'effet de l'incertitude concernant les objectifs, en notant que l'effet est un écart par rapport à ce qui est escompté. C'est pourquoi les études HAZOP, qui ont trait aux écarts par rapport à ce qui est escompté, ainsi qu'à leurs causes et à leurs effets sur les objectifs dans le cadre de la conception du processus, sont désormais correctement caractérisées comme de puissants outils d'identification des risques.

Il existe de nombreux outils et techniques destinés à identifier les risques, depuis les listes de contrôle jusqu'à HAZOP en passant par l'analyse des modes de défaillance et de leurs effets (AMDE). Certaines techniques, telles que les listes de contrôle et l'analyse par simulation, peuvent être utilisées dès le début du cycle de vie du système alors qu'il existe peu d'informations, ou lors d'une phase ultérieure si une analyse moins détaillée est nécessaire. Les études HAZOP exigent plus de détails sur les systèmes à l'étude, mais fournissent des informations plus complètes sur les risques et les faiblesses dans la conception du système.

Le terme HAZOP est parfois associé, dans un sens plus large, à d'autres techniques d'identification des phénomènes dangereux (par exemple HAZOP sur liste de contrôle, HAZOP 1 ou 2, HAZOP basé sur les connaissances, etc.). L'utilisation du terme HAZOP en relation avec ces techniques est considérée comme inappropriée et elle est volontairement exclue de ce document.

Avant de commencer une étude HAZOP, il convient de s'assurer qu'il s'agit de la technique la plus appropriée (autant individuellement qu'en combinaison avec d'autres techniques) pour la présente tâche. Il convient que cette appréciation prenne en compte l'objet de l'étude, la sévérité de toutes les conséquences possibles, le niveau approprié de détail, la disponibilité des données et des ressources pertinentes ainsi que les besoins des décideurs.

La présente norme a été mise au point pour donner les lignes directrices dans un grand nombre d'industries et types de systèmes. Dans certaines industries, notamment les industries de transformation où cette technique a vu le jour, il existe des normes et des guides plus spécifiques qui établissent des méthodes d'application préférentielles pour ces industries. Pour plus de détails, voir la bibliographie donnée en annexe de la présente norme.

ÉTUDES DE DANGER ET D'EXPLOITABILITÉ (ÉTUDES HAZOP) – GUIDE D'APPLICATION

1 Domaine d'application

La présente Norme internationale constitue un guide pour les études HAZOP de systèmes qui utilisent des mots-guides. Elle donne des lignes directrices relatives à l'application de la technique et à la procédure de l'étude HAZOP, y compris la définition, la préparation, les sessions d'examen ainsi que les documents et le suivi qui en résultent.

Elle fournit également des exemples de documentation ainsi qu'un grand choix d'exemples concernant diverses applications qui présentent les études HAZOP.

2 Références normatives

Les documents suivants sont cités en référence de manière normative, en intégralité ou en partie, dans le présent document et sont indispensables pour son application. Pour les références datées, seule l'édition citée s'applique. Pour les références non datées, la dernière édition du document de référence s'applique (y compris les éventuels amendements).

IEC 60050-192, *Vocabulaire électrotechnique international – Partie 192: Sécurité de fonctionnement* (disponible à l'adresse <http://www.electropedia.org>)