

Performance-Based Gas Detection System Design for Hydrocarbon Storage Tank Systems

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ABSTRACT

The design of hydrocarbon gas detection systems using risk analysis methods is drawing a lot of attention because industry experts have come to a consensus that design codes used in traditional gas detection system design work are not sufficient for open-door process areas having serious hazards, such as fire, flammable gas and toxic gas. The ISA Technical Report TR 84.00.07 provides guidelines for the design of fire and gas systems in unenclosed process areas in accordance with the principles given in IEC 61511 standards. This paper presents an overview of the design of gas detection systems using risk assessment methods that are described in the ISA technical report. These methods are statistical in nature and are used to assign and verify targets for the performance metrics (detector coverage and safety availability) of gas detection systems. This paper also provides an overview of the performance based safety life cycle of gas detection systems from conceptual design stage to operations and maintenance.

1. INTRODUCTION

Risk assessment techniques are being increasingly used in the design of engineered safeguards, such as Fire and Gas Detection and Suppression Systems (FGS), Safety Instrumented Systems (SIS) and Alarm Systems. The principles of risk assessment used in the design of SIS can also be used in the design of Gas Detection Systems. A Gas Detection System is a type of instrumented safeguard intended to reduce risks posed by process plants, such as safety risk, environmental risk, and asset risk (commercial/business) to tolerable levels. However, gas detection systems are only capable of mitigating the consequence of a loss of containment, whereas safety instrumented systems are capable of preventing the consequence from occurring altogether.

All automated safety systems such as FGS, SIS, and High Integrity Pressure Protection Systems (HIPPS) need a "basis of safety" for the selection and design of its functional elements (sensor, logic solver and final control elements). In the design of Gas Detection Systems, it is important to select detectors of the appropriate technology and care must be taken to position the right number of detectors at the correct location for the system to respond on demand. In addition, the basis of safety specifies the mechanical integrity requirements for the equipment with respect to the type and frequency of preventive maintenance tasks required. In short, the basis of safety is at the core of decisions that are made with reference to selection and maintenance of instruments.

The two options for choosing basis of safety are – prescriptive and performance-based. Prescriptive basis of safety (such as NFPA 72 and EN 54 for fire alarming equipment) specifies the type of equipment, its location for installation and also addresses the requirements to maintain them. Not only do the prescriptive standards for FGS design provide a very comprehensive set of

Performance Based Gas Detection System Design For

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Standards**



Performance Based Gas Detection System Design For:

Plant Hazard Analysis and Safety Instrumentation Systems Swapan Basu, 2025-01-28 Plant Hazard Analysis and Safety Instrumentation Systems serves as a comprehensive guide to the development of safety instrumented system SIS outlining the connections between SIS requirements process hazard analysis SIS lifecycle implementation safety analysis and realization in control systems The book also explores the impact of recent advances such as SIL SIS and Fault Tolerance In line with technological developments it covers safety in wireless systems as well as in Industrie 4 0 and Digital Transformation Plant Hazard Analysis and Safety Instrumentation Systems incorporates practical examples throughout the book It covers safety analysis and realization in control systems providing up to date descriptions of modern concepts like SIL SIS and SIF The inclusion of security issues alongside safety issues is particularly relevant for the programmable systems used in modern plant instrumentation systems The new chapters in this updated edition address security concerns crucial for programmable systems in modern plants including topics such as discussion of hazardous atmospheres and their impact on electrical enclosures the use of IS circuits and their links to safety considerations in major developmental areas including IIoT Cloud computing wireless safety Industry 4 0 and digital transformation This book is a valuable resource for Process Control Engineers Process Engineers Instrumentation Engineers Safety Engineers and Mechanical Manufacturing Engineers from various disciplines helping them understand how instrumentation and controls provide layers of protection for basic process control systems ultimately increasing overall system reliability Plant Hazard Analysis and Safety Instrumentation Systems will also be a great guide for researchers students and graduate level professionals in process safety disciplines Electrical and Industrial Engineers specializing in safety and area classifications as well as plant managers and engineers in the industry Offers a framework to choose which hazard analysis method is the most appropriate covers ALARP HAZOP FMEA LOPA Provides and practical guidance on how to manage safety incidents at plants through the use of Safety Instrumentation Systems Provides comprehensive details on the fundamentals and recent advances in safety analysis and realization in control systems Explores the impacts of Industry 4 0 and digitalization in safety culture and what this could mean for the future of process safety Includes a step by step guide which walks you through the development of safety instrumented systems and includes coverage of standards such as IEC 61508 61511 and ANSI ISA 84 Safety coverage in wireless network Safety issues impacting Industrie 4 0 and Digital transformation **A Guide to Fire and Gas Detection**

Design in Hazardous Industries James McNay, 2022-08-10 In the last 15 years the field of fire and gas mapping has grown extensively yet very little is published on the subject The text includes deeper discussions on important engineering factors associated with fire and gas detection along with anecdotes and examples It will guide the readers on what to consider when you do not have access to proprietary guides and how to interpret the design process even when one does not have access to a guidance document The text covers important topics including visual flame detection flame detection mapping infrared

point gas detector IRPGD infrared open path gas detector OPGD ultrasonic acoustic design and gas detection mapping The book plays the following roles Explores practical aspects of designing a detection layout Enables users in interpreting a detector data sheet and coverage analysis Teaches readers working on a project to cut through the marketing of detection and design an effective system Inclusion of real life experiences on projects will provide engineers with clear examples of where things can and often do go wrong It is an ideal text for professionals and graduate students working in the fields of occupational health and safety fire protection engineering and environmental safety The text discusses fundamental aspects of fire and gas mapping which has been applied with great success in many parts of the world and is commonly adopted by the major operators in the process industries

Performance-Based Fire and Gas Systems Engineering Handbook

Austin Bryan, Elizabeth Smith, Kevin Mitchell, Associate Dean of Academic Affairs Kevin Mitchell, 2015-09-01 With the release of the ISA TR84 00 07 technical report on performance based design of fire and gas detection systems for process industries risk based techniques for detector placement have become prevalent in fire and gas system FGS design While the technical report addresses designing the FGS based on the user s risk profile and performance requirements it does not provide any guidance on implementing the FGS lifecycle This handbook provides a thorough overview of the FGS design lifecycle presented in the technical report with an examination of each phase of the lifecycle and the practical activities required to develop an FGS design In addition to discussing the design process this handbook also provides valuable appendices that contain data for FGS system risk analysis FGS risk grading procedures and a discussion of the FGS mapping techniques used to verify the achievement of the newly defined coverage targets

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