

Quantitative Approach to Safety Assessment of the Railway Interlocking System

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Abstract

The paper deals with a quantitative approach to safety assessment process applicable to the safety-related systems, specially the railway interlocking one. The authors present the methodology based on the Failure Mode and Effects Analysis (FMEA) and the Fault Tree Analysis (FTA) that is applicable to performing safety analysis of both electronic and computer based systems. The mathematical basis for the FTA is detailed, with a special attention paid to the mechanisms used to determine probability of hazardous events based on primary event occurrence. For the sake of better understanding examples of Markov's graphs for a different number of simultaneous hazardous faults are given. Relation between the presented approach and European Standards is indicated.

1. Introduction

The railway interlocking system is a special kind of control system that in addition to control functions must also

involve safety-related functions. Safety is considered to be a basic property inherent to such kind of systems. There is necessity to build a model describing transition of an interlocking system from failure-free (safe) mode to failure involved (potentially hazardous) mode as a consequence of random external influences in the process of system ageing. For the sake of introduction, let's give some ideas on such a model.

External influences can generally be characterised as the n -dimensional random process with time-dependent random quantities (temperature, voltage, electromagnetic interference etc.) of the n -dimensional random vector. Analysis of influences of this random process on operation of the interlocking system is possible only if its marginal, coupling and conditional characteristics are known. It is a complex task of mathematical statistics.

On the base of data analysis the process must be identified and its prognosis performed for the whole useful life of the interlocking system. In addition, external influences on the interlocking system depend on particular operation environment (i.e. on local conditions). It is unthinkable (for time and financial reasons) to perform the overall analysis of external influences on system safety individually for any operation environment. For the practical use it is acceptable if system requirements specification defines limit values for monitored random variables and in the interlocking system design there are used such technological and circuit solutions (barriers) that enable to omit (fully or partially) external influences. Operation environment of a system must be chosen in accordance with system requirements specification. This solution will also exclude possible

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Computer Science and Information Technologies
CSIT'2000
Ufa, Russia, 2000

Safety Assessment A Quantitative Approach

**Veysi Başkan, Hakan
Demirel, Muhammet Gul**



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Safety Assessment B.S. Dhillon, Abdul Raouf, S.I., 1993-10-13 Over the years there have been several books and hundreds of articles and reports on safety with more than three dozen journals and newsletters in English alone on this subject Unlike other books however Safety Assessment gathers together vital information and presents a unified approach to current quantitative safety assessment Previous knowledge of this subject is not necessary since two chapters on introductory material are provided to give sufficient background All chapters discuss topics of current interest This book is excellent as a text for elective courses on safety for science business and engineering students It is also an indispensable guide for engineers and professionals in industrial ergonomics operations management and production

Offshore Risk Assessment Vol. 1 Jan-Erik Vinnem, Willy Røed, 2019-09-11 This is the first textbook to address quantified risk assessment QRA as specifically applied to offshore installations and operations As the first part of the two volume updated and expanded fourth edition it adds a new focus on the EU Offshore Safety Directive and discusses the new perspective on risk from the Norwegian Petroleum Safety Authority followed by new and updated international standards New safety statistics for the Norwegian sectors are presented as well as new case studies on international offshore accidents such as the explosion on FPSO Sao Mateus in 2015 which involved 9 fatalities Separate chapters analyse the main hazards for offshore structures fire explosion collision and falling objects as well as structural and marine hazards Risk mitigation and control are discussed as well as how the results of quantitative risk assessment studies should be presented The fourth edition presents updated hydrocarbon release statistics together with new methods for modelling the risk from ignited hydrocarbon releases There have been recent advances in the modelling of collision risk from passing and attending vessels based on extensive research these advances are described in detail in addition to new developments in the safety of Dynamic Positioning vessels In closing the book provides updated statistics and lessons learned from accidents involving offshore helicopter transportation of personnel The book offers a comprehensive reference guide for academics and students of marine offshore risk assessment and management It will also be of interest to professionals in the industry as well as contractors suppliers consultants and regulatory authorities

A Novel Risk Evaluation Approach For Frequently Encountered Risks In Ship Engine Rooms Veysi Başhan, Hakan Demirel, Muhammet Gul, The purpose of this study is to evaluate risks which are frequently encountered in the engine room on board In this context twenty common risks are assessed using the neutrosophic analytic hierarchy process N AHP and trapezoidal fuzzy technique for order preference by similarity to ideal solution TrF TOPSIS

Introduction to Oil and Gas Operational Safety Wise Global Training Ltd, 2014-12-05 Introduction to Oil and Gas Operational Safety is aligned directly to the NEBOSH International Technical Certificate in Oil and Gas Operational Safety Concisely written by a highly experienced team this full colour reference provides complete coverage of the syllabus including chapters on fire hazards risk management and emergency response It will ensure that you

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Proceedings of the International Symposium on Engineering under Uncertainty: Safety Assessment and Management (ISEUSAM - 2012) Subrata Chakraborty, Gautam Bhattacharya, 2013-03-12 International Symposium on Engineering under Uncertainty Safety Assessment and Management ISEUSAM 2012 is organized by Bengal Engineering and Science University India during the first week of January 2012 at Kolkata The primary aim of ISEUSAM 2012 is to provide a platform to facilitate the discussion for a better understanding and management of uncertainty and risk encompassing various aspects of safety and reliability of engineering systems The conference received an overwhelming response from national as well as international scholars experts and delegates from different parts of the world Papers received from authors of several countries including Australia Canada China Germany Italy UAE UK and USA besides India More than two hundred authors have shown their interest in the symposium The Proceedings presents ninety two high quality papers which address issues of uncertainty encompassing various fields of engineering i e uncertainty analysis and modelling structural reliability geotechnical engineering vibration control earthquake engineering environmental engineering stochastic dynamics transportation system system identification and damage assessment and infrastructure engineering **Benefit-Risk**

Assessment of Medicines James Leong, Sam Salek, Stuart Walker, 2015-04-21 This book proposes and investigates a universal framework and accompanying documentation system to facilitate and catalogue benefit risk decisions a valuable addition to the benefit risk toolbox Over the past decade pharmaceutical companies and regulatory agencies have been reviewing the benefit risk assessment of medicines with a view to developing a structured systematic standardized approach Examining the evaluation of such an approach by several mature regulatory authorities ensures that the reader gains a unique insight into the ongoing debate in this area The field of benefit risk assessment continues to evolve at a rapid pace due to political and societal pressure as is reflected in the recent FDA PUDFA agreement as well as in the EMA 2015 Roadmap Rather than provide a comprehensive snap shot of this constantly changing environment this book evaluates selected current approaches to benefit risk assessment The strengths and weaknesses of publicly available documents in communicating benefit risk decisions to stakeholders are reviewed and these evaluations are used to inform development of a prospective framework that could be used to harmonise procedures globally *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, Industrie 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 Industrie 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.

Thermal Power Plant Performance Analysis Gilberto Francisco Martha de Souza, 2012-01-04. The analysis of the reliability and availability of power plants is frequently based on simple indexes that do not take into account the criticality of some failures used for availability analysis. This criticality should be evaluated based on concepts of reliability which consider the effect of a component failure on the performance of the entire plant. System reliability analysis tools provide a root cause analysis leading to the improvement of the plant maintenance plan. Taking in view that the power plant performance can be evaluated not only based on thermodynamic related indexes such as heat rate, Thermal Power Plant Performance Analysis focuses on the presentation of reliability based tools used to define performance of complex systems and introduces the basic concepts of reliability, maintainability and risk analysis aiming at their application as tools for power plant performance improvement including selection of critical equipment and components, definition of maintenance plans mainly for auxiliary systems and execution of decision analysis based on risk concepts. The comprehensive presentation of each analysis allows future application of the methodology making

Thermal Power Plant Performance Analysis a key resource for undergraduate and postgraduate students in mechanical and nuclear engineering

The Security Risk Assessment Handbook Douglas Landoll, 2021-09-27 Conducted properly information security risk assessments provide managers with the feedback needed to manage risk through the understanding of threats to corporate assets determination of current control vulnerabilities and appropriate safeguards selection Performed incorrectly they can provide the false sense of security that allows potential threats to develop into disastrous losses of proprietary information capital and corporate value Picking up where its bestselling predecessors left off The Security Risk Assessment Handbook A Complete Guide for Performing Security Risk Assessments Third Edition gives you detailed instruction on how to conduct a security risk assessment effectively and efficiently supplying wide ranging coverage that includes security risk analysis mitigation and risk assessment reporting The third edition has expanded coverage of essential topics such as threat analysis data gathering risk analysis and risk assessment methods and added coverage of new topics essential for current assessment projects e g cloud security supply chain management and security risk assessment methods This handbook walks you through the process of conducting an effective security assessment and it provides the tools methods and up to date understanding you need to select the security measures best suited to your organization Trusted to assess security for small companies leading organizations and government agencies including the CIA NSA and NATO Douglas J Landoll unveils the little known tips tricks and techniques used by savvy security professionals in the field It includes features on how to Better negotiate the scope and rigor of security assessments Effectively interface with security assessment teams Gain an improved understanding of final report recommendations Deliver insightful comments on draft reports This edition includes detailed guidance on gathering data and analyzes over 200 administrative technical and physical controls using the RIIOT data gathering method introduces the RIIOT FRAME risk assessment method including hundreds of tables over 70 new diagrams and figures and over 80 exercises and provides a detailed analysis of many of the popular security risk assessment methods in use today The companion website infosecurityrisk.com provides downloads for checklists spreadsheets figures and tools

Safety and Reliability - Safe Societies in a Changing World Stein Haugen, Anne Barros, Coen Gulijk, Trond Kongsvik, Jan Erik Vinnem, 2018-06-15 Safety and Reliability Safe Societies in a Changing World collects the papers presented at the 28th European Safety and Reliability Conference ESREL 2018 in Trondheim Norway June 17 21 2018 The contributions cover a wide range of methodologies and application areas for safety and reliability that contribute to safe societies in a changing world These methodologies and applications include foundations of risk and reliability assessment and management mathematical methods in reliability and safety risk assessment risk management system reliability uncertainty analysis digitalization and big data prognostics and system health management occupational safety accident and incident modeling maintenance modeling and applications simulation for safety and reliability analysis dynamic risk and barrier management organizational factors and safety culture human factors and human

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