Human Reliability Analysis A Critique And Review For Managers

Culture Representation in Human Reliability Analysis

This volume presents selected papers from the International Conference on Reliability, Safety, and Hazard. It presents the latest developments in reliability engineering and probabilistic safety assessment, and brings together contributions from a diverse international community and covers all aspects of safety, reliability, and hazard assessment across a host of interdisciplinary applications. This book will be of interest to researchers in both academia and the industry.

Human Reliability Analysis for Design

Safety and Reliability – Theory and Applications contains the contributions presented at the 27th European Safety and Reliability Conference (ESREL 2017, Portorož, Slovenia, June 18-22, 2017). The book covers a wide range of topics, including: Accident and Incident modelling; Economic Analysis in Risk Management; Foundational Issues in Risk Assessment and Management; Human Factors and Human Reliability; Maintenance Modeling and Applications; Mathematical Methods in Reliability and Safety; Prognostics and System Health Management; Resilience Engineering; Risk Assessment; Risk Management; Simulation for Safety and Reliability Analysis; Structural Reliability; System Reliability; and Uncertainty Analysis. Selected special sessions include contributions on: the Marie Skłodowska-Curie innovative training network in structural safety; risk approaches in insurance and finance sectors; dynamic reliability and probabilistic safety assessment; Bayesian and statistical methods, reliability data and testing; organizational factors and safety culture; software reliability and safety; probabilistic methods applied to power systems; socio-technical-economic systems; advanced safety assessment methodologies: extended Probabilistic Safety Assessment; reliability; availability; maintainability and safety in railways: theory & practice; big data risk analysis and management, and model-based reliability and safety engineering. Safety and Reliability – Theory and Applications will be of interest to professionals and academics working in a wide range of industrial and governmental sectors including: Aeronautics and Aerospace, Automotive Engineering, Civil Engineering, Electrical and Electronic Engineering, Energy Production and Distribution, Environmental Engineering, Information Technology and Telecommunications, Critical Infrastructures, Insurance and Finance, Manufacturing, Marine Industry, Mechanical Engineering, Natural Hazards, Nuclear Engineering, Offshore Oil and Gas, Security and Protection, Transportation, and Policy
Considerations for the Treatment of Computerized Procedures in Human Reliability Analysis

To date, there has been considerable work on dynamic event trees and other areas related to dynamic probabilistic safety assessment (PSA). The counterpart to these efforts in human reliability analysis (HRA) has centered on the development of specific methods to account for the dynamic nature of human performance. In this paper, the author posits that the key to dynamic HRA is not in the development of specific methods but in the utilization of cognitive modeling and simulation to produce a framework of data that may be used in quantifying the likelihood of human error. This paper provides an overview of simulation approaches to HRA; reviews differences between first, second, and dynamic generation HRA; and outlines potential benefits and challenges of this approach.

Human Reliability Impact on Inservice Inspection: Review and analysis of human performance in nondestructive testing (emphasizing ultrasonics)

This book contains the results of the latest research on energy-related topics in transportation, economics, and management. The book is composed of select research proceedings of the EMMFT 2019 conference, and covers such issues as energy efficiency in the transport sector, infrastructure, mobile equipment, rail transportation safety and reliability assessment methods, communication and signal, traction power supply, operation organization, and modeling unique transport scenarios. This book also gathers cutting-edge studies on the relationship between energy innovations and economic growth, the impacts of globalization and energy policies of countries on economics and environmental quality, and design and analysis of energy management systems. This book is of considerable interest to engineers, scientists, graduate students, and researchers in the field of transportation engineering, as well as to professionals working in the energy industries. It is also of use to employees and investors concerned with energy management, including utilities and industry professionals, and regulators.

Advances in Human Error, Reliability, Resilience, and Performance

This report describes a peer review of the draft Handbook for Human Reliability Analysis with Emphasis on Nuclear Power Plant Applications, NUREG/CR-1278. The purpose of the study was to determine to what extent peers agree with the human behavior models and estimates of human error probabilities (HEPs) contained in the Handbook. Twenty-nine human factors experts participated in the study. Twenty of the participants were Americans; nine were from other countries. The peers performed human reliability analyses of a variety of human performance scenarios describing operator activities in nuclear power plant settings. They also answered questionnaires pertaining to the contents and application of the Handbook. An analysis of peer solutions to the human reliability analysis problems and peer responses to the questionnaire was performed. Recommendations regarding the format and contents of the Handbook were developed from the study findings.

Issues in Benchmarking Human Reliability Analysis Methods

In this survey, 34 subject matter experts from the U.S. nuclear industry were interviewed to determine specific needs for human reliability analysis (HRA). Conclusions from the interviews are detailed in this article. A summary of the findings includes: (1) The need for improved guidance on the use of HRA methods generally and for specific applications. (2) The need for additional training in HRA to provide more hands-on experience in the application of HRA methods. (3) The development of HRA approaches suitable for advanced reactors, severe accident situations, and low-power and shutdown applications. (4) The refinement of HRA methods to account for factors such as crew variability, latent errors, more sophisticated dependency modeling, and errors of commission. (5) The continued need for simplified HRA methods appropriate for field applications. (6) The need for tighter coupling of HRA and human factors. (7) The need for improvements in the quantitative basis of HRA methods. These findings suggest the field of HRA is mature but still benefits from refinements.

Dynamic Human Reliability Analysis
There is a diversity of human reliability analysis (HRA) methods available for use in assessing human performance within probabilistic risk assessment (PRA). Due to the significant differences in the methods, including the scope, approach, and underlying models, there is a need for an empirical comparison investigating the validity and reliability of the methods. To accomplish this empirical comparison, a benchmarking study is currently underway that compares HRA methods with each other and against operator performance in simulator studies. In order to account for as many effects as possible in the construction of this benchmarking study, a literature review was conducted, reviewing past benchmarking studies in the areas of psychology and risk assessment. A number of lessons learned through these studies are presented in order to aid in the design of future HRA benchmarking endeavors.

Reliability and Risk Issues in Large Scale Safety-critical Digital Control Systems

This book brings together studies broadly addressing human error from different disciplines and perspectives. It discusses topics such as human performance; human variability and reliability analysis; medical, driver and pilot error, as well as automation error; root cause analyses; and the cognitive modeling of human error. In addition, it highlights cutting-edge applications in safety management, defense, security, transportation, process controls, and medicine, as well as more traditional fields of application. Based on the AHFE 2019 International Conference on Human Error, Reliability, Resilience, and Performance, held on July 24-28, 2019, Washington D.C., USA, the book includes experimental papers, original reviews, and reports on case studies, as well as meta-analyses, technical guidelines, best practice and methodological papers. It offers a timely reference guide for researchers and practitioners dealing with human error in a diverse range of fields.

Human Reliability Analysis


Human Reliability, Error, and Human Factors in Power Generation

Part of the U.S. Department of Energy’s (DOE’s) Light Water Reactor Sustainability (LWRS) Program, the Risk-Informed Safety Margin Characterization (RISMC) Pathway develops approaches to estimating and managing safety margins. RISMC simulations pair deterministic plant physics models with probabilistic risk models. As human interactions are an essential element of plant risk, it is necessary to integrate human actions into the RISMC risk framework. In this paper, we review simulation based and non-simulation based human reliability analysis (HRA) methods. This paper summarizes the foundational information needed to develop a feasible approach to modeling human interactions in RISMC simulations.

Current Human Reliability Analysis Methods Applied to Computerized Procedures

Industry underestimates the extent to which behaviour at work is influenced by the design of the working environment. Designing for Human Reliability argues that greater awareness of the contribution of design to human error can significantly enhance HSE performance and improve return on investment. Illustrated with many examples, Designing for Human Reliability explores why work systems are designed and implemented such that “design-induced human error” becomes more-or-less inevitable. McLeod demonstrates how well understood psychological processes can lead people to make decisions and to take actions that otherwise seem impossible to understand. Designing for Human Reliability sets out thirteen key elements to deliver the levels of human reliability expected to achieve the return on investment sought when decisions are made to invest in projects. And it demonstrates how investigation of the human contribution to incidents can be improved by focusing on what companies expected and intended when they chose to rely on human performance as a barrier, or control, against incidents. Recognise some ‘hard truths’ of human performance and learn about the importance of
applying the principles of Human Factors Engineering on capital projects Learn from analysis of real-world incidents how differences between ‘fast’ and ‘slow’ styles of thinking can lead to human error in industrial processes Learn how controls and barrier against major incidents that rely on human performance can be strengthened throughout the design and development of assets and equipment

**Safety and Reliability. Theory and Applications**

Computerized procedures (CPs) are an emerging technology within nuclear power plant control rooms. While CPs have been implemented internationally in advanced control rooms, to date no US nuclear power plant has implemented CPs in its main control room (Fink et al., 2009). Yet, CPs are a reality of new plant builds and are an area of considerable interest to existing plants, which see advantages in terms of enhanced ease of use and easier records management by omitting the need for updating hardcopy procedures. The overall intent of this paper is to provide a characterization of human reliability analysis (HRA) issues for computerized procedures. It is beyond the scope of this document to propose a new HRA approach or to recommend specific methods or refinements to those methods. Rather, this paper serves as a review of current HRA as it may be used for the analysis and review of computerized procedures.

**A Review of Human Reliability Needs in the U.S. Nuclear Industry**

**Safety, Reliability, Human Factors, and Human Error in Nuclear Power Plants**

While human reliability analysis (HRA) methods include uncertainty in quantification, the nominal model of human error in HRA typically assumes that operator performance does not vary significantly when they are given the same initiating event, indicators, procedures, and training, and that any differences in operator performance are simply aleatory (i.e., random). While this assumption generally holds true when performing routine actions, variability in operator response has been observed in multiple studies, especially in complex situations that go beyond training and procedures. As such, complexity can lead to differences in operator performance (e.g., operator understanding and decision-making). Furthermore, psychological research has shown that there are a number of known antecedents (i.e., attributable causes) that consistently contribute to observable and systematically measurable (i.e., not random) differences in behavior. This paper reviews examples of individual differences taken from operational experience and the psychological literature. The impact of these differences in human behavior and their implications for HRA are then discussed. We propose that individual differences should not be treated as aleatory, but rather as epistemic. Ultimately, by understanding the sources of individual differences, it is possible to remove some epistemic uncertainty from analyses.

**Individual Differences in Human Reliability Analysis**

Part of the U.S. Department of Energy’s Light Water Reactor Sustainability (LWRS) Program, the Risk-Informed Safety Margin Characterization (RISMC) Pathway develops approaches to estimating and managing safety margins. RISMC simulations pair deterministic plant physics models with probabilistic risk models. As human interactions are an essential element of plant risk, it is necessary to integrate human actions into the RISMC risk model. In this report, we review simulation-based and non-simulation-based human reliability assessment (HRA) methods. Chapter 2 surveys non-simulation-based HRA methods. Conventional HRA methods target static Probabilistic Risk Assessments for Level 1 events. These methods would require significant modification for use in dynamic simulation of Level 2 and Level 3 events. Chapter 3 is a review of human performance models. A variety of methods and models simulate dynamic human performance; however, most of these human performance models were developed outside the risk domain and have not been used for HRA. The exception is the ADS-IDAC model, which can be thought of as a virtual operator program. This model is resource-intensive but provides a detailed model of every operator action in a given scenario, along with models of numerous factors that can influence operator performance. Finally, Chapter 4 reviews the treatment of timing of operator actions in HRA methods. This chapter is an example of one of the critical gaps between existing HRA methods and the needs of dynamic HRA. This report summarizes the foundational information needed to develop a feasible approach to modeling human interactions in the RISMC simulations.

**Safety and Reliability: Methodology and Applications**

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Human reliability, error, and human factors in the area of power generation have been receiving increasing attention in recent years. Each year billions of dollars are spent in the area of power generation to design, construct/ manufacture, operate, and maintain various types of power systems around the globe, and such systems often fail due to human error. This book compiles various recent results and data into one volume, and eliminates the need to consult many diverse sources to obtain vital information. It enables potential readers to delve deeper into a specific area, providing the source of most of the material presented in references at the end of each chapter. Examples along with solutions are also provided at appropriate places, and there are numerous problems for testing the reader’s comprehension. Chapters cover a broad range of topics, including general methods for performing human reliability and error analysis in power plants, specific human reliability analysis methods for nuclear power plants, human factors in control systems, and human error in power plant maintenance. They are written in such a manner that the potential reader requires no previous knowledge to understand their contents. “Human Reliability, Error, and Human Factors in Power Generation” will prove useful to many individuals, including engineering professionals working in the power generation industry, researchers, instructors, and undergraduate and graduate students in the field of power engineering.


During the last decade there have been increasing societal concerns over sustainable developments focusing on the conservation of the environment, the welfare and safety of the individual and at the same time the optimal allocation of available natural and financial resources. As a consequence the methods of risk and reliability analysis are becoming

**Designing for Human Reliability**

This paper reviews the application of human reliability analysis methods to human factors design issues. An application framework is sketched in which aspects of modeling typically found in human reliability analysis are used in a complementary fashion to the existing human factors phases of design and testing. The paper provides best achievable practices for design, testing, and modeling. Such best achievable practices may be used to evaluate and human system interface in the context of design safety certifications.

**Risk, Reliability and Safety: Innovating Theory and Practice**

The use of Human Reliability Analysis (HRA) to identify and resolve human factors issues has significantly increased over the past two years. Today, utilities, research institutions, consulting firms, and the regulatory agency have found a common application of HRA tools and Probabilistic Risk Assessment (PRA). The "1985 IEEE Third Conference on Human Factors and Power Plants” devoted three sessions to the discussion of these applications and a review of the insights so gained. This paper summarizes the three sessions and presents those common conclusions that were discussed during the meeting. The paper concludes that session participants supported the use of an adequately documented "living PRA” to address human factors issues in design and procedural changes, regulatory compliance, and training and that the techniques can produce cost effective qualitative results that are complementary to more classical human factors methods.

**Human Reliability Assessment Theory and Practice**

**Advances in Human Error, Reliability, Resilience, and Performance**

Computerized procedures (CPs) are an emerging technology within nuclear power plant control rooms. While CPs have been implemented internationally in advanced control rooms, to date no U.S. nuclear power plant has implemented CPs in its main control room. Yet, CPs are a reality of new plant builds and are an area of considerable interest to existing plants, which see advantages in terms of easier records management by omitting the need for updating hardcopy procedures. The overall intent of this paper is to provide a characterization of human reliability analysis (HRA) issues for computerized procedures. It is beyond the scope of this document to propose a new HRA approach or to recommend specific methods or refinements to those methods. Rather, this paper serves as a review of current HRA as it may be used for the analysis and review of...
Cognitive Reliability and Error Analysis Method (CREAM)

"This report describes a peer review of the draft Handbook for Human Reliability Analysis with Emphasis on Nuclear Power Plant Applications, NUREG/CR-1278'.

Bridging Human Reliability Analysis and Psychology, Part 2

The prevalence of human erroneous actions as the major cause of accidents in man-machine systems has created a need for better descriptions of human performance, both for accident analysis and system design purposes. Models and methods are therefore required to assess human reliability, identify potential erroneous actions, and specify ways of preventing them from happening. This book discusses how modelling of cognition is applied to the analysis of human reliability and performance in complex technical domains. It provides a critique of existing approaches to modelling of cognition, and offers an alternative which recognises that the control of human actions is determined by the context as well as cognitive functions. This approach produces an improved qualitative analysis of human performance as a basis for later quantitative reliability assessment. Human Reliability Analysis will be essential reading for practitioners of human reliability analysis as well as students of cognitive psychology and ergonomics at advanced undergraduate and graduate level. Computers and People Series: this series is concerned with all aspects of person-computer relationships, including interaction, interfacing, modelling and artificial intelligence. The volumes are interdisciplinary, communicating results derived in one area of study to workers in another. Applied, experimental, theoretical and tutorial studies are included.

Human Reliability Analysis

Within the last fifty years the performance requirements for technical objects and systems were supplemented with: customer expectations (quality), abilities to prevent the loss of the object properties in operation time (reliability and maintainability), protection against the effects of undesirable events (safety and security) and the ability to

Advances in Human Error, Reliability, Resilience, and Performance

This book brings together studies broadly addressing human error from different disciplines and perspectives. It discusses topics such as human performance; human variability and reliability analysis; medical, driver and pilot error, as well as automation error; root cause analyses; and the cognitive modeling of human error. In addition, it highlights cutting-edge applications in safety management, defense, security, transportation, process controls, and medicine, as well as more traditional fields of application. Based on the AHFE 2018 International Conference on Human Error, Reliability, Resilience, and Performance, held on July 21–25, 2018, in Orlando, Florida, USA, the book includes experimental papers, original reviews, and reports on case studies, as well as meta-analyses, technical guidelines, best practice and methodological papers. It offers a timely reference guide for researchers and practitioners dealing with human error in a diverse range of fields.

Risk Assessment in Air Traffic Management

A continually evolving discipline, human reliability assessment (HRA) has elements of controversy from the definition of terms to the application of appropriate methods for the representation of human failure probability. The idea that human error is a random event is falling out of favor and the concept that humans can be set up to fail or succeed depending on context is gaining credibility. An in-depth exploration of current theories, Human Reliability Assessment Theory and Practice demonstrates how to model, change, and apply new approaches to a number of different high-risk industries. The book covers data and data sources, choice of methods, training of individuals, use of simulators for HRA purposes, and the relationship between psychology, human factors, accident analyses, and human reliability. Author Anthony Spurgin has been in the forefront of HRA development for the past 20 years and has contributed to developing human reliability methods and tools that have been applied to the enhancement of nuclear power plant and space vehicle safety. He explores reactor performance and the demands it makes on operators to ensure plant safety. He also covers the roles of plant management in the decision-making applied to both design and operation. The book includes a number of accident studies that illustrate the key roles of operators and managers in accident
mitigation and control. The heart of HRA will always be to find creative ways of helping designers, management, operators, and authorities increase the safety and profitability of technological systems. Drawing on his personal experience, Spurgin reviews HRA from the viewpoint of the operator. The book uses examples from the nuclear industry, always on the forefront of safety, and translates how to apply the concepts to other high risk industries.

**Reliability, Safety and Hazard Assessment for Risk-Based Technologies**

This paper provides a characterization of human reliability analysis (HRA) issues for computerized procedures in nuclear power plant control rooms. It is beyond the scope of this paper to propose a new HRA approach or to recommend specific methods or refinements to those methods. Rather, this paper provides a review of HRA as applied to traditional paper-based procedures, followed by a discussion of what specific factors should additionally be considered in HRAs for computerized procedures. Performance shaping factors and failure modes unique to computerized procedures are highlighted. Since there is no definitive guide to HRA for paper-based procedures, this paper also serves to clarify the existing guidance on paper-based procedures before delving into the unique aspects of computerized procedures.

**Human Reliability Analysis of Errors of Commission**

Understanding human-system response is critical to being able to plan and predict mission success in the modern battlespace. Commonly, human reliability analysis has been used to predict failures of human performance in complex, critical systems. However, most human reliability methods fail to take culture into account. This paper takes an easily understood state of the art human reliability analysis method and extends that method to account for the influence of culture, including acceptance of new technology, upon performance. The cultural parameters used to modify the human reliability analysis were determined from two standard industry approaches to cultural assessment: Hofstede’s (1991) cultural factors and Davis’ (1989) technology acceptance model (TAM). The result is called the Culture Adjustment Method (CAM). An example is presented that (1) reviews human reliability assessment with and without cultural attributes for a Supervisory Control and Data Acquisition (SCADA) system attack, (2) demonstrates how country specific information can be used to increase the realism of HRA modeling, and (3) discusses the differences in human error probability estimates arising from cultural differences.

**Human Factors and Reliability Engineering for Safety and Security in Critical Infrastructures**

This book collects a high-quality selection of contemporary research and case studies on the complexity resulting from human/reliability management in industrial plants and critical infrastructures. It includes: Human-error management issues—considering how to reduce human errors as much as possible. Reliability management issues—considering the ability of a system or component to function under certain conditions for a specified period of time. Thus, the book analyses globally the problem regarding the human and reliability management to reduce human errors as much as possible and to ensure safety and security in critical infrastructures. Accidents continue to be the major concern in “critical infrastructures”, and human factors have been proved to be the prime causes to accidents. Clearly, human dynamics are a challenging management function to guarantee reliability, safety and costs reduction in critical infrastructures. The book is enriched by figures, examples and extensive case studies and is a valuable reference resource for those with involved in disaster and emergency planning as well as researchers interested both in theoretical and practical aspects.

**Human Reliability Analysis for Computerized Procedures**

For the past two years Alan Swain and Henry E. Guttmann, of the Statistics, Computing, and Human Factors Division, Sandia Laboratories, have been developing a handbook to aid qualified persons to evaluate the effect of human error on the availability of engineered safety systems and features in nuclear power plants. The handbook includes a mathematical model, procedures, derived human failure data, and principles of human behavior and ergonomics. The handbook is expanding the human error analyses which were presented in WASH–1400. The work, under the sponsorship of Probabilistic Analysis Staff, NRC Office of Nuclear Regulatory Research (Dr. M.C. Cullingford, NRC Program Manager), is about half completed. An outline of the handbook contents is given in copies of vugraphs (attached), followed by copies of human performance model abstractors (also attached). A first draft of the handbook is scheduled for NRC review by July 1, 1979.
Human Performance Modeling for Dynamic Human Reliability Analysis

“Reliability and Risk Issues in Large Scale Safety-critical Digital Control Systems” provides a comprehensive coverage of reliability issues and their corresponding countermeasures in the field of large-scale digital control systems, from the hardware and software in digital systems to the human operators who supervise the overall process of large-scale systems. Unlike other books which examine theories and issues in individual fields, this book reviews important problems and countermeasures across the fields of software reliability, software verification and validation, digital systems, human factors engineering and human reliability analysis. Divided into four sections dealing with software reliability, digital system reliability, human reliability and human operators in large-scale digital systems, the book offers insights from professional researchers in each specialized field in a diverse yet unified approach.

Summary of Project to Develop Handbook of Human Reliability Analysis for Nuclear Power Plant Operations

Computerized procedures (CPs) are an emerging technology within nuclear power plant control rooms. While CPs have been implemented internationally in advanced control rooms, to date no US nuclear power plant has implemented CPs in its main control room. Yet, CPs are a reality of new plant builds and are an area of considerable interest to existing plants, which see advantages in terms of easier records management by omitting the need for updating hardcopy procedures. The overall intent of this paper is to provide a characterization of human reliability analysis (HRA) issues for computerized procedures. It is beyond the scope of this document to propose a new HRA approach or to recommend specific methods or refinements to those methods. Rather, this paper serves as a review of current HRA as it may be used for the analysis and review of computerized procedures.

Bridging Human Reliability Analysis and Psychology, Part 1

In response to Staff Requirements Memorandum (SRM) SRM-M061020, the U.S. Nuclear Regulatory Commission (NRC) is sponsoring work to update the technical basis underlying human reliability analysis (HRA) in an effort to improve the robustness of HRA. The ultimate goal of this work is to develop a hybrid of existing methods addressing limitations of current HRA models and in particular issues related to intra- and inter-method variabilities and results. This hybrid method is now known as the Integrated Decision-tree Human Event Analysis System (IDHEAS). Existing HRA methods have looked at elements of the psychological literature, but there has not previously been a systematic attempt to translate the complete span of cognition from perception to action into mechanisms that can inform HRA. Therefore, a first step of this effort was to perform a literature search of psychology, cognition, behavioral science, teamwork, and operating performance to incorporate current understanding of human performance in operating environments, thus affording an improved technical foundation for HRA. However, this literature review went one step further by mining the literature findings to establish causal relationships and explicit links between the different types of human failures, performance drivers and associated performance measures ultimately used for quantification. This is the first of two papers that detail the literature review (paper 1) and its product (paper 2). This paper describes the literature review and the high-level architecture used to organize the literature review, and the second paper (Whaley, Hendrickson, Boring, & Xing, these proceedings) describes the resultant cognitive framework.

An Overview of the Evolution of Human Reliability Analysis in the Context of Probabilistic Risk Assessment

Since the Reactor Safety Study in the early 1970’s, human reliability analysis (HRA) has been evolving towards a better ability to account for the factors and conditions that can lead humans to take unsafe actions and thereby provide better estimates of the likelihood of human error for probabilistic risk assessments (PRAs). The purpose of this paper is to provide an overview of recent reviews of operational events and advances in the behavioral sciences that have impacted the evolution of HRA methods and contributed to improvements. The paper discusses the importance of human errors in complex human-technical systems, examines why humans contribute to accidents and unsafe conditions, and discusses how lessons learned over the years have changed the perspective and approach for modeling human behavior in PRAs of complicated domains such as nuclear power plants. It is argued that it has become increasingly more important to understand and model the more cognitive aspects of human performance and to address the broader range of factors that have been shown to influence human performance in complex domains. The paper concludes by addressing the current ability of HRA to adequately predict human failure events and their likelihood.
Each year billions of dollars are being spent in the area of nuclear power generation to design, construct, manufacture, operate, and maintain various types of systems around the globe. Many times these systems fail due to safety, reliability, human factors, and human error related problems. The main objective of this book is to combine nuclear power plant safety, reliability, human factors, and human error into a single volume for those individuals that work closely during the nuclear power plant design phase, as well as other phases, thus eliminating the need to consult many different and diverse sources in obtaining the desired information.

**Human Reliability Analysis**

This is the second of two papers that discuss the literature review conducted as part of the U.S. Nuclear Regulatory Commission (NRC) effort to develop a hybrid human reliability analysis (HRA) method in response to Staff Requirements Memorandum (SRM) SRM-M061020. This review was conducted with the goal of strengthening the technical basis within psychology, cognitive science and human factors for the hybrid HRA method being proposed. An overview of the literature review approach and high-level structure is provided in the first paper, whereas this paper presents the results of the review. The psychological literature review encompassed research spanning the entirety of human cognition and performance, and consequently produced an extensive list of psychological processes, mechanisms, and factors that contribute to human performance.

To make sense of this large amount of information, the results of the literature review were organized into a cognitive framework that identifies causes of failure of macrocognition in humans, and connects those proximate causes to psychological mechanisms and performance influencing factors (PIFs) that can lead to the failure. This cognitive framework can serve as a tool to inform HRA. Beyond this, however, the cognitive framework has the potential to also support addressing human performance issues identified in Human Factors applications.

**Safety, Reliability and Risk Analysis**

One of the most complex challenges for the future of aviation is to ensure a safe integration of the expected air traffic demand. Air traffic is expected to almost double its current value in 20 years, which cannot be managed without the development and implementation of a safe air traffic management (ATM) system. In ATM, risk assessment is a crucial cornerstone to validate the operation of air traffic flows, airport processes, or navigation accuracy. This book tries to be a focal point and motivate further research by encompassing crosswise and widespread knowledge about this critical and exciting issue by bringing to light the different purposes and methods developed for risk assessment in ATM.

**Human Reliability Analysis for Computerized Procedures, Part Two**

Risk, Reliability and Safety contains papers describing innovations in theory and practice contributed to the scientific programme of the European Safety and Reliability conference (ESREL 2016), held at the University of Strathclyde in Glasgow, Scotland (25—29 September 2016). Authors include scientists, academics, practitioners, regulators and other key individuals with expertise and experience relevant to specific areas. Papers include domain specific applications as well as general modelling methods. Papers cover evaluation of contemporary solutions, exploration of future challenges, and exposition of concepts, methods and processes. Topics include human factors, occupational health and safety, dynamic and systems reliability modelling, maintenance optimisation, uncertainty analysis, resilience assessment, risk and crisis management.

**Simulation and Non-Simulation Based Human Reliability Analysis Approaches**

This book brings together studies broadly dealing with human error from different disciplines and perspectives. They concern human performance; human variability and reliability analysis; medical, driver and pilot error, as well as automation error; reports on root cause analyses; and the cognitive modeling of human error. In addition, they highlight cutting-edge applications in safety management, defense, security, transportation, process controls, and medicine, as well as more traditional fields of application. Based on the AHFE 2017 International Conference on Human Error, Reliability, Resilience, and Performance, held on July 17–21, 2017 in Los Angeles, California, USA, the book includes experimental papers, original reviews, and reports on case studies, as well as meta-analyses, technical guidelines, best practice and methodological papers. It offers a
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