

# INPO's Approach to Human Performance in the United States Commercial Nuclear Power Industry

Tony Muschara, CPT

Institute of Nuclear Power Operations (INPO), Atlanta, Georgia, USA  
muscharatm@inpo.org

*Abstract—Strategically, INPO's approach to human performance in commercial nuclear power stations encompasses two elements: 1) reduce the frequency of events triggered by human error, and 2) minimize the severity of human performance events that still occur. The frequency of events is primarily reduced by anticipating, preventing, and catching active errors at the job site during work execution, which involves three phases: 1) work preparation, 2) work performance, and 3) work feedback. During work execution, the human performance objective is to anticipate, prevent, or catch active errors, especially at critical steps, where error-free performance is absolutely necessary. The severity of events is minimized by verifying the integrity and robustness of defenses. Lines of defense are scrutinized aggressively through ongoing monitoring, evaluation, and correction. Defenses against human error and its consequences involve four primary lines of defense to improve station resilience: 1) engineered controls, 2) administrative controls, 3) cultural controls, and 4) oversight controls. This paper describes INPO's risk-based approach to human performance—reducing error during work execution and managing defense-in-depth.*

## I. INTRODUCTION

Success means being the best. Excellence means being your best—matching your practice with your potential. Excellence also means being better tomorrow than yesterday, which implies that the standards of excellence continually change.<sup>1</sup> The quality of excelling is an ongoing pursuit, a habit of thought and action—a daily pursuit of high-performing stations. Each station's safety culture and organizational effectiveness have a direct influence on the quality of human performance, for good or for bad. Human performance is defined as a series of behaviors executed to accomplish a specific result.<sup>2</sup> If the value of excellence is embedded in the station's culture, the organization will find ways to better itself. Pursuing excellence, therefore, promotes the highest levels of safety and reliability.

However, human error is normal—a natural part of being human. But it can also be provoked by conflicting management and leadership practices and by weaknesses in a station's organization, processes, and culture. Understanding human error helps one recognize that human beings are complex creatures possessing a wide range of capabilities and limitations. No matter how efficiently plant equipment functions; how good the training, supervision, and procedures are; and how well the best worker, engineer, or manager perform his or her duties, people cannot perform better than the organization supporting them.<sup>3</sup> Therefore, to preserve and improve the plant's resistance to human error and events, defense-in-depth with respect to human activities is necessary.

## II. STRATEGIC HUMAN PERFORMANCE

In the USA, managers take a risk-based approach toward excellence in human performance. Risk is a function of probability and consequence. Identifying and minimizing the risk of human error and its impact on plant equipment, personnel, and property (assets) is the aim of line management.<sup>4</sup> The principal hazard to these assets is anyone who can touch and alter the status of the assets, primarily workers. Regardless of how conscientious and careful people are, they still err, sometimes at inopportune moments. Exposure to the hazard of human error is most acute when people touch the equipment. When assets are exposed to human error, the risk of a plant event is present. How often events occur tends to follow how often people err.

Therefore, minimizing the frequency by reducing the probability of active error and improving the robustness of defenses to reduce the severity of plant events triggered by human error will reduce the risk to plant, person, property, and production. When the risk of human error at the job site is systematically reduced or eliminated, the frequency of active errors and related events will drop. Controls that reduce the chances of error include the use of human performance (error-prevention) tools as well as engineered, administrative,

<sup>1</sup> INPO, Long-Range Plan, 2005-2007, p.5.

<sup>2</sup> Daniels, A., *Bringing out the Best in People*, 1994, pp.79-82.

<sup>3</sup> Maurino, Reason, Johnston, and Lee, *Beyond Aviation Human Factors*, 1995.

<sup>4</sup> Hillson and Murray-Webster, *Understanding and Managing Risk Attitude*, 2005, pp.17-37.

# Human Performance Reference Manual Inpo

**James D. Foley**



## **Human Performance Reference Manual Inpo:**

**Risk-Based Thinking** Tony Muschara, 2017-11-13 Society at large tends to misunderstand what safety is all about. It is not just the absence of harm. When nothing bad happens over a period of time, how do you know you are safe? In reality, safety is what you and your people do moment by moment, day by day, to protect assets from harm and to control the hazards inherent in your operations. This is the purpose of risk-based thinking, the key element of the six building blocks of Human and Organizational Performance (HOP). Generally, HOP provides a risk-based approach to managing human performance in operations. But specifically, risk-based thinking enables foresight and flexibility, even when surprised, to do what is necessary to protect assets from harm but also achieve mission success despite ongoing stresses or shocks to the operation. Although you cannot prepare for every adverse scenario, you can be ready for almost anything. When risk-based thinking is integrated into the DNA of an organization's way of doing business, people will be ready for most unexpected situations. Eventually, safety becomes a core value, not a priority to be negotiated with others depending on circumstances. This book provides a coherent perspective on what executives and line managers within operational environments need to focus on to efficiently and effectively control, learn, and adapt. *Process Safety for Engineers* CCPS (Center for Chemical Process Safety), 2022-04-12

*Process Safety for Engineers* Familiarizes an engineer new to process safety with the concept of process safety management. In this significantly revised second edition of *Process Safety for Engineers: An Introduction*, CCPS delivers a comprehensive book showing how process safety concepts are used to reduce operational risks. Students, new engineers, and others new to process safety will benefit from this book. In this updated edition, each chapter begins with a detailed incident case study, provides steps that help address issues, and contains problem sets which can be assigned to students. The second edition covers process safety including an overview of CCPS Risk-Based Process Safety Hazards, specifically fire and explosion, reactive chemical, and toxicity; Design considerations for hazard control including Hazard Identification and Risk Analysis; Management of operational risk including management of change. In addition, the book presents how process safety performance is monitored and sustained. The associated online resources are linked to the latest online CCPS resources and lectures. *High Reliability Operations* Babcock & Wilcox Technical Services Pantex, 2008

**Causal Factors Analysis** Babcock & Wilcox Technical Services Pantex, 2008

**Handbook for Process Safety in Laboratories and Pilot Plants** CCPS (Center for Chemical Process Safety), 2023-08-29

*Handbook for Process Safety in Laboratories and Pilot Plants* Effectively manage physical and chemical risks in your laboratory or pilot plant. In *Handbook for Process Safety in Laboratories and Pilot Plants: A Risk-based Approach*, the Center for Chemical Process Safety delivers a comprehensive and authoritative presentation of process safety procedures and methods for use in laboratories and pilot plants. LAPPs Of the four broad hazard categories: chemical, physical, biological, and ionizing radiation, this book focuses on the two most common chemical and physical hazards. It addresses the storage and handling of the hazardous materials associated with activities.

commonly performed in LAPPs and presents many of the physical and chemical analytical techniques used to verify and validate the efficacy of safety management systems This book will present tools and techniques for effectively managing the risks in any laboratory or pilot plant using engineered and administrative controls as well as the CCPS Risk Based Process Safety RBPS Management Systems Readers will also find A thorough introduction to process safety Comprehensive explorations of understanding hazards and risks as well as managing risk with engineered controls administrative controls and RBPS Management Systems Practical discussions of how to learn from the experiences of your own LAPP and others Detailed case reports and examples as well as practical tools control banding strategies and glass equipment design Perfect for any LAPP staff member working with or managing hazardous materials Handbook for Process Safety in Laboratories and Pilot Plants A Risk based Approach will also benefit LAPP engineering and scientific professionals LAPP technical support staff and LAPP managers The Center for Chemical Process Safety is a world leader in developing and distributing information on process safety management and technology Since 1985 CCPS has published over 100 books in its process safety guidelines and concept series 33 training modules as part of its Safety in Chemical Engineering Education series and over 220 online offerings

**Nuclear Power Plants: Innovative Technologies for Instrumentation and Control Systems**

Yang Xu, Yongbin Sun, Yanyang Liu, Feng Gao, Pengfei Gu, Zheming Liu, 2022-04-18 This book is a compilation of selected papers from the Sixth International Symposium on Software Reliability Industrial Safety Cyber Security and Physical Protection of Nuclear Power Plant held in October 2021 in Zhuji Zhejiang China The purpose of this symposium is to discuss Inspection test certification and research for the software and hardware of Instrument and Control I C systems in nuclear power plants NPP such as sensors actuators and control system It aims to provide a platform of technical exchange and experience sharing for those broad masses of experts and scholars and nuclear power practitioners and for the combination of production teaching and research in universities and enterprises to promote the safe development of nuclear power plant Readers will find a wealth of valuable insights into achieving safer and more efficient instrumentation and control systems

The Healthcare Quality Book: Vision, Strategy, and Tools, Fifth Edition Elizabeth R. Ransom, Maulik S. Joshi, Scott B. Ransom, David B. Nash, 2022-10-03 The Healthcare Quality Book provides a framework methodology and practical approaches to assist healthcare professionals in championing improvement efforts The book is divided into three sections that cover the fundamentals of healthcare quality critical quality topics and key strategies for effectively leading quality The extensively revised fifth edition of this definitive text brings together healthcare thought leaders with a wide range of subject matter expertise Chapter contributors explore the foundation of healthcare quality share their perspectives on essential and cutting edge topics and offer strategies for learning the skills to lead a culture of quality New content includes chapters on health equity and disparities in care and expanded content on quality improvement tools the patient experience and digital technologies The book concludes with three well developed case studies of quality improvement in action that incorporate

the lessons learned in the preceding chapters The Healthcare Quality Book will assist leaders at all levels in developing a solid foundation of quality leadership knowledge skills and tools

Elektricheskie stant[s]ii ,2015 **JTEC Panel on Human-computer Interaction Technologies in Japan** James D. Foley,1996 **Proceedings of the XIVth Triennial Congress of the International Ergonomics Association and 44th Annual Meeting of the Human Factors and Ergonomics Society** Human Factors and Ergonomics Society. Annual meeting,2000 *Journal of Nuclear Science and Technology* ,1994 **IEEE Standards** Institute of Electrical and Electronics Engineers,1988 Human Factors Issues in Aircraft Maintenance and Inspection ,1990 Conference Record for 1992 Fifth Conference on Human Factors and Power Plants E. W. Hagen,Institute of Electrical and Electronics Engineers,1992 **Conference Record for ... IEEE ... Conference on Human Factors and Nuclear Safety** ,1985 Intervention Resource Guide Danny G. Langdon,1999-02-12

From the leaders in the field a comprehensive hands on resource for identifying and solving the most common performance related problems in the workplace The authors provide tools designed for conflict management diversity management recognition programs on the job training change management strategic planning and more All of these resources are field tested and formulated for immediate application

Proceedings of the American Nuclear Society International Topical Meeting on Computer Applications for Nuclear Power Plant Operation and Control ,1986 **Guidelines for Investigating Chemical Process Incidents** American Institute of Chemical Engineers. Center for Chemical Process Safety,1992 Newest techniques for complex investigations based on actual plant and industry data These Guidelines establish a basis for successful feedback through investigation of process incidents to determine the many causes and to implement changes which will prevent recurrence It provides a clear definition of the role of incident investigation in overall process safety management as well as guidelines concepts and options Detailed investigation techniques and how to establish such a system are set out for plant staff technical professionals or middle level managers Primary focus is on incidents with catastrophic potential but the concepts should also be used for investigating environmental incidents minor injuries less significant property damage events or near misses Also provides an overview of incident investigation principles as implemented by other industries worldwide The annotated bibliography included makes this practical handbook an invaluable reference source

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