

# Methodology for incorporating human reliability analysis in the emergency evacuation planning for industrial installation

I. J. A. L. Santos<sup>1</sup>; P. V. R. Carvalho<sup>1</sup>, C. H. S. Grecco<sup>1</sup>; G. D. G. Jaime<sup>1</sup>  
e-mail: [luquetti@ien.gov.br](mailto:luquetti@ien.gov.br)

<sup>1</sup> Division of Nuclear Engineering - IEN

*Keywords: human reliability; human factors; emergency evacuation; safety*

The human reliability is the likelihood that a person correctly performs an action required by the system within a required time and does not perform any extraneous activity that could degrade the system [1]. The human reliability analysis (HRA) is the analysis, prediction and evaluation of work-oriented human performance in quantitative or qualitative approaches. In the qualitative approach human actions are modeled; tasks are analyzed and the possible sources of errors identified. In the quantitative approach human error probabilities (HEPs) are estimated and certain factors that could affect the human performance are identified. There are two representative methods. The first-generation methods emphasize the operator behavior in response to stimuli from the system which the operator is interacting. One example is the THERP method (Technique for Human Error Rate Prediction) [2]. The second-generation methods identify tasks and activities that are affected by variation in human cognition and the work context under which the reliability of cognition may be reduced, and where therefore the tasks or actions may constitute a source of risk. One example is the CREAM Method (Cognitive Reliability Analysis method) [3]. An industrial installation presents many risks related to process hazards, such as fire, explosion, gas and radiation release. In this case, the emergency evacuation planning is a key element that involves an interactive process to identify the best evacuation routes and to estimate the time required to evacuate the workplace. The main aspects for a successful emergency evacuation are influenced by the type of human error and the severity of the initiator event. To preserve the workers' life, it is necessary to take

account the anticipation of the need to initiate the evacuation process, to choose the best escape route, to access quickly the escape route and to arrive safely at the temporary refuge. The aim of this work is to present a methodological framework for the identification of the performance shaping factors that affect the human performance, using an approach centered on a human reliability method based on the expert judgment [4]. Therefore, enabling the allocation of human factors in risk management of industrial plants [5] [6]. The methodological framework was used to identify the factors that affect the human performance during an emergency evacuation of an industrial installation.

## References

- [1] Reason, J. Human Error. Cambridge, University Press, 1990.
- [2] Swain, A. D. and H. E. Guttmann, H.E. Handbook of Human Reliability Analysis with Emphasis on Nuclear Power Plant applications, NUREG/CR-1278, U. S. Nuclear Regulatory Commission, 1983.
- [3] Hollnagel, E. Cognitive Reliability and Error Analysis Method- CREAM. Oxford, 1998.
- [4] Embrey, D. E., Humphreys, P. C., Rosa, E. A., Kirwan, B. and Rea, K. *SLIM-MAUD: An Approach to Assess Human Error Probabilities Using Structured Expert Judgment*. Report No. NUREG/CR-3518. Department of Nuclear Energy, Brookhaven National Laboratory, Upton, NY, 1984.
- [5] Oliveira, M. V. e Santos, I. J. A. Confiabilidade Humana Aplicada no Processo de Retirada de Emergência: Estudo de Caso em um Terminal Petrolífero Aquaviário. Dissertação de Mestrado do Programa de Engenharia ambiental da Universidade Federal do Rio Janeiro, 2012.
- [6] Santos, I. J. A. L., Oliveira, M. M. P. e Oliveira, M. V. Uso da Ferramenta FMEA na Identificação dos Fatores que Afetam o Desempenho Humano Durante o Processo de Evacuação de Emergência. Simpósio de Confiabilidade Reliasoft, Fortaleza, 2011