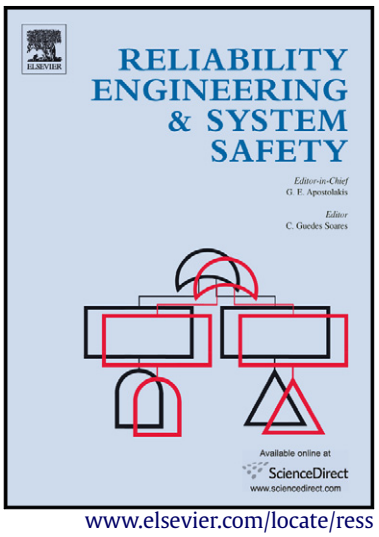

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PII: S0951-8320(15)00145-3
DOI: http://dx.doi.org/10.1016/j.ress.2015.05.004
Reference: RESS5313

To appear in: *Reliability Engineering and System Safety*

Received date: 6 April 2013
Revised date: 17 April 2015
Accepted date: 15 May 2015

Cite this article as: Candice D. Griffith, Sankaran Mahadevan, Human Reliability under Sleep Deprivation: Derivation of Performance Shaping Factor Multipliers from Empirical Data, *Reliability Engineering and System Safety,* http://dx.doi.org/10.1016/j.ress.2015.05.004

Human Reliability under Sleep Deprivation: Derivation of Performance Shaping Factor Multipliers from Empirical Data

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Abstract

This paper develops a probabilistic approach that could use empirical data to derive values of performance shaping factor (PSF) multipliers for use in quantitative human reliability analysis (HRA). The proposed approach is illustrated with data on sleep deprivation effects on performance. A review of existing HRA methods reveals that sleep deprivation is not explicitly included at present, and expert opinion is frequently used to inform HRA model multipliers. In this paper, quantitative data from empirical studies regarding the effect of continuous hours of wakefulness on performance measures (reaction time, accuracy, and number of lapses) are used to develop a method to derive PSF multiplier values for sleep deprivation, in the context of the SPAR-H model. Data is extracted from the identified studies according to the meta-analysis research synthesis method and used to investigate performance trends and error probabilities. The error probabilities in test and control conditions are compared, and the resulting probability ratios are suggested for use in informing the selection of PSF multipliers in HRA methods. Although illustrated for sleep deprivation, the proposed methodology is general, and can be applied to other performance shaping factors.

Keywords: Human reliability analysis, Sleep deprivation, Performance shaping factors, Human error probability

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