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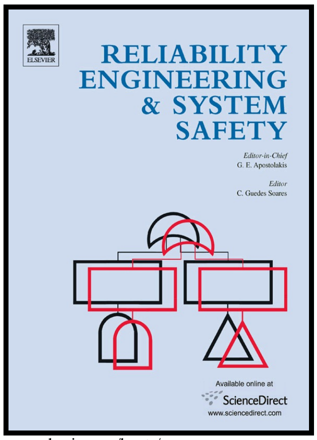

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Incorporating Assumption Deviation Risk in Quantitative Risk Assessments: A Semi-Quantitative Approach

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Abstract

Quantitative risk assessments (QRAs) of complex engineering systems are based on numerous assumptions and expert judgments, as there is limited information available for supporting the analysis. In addition to sensitivity analyses, the concept of assumption deviation risk has been suggested as a means for explicitly considering the risk related to inaccuracies and deviations in the assumptions, which can significantly impact the results of the QRAs. However, challenges remain for its practical implementation, considering the number of assumptions and magnitude of deviations to be considered. This paper presents an approach for integrating an assumption deviation risk analysis as part of QRAs. The approach begins with identifying the safety objectives for which the QRA aims to support, and then identifies critical assumptions with respect to ensuring the objectives are met. Key issues addressed include the deviations required to violate the safety objectives, the uncertainties related to the occurrence of such events, and the strength of knowledge supporting the assessments. Three levels of assumptions are considered, which include assumptions related to the system's structural and operational characteristics, the effectiveness of the established barriers, as well as the consequence analysis process. The approach is illustrated for the case of an offshore installation.

Keywords: QRA; Uncertainties; Risk Analysis; Assumptions; Assumption; Deviation Risk

1. Introduction

Quantitative risk assessments (QRAs) are widely used for risk-informing decisions where limited information of the systems under consideration is available. A common approach to performing QRAs is to consider risk according to the Kaplan and Garrick [1] definition as the triplet of i) scenarios (i.e., what can happen?), ii) probabilities of the scenarios, and iii) their consequences. Risk indices are then used to present the results of the analysis, which can include for example the FAR (the expected number of fatalities per 100 million exposed hours), safety function impairment frequencies and probabilities, F–N curves showing the frequencies of accidents with at least N fatalities, etc.

The QRAs are typically dependent on numerous assumptions and expert judgments. The validity of the QRA is then conditional on the validity of these assumptions. These assumptions may relate to variation, for example the number of people exposed in an area, where this variation is commonly referred to as stochastic or aleatory uncertainties in a risk assessment context [1],

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