Uncertainty aspects in process safety analysis

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ABSTRACT

Uncertainties of input data as well as of simulation models used in process safety analysis (PSA) are key issues in the application of risk analysis results. Mostly, it is connected with an incomplete and uncertain identification of representative accident scenario (RAS) and other vague and ambiguous information required for the assessment of particular elements of risk, especially for determination of frequency as well as severity of the consequences of RAS. The authors discuss and present the sources and types of uncertainties encountered in PSA and also methods to deal with them. There are different approaches to improve such analysis including sensitivity analysis, expert method, statistics and fuzzy logic. Statistical approach uses probability distribution of the input data and fuzzy logic approach uses fuzzy sets. This paper undertakes the fuzzy approach and presents a proposal for fuzzy risk assessment. It consists of a combination of traditional part, where methods within the process hazard analysis (PHA) are used, and “fuzzy part”, applied quantitatively, where fuzzy logic system (FLS) is involved. It concerns frequency, severity of the consequences of RAS and risk evaluation. In addition, a new element called risk correction index (RCI) is introduced to take into account uncertainty concerned with the identification of RAS. The preliminary tests confirmed that the final results on risk index are more precisely and realistically determined.

Keywords: Process safety analysis; Quantitative risk analysis; Risk assessment; Accident scenario; Uncertainty; Fuzzy sets