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Application of High-Order Uncertainty for Severe Accident Management

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ABSTRACT

The use of probability distribution to represent uncertainty about point-valued probabilities has been a controversial subject. Probability theorists have argued that it is inherently meaningless to be uncertain about a probability since this appears to violate the subjectivists' assumption that individual can develop unique and precise probability judgments. However, many others have found the concept of uncertainty about the probability to be both intuitively appealing and potentially useful. Especially, high-order uncertainty, i.e., the uncertainty about the probability, can be potentially relevant to decision-making when expert's judgment is needed under very uncertain data and imprecise knowledge and where the phenomena and events are frequently complicated and ill-defined. This paper presents two approaches for evaluating the uncertainties inherent in accident management strategies: "a fuzzy probability" and "an interval-valued subjective probability". At first, this analysis considers accident management as a decision problem (i.e., "applying a strategy" vs. "do nothing") and uses an influence diagram. Then, the analysis applies two approaches above to evaluate imprecise node probabilities in the influence diagram. For the propagation of subjective probabilities, the analysis uses the Monte-Carlo simulation. In case of fuzzy probabilities, the fuzzy logic is applied to propagate them. We believe that these approaches can allow us to understand uncertainties associated with severe accident management strategy since they offer not only information similar to the classical approach using point-estimate values but also additional information regarding the impact from imprecise input data.

Keywords: High-Order Uncertainty, Severe Accident Management, Fuzzy Probability, Bayesian Probability