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Seminarium Zakładu Energetyki Jądrowej i Analiz Środowiska (UZ3) Departament Badań Układów Złożonych (DUZ)

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11:30

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Quantification of initiating events probability based on fragility functions and Bayesian network applied for multi-hazard

Abstract:

There are many ways to quantify initiating event probability and most of them are described in the document “Defining initiating events for purposes of probabilistic safety assessment”, developed by the International Atomic Energy Agency. This guide describes seven methods: engineering evaluation or technical study of a plant; reference to previous probabilistic safety assessment; EPRI list of initiating events; logical classification; plant energy balance fault tree; analysis of operation experience for an actual plant; failure mode and effect analysis. In practice, currently, many of PSA specialists use EPRI list of IEs, which has been originally prepared for single hazard and application to multiple hazards is not straightforward. Therefore other approaches are considered. In the presentation combined method based on fragility functions and Bayesian network will be shown which allows easier and more accurate approximation of the probability of initiating events caused by multiple hazards. In this respect, first of all, events fragility functions for hazards considered or multi-hazard fragility function are needed, which can have a various form like, for example, parameterized fragility functions or logit fragility function. The next step is to develop a model of the Bayesian network with the implementation of derived fragility functions. This can be performed using widely available computing programs for interactive building Bayesian network models. Depending on the hazards considered, the Bayesian network should be then developed accordingly. Example of such Bayesian network will be given.

Finally, after calculating the probability of initiating events using this combined method, the results can be used in Event Trees and Fault Trees already developed for considered nuclear installation, in order to update the estimations of probabilities. Such an

approach has also practical meaning as it will reduce man-month costs in comparison with the approach based on building full PSA models in a Bayesian network.

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