

Structural Reliability Issues in Natech Risk Assessment

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The general procedure recently accepted for the assessment of industrial risk caused by natural events (Natech) consists of the following steps: (1) Characterization of the external event; (2) Identification of vulnerable equipment; (3) Identification of damage states for reference scenarios; (4) Estimation of the damage probability given the impact; (5) Consequence evaluation of the selected scenarios; (6) Identification of credible combinations of events; (7) Probability calculation for each combination; (8) Consequence calculation for each combination; (9) Calculation of risk indexes. This procedure in comparison to standard QRA approach requires in particular the development of specific damage models to estimate the probability and extent of equipment damage caused by a natural event and to invent a procedure accounting for the possibility of simultaneous releases of hazardous substances or energy. It should be also noted, that the credible scenarios identified as a possible consequence of natural events impact are associated to the different storage or operating conditions. The four following categories of storage and process equipment can be defined, having a progressively increasing hold-up: 1) reactors and heat exchangers; 2) columns; 3) piping; 4) vessels (process and storage).

Damage probabilities of all this equipment can be calculated from specific vulnerability or fragility models, based on the parameters suitable to characterize the severity of the identified natural event. The development of simplified equipment damage models, suitable for the use within a QRA approach, is a specific issue required to apply this procedure. Observational models were developed from the analysis of past accident data.

The paper discusses these issues for hurricane, flood, lightning and earthquake events. An account approaches recommended to analyze external events in nuclear installation risk assessment will be also given. In Poland, within a general programme on the development of IT system of country protection against extreme hazards (ISOK), one of the projects has been devoted to the risk assessment of major industrial accidents triggered by natural hazards. Some of the results of this project, relevant to structural reliability will be also presented.