ExSys-LOPA for the chemical process industry

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\textbf{ABSTRACT}

The chemical process industries are characterized by the use, processing, and storage of large amounts of dangerous chemical substances and/or energy. Among different missions of chemical plants there are two very important ones, which: 1. provide a safe work environment, 2. fully protect the environment. These important missions can be achieved only by design of adequate safeguards for identified process hazards. Layer of Protection Analysis (LOPA) can successfully answer this question. This technique is a simplified process of quantitative risk assessment, using the order of magnitude categories for initiating cause frequency, consequence severity, and the likelihood of failure of independent protection layers to analyze and assess the risk of particular accident scenarios. LOPA requires application of qualitative hazard evaluation methods to identify accident scenarios, including initiating causes and appropriate safeguards. This can be well fulfilled, e.g., by HAZOP Studies or What-If Analysis. However, those techniques require extensive experience, efforts by teams of experts as well as significant time commitments, especially for complex chemical process units. In order to simplify that process, this paper presents another strategy that is a combination of an expert system for accident scenario identification with subsequent application of LOPA. The concept is called ExSys-LOPA, which employs, prepared in advance, values from engineering databases for identification of loss events specific to the selected target process and subsequently a accident scenario barrier model developed as an input for LOPA. Such consistent rules for the identification of accident scenarios to be analyzed can facilitate and expedite the analysis and thereby incorporate many more scenarios and analyze those for adequacy of the safeguards. An associated computer program is under development. The proposed technique supports and extends the Layer of Protection Analysis application, especially for safety assurance assessment of risk-based determination for the process industries. A case study concerning HF alkylation plant illustrates the proposed method.

\textbf{Keywords:} Process industries; Risk assessment; Expert system; LOPA; HF alkylation; Seveso II Directive