

Accepted Manuscript

Title: A Fuzzy Bayesian Network approach for Risk Analysis in Process Industries

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PII: S0957-5820(17)30258-6
DOI: <http://dx.doi.org/10.1016/j.psep.2017.08.015>
Reference: PSEP 1146

To appear in: *Process Safety and Environment Protection*

Received date: 21-5-2017
Revised date: 21-7-2017
Accepted date: 13-8-2017

Please cite this article as: Yazdi, Mohammad, Kabir, Sohag, A Fuzzy Bayesian Network approach for Risk Analysis in Process Industries. *Process Safety and Environment Protection* <http://dx.doi.org/10.1016/j.psep.2017.08.015>

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A Fuzzy Bayesian Network approach for Risk Analysis in Process Industries

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Highlights

- A comprehensive framework is proposed for risk assessment in process industries.
- A combination of expert knowledge and improved fuzzy AHP is used to address uncertainty in failure data.
- Bayesian Network is utilized for probabilistic reasoning about system reliability.
- Fault tree and Bayesian network are employed for the risk analysis of ethylene transportation line.
- Critical basic events are identified considering dependency among events.

Abstract

Fault tree analysis is a widely used method of risk assessment in process industries. However, the classical fault tree approach has its own limitations such as the inability to deal with uncertain failure data and to consider statistical dependence among the failure events. In this paper, we propose a comprehensive framework for the risk assessment in process industries under the conditions of uncertainty and statistical dependency of events. The proposed approach makes the use of expert knowledge and fuzzy set theory for handling the uncertainty in the failure data and employs the Bayesian Network modeling for capturing dependency among the events and for a robust probabilistic reasoning in the conditions of uncertainty. The effectiveness of the approach was demonstrated by performing risk assessment in an ethylene transportation line unit in an ethylene oxide (EO) production plant.

Key words

Hazard Analysis, Fault tree analysis, Bayesian Networks, Fuzzy Set Theory, Process Industry

1. Introduction

In recent years, complex chemical plants have been rapidly developed to meet the increasing demand of process industries. As these plants usually process hazardous materials, their failure can cause serious harm both to people and the environment. For this reason, it is necessary to identify potential risks posed by such systems and then take

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