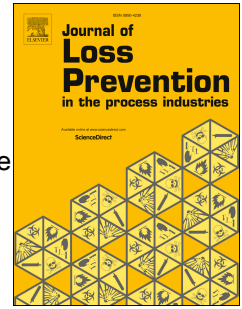


Accepted Manuscript

A set pair analysis based layer of protection analysis and its application in quantitative risk assessment

Fang Yan, Kaili Xu



PII: S0950-4230(18)30295-X

DOI: [10.1016/j.jlp.2018.07.007](https://doi.org/10.1016/j.jlp.2018.07.007)

Reference: JLPP 3734

To appear in: *Journal of Loss Prevention in the Process Industries*

Received Date: 28 March 2018

Revised Date: 10 July 2018

Accepted Date: 10 July 2018

Please cite this article as: Yan, F., Xu, K., A set pair analysis based layer of protection analysis and its application in quantitative risk assessment, *Journal of Loss Prevention in the Process Industries* (2018), doi: 10.1016/j.jlp.2018.07.007.

This is a PDF file of an unedited manuscript that has been accepted for publication. As a service to our customers we are providing this early version of the manuscript. The manuscript will undergo copyediting, typesetting, and review of the resulting proof before it is published in its final form. Please note that during the production process errors may be discovered which could affect the content, and all legal disclaimers that apply to the journal pertain.

A Set Pair Analysis Based Layer of Protection Analysis and Its Application in Quantitative Risk Assessment

Fang Yan,^{a,b,*} and Kaili Xu^c

As an effective risk assessment method, layer of protection analysis (LOPA) is widely used in the evaluation of protection measures, *i.e.*, independent protection layers (IPLs). However, traditional LOPA can only make semi-quantitative assessments for risk. Thus, assessment results with respect to risk will not be accurate or detailed enough, and the evaluation for IPLs may not be scientific or reasonable. By taking advantage of the quantitative analysis of the set pair analysis (SPA), a quantitative LOPA called the set pair analysis-layer of protection analysis (SPA-LOPA) is proposed in this study. The severity of the risk is judged by experts, and expert judgements are reflected by the connection degree (CD) while the corresponding algorithm for the CD is developed. In addition, the diversity degree (DD) and its algorithm are presented to process the CD with respect to the severity, and the assessed severity is measured by the calculated value of the DD. Next, the risk is quantified by the value of the DD and its frequency. Subsequently, the steps of the SPA-LOPA and corresponding assessment flowchart are provided. The SPA-LOPA and semi-quantitative LOPA are utilized to evaluate risks of gas leakage in biomass gasification. It is proved that the SPA-LOPA is more scientific and reasonable in the evaluation for IPLs, based on the comparison results.

Keywords: Layer of protection analysis; Set pair analysis; Connection degree; Diversity degree; Independent protection layer; Quantitative risk assessment

Contact information: a: School of Resources and Safety Engineering, Central South University, Changsha, 410083, P. R. China; b: Safety & Security Theory Innovation and Promotion Center (STIPC), Central South University, Changsha, 410083, P. R. China; c: School of Resources and Civil engineering, Northeastern University, Shenyang, 110819, P. R. China; *Corresponding author: yanfang3543@csu.edu.cn

1. Introduction

Risk assessment is one of the most effective methods in the risk control and risk management of process industries. With years of development, various risk assessment methods have been proposed and developed, including the fault tree analysis (FTA), event tree analysis (ETA), hazard and operability analysis (HAZOP), preliminary hazard analysis (PHA), failure model effect criticality analysis (FMECA), Bayesian network (BN), set pair analysis (SPA), layer of protection analysis (LOPA), fire and explosion index (F&EI), probabilistic risk assessment (PRA), and fuzzy methods. Currently, the development of the risk assessment involves quantitative research. Fuentes-Bargues took advantage of the FTA to perform quantitative analysis of the most relevant risks of industrial chemical plants (Fuentes-Bargues *et al.* 2017). Subsequently, the HAZOP was combined with FTA results, and the most significant danger was identified. In Fu's study (Fu *et al.* 2016), the ETA was integrated with the computational fluid dynamics (CFD) simulation to investigate the hazard in LNG-fuelled vessels. According to the analysis of consequences, the risk of LNG leakage was indicated. Abdo proposed a new quantitative risk assessment approach based on the fuzzy set theory and the Monte Carlo simulation

Download English Version:

<https://daneshyari.com/en/article/6972804>

Download Persian Version:

<https://daneshyari.com/article/6972804>

[Daneshyari.com](https://daneshyari.com)