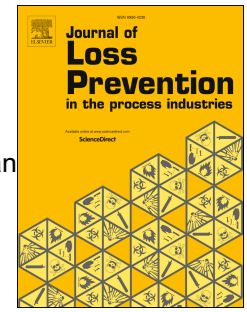

Risk identification of third-party damage on oil and gas pipelines through the Bayesian network

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Risk Identification of Third-party Damage on Oil and Gas Pipelines through the Bayesian Network

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Abstract: This paper aims to identify the risks influencing oil and gas (O&G) pipeline safety caused by third-party damage (TPD). After comprehensive literature study, we found that the traditional risk identification of TPD suffers from defining binary states of risk only and ignores the risk factors after pipeline failure. To overcome this problem, we investigated incident reports to identify previously unrecognized additional factors. This work also developed a graphic model by using Bayesian theory to cope with the multistate risks arising from third parties and to present the incident evolution process explicitly. Furthermore, this paper included a leakage case study conducted to verify the logicality of this model. The results of case study inspire that the proposed methodology can be used in a dual assurance approach for risk mitigation, namely learning from previous incidents and continuously capturing new risk information for risk prevention.

Key words: Oil and Gas Pipeline; Third-party Damage; Risk Identification; Bayesian Network

1 Introduction

Pipelines are a safe form of energy transport, and the industry holds many years of operational experience for this mode (Hopkins, 2008). However, pipeline failures still occur frequently. Besides design defects and operational failures, pipeline exposure to complex environment persists with a constant potential threat from third parties (TPs).

Risk analysis generally involves three parties, namely, “first party,” “second party,” and “third party” (TP). For pipelines, the first party refers to the pipeline company and its employees. The second party typically refers to companies working for the pipeline company, whereas the TP comprises individuals or other companies external to the operation of the pipeline. Third-party damage (TPD) can then be defined as “damage arising from individuals or organizations that are not related to the pipeline company, digging in the vicinity of buried pipelines without realizing the pipeline is there or without taking into account the presence of the pipeline.” This kind of damage often occurs in and around cities and towns and can result from large excavation projects, construction work, and farming activities.

According to the Ninth Report of the European Gas Pipeline Incident Data Group (EGIG report, 2015), 1,309 pipeline incidents on more than 143,000 km of pipeline occurred from 1970 to 2013. From 2004 to 2013, external interference (EI) corresponding to our definition of TPD, corrosion, construction defects, and ground movement were the main causes of incidents and represented 35%, 24%, 16%, and 13%, respectively, of the total pipeline incidents reported. EI mainly results in pinholes, cracks, and holes. Small-diameter pipelines are more vulnerable to EI

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