TITLE:

DYNAMIC PROCESS SAFETY ASSESSMENT BY MAPPING ALOHA SIMULATION INTO BOW-TIE ANALYSIS: APPLICATION TO SEPARATOR (S-102) IN PRODUCTION OF METHANOL ROUTE 2

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ABSTRACT

The increasing use and distribution of chemicals are causing serious chemical accidents such as fires, explosions, and leaks during manufacturing and handling. Regarding the reports on the accident investigation from 1959 to 2005, an accident starts with loss of containment of hazardous substance resulting in fire, explosion, or vapor cloud explosion. The study's goals are to analyze the safety hazard and risks posed during the preliminary design stage and to propose an appropriate risk mitigation strategy for reducing the identified hazard and measured risk using Basic Over Web Tactical Imagery (BOWTIE) analysis and Areal Location of Hazardous Atmospheres (ALOHA) software. In this study, the BOWTIE analysis method and the ALOHA software are combined to improve the present safety assessment methods and their application to the design and design of chemical processes. This is due to existing methods having limitations, such as unable to predict the threat zone and the inability to predict the risk assessment. BOWTIE analysis is incapable to predict the clear consequences of the threat zone and is unable to predict visually. However, using ALOHA software may estimate the threat zone's distance to visualize the damage range of the hazard consequences. ALOHA is needed to overview the accident possibilities that may occur in that location. There are three hazardous chemical releases, namely methanol, carbon monoxide, and hydrogen have been studied by looking at the distances of threat zone for Production of Methanol Route 2 in Separator (S-102). After analysis, the worst chemical release is Carbon Monoxide which consists of the biggest threat zone and contains only two threat zones, i.e. red and orange threat zones. As the result, this study was carried out to enhance and combine ALOHA software and BOWTIE analysis in order to create a more comprehensive assessment towards hazard and risk consequences and also cover a research gap by developing an integration method. Researchers may be able to predict the potential consequences of hazards and risks if BOW-TIE analysis and ALOHA software are used more accurately.

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CHAPTER 1

BACKGROUND OF STUDY

1.1 INTRODUCTION

The demand for oil and gas is increasing, and this is causing the industrial upstream plants to grow and become more complicated. However, chemicals pose a potential threat to human life, and to the surrounding environment because of their flammability, reactivity, and toxicity [1]. These properties can cause fire and explosions that cause significant losses in terms of human health, life, property, and environmental pollution. A safety plan is given top priority in all manufacturing and chemical plants based on laws and standards to prevent any accidents at plants where hazardous substances are used. The safety plan, commonly referred to as industrial accident prevention, works to reduce any resulting health and environmental consequences. The danger and high potential of risks or accidents that could negatively impact every element of life are always present for all employees at chemical plants. As a result, many potential hazards might be identified during the operation of the plant. However, it is challenging for safety researchers to recognize risks and forecast their consequences. Therefore, in order to enhance the overall safety of the plant, safety engineers must plan the first move in the solution-finding strategy.

Hazard mitigation methods play an important role in designing a safe plant in order to reduce accidents occurring in the plant. There are two methods being studied in this case. The BOW-TIE analysis is the first method, followed by the use of the ALOHA software as the second method. The BOW-TIE analysis provides a representation of the relationships between the causes of unwanted events, the escalation of such events to a range of possible outcomes, the controls preventing the event from occurring, and the mitigation measures that are in place to limit the consequences (Brown et al., 2021). This representation is easily understandable. All this information is presented in a graphical format. It provides a simple visual representation of the way to display the preventative and mitigating controls against their respective causes and consequences and highlights gaps in risk control that should be a focus for remediation actions (Tucker et al., 2013). ALOHA software enables users to enter information regarding an actual or future chemical release, and the software will then generate threat zone estimates for a variety of dangers in a graph form [11]. Meanwhile, the BOW-TIE analysis is unable to visualize or predict the clear effects of the threat zone. The ALOHA software and the BOW-TIE analysis were combined and integrated together in order to generate a more comprehensive