

AN EMERGENCY RESPONSE DECISION MATRIX AGAINST TERRORIST ATTACKS WITH IMPROVISED DEVICE IN CHEMICAL CLUSTERS

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ABSTRACT

Chemical industrial areas may constitute potential targets for deliberate actions by terrorists. Terrorists having sufficient knowledge of chemical process operations or plant layout may take advantage of improvised explosive devices (IEDs) to cause major events such as fire, explosion and toxic gas dispersion with cross-border consequences in chemical clusters. Thus, an efficient cluster-wise emergency plan to enhance the promptness and efficacy of responding to such attacks is crucial. In this study, the effects of blast wave caused by IEDs are assessed and its potentiality in triggering domino scenarios are analysed. A decision tree is developed to determine the emergency level of each company within the cluster based on the attack outcomes. Furthermore, an alert notification system is set based on a decision matrix. Finally, the identified emergency levels and the alert levels are presented in form of a multi-plant decision matrix. The application of the developed methodology is demonstrated in a case study.

Keywords: chemical industrial area, decision matrix, decision tree, emergency response, improvised explosive device, terrorist attack

1 INTRODUCTION

Prior to 9/11 attacks, terrorist threats had been recognized for a long time, but a successful terrorist attack on chemical plants was assumed to be quite unlikely [1]. However, the security risks has become an important concern for the chemical industry ever since [2, 3].

Chemical industrial areas due to handling large quantities of hazardous chemicals are potential targets for deliberate actions by terrorists. Compared to safety accidents in the chemical industry, security events could be much worse in terms of the extent and severity and may affect many people in nearby communities. Despite recent concerns about weapons of mass destruction (WMD), explosions are by far the most common cause of mass-casualty incidents associated with terrorism [4]. A successful attack aimed at direct or indirect damage of target equipment by bombs or fire arms can trigger domino scenarios [5] and cause damages to multiple process units or eventually several neighbouring industrial site [6, 7]. The terrorist attacks to Iraq's oil terminal in 2004 and largest refinery in 2015 are examples of terrorist attacks by improvised explosive devices (IEDs) to chemical plants [8, 9]. IEDs are unconventional kinds of bombs usually carried or delivered in a vehicle, package, by a person, or concealed on the roadside [10].

A number guideline and approaches have been proposed regarding the emergency response and preparedness for security threats in chemical industry such as [11], but there is no specific procedure available for managing terrorist attacks in multi-plant chemical industrial areas. Thus, an efficient cluster-wise emergency response seems crucial for enhancing the promptness of reacting to the attack. In this regard, the present study is aimed at introducing an innovative multi-plant response decision matrix that creates an overview of emergency levels and alert levels for individual plants within a cluster in order to help them respond in a pre-agreed procedure to terrorist attacks with IEDs. Each emergency level indicates the