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Securing oil and gas infrastructure

S. Bajpai [1], J.P. Gupta *

Department of Chemical Engineering, Indian Institute of Technology Kanpur, Kanpur-208016, India

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Abstract

Oil and gas facilities involving petroleum exploration and production, refining, storage and transportation are potential targets for terrorists and some disgruntled employees. This is due to the fact that petroleum products contain a lot of energy and are highly flammable. In the post 9-11 era, the risks from deliberate acts are considered both real and credible. The terrorists may act due to political reasons, religious reasons, nationalist causes or personal reasons. Security risks associated with all activities must be estimated for the adequacy of countermeasures. Threat and vulnerability assessment is conducted to evaluate the risks and appropriate countermeasures are suggested for improvement. It is recognised that all existing safety tools are of help in dealing with this emergency. However they should be modified in light of process security. In this paper, we examine the areas of security concern for oil and gas infrastructure and describe steps one can take to make them more secure. We discuss the various measures that can reduce the target attractiveness, and consequences in case of a successful attack.

In the last section of this paper, we have discussed a case study of a refinery to show the application of ideas presented.
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Keywords: Oil/gas facilities; Terrorism; Emergency response; Vulnerability assessment; Refinery

1. Introduction

Oil and gas facilities form a critical infrastructure in every country. Oil is still the most important source of energy and its share in worldwide energy consumption is approximately 40%, while for transport sector it is 97% (EIA, 2004). Oil/gas, being such a critical input in the production of most goods and services, disruption in oil/gas supply will affect the living of common people adversely. Oil and gas facilities, directly or indirectly, provide employment to a very large number of people and contribute a significant part of the world GDP (Gross Domestic Product). It is needless to say that the world economy depends on it.

Oil and gas facilities, involving crude oil and natural gas fields, refineries, transportation (pipeline, railways, trucks, ships) and distribution systems are very attractive targets for terrorists, criminals and disgruntled employees (NPC, 2001). This is due to the fact that petroleum products contain a lot of energy and are highly flammable. Some of them are toxic as well.

The biggest difference in performing risk assessment following 9-11 is that the high consequence-low frequency events (crashing of aircraft) cannot be neglected. The risks from intentional acts are considered both real and credible. These attacks may come from individual or groups, internal or external, which may or may not be

* Corresponding author. Gujarat Energy Research & Management Institute, GSPC Bhavan, Sector 11, Gandhinagar-382011, Gujarat, India. Tel.: +91 79 66701205; fax: +91 79 23233574.
E-mail addresses: bajpais@nitj.ac.in (S. Bajpai), jpg@iitk.ac.in (J.P. Gupta).
[1] Present address: Department of Leather Engineering, National Institute of Technology, Jalandhar, Punjab, India.

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working in collusion. The terrorists may act due to political reasons, religious reasons, nationalist causes or personal reasons. They use the energy already present in the oil/gas to inflict maximum damage with least input, for example, they may blow up the storage tank filled with hazardous chemicals or make explosion in a road tanker carrying flammable material using a shoulder fired missile, bazooka, etc. They may exploit oil and gas facilities and their transportation systems as weapons of mass destruction (WMD). Therefore the risks from deliberate acts to these facilities need to be assessed, and appropriate security countermeasures and emergency response put in place (Bajpai and Gupta, 2005).

A successful attack on oil and gas facilities and their transportation systems may result in fire and explosion, disruption in oil/gas supply, process shut down, severe economic impact, injuries and fatalities. Innovative thinking is required to make these facilities more secure from terrorists attacks, and what should be done to reduce the consequences in case of a successful attack. In other words, the approach suggested in this paper tries to reduce both frequency and consequences from a terrorist attack.

It is important to have exhaustive database comprising terrorist attacks and other serious security incidents in oil and gas facilities on the international arena. Unfortunately, there is no good database on this subject at present. However, Karmon (2002) recorded 90 incidents world wide concerning pipelines, oil and gas facilities, and on personnel involved in the discovery, construction and exploitation of these resources for the period 1980–2000 (Table 1).

Table 1
Security incidents in oil and gas facilities during 1980–2000 (Karmon, 2002)

Continent	Country	Number of incidents
Middle East	Iraq	2
	Kuwait	4
	Lebanon	5
	Saudi Arabia	1
	Turkey	4
Africa and North Africa	Algeria	3
	Angola	6
	Congo	1
	Mozambique	3
	South Africa	2
	Sudan	3
Latin America	Argentina	2
	Colombia	19
	Ecuador	2
	Guatemala	1
	Peru	2
	Suriname	1
	Venezuela	2
North America	US	1
	Canada	1
Europe	Belgium	3
	Cyprus	1
	Germany	7
	Norway	1
	Spain	4
	UK	1
Asia	Afghanistan	2
	Japan	2
	Philippines	1
	Thailand	1

2. Risk assessment

Security risk assessment can be carried out qualitatively by the following:

threat analysis
vulnerability analysis
security risk factor table.

2.1. Threat analysis

Threat analysis (TA) is used to identify the sources, types of threats, and their likelihood. It involves study of all issues that are critical to the likelihood of threat such as history of security incidents in and around the facility, intentions and motivations of adversaries, their capabilities, etc. It is important to mention here that even a small security incident like theft of confidential information may be a precursor to the planned terrorist attacks.

The attack is normally well planned, and it may take years for terrorists to gather important information about the site and look for vulnerabilities. They may also involve some insiders either by luring them for great monetary reward, or by threatening them of dire consequences. The main focus of TA is on the terrorist attacks that might result in major explosion or fire, further resulting in disruption of industrial activity, economic losses and casualties, etc. The aim of TA exercise is to identify the specific threats that are credible to the given oil/gas facility (API, 2003; Bajpai and Gupta, 2005).

The following list includes some of the potential threats to oil and gas facilities and their transportation systems due to deliberate actions by terrorists and others (ACC, 2001; ACC, 2002):

- Major fire and explosion in oil wells, refineries, storage and distribution terminals, etc.
- Serious disruption in oil supply.
- Major damage to the infrastructure facility.
- Fire and explosion at transportation systems such as oil tankers, pipelines, etc. For example, pipeline

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