CHEMICAL SECURITY IN NIGERIA: A CASE STUDY OF SELECTED UPSTREAM OIL AND GAS FACILITIES

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ABSTRACT

This study evaluated the chemical security risks associated with chemical facilities in the upstream oil and gas sector in Nigeria concerning the chemicals they possess, their prevailing security measures, susceptibilities, malicious use and sabotage. The facilities were grouped into various categories such as, very low, low, moderate, high and very high risks using the chemical security risk self-assessment model (CHEM-SAM). Of the seven facilities that were investigated; findings indicated that Facilities II and VII pose low risks, Facilities I and IV pose moderate risks, whereas Facilities III, V and VI pose high risks. Also, there were variations in the security configurations of these facilities. Some had perimeter fences with installed intrusion detection systems, such as, alarms with well-trained onsite guards/mobile policemen as well as chemical cabinets/buildings housing chemicals with electronic access controls. Others had a few of these security components. From these findings, it would appear that there are no standardized chemical security regulations and/or policies in Nigeria for the upstream oil and gas facilities.

Keywords*: chemical security; risk self-assessment; chemical facility; likelihood; consequence*

1. INTRODUCTION

Chemical Plants play a vital role in the economy and the public welfare. However, some of the chemicals produced or used by these plants are sublime and soluble solids, volatile liquids and gases, industrial feedstock and oilfield chemicals which can trigger fire or explosion. These properties can be exploited by people with malicious intent either to cause harm as in the case of terrorists, fight for a cause (sabotage) and/or for personal financial benefits (theft). In fact, chemicals have been deployed in attacks by various terrorist organizations such as; Hamas, Aum Shinrikho, Al-Qaeda and ISIS (Sweijs and Kooroshy, 2010; Nyberg et al., 2011; Forest, 2012; Hoette, 2012). In 2016, several upstream oil and gas infrastructure faced severe threats from militants, where major crude oil pipeline networks (mostly in the delta region of Nigeria) were vandalized (Kachikwu, 2017). It is, therefore, pertinent to have an active physical protection system around critical infrastructures to safeguard them against acts of sabotage, terrorism and natural disaster (Oyeyinka et al., 2014).

Relatively, terrorist attacks on chemical facilities have been few and far between. Nonetheless, the use of chemicals in more than half of the terrorist attacks worldwide further emphasizes the importance of security assessment and the management of chemical plants (Khakzad et al., 2018). Several studies have shown that chemical facilities and their highly valued products remain attractive to terrorists and criminals worldwide. In Nigeria, numerous bombings have been carried out by terrorist organizations where improvised explosive devices were utilized, and the trend appears not to have abated. Unfortunately, the precursors used for these devices are either obtained or obtainable from chemical facilities or somewhere along the chemical supply chain. The 2016 global terrorism index rating placed Nigeria as the third most terrorized nation with the seventh worst economic impact of 4.5% of GDP globally (GTI, 2016). Clearly, this indicates that the impact of terrorist organizations in Nigeria has extended far beyond political and religious boundaries.

As noted earlier, certain chemicals are precursors for improvised explosive devices. They can also be precursors for drug and may have dual use. There is need to protect such chemicals from people with malicious intent. This is the focus of chemical security. Chemical security is the prevention and protection against the intentional misuse of chemicals, people, or equipment for non-peaceful purposes. Thus, the present work evaluates the chemical security risk posture of seven selected chemical facilities in the upstream oil and gas sector of the Nigerian economy based on the chemicals they possess, their existing (onsite) security measures and vulnerabilities. For security reasons, the names of the facilities or the chemicals they handle would not be mentioned.

2. METHODOLOGY

This study employed the non-experimental descriptive survey technique. The instrument used was the questionnaire. The questionnaire, designed as part of the Chemical Risk Security Management Self-Assessment Model (Chem-SAM, 2017), consisted of 87 questions which were divided into 11 sections namely: (a) demography (Name, Gender etc.); (b) chemical asset and the likelihood of a chemical being targeted; (c) the effect of the release of the chemicals on human health; (d) the socio-economic impact of release of the chemicals; (e) chemical receiving; (f) materials control and accountability; (g) physical security of the chemicals at the facility; (h) personnel reliability; (i) information security; (j) the sales, distribution and disposal of chemicals and (k) chemical security management program. Further details about the questionnaires are given by Konee (2018). The questionnaires were administered to 400 employees from the seven selected chemical facilities designated as Facility I, II, III, IV, V, VI and VII respectively. Three of the facilities either produce or supply chemicals while the remaining ones are chemical users A brief description of each facility and the distribution of the questionnaires are shown in Table 1.

The responses were analyzed using the Chem-SAM. The Chem-SAM was developed by Sandia National Laboratories' International Chemical Threat Reduction Department in partnership with the U.S. Department of State's Chemical Security Engagement Program. (Chem-SAM, 2017). Chem-SAM model consists of four steps: 1. Administer the questionnaire and code the responses with the value between 0 and 4; 2. Define the potential adversaries; 3. Calculate the chemical security risk (the chemical security risk is viewable as a relative number between 0 and 4 or as a graph) and 4. Determine the risk acceptability (based upon the relative risks that were provided: the facility/laboratory must determine this risk) (Karimi Zeverdegani et al., 2016). In the Chem-SAM, the results are shown graphically for insiders and outsiders about theft risk, sabotage risk near populated area and sabotage risk near industrial areas in 5 ranges namely: very low, low, moderate, high and very high.

3. RESULTS AND DISCUSSION

Table 1 shows that out of the 400 questionnaires administered, 200 were fully completed and were used for the analysis. The number of responses ranged from 22 to 35 representing a response rate of 44% to 58.3% respectively. We are not aware of any standard for response rate. However, our values fall within the range suggested by Baruch and Holtom (2008).

Table 1: Facilities description, number of questionnaires administered and retrieved

Facility	Brief description	No. of Questionnaires Administered	No. of Questionnaires Returned	Response Rate (%)
I	Producer and supplier of diverse oilfield chemicals for drilling, completion, production and treating.	60	35	58.3
II	Exploits oilfield chemicals for drilling, completion, production and treating. Provides drilling and well services, directional drilling, mud logging and reservoir services.	60	31	51.7
III	Supplier of oilfield chemicals and services.	60	30	50
IV	Producer and supplier of diverse oilfield chemicals such as, drilling, completion, production and treating chemicals.	60	28	46.7
V	Spans the full – cycle of exploration, appraisal and development through production.	60	27	45
VI	Exploits drilling and completion chemicals.	50	27	54
VII	Conducts drilling and well services, directional drilling mud logging and reservoir services.	50	22	44
Total		**400**	**200**	

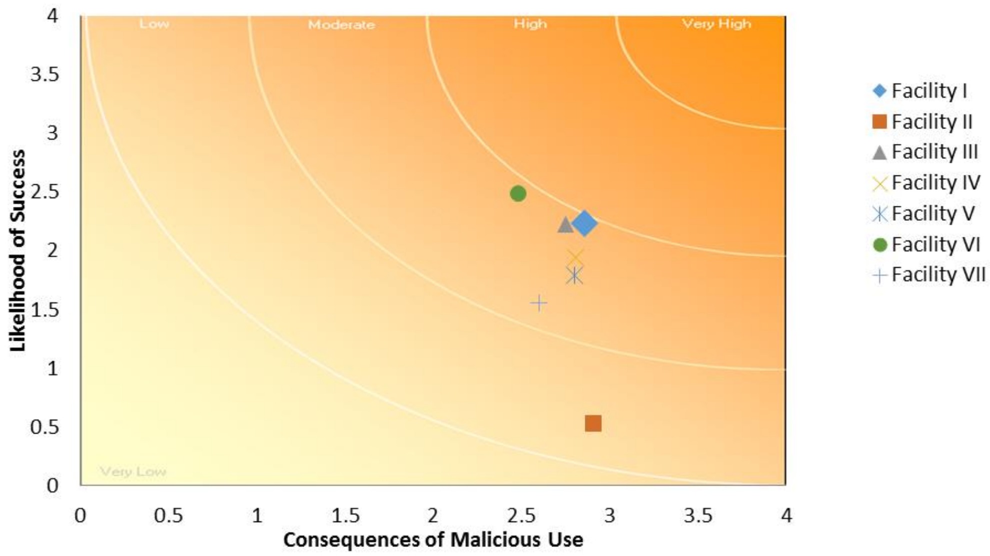
The results of the chemical security risk evaluation using the Chem-SAM software version 1.0 for each of the seven chemical facilities are shown in Table 2 and graphically in Figures 1 to 3. The risk evaluations were done for theft, sabotage near populated areas (SNPA) and sabotage near industrial areas (SNIA) for two scenarios namely outsider (external adversary) and insider (internal adversary). In Table 2 and Figures 1 to 3, the likelihood of success is a measure of the attractiveness of the chemical for misuse in the case of sabotage or potential for successful theft/diversion of the chemical based upon facility characteristics while consequences of malicious use is a measure of the impact to human health and/or facility of misuse of the chemical. The risk will, therefore, be very low if both the consequence and likelihood are very low (below 0.5). As Table 2 indicates, none of the facilities have very low risk; although the likelihood of success for Facility II is very low, its consequence is high especially near the industrial area.

Figure 1 indicates that for the outsider risks for theft are moderate for Facilities 1, III to VII while they are low for Facility II. For the insider, the corresponding risks for theft are low for Facility II, moderate for Facility I and III and high for the remaining Facilities. Figure 2 indicates that the risk levels are moderate for Facilities I, III, IV, V and VII while that for II is low and that for VI is high for the outsiders; the insider levels are the same or at the higher level. Similar deductions can be made from Figure. 3.

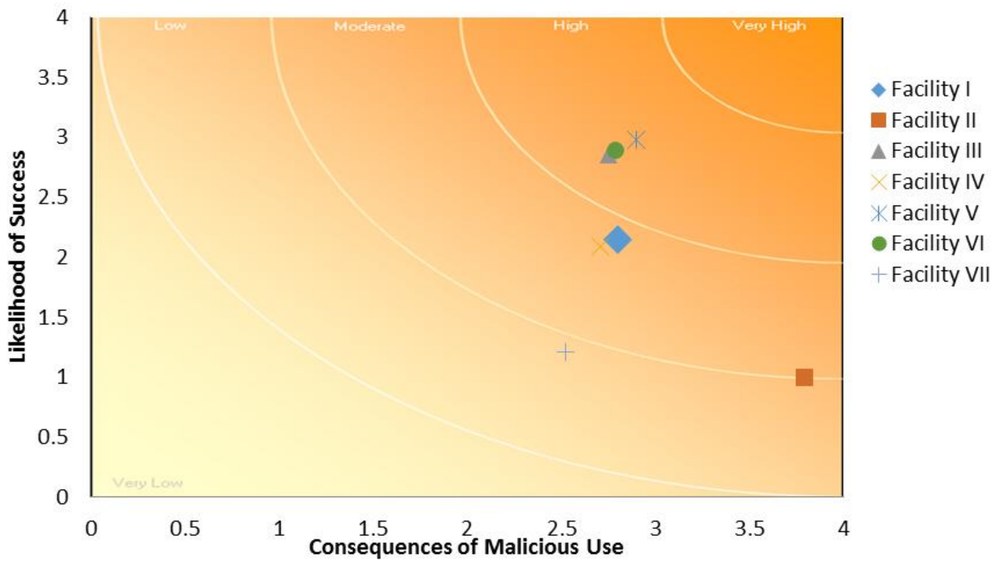
Table 2: Risks Values for Each Facility for External and Internal Adversaries

Facilities	External Adversaries	Likelihood of Success	Consequence of Malicious Use	Internal Adversaries	Likelihood of Success	Consequence of Malicious Use
I	Theft	2.23	2.86	Theft	2.15	2.80
	SNPA	2.30	2.32	SNPA	2.21	2.27
	SNIA	2.38	3.87	SNIA	2.31	3.85
II	Theft	0.53	2.91	Theft	1.00	3.79
	SNPA	0.53	2.54	SNPA	0.95	3.61
	SNIA	0.55	3.88	SNIA	1.12	3.81
III	Theft	2.22	2.75	Theft	2.85	2.75
	SNPA	2.37	2.31	SNPA	3.02	2.92
	SNIA	2.40	3.90	SNIA	3.17	3.83
IV	Theft	1.94	2.81	Theft	2.09	2.71
	SNPA	2.01	2.56	SNPA	2.21	2.50
	SNIA	2.11	3.87	SNIA	2.33	3.91
V	Theft	1.79	2.80	Theft	2.98	2.90
	SNPA	1.84	2.60	SNPA	3.00	2.53
	SNIA	1.98	3.89	SNIA	3.09	3.87
VI	Theft	2.49	2.48	Theft	2.89	2.79
	SNPA	2.52	2.77	SNPA	2.97	2.56
	SNIA	2.53	2.86	SNIA	3.00	2.90
VII	Theft	1.56	2.60	Theft	1.21	2.52
	SNPA	1.61	2.90	SNPA	1.24	2.87
	SNIA	1.72	3.85	SNIA	1.36	3.93

These results also indicate that Facilities II and VII have comparable risk levels which are generally lower than those for the other facilities. These low-risk levels are probably because the two facilities have similar security configuration. Facilities II and VII have perimeter fences with installed intrusion detection systems such as alarms with well-trained onsite guards/mobile policemen. Chemical cabinets/buildings housing chemicals have electronic access controls and are well-alarmed. They uphold proper chemical transportation as well as information policies, and all chemical incidences are tracked, reported, with follow-up actions. They also conduct regular vetting, safety and security drills amongst others. Facilities I and IV have perimeter fences with no intrusion detection systems, except alarms at the main entry and exit points. Chemical cabinets/buildings housing chemicals have manual access controls, but no alarms. They uphold proper chemical transportation policies, and all chemical incidences are tracked and reported. They also conduct periodic vetting, safety and security drills amongst others. In Facilities III, V and VI, chemical cabinets have no well-defined perimeters, no formal vetting for personnel, but there exist safety drills amongst others.

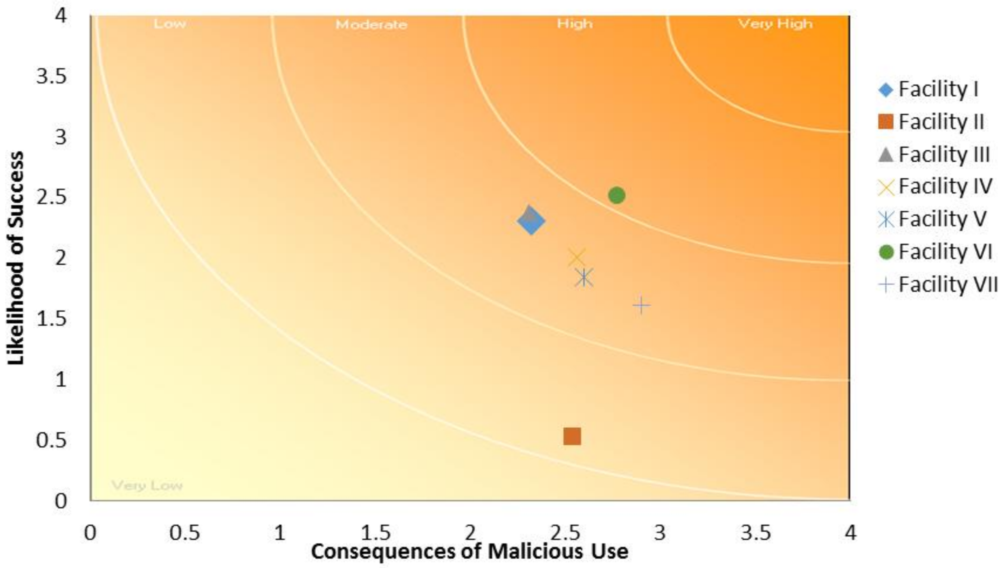


(a) Outsider

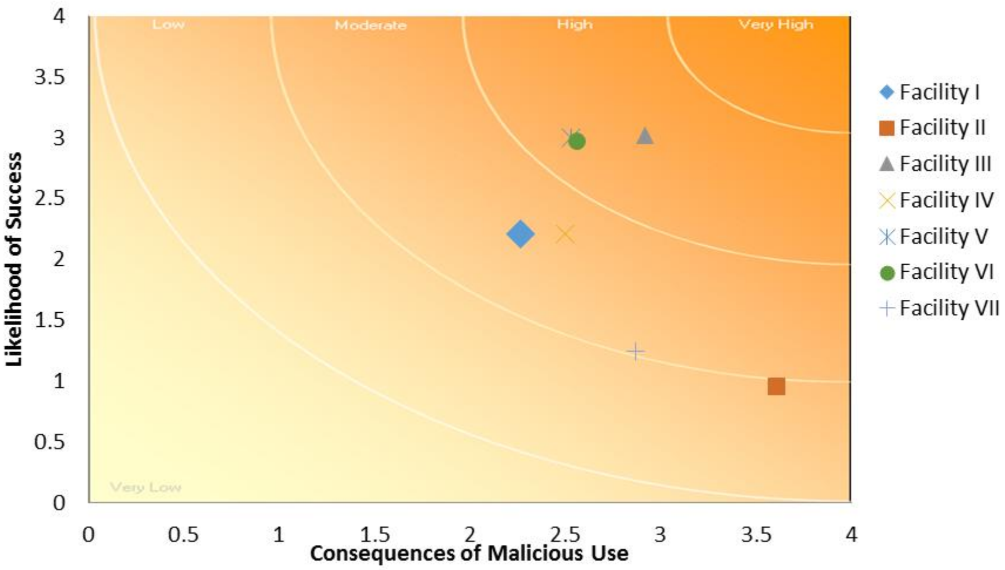


(b) Insiders

Figure 1: Facility Chemical Security Theft Risk

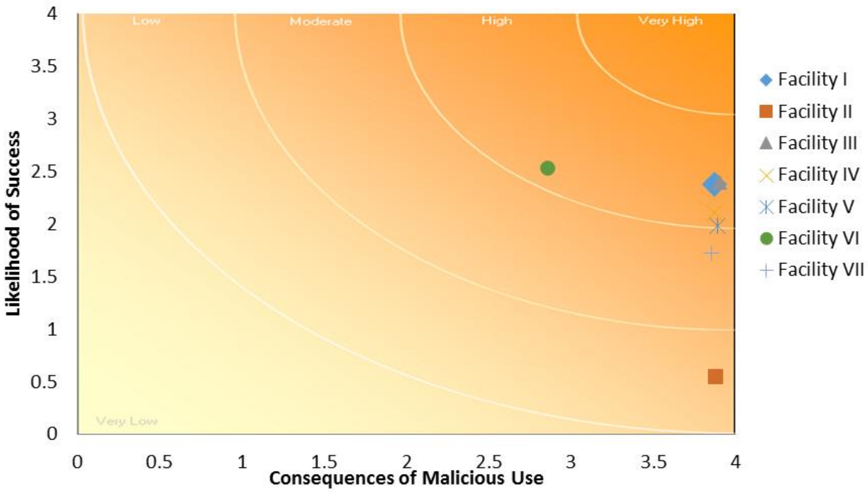


(a) Outsider

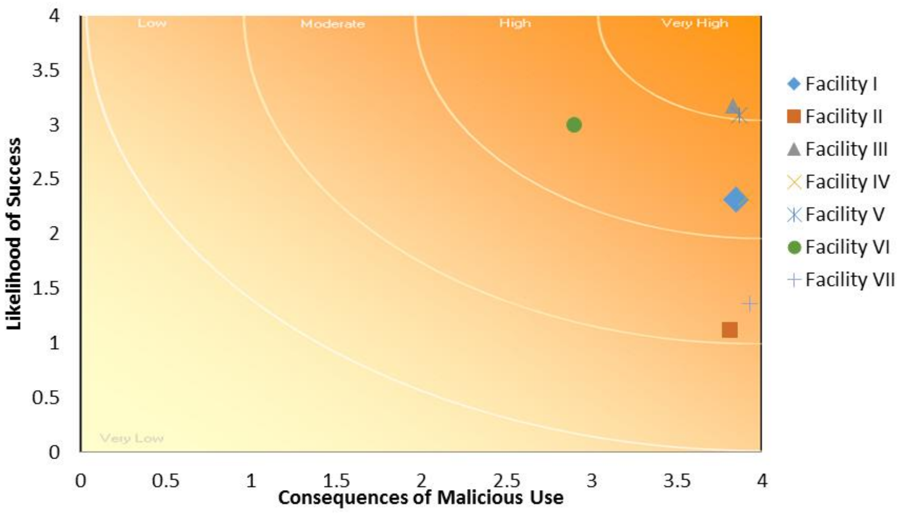


(b) Insiders

Figure 2: Facility Chemical Security Sabotage (NPA) Risk



(a) Outsider



(b) Insiders

Figure 3: Facility Chemical Security Sabotage Near Industrial Area Risk

4. CONCLUSION

The assessment and evaluation of the chemical security risks (insider and outsider) associated with the seven selected chemical facilities were carried out. The findings indicate that facilities II and VII pose low risks, facilities I and IV pose moderate risks, whereas facilities III, V and VI pose high risks. The differences in the risk levels may be attributed to the different security configurations put in place at the various facilities examined. This observation tends to suggest the need for a regulation on the minimum security configuration requirement for chemical facilities in Nigeria.

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