

Risk Identification of Major Petrochemical Enterprises Under the Background of Terrorist Attack

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Keywords: Terrorist attack, Major petrochemical enterprise, Risk identification, WBS-RBS method.

Abstract: The possible risk categories of terrorist attack are filtered by the way of its attraction towards terrorists as well as the target's selection of terrorism attack. The judging content of threatening against terrorists attack, building vulnerability and safety risk in industry are debated therein. The possible risks of major petrochemical enterprises are derived from two aspects of inherent attraction of the target and target selection of terrorists attack. Based on possible hazard classification of major petrochemical enterprise, this paper completes risk identification of the targets against terrorist attacks. Furthermore, it expands the identification from single target to multi-target cluster. Thereafter, it performs risk identification of major petrochemical enterprise cluster by WBS-RBS method. The works provide effective theoretic basis for risk and hazard assessment, evaluation as well as controlling of major petrochemical enterprises.

1. Introduction

It had made a large study about the risk identification of major chemical and economic target at home and abroad. Dongmei LI made a study from the aspect of hazard source identification and analysis, Qingqian GAO made a study about the technology of major hazard sources identification and analysis, Changrong GE made a study about the method of major hazard sources identification according to the major hazard sources identification government standard and safety production license condition and another laws and regulations through questionnaire survey[1-4]. Some of other researchers discussed the method of major hazard sources identification about the analysis method of accident tree and system security [5]. But these methods focused on the identification characters of the chemical hazard source, however it is short of the research of the external attacked characters and identification on chemical dangerous companies. so the article took example by the research of the judging content of threatening against terrorists attack, building vulnerability at home and abroad, screening and analysing the possible terrorists attack risk and hazard type on major chemical companies, identifying the assaulted risk of the major chemical companies concentrated district based on the WBS-RBS method, and analysing and researching with the example of some large national chemical companies cluster in Nanjing.

2. Identification Criterion of Major Petrochemical Enterprises' Risk of Terrorist Attack

Our country came up with the evaluation methodology of major hazard source aiming at the chemical accident, on this basis, having some improvement considering human factor. although major petrochemical enterprises different from chemical facilities, it has the chemical properties, so the evaluation methodology of major hazard source has an effective on guiding the article's research.

2.1. Risk Assessment and Classification Abroad

2.1.1. The Risk Assessment Method of American Building Vulnerability[6]

Federal Emergency Management Agency (FEMA), Department of Justice (DOJ), and some other government agencies responsible for the risk assessment and consequence management analysed the risk of building vulnerability with the method of seven-factor-analysis. Research developed from seven aspects including the visibility grade, asset value, the target's values for terrorists、 the possibility of terrorists closing target, site population capacity, the availability of hazardous materials and potential collateral damage, dividing the possible risks of building into impersonality risk and subjective risk. Impersonality risk causing by indirect factor includes asset value, site population capacity, the availability of hazardous materials and potential collateral damage. Personality risks causing by subjective judgment includes the visibility grade, the target's value for terrorists, the possibility of terrorists access to target.

2.1.2. American Industrial Department's Risk Classification Method

The American Department of Justice divides industrial department into four parts including the staff workers number, the areas of occupation of land, the properties of industrial department and the degrees of approachability based on the field risk assessment. Subjective risk only considers the degrees of approachability. The subjective risk only includes the degree of accessibility. In view of classification, the American government agencies only consider the protection of object and industrial departments' own risk. So the DOJ focuses more on objective risk other than the terrorists' subjective judgment.

2.1.3. Vulnerability Assessment and Risk Analysis Method

The American application research association researched the attacked risk of potential target with the theory of vulnerability evaluation and risk analysis. Judging the vulnerability of potential target from two parts including the facilities' vulnerability and the degrees of loss, classifying from the impersonal factor including the degree of protection, the degrees of disaster damage, the injuries and deaths and the loss of properties, but it also didn't consider the terrorists' subjective judgment.

2.2. The Assessment Method of Chinese Risk Resources

The assessment of our country's hazard sources analyses from the intrinsic risk and reality risk about chemical and other accidents. The intrinsic risk includes the internal intrinsic character, the process of producing dangerous matter and the internal and external situation of the production element. The reality risk considers the risk deduction brought by the prevention measure at the basis of the intrinsic risk.

Based on this, we divide the accidents caused by human damage into the architecture, coming up with the probability of the risk evaluation described by susceptibility, considering both objectives

and subjective risk factor, improving the architecture of the assessment of risk resources. The improved indexes of the hazard resource are listed on the Table 1 and Table 2.

Table 1 The improved indexes system of large hazard resources of real risk

Real risk				Risk-offsetting factors
Inherent risk				
Accident susceptibility		Severity of accident		
susceptibility of dangerous material accident	Susceptibility of process accident	The accident intensity	Environmental factors at the scene of the accident	

Table 2 The improved indexes system of large hazard resources on terrorist attack

Real risk on terrorist attack							
Risk mitigation factor		Risk of terrorist attack					
Physical protection facilities	Safety management	Severity of loss		Susceptibility to attack			
		Casualties	Property damage	Recognition	Accessibility	Symbolism and sensationalism	Intrinsic risk

3. Terrorist Attack Risk Identification of Major Petrochemical Cluster

Use the WRS-RBS method to identify the risk of major chemical and economic target. Based upon analysis of the relation between risk and risk event, construct the Work Break-down Structure and Risk Break-down Structure, thereby forming WBS-RBS matrix, to estimate the risk degree and transform condition one by one.

3.1. Introduction of WRS-RBS Method

The WBS in WBS-RBS means Work Break-down Structure, the individual cell in the Work Structure is a Work Package. RBS means Risk Break-down Structure. Comprehensive combine the Work Break-down Structure and Risk Break-down Structure to construct WBS-RBS matrix to analyse the possible risks and its degree. In order to apply the WBS-RBS method to the terrorist attacks Risk Identification of major chemical and economic target in the chemical area, two problems need to be solved, the first is to estimate whether the risk exists, and the second is to estimate the condition of the risk factor turning into the risk event and accident.

Procedure of using WBS-RBS method to identify the risk:

Confirm the object of risk Identification. Confirm the object and range of the risk Identification according to the demand before the risk Identification.

Work Break-down, build the Main Part Break-down Structure.

Risk Break-down, construct the Work Break-down Structure. Based on condition of risk, predict the possible risk, and analyze the risk layer-by-layer until all kinds of risks' attribute come to the similarity.

Construct risk Identification matrix. Make the Work Package of Work Break-down Structure in the bottom levels as the line of the matrix, then make the bottom levels' risk of Risk Break-down Structure as the row of the matrix, to build the risk Identification matrix.

Estimate whether the risk exists and the condition of the risk translation. Based on the element of the risk Identification matrix, estimate the possibility of the existence of the "I" Work Package's number "j" risk, if the risk exists, reach "1", if not or have the less risk, reach "0".

The above steps are described in Figure 1.

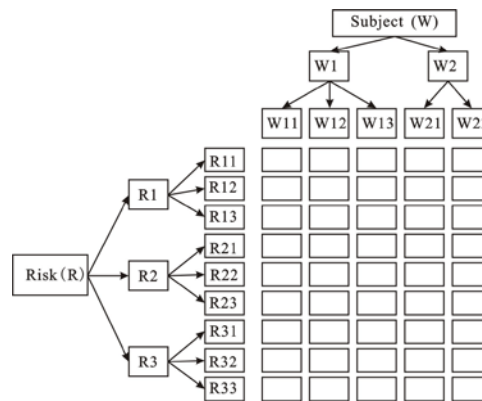


Figure 1 Risk identification matrix.

3.2. Design of Risk Identification Matrix

Terrorist attacks of major petrochemical enterprises may cost fire disaster, explosion and poison blab. Consider the influence secondary disaster costs, identifying the areas` risk in major different petrochemical enterprises after the terrorist attacks in chemical areas, we should mainly research the different type of secondary disaster costs the different influence to the circumstance and other major petrochemical enterprises in the chemical area after the terrorist attacks.

3.2.1. Risk Subject Break-down

In the chemical area, all the major different petrochemical enterprises have possibility of attack, suppose A chemical area has a, b, c and d four major petrochemical enterprises, therefore, there are major chemical company A, B, C and D four risk subject items in this chemical area. These can constitute Risk subject break-down structure.

3.2.2. Risk event break-down

Breaking down the risk event into the risk break-down structure, is to find the risk factor in the risk event, risk event and risk factor are cause-and-effect, therefore, building the RBS is to build the causal relationship between risk event and risk factor. Terrorist attacks of major petrochemical enterprises may cost fire disaster, explosion and poison blab. If these happen may cost fire disaster thermal radiation (R1), explosive blast (R2), secondary explosive debris (R3) and poisonous and harmful substance spread (R4). Therefore, the risk events occur mainly references these four possibilities.

3.2.3. Constructing WBS-RBS Matrix to Identify the Risk in the Area

WBS-RBS matrix composed of risk subject unit (major chemical companies A, B, C and D) and risk event, i.e. fire disaster thermal radiation (R1), explosive blast (R2), secondary explosive debris (R3) and poisonous and harmful substance spread (R4). Table 3 lists the matrix element`s risk condition and risk transition are judged by experts and the feedback of survey table. Risk conditions in this case are high, middle and low. If the matrix element is “0”, expressed as the corresponding subject unit correspond low risk event, has the tiny influence, can be neglected; if the matrix element is “0.5”, expressed as the corresponding subject unit correspond middle risk event; If the matrix element is”1”,expressed as the corresponding subject unit correspond high risk event. All the risk matrix element expressed by “0”, “0.5” and “1”. After the estimation of every risk event condition, then add all the risk event that may happen in the subject unit together, according to the

value of the number to estimate the risk of the subject unit, this text considers risk number in proportion to the risk occurrence possibility.

3.3. Case Analysis of Risk Identification

Taking Nanjing as example, we calculate and analyse the major chemical and petrochemical enterprises' risk Identification. According to incomplete statistics, Jiangsu province has about 1300s petrochemical enterprises, four national level chemical industrial parks, respectively are Nanjing Chemical Industrial Park, Nanjing Economic Development Zone Fine Chemical Industrial Park, Changzhou Binjiang Chemical Industrial Park and Nantong Chemical Industrial Park. Nanjing, as the capital of Jiangsu province, has the advantages of location, good investment condition, large market requirement. Thus over 200 petrochemical enterprises are seated in Nanjing. Combining the characteristic of the major petrochemical enterprises, this article through the investigation and analysis, summarized 18 representative major petrochemical enterprises. Furthermore, these major petrochemical enterprises have the characteristic of numerous in varieties, adjoin the Yangtze River, position concentrated and closing to the residential area, once occur terrorist attacks, easily trigger secondary disaster, polluting water environment, causing permanent damage, existing significant potential safety hazard.

According to the overall situation of the analysis objects, we select position concentrated area of major petrochemical enterprises to identify the major petrochemical enterprises in these areas as shown in Figure 2.

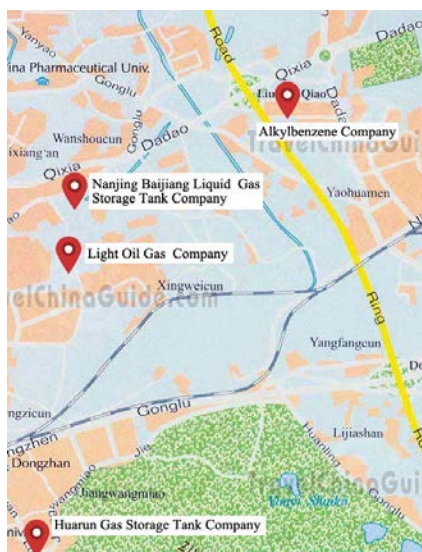


Figure 2 Concentrated area of major petrochemical enterprises.

Therefore, the concentrated area of major petrochemical enterprises' risk subject elements are HuaRun Gas Storage Tank Company、 Alkylbenzene Company、 Light Oil Gas Company、 NanJing Baijiang Liquid Gas Storage Tank Company, risk event units are fire disaster thermal radiation (R1)、 explosive blast (R2)、 secondary explosive debris (R3) and poisonous and harmful substance spread (R4),based on the risk exists possibility and the condition of the risk translation, building the WB-RBS matrix as shown in Table 3.

The results show that the largest attack possibility of the major petrochemical enterprises in this area is NanJing Baijiang Liquid Gas Storage Tank Company, secondly, the Alkylbenzene Company, thirdly, the Light Oil Gas Company, HuaRun Gas Storage Tank Company has the minimum influence.

Table 3 Risk identification in the petrochemical area.

Item	HuaRun Gas Storage Tank Company	Alkylbenzene Company	Light Oil Gas Company	NanJing Baijiang Liquid Gas Storage Tank Company
R ₁	0.5	1	0.5	1
R ₂	0.5	0.5	0.5	1
R ₃	0	0.5	0.5	1
R ₄	0.5	1	0.5	1
R	1.5	3	2	4

4. Conclusions

The paper analyses the terrorist attacks risk and the disaster types that the major chemical company might existing and causing taking example by the judging content of threatening against terrorists attack and building vulnerability, Thereafter we perform risk identification of major petrochemical enterprises cluster by WBS-RBS method, and analysing and researching with the example of some major chemical and economic company concentrated district in Nanjing.

Acknowledgements

This work was financially supported by Military Science Project of the National Social Science Fund of China (16GJ003-163).

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