Progress Report on Standard “External Safety Protection Distance Standard for Hazardous Chemical Production and Storage Installations”

YANG Guoliang

China Academy of Safety Science and Technology

2018.9

CONTENT

1. Background

1.1 urbanization process

From 1978 to 2015, China's urbanization rate increased from 17.9% to 56.1%. China is experiencing the most rapid and complex urbanization process in world history.

Year	Urbanization rate
2000	36.22%
2001	37.66%
2002	39.09%
2003	40.53%
2004	41.76%
2005	42.99%
2006	43.90%
2007	44.94%
2008	45.68%
2009	46.59%
2010	49.68%
2011	51.27%
2012	52.57%
2013	53.70%
2014	54.77%
2015	56.10%
2020	63.40%

1. Background

1.2 Production safety: current situation

The intense spatial development increases the severity of the accident

- The accident bearing body is highly concentrated
- Cities are more vulnerable
- The chain effect of accident disasters has increased

1. Background

1.2 Production safety: current situation

Rapid development in time has led to frequent accidents and disasters

- Early design standards are low and the layout of old industrial areas is unreasonable
- The phenomenon of “city surrounded by petrochemical facilities” and “petrochemical facilities surrounded by city” is outstanding

1. Background

1.1 Production safety: current situation

With the rapid development of urbanization in China, some hazardous chemical enterprises have shown an inadequate safety protection distance from urban areas, residential areas and other enterprises around them, making the risk posed by hazardous chemical enterprises to social public security increasingly prominent.

1.2 Necessity

Guofa [2006] No. 24 “Opinion on comprehensively strengthening emergency management”
Safety Office of State Council [2008] No. 26 “Guidance on further strengthening the work of safe production of hazardous chemicals”
Safety Office of State Council [2009] No. 7 “Notice on the issue of safe production management action implementation plan”
Guofa [2011] No. 40 “Opinion on insisting scientific and safe development, promoting sustained and stable improvement in production safety
Guobanfa [2014] No. 9 “Guidance on promoting the relocation and renovation of old industrial areas in urban areas ”
Guobanfa [2016] No. 57 “Guidance on structural adjustment, transformation and to increment performance in petrochemical industry”
Guobanfa [2016] No. 88 “Circular on the issue of comprehensive management system of hazardous chemicals”
Guobanfa [2017] No. 77 “Guidance on relocation and transformation of hazardous chemical production enterprises in densely populated areas”
State Council Decree No. 591 “Regulations on the Control over Safety of Hazardous Chemicals”
State Council Decree No. 593 “Regulations on the highway protection”

1.2 Necessity

State Council Decree No. 591 “Regulations on the Control over Safety of Hazardous Chemicals”
State Council Decree No. 593 “Regulations on the highway protection”
“Code for fire protection design for petrochemical enterprises” GB50160-2008
“Code for fire protection design of building” GB50016-2014
“Code for design of oil depot” GB 50074-2002
“Code for design of petrochemical industrial warehouse and storage yard” GB50475-2008
“Design code for hydrogen station” GB 50177-2005
“Design code for oxygen station” GB 50030-91
“Safety regulations for the production of phosgene and phosgenation products” GB 19041- 2003

1. Background

1.3 Objective

In order to implement the requirements of Decree No. 591 issued by the state council, this standard has been issued to properly solve the problems of site selection of new hazardous chemical enterprises, relocation of high-risk enterprises and unclear external safety protection distance of hazardous chemical production and storage installations in existing enterprises.

1 Background

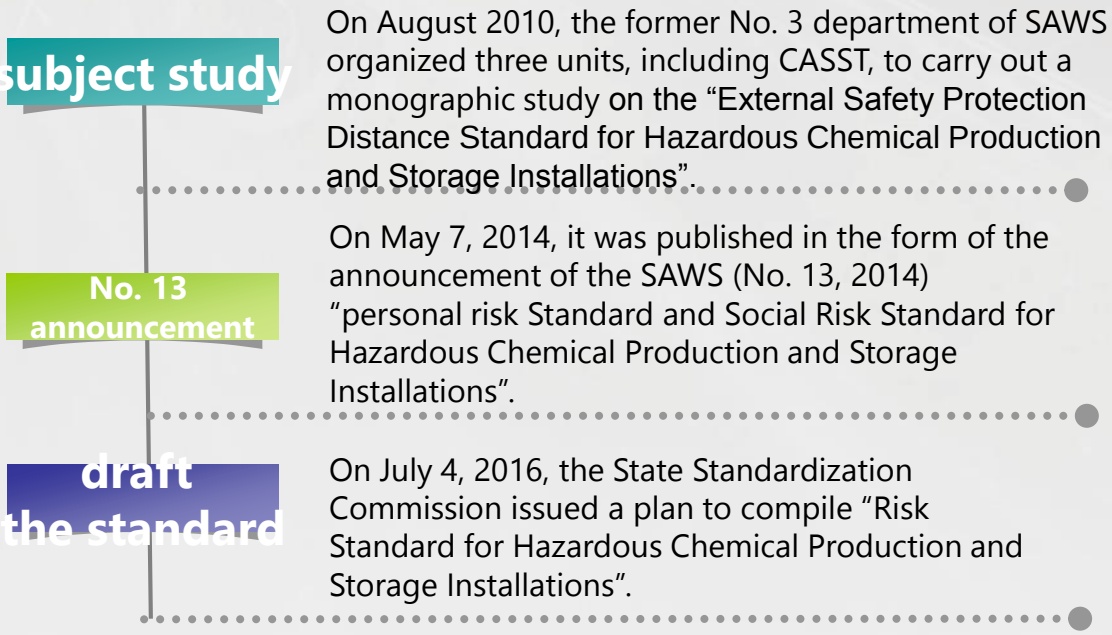
2 Drafting process

3 Main content

4 Summary

2. Drafting process

This standard is a mandatory national standard, the general timeline is divided into three stages: subject study, No. 13 announcement and drafting of standard.



2. Drafting process

On July 27, 2017, the public consultation draft was submitted to the public through the website of the SAWS and the SCSA.

On October 28, 2017, the standards (submitted for review) passed the standards review meeting organized by the chemical safety standards sub-committee and formed the standards after modification (submitted for approval).

内容提要

1. Background
2. Drafting process
3. Main content
4. Summary

3.1 Application

“Determination Method of External Safety Protection Distance for Hazardous Chemical Production and Storage Installations”

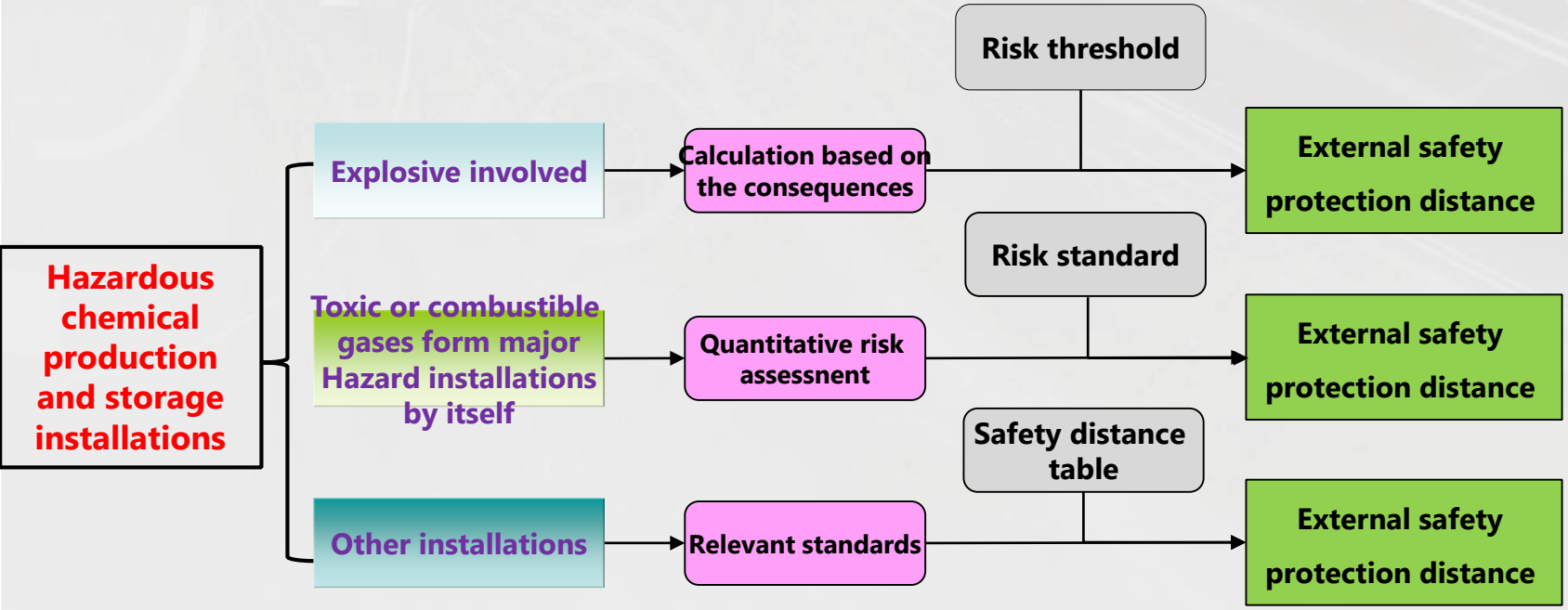
This standard is used to determine the external safety protection distance for hazardous chemical production and storage installations.

This standard is not applicable to the production and distribution enterprises in civil explosives industry, fireworks and firecrackers production enterprises and storage warehouses, automobile refueling and gas filling stations, oil and gas pipelines, town gas, port area and hazardous chemical production and storage installations used for national defense scientific research and production.

“Risk Standard for Hazardous Chemical Production and Storage Installations”

This standard is applicable to the risk assessment of the site selection and surrounding land use planning for hazardous chemical production and storage installations.

3.2 Method selection procedures



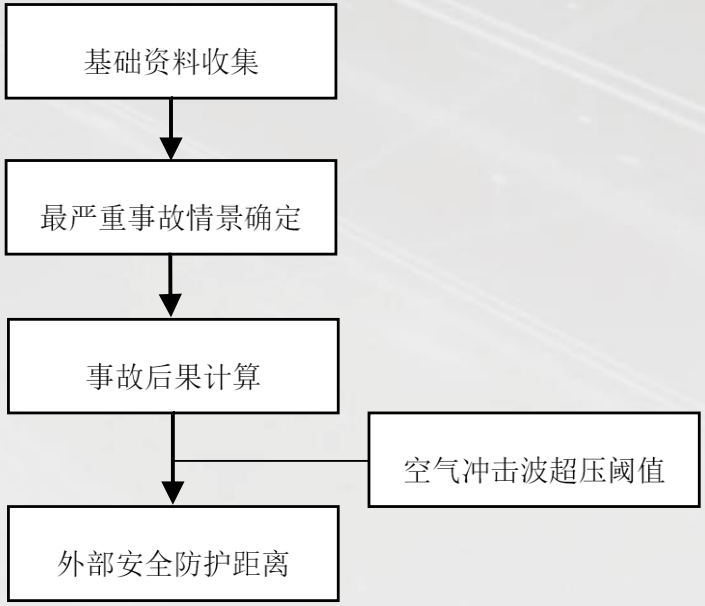
3.2 Methods of Consequences

Methods of Consequences is based on he explosion accident consequence model. The method used to determine the external safety protective distance is calculated according to the most serious explosion accident scenario that may occurred to the device. The calculation procedure is as follows：

① Determine the most serious accident scenario;

② Calculate the accident consequences;

③ Determine the external safety protection distance.



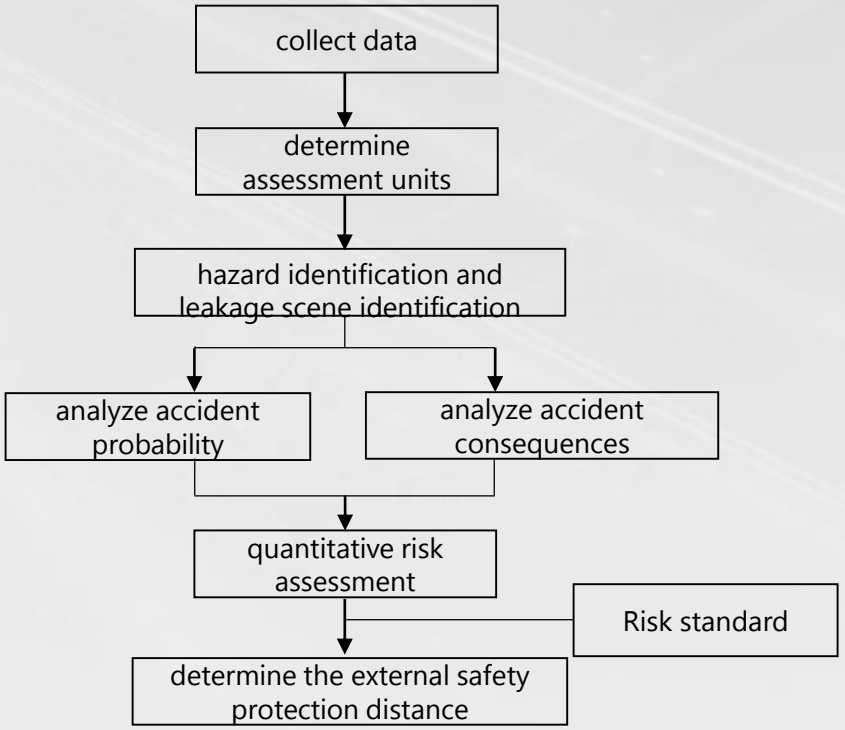
3.2 Methods of Consequences

Protected targets	Air shock wave Overpressure threshold (pa)
High sensitive protected targets, important protected targets Type 1 protected targets in general protected targets	2000
Type 2 protected targets in general protected targets	5000
Type 3 protected targets in general protected targets	9000
Note 1: Types of protected targets are divided acc.toGB XXXXX. Note 2: 2000 Pa is the ceiling that causing no damage to buildings; 5000 Pa is below average that causing minor damage to buildings (2000~9000 Pa), possible to cause glass to be completely broken, tile roofing a little move, a small amount of dust on the inner wall falling; 9000 Pa is the ceiling that causing minor damage to buildings (2000~9000 Pa), possible to cause partial damage of buildings and uninhabitable, slight deformation of steel structure and no damage to reinforced concrete columns; The above threshold does not cause direct death to outdoor personnel.	

3.3 Quantitative risk assessment method

Quantitative risk assessment method is a method to quantitatively analyze and calculate the accident frequency and consequence for hazardous chemical production and storage installations, to determine the external safety protective distance with acceptable risk standards. Calculation is as follows:

a) collect data;
b) determine assessment units;
c) hazard identification and leakage scene identification;
d) analyze accident probability;
e) analyze accident consequences;
f) quantitative risk assessment;
g) determine the external safety protection distance.

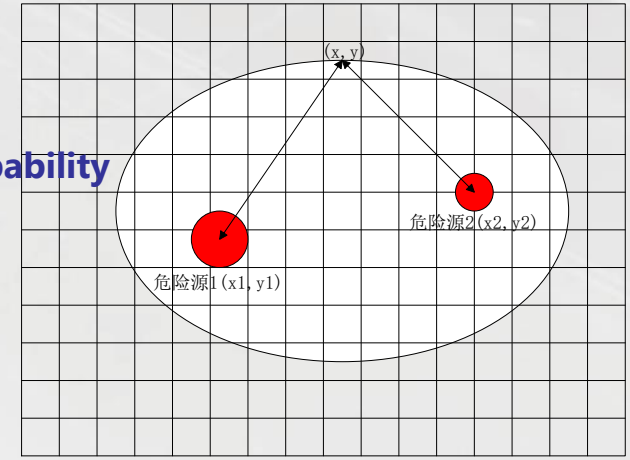


3.3 Quantitative risk assessment method

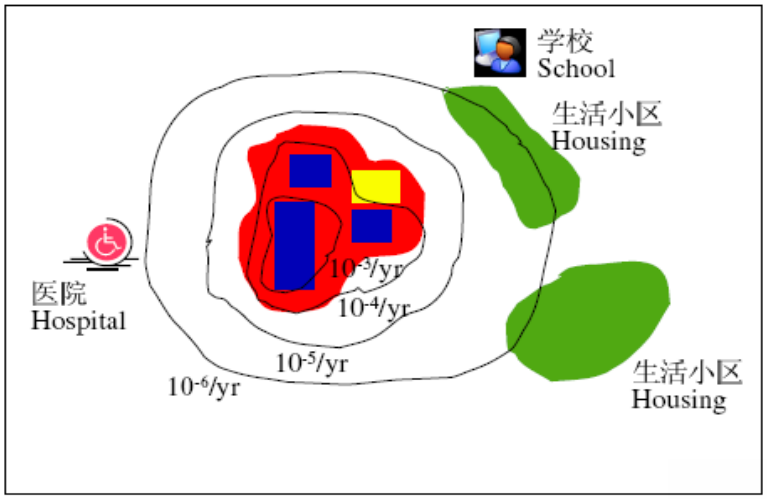
Basic theory

Risk = Possibility of accident × accident consequence

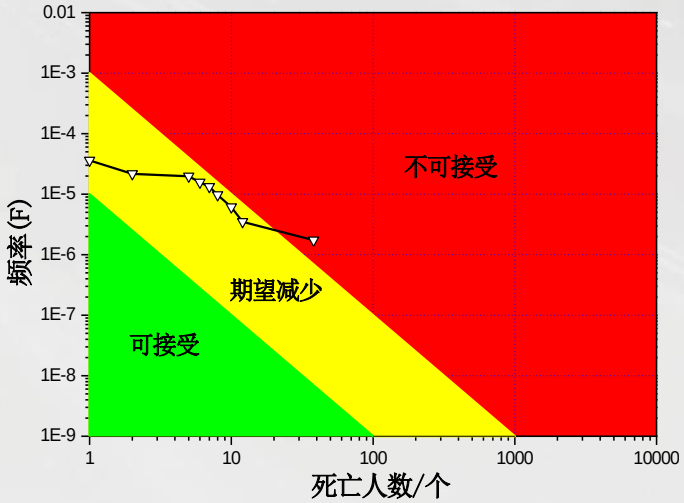
Probability of death	Annual probability	Resulting casualty probability
times/year*person	times/year	times/person



Result of Calculation



personal risk



Social risk

3.4 Personal risk standard

Types of protected targets

According to the main properties of the facilities or sites, protected targets are divided into:

Classification of protected targets	Scope of protected targets
High sensitive protected targets	Cultural facilities, education facilities, medical and health facilities, social welfare facilities, and other places with relatively low self-protection capacity in the accident scene.
Important protected targets	Public book exhibition centers, cultural relics protection units, places of worship, urban rail transit facilities, military and security facilities, places for foreign affairs management and other places with special protection value or inconvenient for the evacuation of personnel in accident scenes.
General protected targets	Other protected targets, divided into type 1, 2, 3 protected targets based on the scale.

3.4 Personal risk standard

Classification of protected targets

Types of protected targets	Type 1 protected targets	Type 2 protected targets	Type 3 protected targets
Residential buildings and corresponding service facilities Residential areas include: rural settlements, low-rise residential areas, middle and high-rise residential buildings. Corresponding service facilities include: residential area and its child-care facilities, cultural facilities, sports facilities, commercial facilities, health services and facilities for the aged and disabled, excluding primary and secondary schools.	Above 30 households or containing in total less than 100 people.	Above 10 and below 30 households above 10 and less than 30, or persons are above 30 and less than 100.	Below 10 households, or less than 30 persons.
Administrative facilities Including: political party and government bodies, social organizations, scientific research centers, public institutions and other office buildings and related facilities.	Party and government bodies above the county level and other administrative office buildings with more than 100 employees.	An administrative office building with fewer than 100 employees.	
Sports venues Does not include: dedicated sport facilities for school and other institutions.	The total construction area is over 5000m^2.	The total construction area is less than 5000m^2.	

Note: Refer to "Code for classification of urban and rural land use and planning standards of development land" (GB 50137)

3.4 Personal risk standard

By multiplying the average mortality rate of the lowest age and the risk control factor corresponding to different protected targets we reach the acceptable personal risk standard in China:

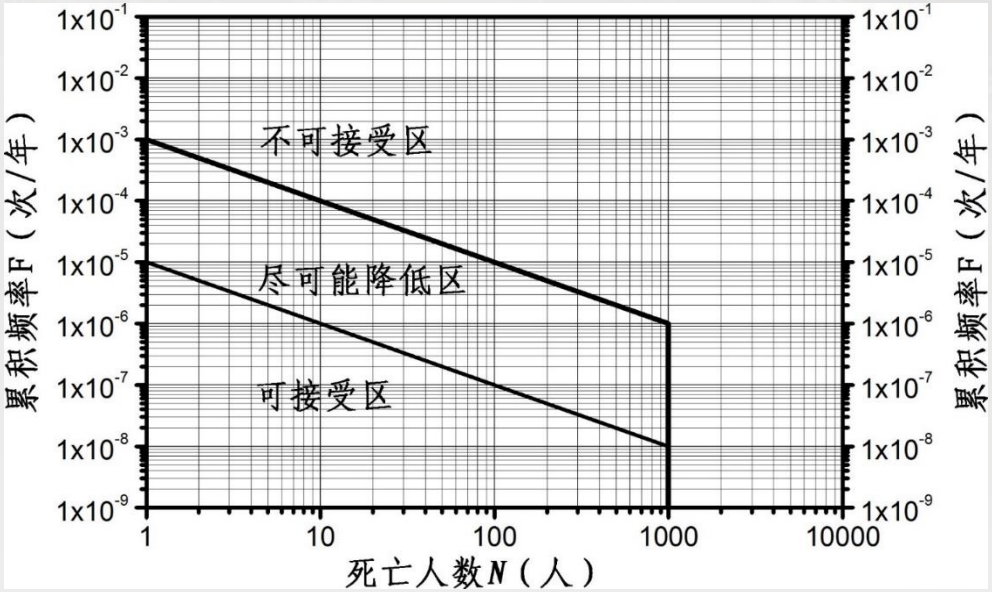
Protected targets	Personal risk standard	
	newly built, renovated or expanded hazardous chemical production and storage installations (times/per year) ≤	Existing hazardous chemical production and storage installations (times/per year) ≤
High sensitive protected targets Important protected targets Type 1 protected targets in general protected targets	3×10^{-7}	3×10^{-6}
Type 2 protected targets in general protected targets	3×10^{-6}	1×10^{-5}
Type 3 protected targets in general protected targets	1×10^{-5}	3×10^{-5}

3.4 Personal risk standard

Country or region		Standard (Per year)		
		Type 1 protected targets Important protected targets High sensitive protected targets	Type 2 protected targets	Type 3 protected targets
The Netherlands	New installations	1×10^{-6}	1×10^{-6}	1×10^{-6}
	Existing installations	1×10^{-5}	1×10^{-5}	1×10^{-5}
The United Kingdom		3×10^{-7}	1×10^{-6}	1×10^{-5}
Hong Kong		1×10^{-5}	1×10^{-5}	1×10^{-5}
Singapore		1×10^{-6}	1×10^{-6}	5×10^{-5}
Malaysia		1×10^{-6}	1×10^{-6}	1×10^{-5}
Australia		5×10^{-7}	1×10^{-6}	5×10^{-5}
Canada		1×10^{-6}	1×10^{-5}	1×10^{-5}
Brazil	New installations	1×10^{-6}	1×10^{-6}	1×10^{-6}
	Existing installations	1×10^{-5}	1×10^{-5}	1×10^{-5}
Note: There are differences in the types of protected targets set by different countries. The above personal risk standard table is only a summarized comparison based on this standard.				

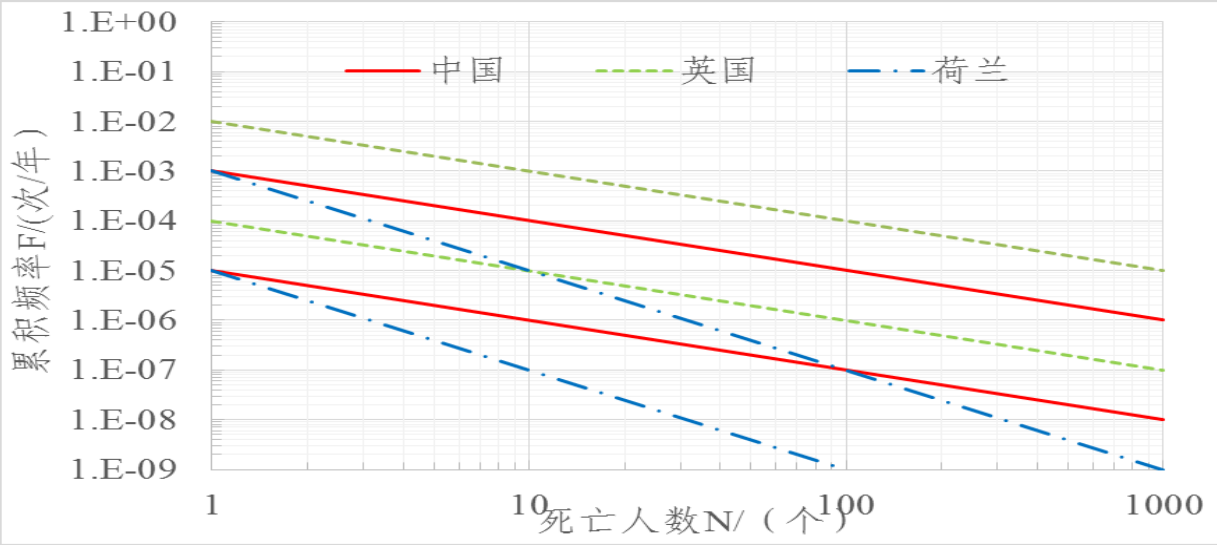
3.4 Social risk standard

Taking into account China's national conditions and observing relevant practices of international existing acceptable social risk standards, China's standard social risk value is determined as follows.



3.4 Social risk standard

Comparing China's social risk standard with other countries (regions), it can be seen that China's social risk standard is lower than the Netherlands, but higher than the UK.



1 Background

2 Drafting process

3 Main content

4 Summary

4 Summary

- the new standard fully takes into account the characteristics of high population density and dense production and storage facilities for hazardous chemicals in China, which is more suitable for China's national conditions.
- The new standard realizes the application of quantitative risk method in determining the safe distance of dangerous chemical production and storage devices, and makes the external safe distance more scientific and flexible.


谢 谢！