# Introduction of Tianjin Port Accident

The extremely severe fire and explosion at Ruihai International Logistics hazardous goods warehouse at Tianjin Port on 12 August 2015

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## Background Information

8/12/2015

 A fire broke out in the delivery zone of the hazardous chemical warehouse of Ruihai International Logistics company inside the Tianjin port

22:51:46



Map 1: Ruihai's geographical location

## Background Information

- The first explosion occurred at 23:34:06
  - 43 minutes after the fire broke out
- The second explosion occurred at 23:34:37.
   (Much more Violent !!!)
- 6 major fires and dozens of small fires at the scene of the accident.





According to the degree of damage, the area was categorized into the central zone and the affected zone.

The surface area of the central zone is approximately 540 000 m<sup>2</sup>.

The explosion pit was considered to be the main centre of the explosion. (diameter: 97 m; depth: 2.7 m)



Ground shaking caused by the explosions detected as far as 13.3 km away from the explosion center in the north

Map 4: Schematic sketch of the blast shock-wave affected zones

165 lives were lost in the accident

— 99 fire-fighters

— 11 police officers



55 civilians from Ruihai, neighbouring companies and residential areas
 8 people were missing
 798 people were injured and hospitalized
 58 people with severe or moderate injuries
 740 people with minor injuries

304 buildings were damaged 12428 cars and 7533 cargo containers were damaged or destroyed 30 fire trucks totally destroyed

The direct economic loss: 6.8 billion RMB\* (approximately the equivalent of **0.93 billion euros**).

\* Based on the Standard for Evaluating Economic Loss Incurred Following Injuries and Deaths of Company Personnel (GB6721-1986) . Other kinds of loss remain to be determined.

#### **Consequences** (Environmental pollution)

- At least **129 chemical substances** were found to have exploded, combusted, leaked or diffused.
- 50% of those are the following substances (by weight): Sodium Hydroxide(NaOH,1900T), Potassium Nitrate (KNO<sub>3</sub>,1300T), Ammonium Nitrate (NH<sub>4</sub>NO<sub>3</sub>,800T), Sodium Cyanide(NaCN,680T), Magnesium (Mg,500T) and Sodium Sulfide(Na<sub>2</sub>S,480T).

## **Consequences** (Environmental pollution)

#### X Air pollution

- Environmental authorities conducted air quality surveillance outside the central zone of the accident, 3-5 km away from the centre of the explosion.
- The accident had caused severe air pollution in the central zone of the accident.
- From the day of accident till 12 September, sulphur dioxide, hydrogen cyanide, hydrogen sulphide and ammonia levels in the central zone of the accident exceeded by 1 to 4 times the standard limits

## **Consequences** (Environmental pollution)

#### **X** Water pollution →

- The accident also polluted water and underground water around the explosion centre
  - The main pollutant was cyanide.
- Tianjin municipal authorities carried out effective monitoring and responding measures to handle polluted water bodies

#### ✗ Soil pollution

- Some locations had cyanide and arsenic out of limits.\*
- The environmental impact on soil outside the central zone of was relatively small.

# X A need to conduct mid-to-long-term environmental risk assessments.

\* Based on the Screening Value for Environmental Risk Assessment of Site Soil (DB11/T 798-2011) for Parks and Green Spaces

The cause of the fire:
Intentional or lightning factors eliminated
The primary combustible material was nitrocellulose, which was determined by experiments and video evidence.

#### **About Nitrocellulose**



Nitrocellulose (also known as cellulose nitrate, flash paper, flash cotton, guncotton, and flash string) is a highly flammable compound formed y nitrating cellulose through exposure to nitric acid or other powerful nitrating agent.







Damping agent ethanol was Used in the packaging

Nitrocellulose packaging with packaging strings, instead Of thermoplastic sealing





The total strength of the explosions involved in the accident was equivalent to approximately **450 tonnes of TNT.** 



TIME: 23:34:37



#### Surveillance video No 4

Combustion experiment on a 40 kg drum of nitrocellulose

# Indirect causes

- Main issues of the Warehouse company
- Ruihai constructed the hazardous storage warehouse before obtaining approval and conducted business during the construction.
- Approvals for hazardous goods business operations obtained illegally
  - They bribed some of the authority officers to get the permit and require less supervision
- Heavily overloaded business operations with chaotic storage against regulations
- No official registration or records of major hazardous materials
- Seriously lack of training in work safety
  - Some of the forklift drivers did not acquire qualifications of hazardous goods on-shore operations and did not receive relevant training on safe operations of hazardous goods.
  - Their knowledge of protection against hazardous goods was limited to no smoking at the site and that vehicles need to be fire proof.
- Emergency preparedness incompliant to emergency response regulations

## Indirect causes

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- Main issues identified among relevant authorities, departments and intermediary agencies
- Tianjin Transport Committee abused their power, issued permits and approved projects in violation of the law;
- Some departments and units of the Tianjin Port Group Company falsified documents and gave approvals in violation of the law, and did not sufficiently supervise hazardous goods warehouses at the port
- Tianjin Customs approved permits against laws and regulations, neglected their duty and did not carry out regular supervision.
- Tianjin Safety Supervision authorities neglected their duty, did not regularly supervise or inspect Ruihai's business operations in accordance with laws and regulations, and did not regularly supervise safety assessment institutes.
- Tianjin public security authorities failed to conscientiously implement the relevant laws and regulations and failed to conduct fire safety monitoring, guidance and inspections according to policy

# Lessons Learned

- Urge business entities to effectively implement accountability systems for work safety.
- Further streamline the Port Safety Management System.
- Establish a unified national supervision information platform for hazardous chemicals.
- Supervise intermediary agencies responsible for safety assessment, environmental impact assessment, etc.



# Lessons Learned

- Staff and managers should have the capacity to apply procedures for safe operation. All staff should be well-trained and aware of the importance of safety.
- Strictly regulate the safety distance between the hazardous goods warehouse and important public buildings including neighbouring residential areas.
- Strengthen work safety emergency preparedness and response capacity



# Thank you for your attention!

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