Lecture PA3

Enschede Accident

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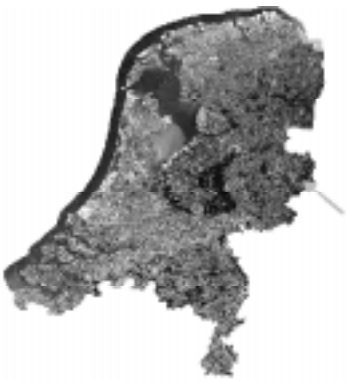
Some facts

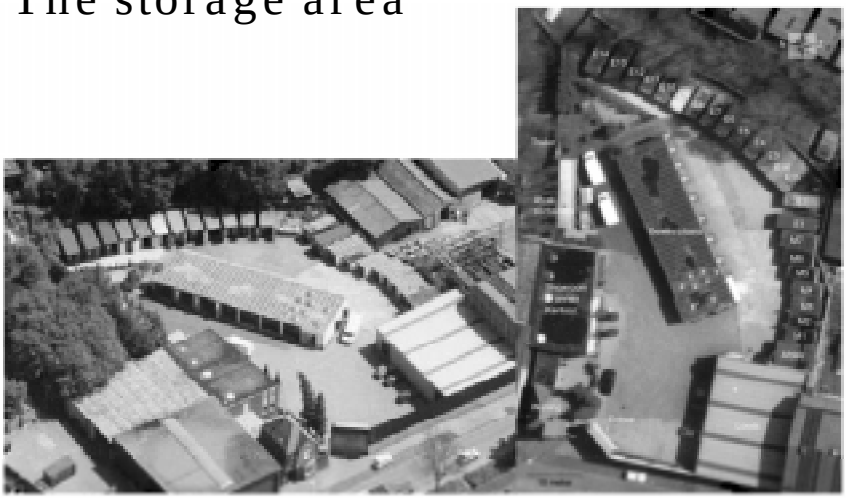
- **On the 13th May 2000; 15.35 an explosion of a fireworks storage facility caused 22 casualties; 947 injuries; destroyed a complete living area (500 houses) and 1350 houses damaged; over one billion guilders damage**
- **Forensic investigations are completed; legal procedures on going**
- **Government commission (Oosting) has completed task of investigating role of local and national authorities**

Location

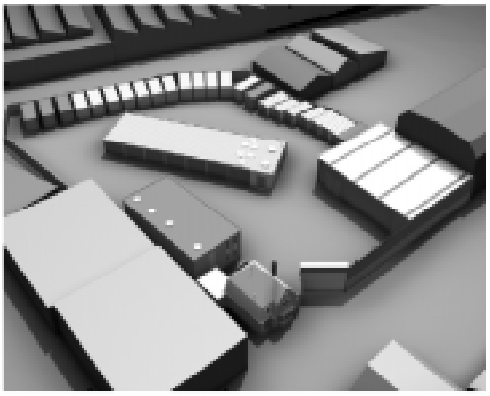
- City of Enschede, eastern part of Netherlands



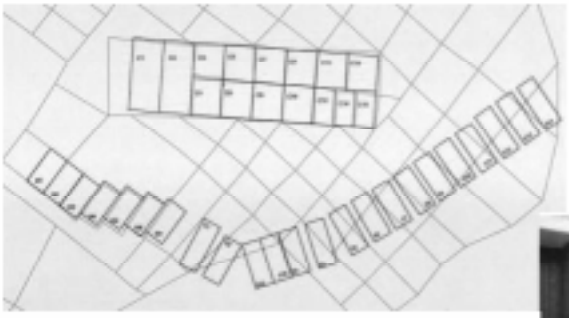
The storage area

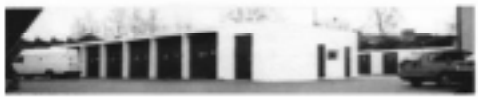


On the day of the accident . . .



The storage facilities





Permits

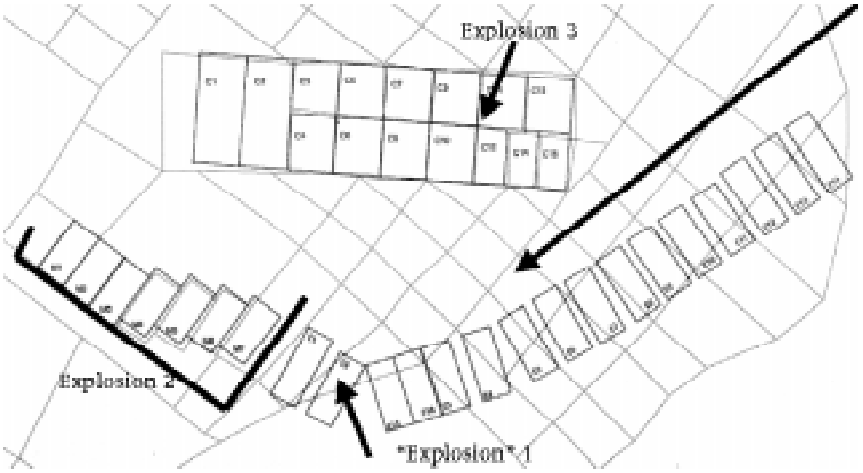
- **The facility had permission to store:**

Location	Gros mass	Hazard Division
C3 to C11	7000 kg	1.4S and 1.4G
C13	500 kg	1.3G (OR 7000 kg 1.4S en 1.4)
C12, C14, C15	500 kg	1.3G (OR 5000 kg 1.4S en 1.4G)
C2	500 kg	1.4S and 1.4G, during work hours
M1 to M7	3500 kg	1.4S and 1.4G
E1 to E14	3500 kg	1.4S and 1.4G

- **TOTAL: 159000 kg 1.4S / 1.4G**
- *OR* **147000 kg 1.4S / 1.4G and 2000 kg 1.3G**

The storage facilities

Camera view point



Crater central storage area (mostly C11)

Sequence of events

14.45	**Fireworks emanating from facilities**
15.02	**First report to fire brigade, 6 minutes arrival**
15.08	**Fire in C2, 15.15 under control**
≈15.18	**Fire in C4**
≈15.28	**Fire observed between E2 and E15, rockets C4**
15.33.58	**E2: exploding article in E2, 20 s later: jet of flames ≈ 30 m**
15.34.40	**Explosion MAVO boxes, fire ball ≈ 85 m**
15.35.46	**Explosion cell C11 (and rest), fireball ≈ 135 m**

What was stored?

- **Container E2: 6” color shells and larger**
- **Garage box M 6: Roman candles, cakeboxes, fuse**
- **Garage box M 7: 6” color shells and larger**
- **Concrete cell C 11: 6” report shells, 6” color shells**

What was stored where?

Explanation

- **For some reason, a fire started in C2, arson is suspected**
- **Fireworks thrown out of C2**
- **Some fireworks landed between E2 and E15, an old trailer was parked there, providing enough fuel**
- **The fire initiated the fireworks inside the container; resulting in a jet of flames of about 30 meter and projection of fireworks**
- **Some of the projected fireworks may have damaged the garage doors and fire was started in M6 or M7**

Explanation (2)

- **M6 or M 7 exploded first, (M7 most violent) followed by the explosion of the other garage boxes within a fraction of a second; strength of the explosion 700 to 1700 kg TNT, fire ball 85 m (≈ 17000 kg propellant)**
- **The force of the explosion destroyed all doors of the concrete cells, the fireball engulfed the whole area**
- **One minute later, the reaction of fireworks increases; followed by the explosion of cell C11, strength 4000 to 5000 kg TNT, fire ball 135 m (≈ 86500 kg propellant)**
- **Virtually instantaneously the other cells (and containers) exploded sympathetically**

Conclusion

- **Exact reason for the first fire not proven, trial against suspect of arson is on going**
- **Sequence of events is established, video's very helpful**
- **Proper 1.4 fireworks (and 2000 kg 1.3) could not have caused this disaster**
- **All boxes were labeled 1.4**
- **Apparently, the classification was wrong**
- **Extensive classification trials were performed**

What did we learn?

- **Classification of fireworks often wrong, usually it is common practice to accept the classification of the sender……**
- **Most of the fireworks is classified by the 'grandfather clause' (once tested, similar articles have the same classification), but fireworks have developed a lot (louder, more spectacular, more……)**
- **Set up of the UN 6(c) tests was changed some years ago**
- **UN test 6(a) and 6(b) is the essential test to assess mass explosive behaviour for certain types of fireworks**
- **Is UN system always suitable for storage?**

How can we prevent it from happening again?

- **On the UN level, activities are going on to come to a system of default classification of fireworks; deviation from the default has to be demonstrated with test reports**
- **At EU level, a research project is about to start to assess UN tests for fireworks storage purposes**
- **Extensive enforcement in the port of Rotterdam and in storage facilities**
- **New (restrictive) law on fireworks**
- **Whole of Class 1 (and other substances that can give an explosion) under scrutiny at the moment**