The Tragedy Of San Juanico, PEMEX, Mexico City, 19 Nov 84

- A BLEVE Case Study
- Presented to ES-317y at UWO in 1999
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Definition of a BLEVE

- B = Boiling
- L = Liquid
- E = Expanding
- V = Vapor
- E = Explosion

BLEVE Causes

- Flame impinging on the vapor space of a pressure vessel.
- Mechanical failure in the vapor phase.
- Corrosion in the vapor phase.
- Vapor phase is hit by flying fragment.

The BLEVE Event

- There is an initial damaging shock wave.
- The liquid flashes to a fraction of vapor.
- If an ignition source is nearby a fireball is created.
- A high energy release can tear the vessel into pieces creating flying fragments.
- Fragments can rocket as far as 1,200 meters.

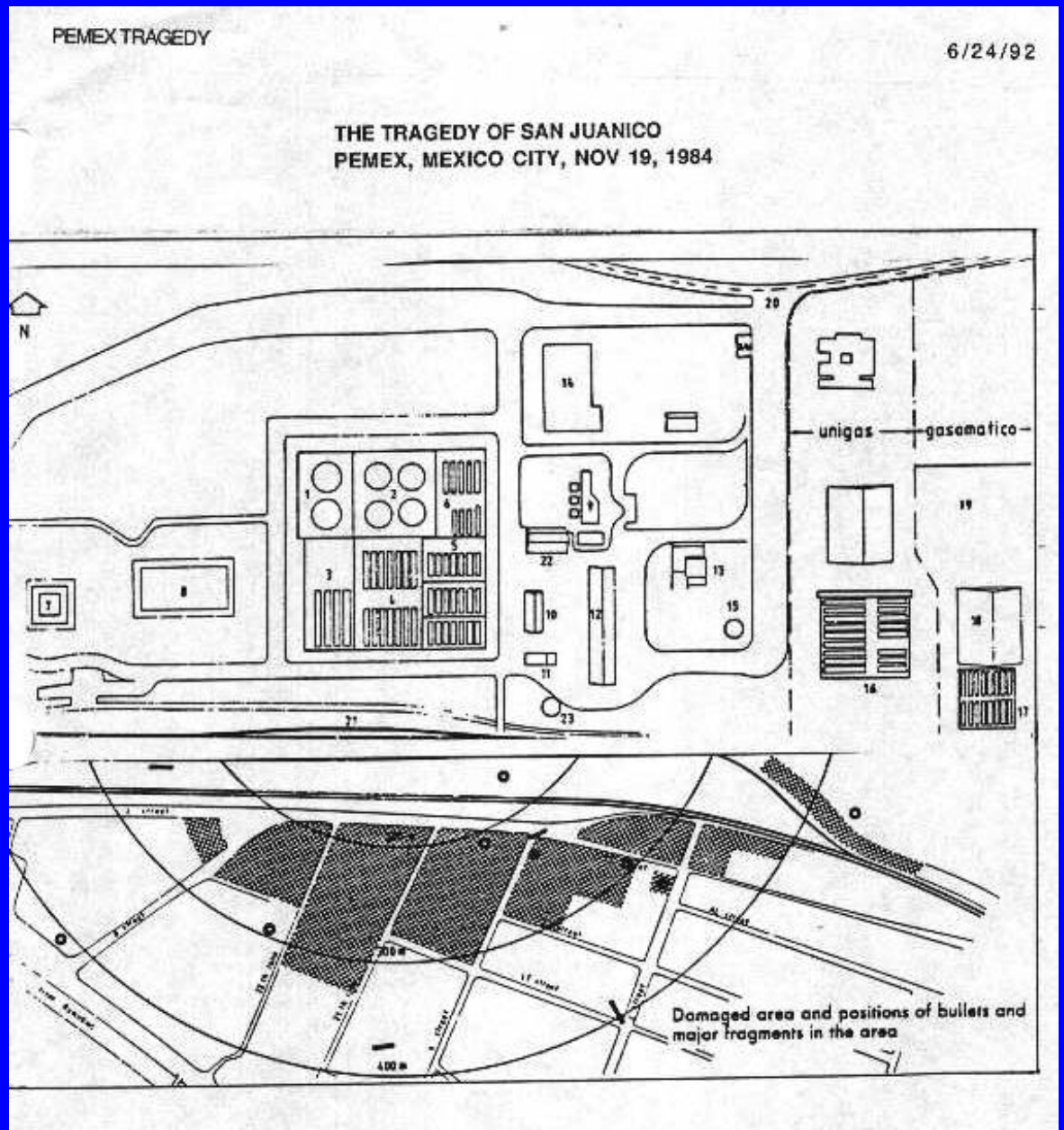
BLEVE Analysis

- BLEVE consequence calculations are provided in numerous spreadsheet programs in the Hazard Analysis folder available to all students.
- One particularly useful program is called Flammable Hazard V1.2.

Pemex (Petroleos Mexicanos)

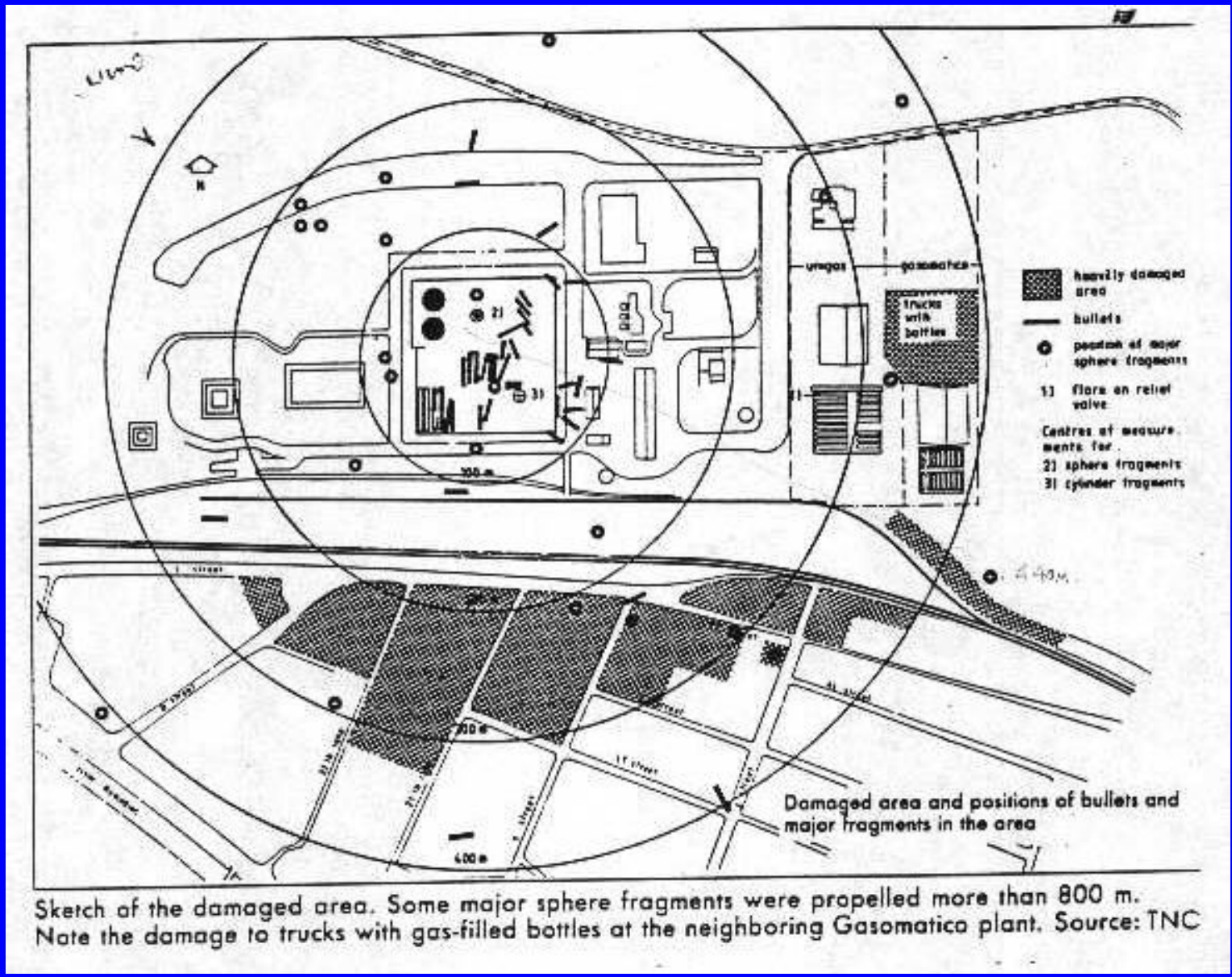
- Pemex is a liquid petroleum gas (LPG) distribution plant.
- Pemex is located a few km. north of Mexico City (Pop = 16MM).
- Plant was 25 years old and built to 1950 API standards of the U.S.
- LPG gas is used for heating and cooking in almost every household.

Pemex Plot Plan - Before



Pemex Before BLEVEs

Plot Plan - After



Sketch of the damaged area. Some major sphere fragments were propelled more than 800 m. Note the damage to trucks with gas-filled bottles at the neighboring Gasomatico plant. Source: TNC

Results When 15 of 48 Vessels BLEVE In Domino Fashion

- 550 people killed.
- 2,000 people receive severe burns.
- 7,231 people classed as injured.

Initiating Event

- EBV shuts feed to a sphere at 90% full.
- Possible “water hammer” damages the 8 in. feed pipe near the vapor phase of F-4.
- Vapor cloud drifts toward a ground flare, ignites and causes a flash fire.
- The flame burns back to source and impinges on vapor space of sphere F-4.

Initiating Event Cont'd

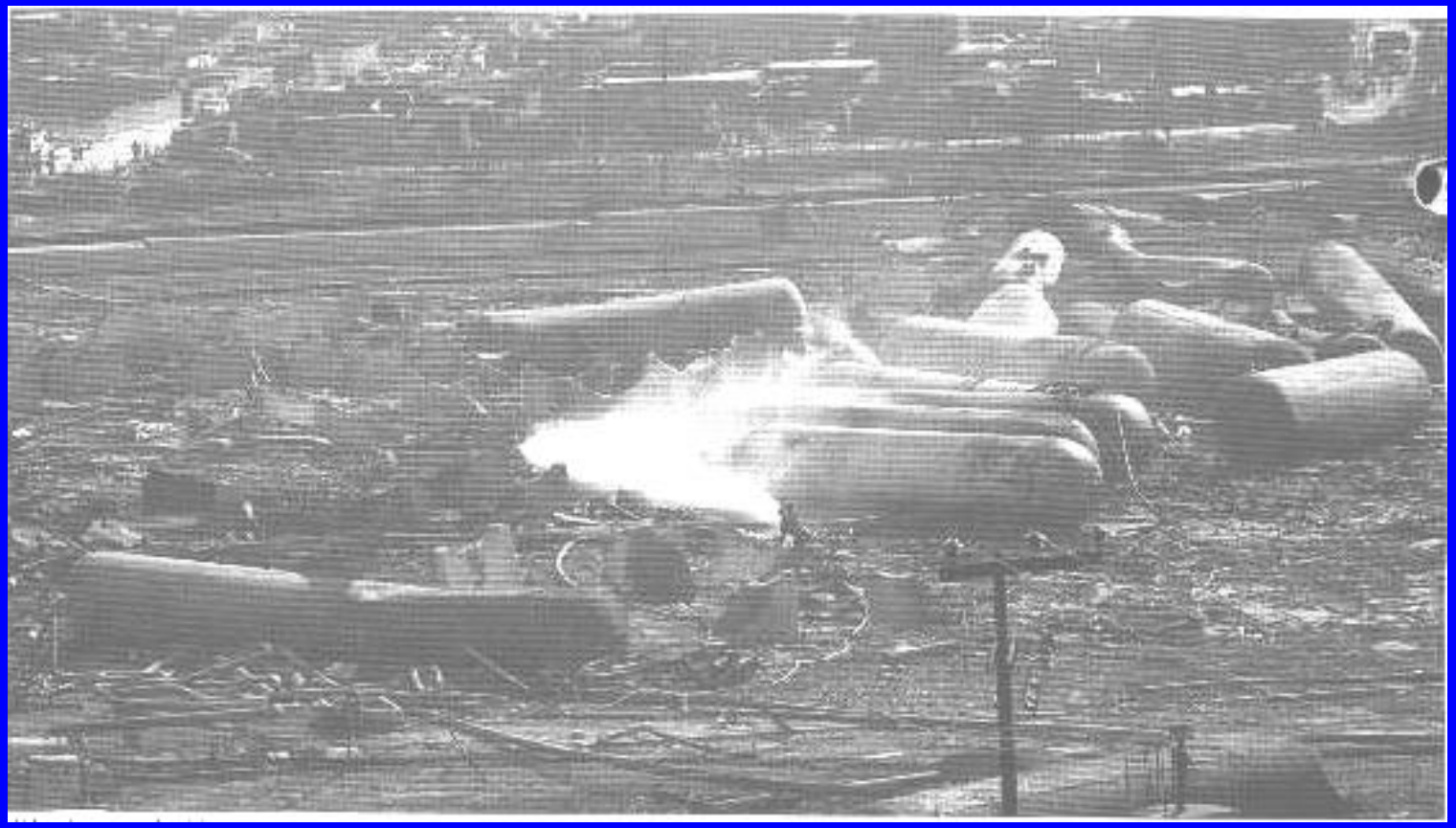
- 10 minutes after line rupture, sphere F-4 BLEVEs.
- Vessel explosion as pressure is relieved.
- Fire ball from flashing contents.
- Large energy release breaks vessel into pieces which fly off as missiles.

Initiating Event Cont'd

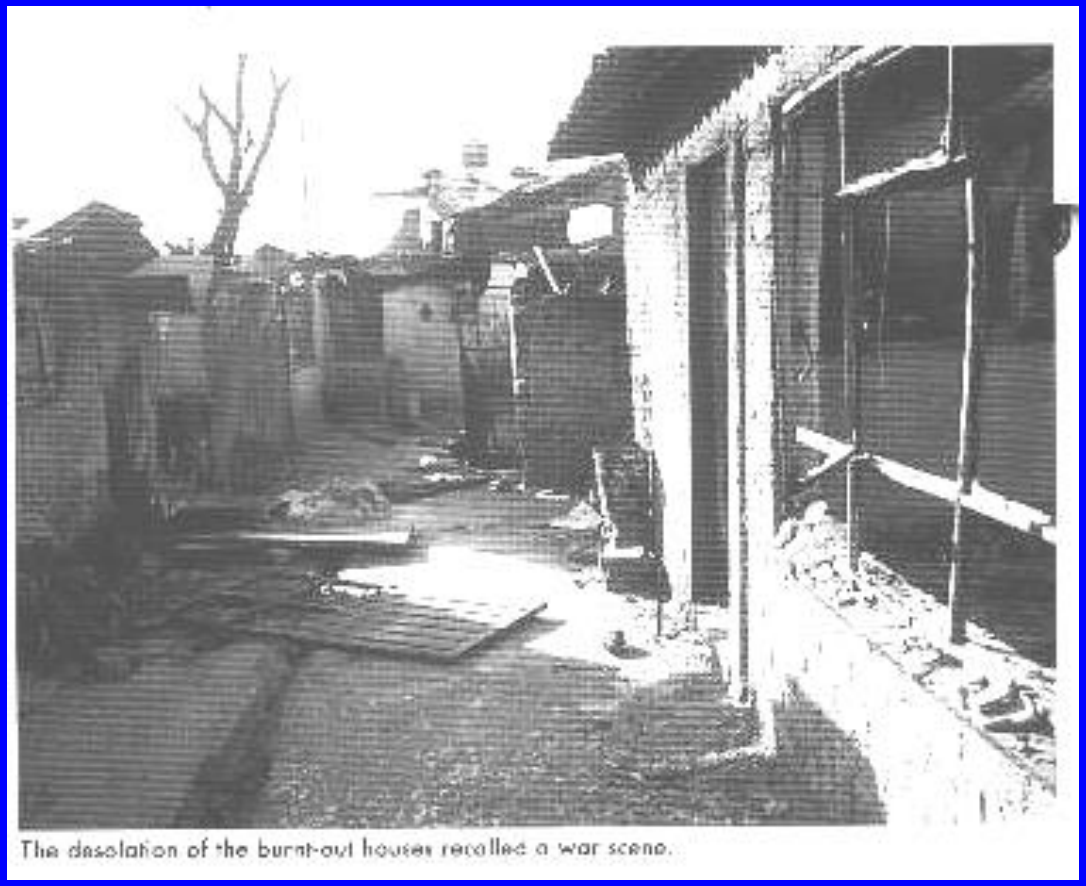
- Missiles from F-4 strike other vessels.
- More liquid leaks, more fires and other BLEVEs are created.
- 14 other vessels BLEVE in domino fashion over a 5 hour period.
- The site emergency fire water system is overwhelmed.

F-4 Failure

Bullet Tank Area



Nearby Houses



The desolation of the burnt-out houses recalled a war scene.

Missile Alert

- F1, F2, F3 and F4 spheres disappear.
- Avg. wt. of a bullet vessel was 20 tons.
- Furthest missile traveled 1,200 meters.
- Burning HCs rained on neighboring village 130m from fence line.

Maximum Missle

The cylindrical tank that flew furthest penetrated some 1,200 m into the housing area and crashed into a 2 storey house vacated one hour before.

Emergency Response

- First firefighters arrive 15 minutes after F-4 BLEVE.
- 100 ambulances and 200 firefighters involved.
- 985 medics and 1,780 paramedics involved.
- 1,332 medical volunteers in 33 hospitals involved.

Lessons Learned

- Old plant, too congested, poor maintenance & poor operator training were cited.
- Village should have been 1,500 meters from terminal (determined by QRA analysis).
- Require many gas detectors and alarms.
- EBV closure rates need adjustment.
- Emergency plan required.

Possible Exam Questions

- What do the letters in the acronym BLEVE stand for?
- Name four possible causes of a BLEVE.
- Describe the events that can take place in a BLEVE.