5. SPECTATORS AND OTHER VULNERABLE EXPOSEES TO MAJOR ACCIDENT HAZARDS : AN EMERGENCY SERVICES HEADACHE?

by

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(Some of the views expressed in this article are solely those of the author and do not necessarily reflect the views or policies of the SRD.)

5.1 INTRODUCTION

Almost by definition major accidents are very rare events and particularly so in the UK. Much of our knowledge on the potential consequences and frequency of such events has therefore been picked up from examples elsewhere in the world.

A considerable amount of the case history information useful for comparison with predictive models derives from transportation incidents. There are many fairly obvious reasons for this, for example, the impracticality of making major hazard transport totally immune to damage in traffic incidents on public road or rail systems. It is this interfacing with the general public at locations dictated by chance that have provided accident scenarios involving generally unprepared and vulnerable exposees. The recent setting up of a study group on transportation of dangerous substances sponsored by the Institution of Chemical Engineers is therefore welcomed.

In many incidents persons have, rashly, or unwittingly, increased the likelihood of their being seriously affected by sudden escalation of a hazard, by looking on the incident as a source of spectacular entertainment.

The implementation of the CIMAH* regulations should ensure that only that part of a population not normally living in an area could reasonably claim to have been totally unprepared in the event of a major accident, from 'static' hazards at least.

Historical evidence however shows that within the population there are those persons, who, for a variety of reasons, will on encountering the drama of a hazardous event, approach to close range. Such persons are an additional burden to emergency services by causing vital time to be lost, e.g. during precautionary evacuation and inexcusably during the extraction of casualties.

This paper examines just a few examples of imprudent, but occasionally pardonable exposee behaviour.

5.2 CASE STUDIES

5.2.1 KINGMAN, ARIZONA

Against police advice a large crowd of spectators jostled to get close to where a 'Jumbo' LPG rail tanker was leaking and burning some of its cargo. The upper surface of the tanker was being irradiated by burning jets from a relief valve and a coupling leak.

An enormous fireball was produced when the tanker ruptured, killing 13 firemen and injuring more than 90 of the spectators, 300 m away (Figure 5.1).

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* Control of Industrial Major Accident Hazards, Health & Safety Booklet, HS(R) 21, HMSO 1984.

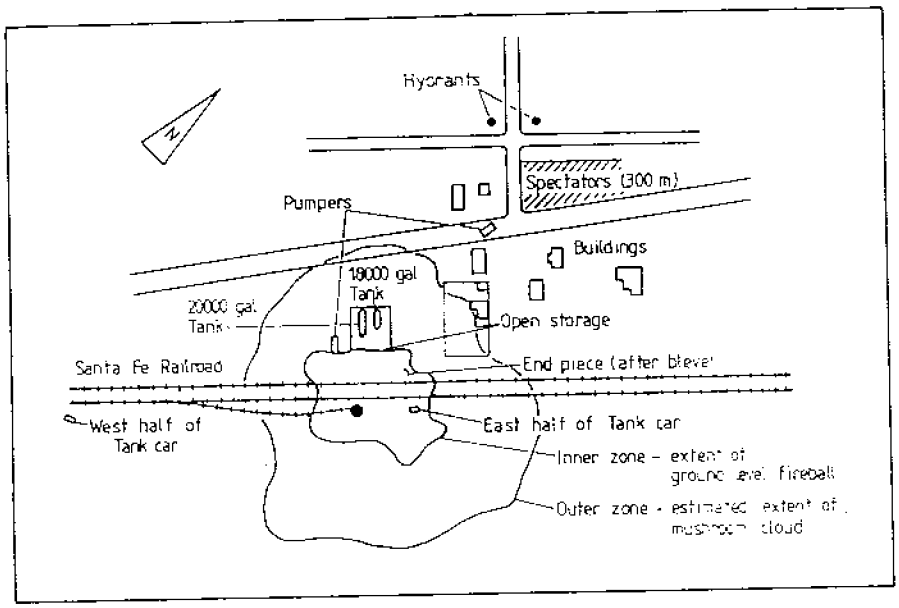

FIGURE 5.1
LPG Railcar explosion

FIGURE 5.2
Rear portion of Propylene Tanker

FIGURE 5.3
Campsite at Los Alfaques

5.2.2 LOS ALFAQUES CAMPSITE, SPAIN, 1978

Campers who did not fully appreciate that the full hazard from a burning tanker of propylene had yet to develop, stood around bemused and intrigued whilst escape for many was still feasible. 210 people were killed when the tanker bleved. See Figures 5.2 and 5.3, and also p. 10 of Loss Prevention Bulletin 061.

5.2.3 PICNIC SITE DISASTER NEAR MELDRIM, GEORGIA

An LPG incident which caused over 100 casualties including 29 ultimate deaths, has some features in common with the Los Alfaques disaster. The initial sequence of events was similar:- a partial rupture of the vessel,violent ejection of flashing liquid and rapid dispersion of ground - hugging gas, but with two significant differences. Firstly, the gas cloud at Meldrim was relatively large because of a longer time before ignition and unlike Los Alfaques the fire was the sole main event. Secondly at Meldrim the flash fire also travelled back to the still-ejecting tanker but that the latter was insulated and did not BLEVE.

The vulnerability of the exposed persons was also comparable to those in the Spanish disaster, i.e. picnickers, sunbathers and swimmers.

INCIDENT DETAILS

At approximately 15.40 on Sunday, 29th June 1959, a 124 car freight train hauled by 4 diesel locos had almost made its crossing of an elevated trestle viaduct (see Figure 5.4) over the Ogeechee river in South East Georgia. Suddenly cars 107 to 122 derailed due to buckling of the rails in the 37°C heat - the hottest since the track was resurfaced 16 days previously and indeed the hottest of the year.

Eleven of the sixteen cars slewed down an embankment at one end of the trestle at the edge of a popular picnic and recreation site (see Figure 5.5). Two neighbouring propane tank cars, (the only ones in the mile long train), were amongst these tumbling vehicles. The coupler of one tanker punched through the head of the other causing a flashing release over an estimated 30 acres (see Figure 5.6). The resultant flash fire was possibly caused by a campstove.

The spreading of the gas cloud had been observed by railroad personnel in the end 'caboose' (car 124) which together with the penultimate car had fortunately not been derailed or pulled down the gradient.

One of the persons in the 'caboose' was the conductor, Mr. Ira L. Hines, who gave the following account:

"The train was moving along between 45 and 50 miles an hour. I wal looking out the cab of the caboose. All of a sudden, I saw the cars begin to pile up in front. It looked like they were piling up to the sky.

I told Kimble (William Kimble, brakeman): 'You better say your prayers now because we're gone'.

Just as we stopped, gas began to shoot out in every direction.

It was like water coming out of a fire hydrant under tremendous pressure. One stream was shooting up the river and one was shooting down.

FIGURE 5.4
Derailed Railcars
at Tresle

FIGURE 5.5
Picnic Site

FIGURE 5.6
Burning LPG Tanker

I ran out on the platform of the caboose and started hollering to the people swimming to get out of there, that the gas was going to explode any minute. Some of them started to swim away, but most just stood and looked at me and talked among themselves.

My flagman heard me telling them the gas was going to explode and stepped out onto the trestle.

I told him: 'Son, you better get back in here right away, because that gas is going to explode'.

Then there was a tremendous explosion and flames were everywhere. Fire was everywhere. There was one tremendous sheet of flame.

I jumped back into the cab and pulled the door shut and slammed down all the windows. I thought I was going to be roasted alive.

Then I saw an opening in the flames and started out on the trestle to get to it and climb down and get away from there.

I began to yell for Kimble and he didn't answer. I kept yelling. Just as I got to the opening in the flames, I heard him answer from down in the water.

I don't know how I got my clothes off and down to the water but I did and got him and hauled him to the shore. He would not let me take him out of the water. He was in terrible pain.

I left Kimble in a mudhole at the edge and climbed back on the trestle and got the phone out of the caboose and called Parsons (G.R. Parsons, the engineer). I told him to send everything he could - ambulances, doctors, everything.

It must have been about 15 minutes after the wreck when I called Parsons. Then I saw two men way down the track behind us and began waving to them with a white hankerchief. They finally came down and I got them to take Kimble back with them to a hospital.

Then a man who had been swimming and had swum over to the other other side when the explosion happened, swam back and came around through the swamp and called me. He said there were people everywhere screaming and dying. I couldn't see anything for all the smoke but I could hear people screaming.

I called Parsons and said to get some helicopters because I didn't think they could get any ambulances into here.

I don't know what caused the explosion. Anything could have caused it. Butane doesn't rise. It settles. That gas was settling over that area. A spark or a fire or maybe someone cooking hot dogs. That could have caused it."

Several surviving eye-witness accounts of the accident were related.

Mr. C. R. Saturday, a 17-year old youth:-

"I was looking straight at the trestle when the cars broke through.

I was standing on the sand bar with my buddy, George Hodges and his wife Neatha.

The trestle just started cracking - splinters were flying out of it. There was a cracking sound and then the cars fell through.

We saw the gas shooting out of that car - it looked like a fog.

Hodges thought it was poison gas and told me to help him get his wife out of there.

We grabbed her and started moving downstream. We got out of there by pulling up a tree on the swampy side".

George Hodges Jr. (21) was swimming in the river:-

"The train made a funny bump, bump sound when it came across the trestle." Seeing the gas come out of the tank car, he grabbed his wife from the water and they both ran, not looking back until they were in the woods.

"When we looked back we saw a great sheet of fire sweeping over the water and into the woods. It burned everything it touched. When it first went off it sounded like a bomb. We went back and tried to help some of the people who weren't killed. They were all burned - charred black. It was horrible."

Mr. L. M. Nichols:-

"The gas leak looked like a white ground fog; I thought it might be poison. I joined hands with my wife and fled. The sheet of flame almost reached us but not quite. A teenage girl caught up with us but her hair and bathing suit were burning and she fell to the ground in agony - she died a few days later."

GENERAL COMMENTS

1. At an inquiry in July 1959 it was ruled that the 37°C weather caused the railtrack to warp. The railroad disputed this saying that too much of the trestle had been destroyed to establish the cause.

2. After the flashfire the breached tanker (probably insulated) continued to burn and heated the second tanker (which was definitely stated to be insulated), and this torched from its relief valves. Given the location of the accident it was impossible to muster any significant firefighting action. The tank insulation probably avoided a delayed BLEVE, the consequences of which during rescue operations and with spectators present can be imagined. The NFPA advice on tackling BLEVES lay 10 years in the future.

3. Emergency services were greatly hampered by the remoteness of the site, served by a single dirt road congested by spectators and relatives of the casualties.

4. Indicators of the severity of the flash fire were the very serious burn injuries and the finding of many of the dead in their cars; the handles of the latter (base metal) were

reported to have melted.

5. Although the accident happened on a weekend day thus insuring many exposees, had it occurred a week later during the '4th of July' week informed sources predicted a possible 500 death toll.

6. Ironically at least one of the gas tankers was destined for Collins 45 miles prior to the trestle but it was customary to bring the tanker back over the trestle by a local train.

7. Had the gas ignited sooner the scenario may have been akin to the Spanish incident but with more prospect for escape, (hazard more apparent; insulation reducing BLEVE probability). If however ignition had been delayed or the rate of leakage somewhat smaller, a vapour cloud explosion might have resulted.

8. Many near-misses occur for every disaster. Within 100 miles of Savannah and within the preceding three weeks of this incident there were almost 100 derailments. For example, on June 6th, sixty-four cars were derailed at Limerick S.E. of Savannah whilst the next day 19 cars were derailed at McRae including two tankers of chlorine. On the day before the Meldrim incident and less than 10 miles away at Guylon, two railcars derailed. In 1978 an LPG road tanker rammed a freight train at a level crossing less than one mile from Meldrim. The truck was dragged 35 m, breached and burned, but did not BLEVE. Nearby homes were evacuated by emergency services.

5.2.4 DEER LAKE, PA - LPG FIRE AND BLEVE IN THE STREET

On 2nd June 1959 a road tanker containing LPG was struck by a following truck on a wet street (see Figure 5.7). The impact damaged piping and valves on the tanker and released LPG which ignited and engulfed the rear of the tanker. Firemen attending the incident were misguided into expending water onto a threatened but as yet unaffected nearby guilding. The tanker BLEVE'd after 20 to 40 minutes. Fragments including most of the tank killed 11 spectators and injured 10 more.

Emergency services were hampered both before and after the rupture.

THE EVENTS

An LPG tank truck travelling down US Route 122 in the township of Deer Lake, PA, stopped about 20 m behind a school bus which was picking up passengers. A truck behind the tanker failed to stop and damaged pipework in a cabinet at the rear of the tanker. Escaping LPG quickly ignited (possibly by the truck engine) and flames engulfed the rear of the tanker.

The school bus proceeded quickly on its way and the driver of a second school bus containing about 40 pupils appreciating the hazard turned back and circumvented the street by taking to a nearby field.

Volunteer firemen turned up about 15 minutes after the outbreak of fire and were pursuaded to play water and foam onto a wooded house nearby. They accepted the assurances of the tanker driver that the vessel would be

FIGURE 5.7 Burning LPG Tanker

FIGURE 5.8 Path of Rocketting Tank

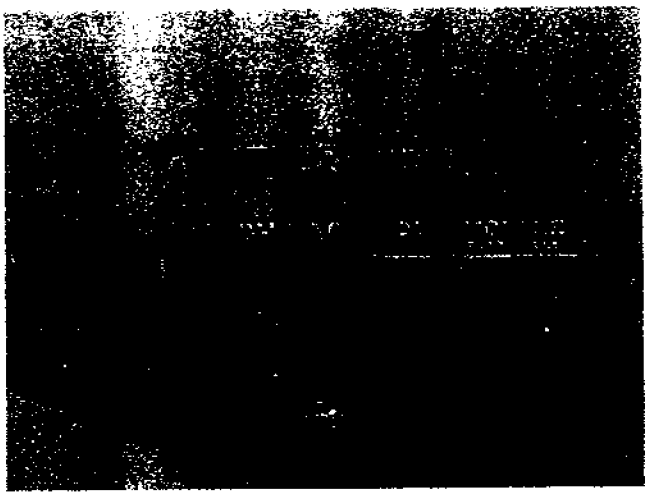

FIGURE 5.9 Final Position of Tank

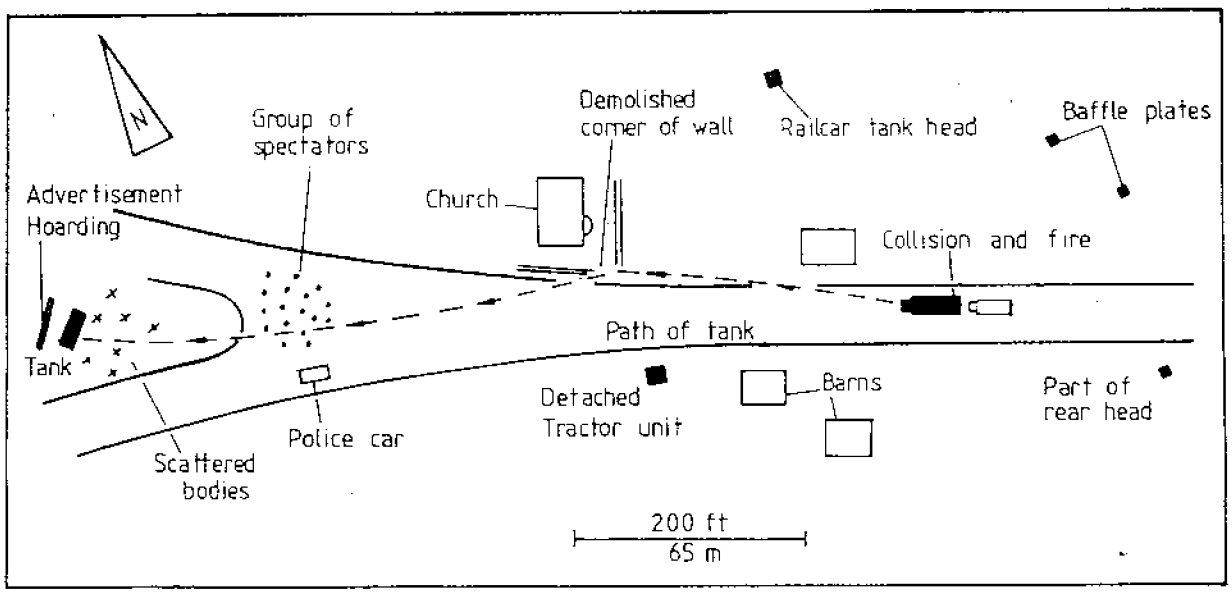

FIGURE 5.10 Scene of Incident (Not to Scale)

saved from explosion by its safety valves.

Spectators assembled in the street at what they perceived to be a safe distance even in the event of an explosion. Police had difficulty in keeping some observers back to 250 to 300 m and had to assign an officer and squad car at this distance. After the fire had burned for a time variously estimated as from 20 to 45 minutes and for part of which the three safety valves were operating, the tanker ruptured violently.

The tractor unit plus almost all of the tank section was propelled forwards roughly along the axis of the street. The rear head of the tank shot back obliquely shedding a baffle plate as it went.

In much the same way as for the Los Alfaques incident the cab unit dropped away at about a third of the final distance travelled by the tank section. The tank roared on at a height of 1 to 2 metres striking a stone wall around a churchyard (200 m), which deflected the tank fragment back up the road and set it spinning like a horizontal propellor. See Figure 5.8. The tank, now accompanied by a large number of stones, and other debris, struck the main group of onlookers, killing most of them. Finally, after gouging a large crater in the road the tank and seven of the dead came to rest at a further 150 m on a mound marking the intersection of Route 122 and the road to Ortwigsburg (see Figure 5.9).

There are many graphic eyewitness accounts of this incident.

Police trooper Robert Klinger who had been assigned to control spectators was standing by his car when the tanker ruptured said "Started out like slow motion first a bright yellow light then debris came flying up the highway. I yelled for everyone to duck and jumped to the ground under my car. When I got up bodies were all around. The truck came down the highway like a jet. Spectators were cut down like with shrapnel."

Klinger's car was severely damaged by bodies and stones (see Figure 5.10).

John Barnhart, a truck driver, had stopped to help the firemen but could not contribute so walked to shelter from the heavy rain near the church. He remembered "seeing the cab travelling up the highway towards him, then something that looked like the front of a tank came spinning up the highway like a childs top. I crawled behind the wall until the debris stopped falling." Barnhart received leg injuries.

One of the few survivors from the main group of spectators was Robert Koslosky who said "I heard a muffled roar just before the explosion and turned to run in a crouched position. I looked around and saw a truck door coming at me which knocked me down. I felt a terrific blast pass over me." He thought the door, in striking him, saved his life.

Radiant heat scorched shrubbery 150 m from the incident despite heavy rain.

5.2.5 BROWNFIELD, TEXAS - 22ND DECEMBER 1958

A twin-tanked butane road tanker was in collision with another vehicle then a steel lamp post which punctured one of the tanks. The tractor unit also became detached from the tanker section, the latter careering along upside down causing severe damage to the relief valves. Butane leaking from the punctured tank ignited and the flames engulfed both tanks.

FIGURE 5.11 Spectators watching Refinery Fire

FIGURE 5.12
Rocketting Tank

FIGURE 5.13
Spectators watching as Varnish Tank Bleves

FIGURE 5.14
Fireballs break nearby residents' windows at B & R Hauliers, Salford, U.K.

The inverted safety valves were unable to relieve the pressure and the initially unpunctured tank ruptured.

Fragments flew hundreds of metres and killed three emergency services personnel and injured 160 other persons mainly spectators.

5.2.6 OTTAWA, KANSAS - 28TH AUGUST 1961

Following a collision between freight trains on a bridge, many railcars fell onto the bed of a creek and caught fire. Fifteen railcars were involved in the incident.

Police reported great difficulty in keeping back spectators until the first LPG tank ruptured.

A second more severe BLEVE did not then cause casualties.

5.2.7 WELLSVILLE, NY : SINCLAIR REFINERY FIRE - 17TH JULY 1938

In this incident a tank of naphtha in the fire (see Figure 5.11) BLEVE'd and rocketted 200 m over a river and a field. The tank shell crashed down amongst a group of spectators who had assumed they were at a safe distance. Three were killed and several injured (see Figure 5.12).

5.2.8 TIMBERYARD FIRE, USA - 1950's

Spectators clustered around the site watching a fierce fire. They narrowly escaped serious injury when a tank of varnish BLEVE'd (see Figure 5.13).

5.2.9 B & R HAULIERS WAREHOUSE FIRE AND EXPLOSIONS, SALFORD, UK - 1983

A severe fire interspersed with several spectacular fireball-explosions involving sodium chlorate, caused extensive damage to local flats and houses. Fortunately injuries were slight though scores of windows were shattered and roof girders from the warehouse were thrown great distances (see Figure 5.14).

5.3 CONCLUDING COMMENTS

These incidents illustrate that emergency plans should contain strategies for the swift and firm exclusion of sightseers from an escalating spectacular major incident. Casualties may otherwise result in far greater numbers than may have been predicted from consideration of separation distances or the 'normal' disposition of residents around a major hazard site.

For transport incidents which can occur almost anywhere and involve almost any substance, the emergency services will not have detailed knowledge of the hazards until reaching the incident and must, therefore, attend in a general manner. Unlike an event at, for example, a notified CIMAH (Control of Industrial Major Accident Hazards) site, the nature of the hazard may be difficult to establish quickly, although the Hazchem labelling in the EEC for hazardous cargoes has made vast improvements in the position compared to 10 years ago. The police and fire services have a good record in tackling transport accidents. However, it is important that sufficient manpower is allocated to ensure that spectators do not enter an area that has been or is being evacuated.

Industrial sites often have road or railcars containing flammables regularly parked on them. In the absence of compelling reasons against the concept. vehicles should, where practical, be orientated with regard to minimising the on and offside hazard potential from rocketting fragments in the small but finite chance of a BLEVE.

Emergency services should assemble information on the location of all high density public gathering places which are so close to road or rail routes as to carry a high societal risk given an accident involving toxic or flammable substances.*

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* Editorial Comment

Many authorities do at present take into consideration population centres and transport routes for hazardous materials when considering emergency plans. A large number of companies responsibly choose 'safe' routes for transporting hazardous materials avoiding population centres and congested traffic situation.