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THE KANSAS CITY TRAGEDY— PART 2

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The conclusion of the NFPA investigative report looks at the tragic aftermath, analyzes the cause and origin, and cites the lessons to be learned from the fatal explosions in Kansas City last November.

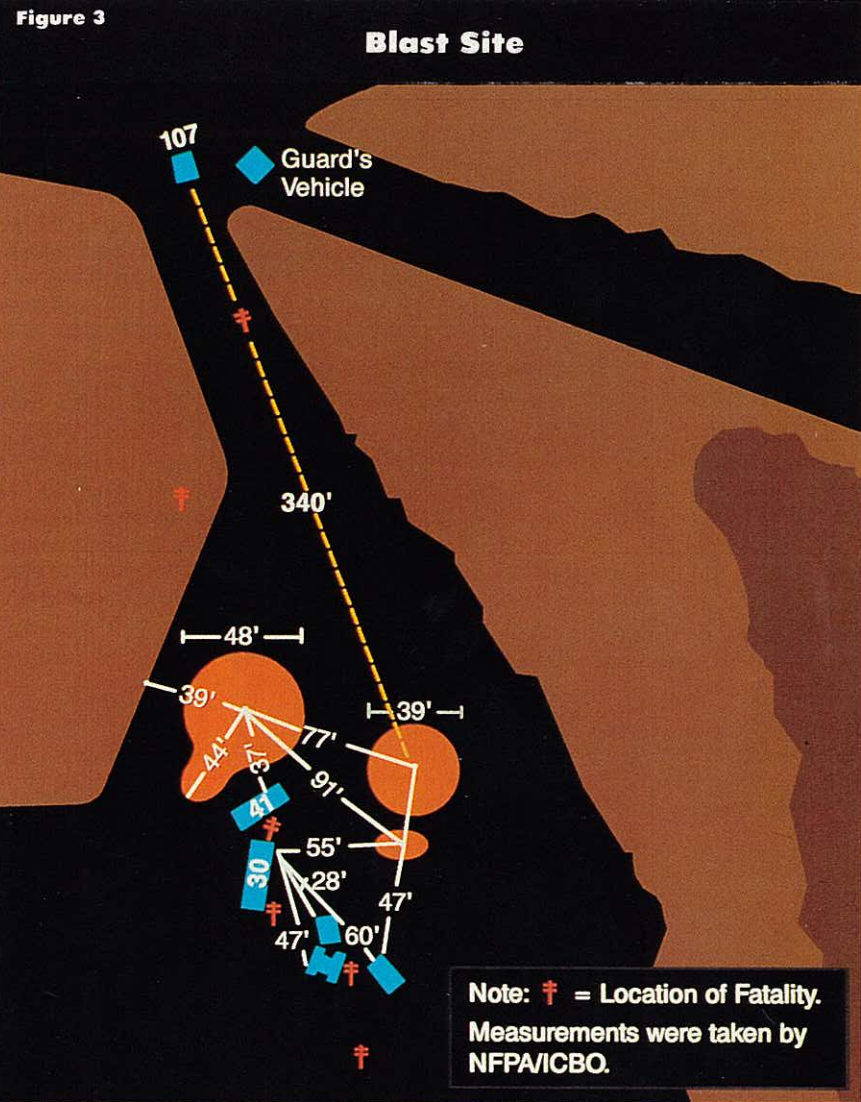
ALL SIX FIRE FIGHTERS FROM PUMPERS 30 AND 41 WERE killed in the first explosion. The figure shows the location of the bodies. The battalion chief's driver, who was standing next to the guard's vehicle on the north access road, received minor injuries; he was released from the hospital the same day.

Pumper 41 was nearest the crater where Trailer No. 2 once had been. The fire pump and the occupant cab of Pumper 41 were still attached to its chassis, but most of this vehicle's body was missing. The remaining components of the cab were so heav-

ily damaged that they were almost indistinguishable. Rocks, dirt, and other debris covered much of the wreckage.

Pumper 30 lay about 8 to 10 feet south of the other pumper. Though heavily damaged, this vehicle's major body components remained in place on the chassis, and Pumper 30 was recognizable.

Three craters marked the locations of the two parked trailers. When Trailer No. 1 exploded, two craters were formed, one 38 feet across and 6 feet deep, the other 20 feet long and 4½ feet deep. It is not known why two craters were formed, but an



imaginary line drawn between the center of the craters corresponds to the longitudinal axis of Trailer No. 1 as it reportedly was parked. The third crater showed where Trailer No. 2 had been parked. This crater was 49 feet across, 6½ to 7 feet deep, and had a 20-foot elongation at one point. It is assumed that the direction of the elongation corresponds to the longitudinal axis of Trailer No. 2.

All pieces of the trailers were found in areas well away from the craters. A 5-foot-long section of what appeared to be part of a trailer frame was located about 60 feet southeast of Trailer No. 1. A large piece of trailer body with the explosives manufacturer's name still printed on it lay near the position where the battalion chief had parked his car. Many small pieces of trailer body were found on the berm, while others had landed on US Highway 71. Some of the pieces had small puncture holes and were bent inward as if an outside force had caused the damage to the trailer skin.

The pickup truck that had been parked against Trailer No. 1 was heavily dam-

aged. The cab was peeled back almost to the cargo box, and the pickup was blown about 40 feet away from its original location. An air compressor and one drilling unit were damaged but apparently had remained near their original positions. An-

Prior to this incident, the fire department apparently had little or no information on the blasting activities at the highway construction site.

other drilling unit was dismembered by the blast, and parts of this unit landed on the wreckage of Pumper 41. A portable light trailer was blown into and almost through Pumper 30.

Reportedly, a 3-by-4-foot piece of metal from the body of one pumper landed ap-

proximately 25 feet south of 87th Street. The pieces of debris that the investigation team observed farthest from the blast area were a portion of the trailer body and the tailgate from the pickup truck that had been parked at the rear of Trailer No. 1. These parts were found along the north side of 87th Street about 450 feet from Trailer No. 1. The battalion chief's car, which was situated 340 feet from the blast areas, received noticeable damage.

People 10 miles away from the construction site have stated that they heard the first blast. Some reports indicate the distance might be even greater. Most of the broken windows and damage to structures occurred to buildings within 30 blocks of the blast area.

Fire cause and origin

Kansas City Police and Bureau of Alcohol, Tobacco and Firearms (ATF) investigators have determined that the fires in the pickup truck and in the first trailer were intentionally set. These investigators are proceeding with an arson/homicide investigation. Preliminary information from the investigation indicates that a flammable liquid was used as an accelerant in the cab of the pickup truck, and its use also is suspected in the fire that was started outside of Trailer No. 1. At the time this report was being prepared, the case remained under investigation and no suspects had been identified.

Fire growth and explosions

If the fire involving Trailer No. 1 was started by a flammable liquid, as the local police and ATF investigators believe, it is likely that a fire outside the trailer would have melted a small portion of the trailer's exterior aluminum walls before it could burn through the ½-inch-thick floorboards. Once a hole had burned through, the fire would have ignited the contents of the trailer.

The fire involving Trailer No. 1 probably was beyond the incipient stage and was growing rapidly when the guard spotted it from her position by the burning pickup truck some 800 feet to the west. Because the hill and the berm would have hidden the trailer from the guard's sight, there must have been substantial flames, enough smoke to reflect the light coming from the flames, or sufficient light to brighten the area.

When fire fighters arrived at the burning trailer, they found an extremely intense fire. Although Pumper 30's crew never described the fire over the air, a member of Pumper 41's crew implied a severe fire when he requested that additional water be brought to the scene. He apparently felt that the water the pumpers carried was insufficient. The fire fighter from Pumper 41 provided additional evidence of an intense fire when he radioed that it appeared the explosion already had oc-

curred and that magnesium or something was burning. The battalion chief's recollection of a glowing red trailer corroborates Pumper 41's apparent assessment that the fire was intense.

The hardwood floors and the plywood that lined the interior trailer walls were not capable of supporting a fire of the intensity described by the fire fighters. Under normal conditions, the aluminum alloys used for the construction of trailer bodies will melt at about 1200°F. The molten material may have formed pools but it would not have burned. It appears that the only other available fuel was the ANFO and ANFO plus aluminum mixture stored in the trailers.

ANFO is classified as a blasting agent and not as a flammable solid.¹ Nonetheless, ANFO still can burn in the absence of any other fuel. When decomposing, the AN (NH₄NO₃) in ANFO liberates about one-third of the available oxygen, as the following simplified reaction equation reveals:



The oxygen radical produced is then free to combine with the carbon and hydrogen contained in the fuel oil (CH_x). The addition of aluminum provides even more fuel for reactions and will intensify an ANFO fire.

Van Dolah indicated that ANFO plus aluminum will burn vigorously and produce a bright white flame with white smoke.² Such a fire clearly exceeds the intensity of one involving standard combustible materials. It appears reasonable that the burning ANFO plus aluminum mixture in Trailer No. 1 could have produced enough heat to quickly melt a large portion of the aluminum skin and frame of the cargo box.

When the fire fighter from Pumper 41 reported that it appeared the explosion had occurred already and that magnesium or something was burning, he probably could see that part of the trailer was missing. But it would have been as a result of melting aluminum and not because of an explosion. The burning "something" would have been the ANFO and the ANFO plus aluminum mixture.

The ANFO and the ANFO plus aluminum mixture in Trailer No. 1 burned intensely for about 30 minutes before detonating.

Fragments of trailer siding found on the berm indicate that the first blast caused heavy damage to Trailer No. 2. Unburned trailer pieces were thrown clear of the blast and fire area, and many showed evidence of having been struck on the outside by rocks and of having been bent inward by forces outside the trailer. If these pieces had been from Trailer No. 1, one would expect to find evidence of an internal pressure forcing the trailer walls outward. A blast force sufficient to blow fragments from Trailer No. 2 onto the berm also would have caused a shock stress on the commodity stored inside. Shock is one of the factors that can affect sensitive ANFO mixtures. In addition, the blast force probably would have upset the arrangement of materials stored in Trailer No. 2. Some of the material could have been blown around, but most of it probably would have stayed in a pile.

It appears that the first blast ignited the ANFO plus aluminum mixture in Trailer No. 2. Once ignited, the material burned intensely for about 40 minutes before it detonated. As was the case in the first trailer, the ANFO plus aluminum mixture was the primary fuel for the fire.

Blasting agents generally are consid-

Blasting caps were stored in this yellow magazine, which measures about 5-by-5-by-5 feet. It was one of two magazines not involved in the explosions.



ered safer than Class A, B, or C explosives; however, when properly initiated, they can function in the same manner as Class A explosives. Not being cap sensitive, they require a strong primer.³ The Kansas City incident clearly shows that under fire conditions, ANFO mixed with aluminum can detonate without the presence of other explosives of higher categories, i.e., without Class A, B, or C explosives.

Two other incidents that highlight the hazards associated with explosives and blasting agents under fire conditions occurred in Roseburg, Ore., and in Marshalls Creek, Pa.

POST-INCIDENT CHANGES IN LOCAL PROCEDURES AND POLICIES

FOLLOWING THIS INCIDENT, THE KANSAS City Fire Department examined current policies and procedures to identify methods to prevent this type of occurrence in the community. The fire department spent several weeks reviewing and evaluating most of the changes before they were enacted.

Almost immediately after the incident, the city fire marshal determined how many permits for blasting were active in Kansas City. He learned that the city engineer's office had records of 64 active permits, though prior to its inquiry the fire department was only aware of two blasting permits. This discovery has led to ac-

tivities designed to improve communications between the city engineer's office and the fire department. The city now requires a blaster to get a permit from the fire department to store the explosives at the site before getting the permit from the city engineer's office to use explosives.

The fire department also has imposed the following requirements for the storage of explosives within city limits:

1. Before a permit will be issued, the applicant must submit a site plan of the proposed explosives storage area.
2. An 8-foot fence with barbed wire must be constructed around

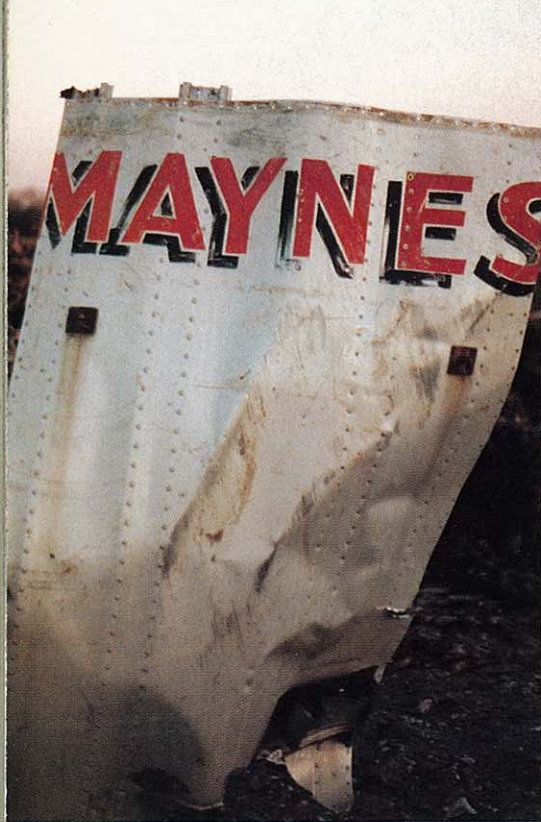
the entire perimeter of the storage area.

3. All points of the fence must be at least 6 feet from the storage building or trailer, and the area within the fence must be clear of debris and other combustible materials.

4. The magazines within the storage area must be placarded with a sign meeting Department of Transportation requirements.

In addition to imposing these requirements, the fire department will inspect all explosives storage facilities periodically. Changes to the storage facility will require re-submittal and reissuance of a storage permit.

This is the largest single piece of debris from the semi-trailers. It probably came from Trailer No. 2, since Trailer No. 1 is the one that was burning prior to the first blast.



■ In August 1959, a truck exploded in Roseburg, Oreg., killing 13 persons and injuring 125. The truck, loaded with blasting agent (ANFO) and dynamite, was parked overnight next to a building materials warehouse. The fire department was fighting a fire in the warehouse and was unaware of the truck with its dangerous cargo. Fire exposure detonated the explosive materials, destroying a 12-block area of the community. An assistant fire chief and a police officer were among those killed. Forty-five buildings were involved in the ensuing conflagration.⁴

■ At Marshalls Creek, Pa., in June 1964, six people were killed including three fire fighters who had responded to a reported truck fire. A truck driver hauling a trailer truck load of nitrocarbonitrate, dynamite, and blasting caps experienced two flat tires. He left the truck to seek assistance. During his absence, the tires caught fire, exposing the trailer and its cargo. The explosion occurred after the arrival of the fire department. Fire fighters did not know that explosives were involved. The adequacy of placarding was an issue in this incident.⁵

Fire department response

Before this incident occurred, the Kansas City Fire Department apparently had

little or no information regarding the blasting activities at the construction site. Neither the fire fighters in stations nor those in the dispatch center knew the quantity, type, or location of explosives on the construction site.

While Pumper 41 was en route, the crew was advised of the possibility of explosives. However, the type of explosives and their location were never stated. Once on the scene, the crew of Pumper 41 appears to have gained more information about the location of the explosives, possibly from the guards. The crew told the dispatch center that the explosives were supposed to be in a trailer that was burning on the hill, even though the dispatcher had not provided that information.

Despite the discussion of explosives, Pumper 30 responded to the burning trailer and requested Pumper 41 to do the same, which it did. Because the officers and fire fighters who made the decision to attack the fire died in the explosion, no one will ever know what those fire fighters knew and why they operated as they did.

After the battalion chief had arrived on the scene and had sized up the situation, he was preparing to remove all fire fighters to a safe distance, a common practice during hazardous materials incidents. Unfortunately, the explosion occurred before he could initiate the order. Once the explosion had occurred, the battalion chief requested the assistance of the trained hazardous materials team from Kansas City, Kans., and eliminated further losses by keeping responding fire fighters at a safe distance until additional information was available regarding the hazards.

Many questions about this incident remain unanswered. The questions address issues that fire fighters have to consider when responding to hazardous materials incidents.

■ Why did both crews attempt to attack the fire in the trailers when there was no life hazard, when the fire apparently was more intense than a fire involving ordinary combustibles, and when there was mention of explosives in the area?

■ Did the appearance of the trailers, *i.e.*, standard over-the-road trailers without placards, special colors, or other visual cautions, decrease the potential hazard in the minds of the responding fire fighters?

■ Did the fire fighters know about the two magazines and believe that the explosives were there and not in the trailers?

■ Did the fire fighters realize that an explosive material can be the fuel for a fire and can burn to detonation over time? Did they know proper, safe emergency procedures?

Conclusions

The tragedy in Kansas City prompts a reexamination of lessons from past experience. It is clear that the hazards of blast-

ing agents in fires have been recognized by the fire service for decades. This recognition is reflected in identification systems and operating procedures. Today, there is an appropriate focus on training, planning, and emergency response procedures for a broad family of hazardous materials. Codes, standards, and procedures are available and need to be applied to avoid such tragic events in the future.⁶

This incident involving the storage of blasting agents illustrates the potential hazard to fire fighters and others under certain fire exposure conditions. This incident also points to several key lessons for the fire service and those concerned with explosives, blasting agents, or other potentially hazardous materials.

1. Blasting agents such as ANFO can be extremely hazardous when exposed to fire and can detonate.

2. Prior to the alarm, the Kansas City Fire Department apparently did not have knowledge of specific details, such as the type, quantities and location of the blasting agents. Permit systems for the storage and use of explosives or blasting agents must include notification to the fire department.

3. It is normal practice to remove hazardous materials warning signs once an over-the-road trailer has reached its destination. Better marking of the storage areas or the trailers might have saved lives in this case, given the lack of detailed prior knowledge about the location of the dangerous materials.

4. In addition to notification of fire departments about the location of explosives and blasting agents through a permit system, adequate pre-fire planning conducted by fire fighters can serve to locate hazardous materials throughout a department's jurisdiction. Such data gathering and inspections can locate unexpected dangerous materials before an emergency occurs, thereby saving the lives of fire fighters and civilians. ♣

Footnotes

1. *Fire Protection Guide on Hazardous Materials*, 9th ed., National Fire Protection Association, Quincy, Mass., 1986.

2. Information provided during the January 24, 1989 telephone conversation with R. W. Van Dolah, former employee of the U.S. Bureau of Mines and member of the NFPA Hazardous Chemicals Committee.

3. Porter, S. J., Section 5, Chapter 7, *Fire Protection Handbook*, 16th ed., National Fire Protection Association, Quincy, Mass., 1986, p. 5-70.

4. The Roseburg, Oregon, Fire, Explosion and Conflagration, August 7, 1959. National Board of Fire Underwriters, New York, N.Y.

5. "Explosives Truck Blast, Marshalls Creek, Pennsylvania," *NFPA Quarterly*, Vol. 58, No. 2, October 1964, pp. 172-177.

6. The NFPA investigative report contains a discussion of national codes and regulations and of local codes. This discussion highlights relevant sections of those codes.

For a copy of the complete NFPA investigative report on the Kansas City incident, call Laurie Ruszyck at (617) 770-3000.