



THE KANSAS CITY TRAGEDY—PART 1

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AN EXPLOSION THAT OCCURRED ON November 29, 1988, at a highway construction site claimed the lives of six Kansas City, Mo., fire fighters. Investigators have determined that two fires were deliberately set and that the material that detonated was an ammonium-nitrate-based blasting agent.

The construction site

The incident occurred at a rock excavation site approximately nine miles south of Kansas City, Mo. The site covered about one-eighth of a square mile and was on property leased by the construction company. Two thoroughfares bordered the area (see Figure 1). The site's south side faced 87th Street, while the west side

faced US 71, a busy four-lane highway with a median strip and several crossover roads.

Contractors for the project, under contract with the state highway department, were removing rock that was to be used as fill for a new state highway. Workers had removed trees, vegetation, and topsoil in order to reach the bedrock, which apparently included both limestone and shale. Blasting was necessary to break up the bedrock for removal. A city engineer had issued a work permit on September 9, 1988, to a blasting subcontractor who was using about 8000 to 10,000 pounds of blasting agent every work day.

One of the areas was about 70 feet above the grade of US 71 (see Figure 2). Two access roads allowed workers to

drive their heavy equipment between the equipment parking area on the west side of US 71 and the blasting site on the east side. Some of the dirt, small rocks, and other surface materials from the blasting had been piled along the west edge of the elevated work area, forming a berm approximately 12 feet high, 100 to 150 feet wide, and 250 feet long.

Some vehicles and equipment were parked overnight on the east side of the berm. Two air-powered mobile drills attached to a compressor and a gas-powered light trailer were also in the area. In addition, there were two semi-trailers with a pickup truck parked against the rear doors of one.

The trailer farthest from the berm (see Trailer No. 1 in Figure 1) was an enclosed,

PHOTOGRAPH: COURTESY OF THE KANSAS CITY FIRE DEPARTMENT

dual-axle, 35-foot-long, over-the-road semi-trailer with two rear doors and a side door. It contained 17,000 pounds of ammonium nitrate fuel oil (ANFO) plus aluminum mixture in 5- and 6-inch-diameter bags commonly called socks, and 3500 pounds of pure ANFO in 50-pound bags. ANFO is classified as a "blasting agent."¹

Reports indicate that Trailer No. 2, also an enclosed, dual-axle, over-the-road semi-trailer, was 38 feet long and had doors only at the rear. This trailer contained 30,000 pounds of the ANFO plus aluminum mixture in 30-pound socks. Both trailers had extruded aluminum frame components for the cargo box and sheet aluminum sides and roofs. The trailers had wood floors and interior wall surfaces lined with 1/4-inch plywood up to a 4-foot height. The trailers reportedly were 15 years old, uninsulated, and in good condition.

The manufacturer and supplier of the blasting agent owned the trailers. The driver for the manufacturer made deliveries, leaving the trailer—with the blasting agent inside—at the construction site. Reportedly, it was the blasting agent manufacturer's standard practice to comply with Department of Transportation (DOT) requirements for placarding. Accordingly, the trailers displayed placards with the words "Blasting Agent" while traveling over the road. When the trailers were parked at the scene, however, the placards were folded up, so they then displayed the words "Please Drive Safely."

According to NFPA 495, *Manufacture, Transportation, Storage, and Use of Explosive Materials, 1985 edition*, parked trailers that are weather-resistant, that can be padlocked, and that can be secured against theft may be considered Type 5 magazines. It appears that the two trailers would have met these criteria and were Type 5 magazines.

Two other magazines were on the east side of the large pile of trees, stumps, rocks, and other debris. Both were painted yellow. One was a metal box of about 5-by-5-by-5 feet, situated an estimated 340 feet from Trailer No. 1; the second was a metal box about 7-by-7-by-8 feet, situated an estimated 210 feet from Trailer No. 1. One magazine contained 2500 pounds of dynamite and the other contained 2000 blasting caps.²

Vandals reportedly had been tampering with the construction equipment, so two security guards were hired to patrol the area after working hours. One guard normally was responsible for watching the blasting site; the other watched the equipment parked on the west side of US 71.

Ammonium nitrate

Two of the most common uses of the chemical ammonium nitrate (NH_4NO_3)

are as an ingredient of fertilizers and as an ingredient in explosives, especially blasting agents. Fertilizer-grade ammonium nitrates (ANs) exposed to fire typically oxidize, decompose into toxic oxides, and provide additional fuel to a fire.³ NFPA 490, *Storage of Ammonium Nitrate*, addresses the storage of AN.

Several disasters highlighted the explosive potential of this material during the first half of the twentieth century, with the best-known incident being the explosion of the *S.S. Grandcamp* in Texas City on April 17, 1947. The ship contained fertilizer-grade AN.^{4,5} Efforts to reduce the impurities in fertilizer-grade AN and the fact that it is no longer coated with wax to prevent caking⁶ have reduced the detonation risks of most fertilizer-grade ANs. However, contamination by petroleum products or other materials increases its potential for detonation and, when contaminated, fertilizer-grade ANs begin to resemble the blasting agent ANFO.

Ammonium nitrate—fuel oil (ANFO)

ANFO is the most common explosive in the United States. The more than two billion pounds of ANFO produced in 1975 accounted for approximately 80 percent of the domestic commercial explosives market that year.⁷ Current estimates in-

dicating that ANFO is used in about 90 percent of all blasting operations employing non-nitroglycerin materials.⁸ NFPA 495 addresses the storage of ANFO and other ammonium-nitrate-based blasting agents.

ANFO is available predominantly in the form of a prill, which is a porous pellet, mixed with fuel oil. The product is usually a pre-mixed, oxygen-balanced, free-flowing mixture of about 94 percent ammonium nitrate prills and six percent No. 2 diesel fuel oil. Materials such as aluminum powder or dust are added to increase the general strength of the explosive.

The cost of ANFO is low compared to nitroglycerin dynamites. This is not the only advantage that ANFO has as a blasting agent. It is less sensitive to shock and does not burn to detonation as readily as nitroglycerin-based explosives.⁹ Yet, under proper conditions, ANFO can produce explosion pressures similar to TNT and explosion velocities similar to dynamite.¹⁰

ANFO does not burn readily, but in a well-established fire it still can burn and produce a detonation.¹¹ One source indicates that *incipient* fires involving blasting agents that are not confined can be fought with large amounts of water. Since AN is an oxidizer, the fires cannot be smothered. The water acts only to cool the burning mass to temperatures below the ignition temperature.¹² When fires de-

ACKNOWLEDGMENTS

The National Fire Protection Association (NFPA), with the assistance of the International Conference of Building Officials (ICBO), investigated the Kansas City, Mo., fire and explosion in order to document and analyze significant factors that resulted in the loss of life.

The NFPA funded the study as part of its ongoing program to investigate technically significant incidents. The ICBO assisted in data collection and analysis under an agreement between the NFPA and the three model building code organizations: ICBO, the Building Officials and Code Administrators International (BOCA), and the Southern Building Code Congress International (SBCCI).

The NFPA became aware of the fire on the day of occurrence, November 29, 1988. Michael S. Isner of the NFPA Fire Investigations Division traveled to Kansas City, where he and William D. Wall of the ICBO conducted a three-day on-site study and subsequent analysis to document the facts of the

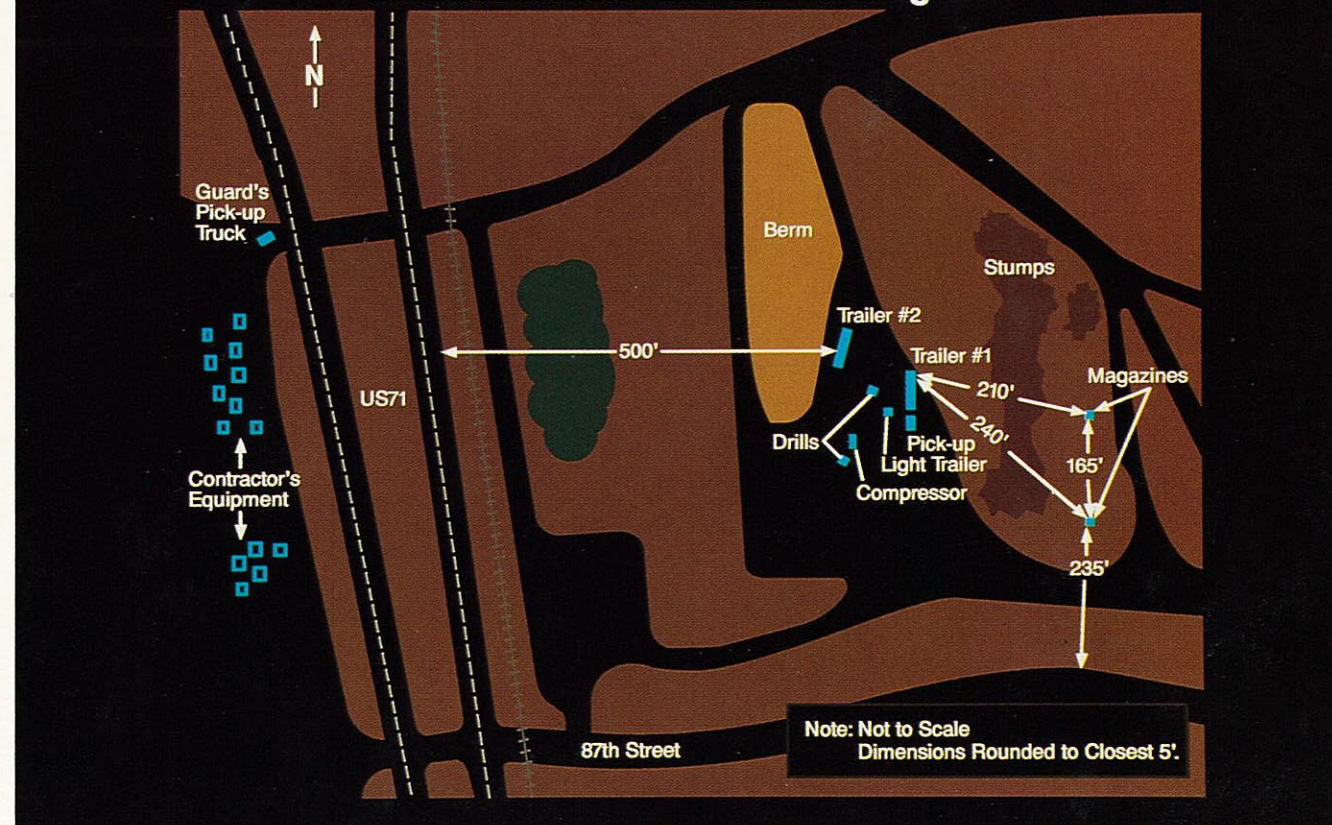
fire and explosion.

This is another of the NFPA's studies of fires having particular educational or technical interest. The information is based on the best data available during the on-site data collection phase and during the report development process. It is not the NFPA's intention that this report pass judgment on, or fix liability for, the loss of life and property during this incident.

The cooperation and assistance of Kansas City Fire Chief Edward W. Wilson, Kansas City Fire Marshal Robert Wallace, State Fire Marshal John Coburn, and Investigator Robert Miller of the State Fire Marshal's Office are acknowledged and appreciated.

Special thanks are given to ICBO regional engineer William D. Wall for his assistance in data collection and in preparing sections of the report that pertain to the Kansas City Codes and to the Uniform Fire Code (UFC). He actively participated in the formulation and review of this report.

Figure 1
Construction Site and Surrounding Area



velop beyond the incipient stage, the only safe method for handling the situation is to abandon direct fire fighting methods and evacuate the area in anticipation of an explosion. The suggested evacuation distance is 2000 feet.¹³ Section 7-1.6 of NFPA 495 indicates that when fires cannot be controlled before reaching explosive materials, including ANFO, they should not be fought. Similarly, the Bureau of Explosives and the Department of Transportation state that fire fighters should not fight fires that directly involve ANFO or other explosive materials.^{14,15} Instead, fire service personnel should withdraw to a safe distance.

Fire discovery

Shortly after 3 a.m., a guard at the construction site thought she had seen a

prowler and radioed to the other guard. The two guards, who were in separate vehicles, met and left their pickup truck near US 71 where the contractor's equipment was parked. They continued their search for prowlers.

Finding no prowlers on the site, the guards drove to a nearby convenience store to see if anyone there had seen two people on foot coming out of the construction site. While the guards were at the store, a motorist stopped and reported that a vehicle at the construction site was burning. The guards returned to the site and found the cab of the pickup they had just left involved in fire.

One guard used the phone in his car to call the Kansas City Fire Department at 3:40 a.m. and to report the fire in their pickup truck in the southbound lane of

Highway 71. While this guard was talking with the dispatcher, the other guard noticed a fire at the construction site on the east side of US 71. The tape recording of the telephone conversation captures the second guard in the background saying, "Oh, the explosives are on fire." Moments later the original caller stated, "Ah, there may be some . . . ah, there's some explosives up on a hill that I also see now is burning." The dispatcher replied, "OK, we'll have units there. Thank you."

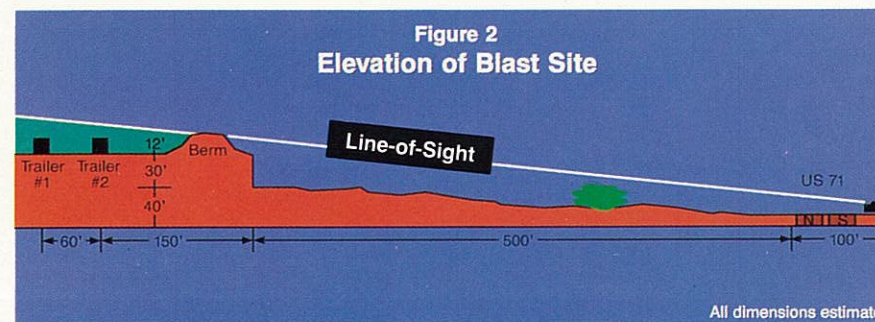
Fire department response

At 3:42 a.m., the dispatch center started the initial response with this transmission:

"Pumper 41. This is a pickup truck at . . . south of Blue River and 71 Highway on the west side. Pumper 41, reported to be a pickup truck on Blue . . . it's just south of Blue River and 71 Highway on the west side. Pumper 41, use caution on your call. There's information there may be explosives. It's in or at a construction area. The pickup truck may be in that area."

Pumper 41, which would have traveled north on US 71 to reach the scene, arrived at 3:46 a.m. and radioed back to dispatch at 3:47 a.m. that there were two fires. This crew asked for a second pumper to be dispatched to the scene. The dispatcher acknowledged the transmission and sent

Figure 2
Elevation of Blast Site



EXPLOSIVE MATERIALS HAZARDS AND THE FIRE SERVICE

DURING 1987, 127 FIRE FIGHTERS WERE KILLED AND 102,600 WERE INJURED in the line of duty in the United States. A large share of the fatalities and most of the injuries occurred on the fire ground. Over the past decade, 36 fire fighters have been killed in explosions in 19 incidents involving a variety of hazardous conditions and materials. These statistics underscore the risks facing career and volunteer fire fighters as well as the need for critical attention to fire fighter safety and to sound fire ground management practices.

Unfortunately, catastrophic incidents, such as the November 29, 1988, explosion which killed six fire fighters in Kansas City, Mo., are not new to the fire service. This latest tragedy, which followed a response to a construction site fire involving blasting agents, requires a reexamination of lessons learned from past experiences. For decades, the fire service has recognized the hazards of blasting agents in fires. Such recognition is reflected in hazard identification systems and operating procedures. Today, there is a focus on training, planning and emergency response procedures for a broad array of hazardous materials, including blasting agents. While codes, standards and procedures whose application would help prevent such tragic events already exist, it is clear that an additional effort is required to meet this challenge.

Following the Kansas City tragedy, NFPA investigator Mike Isner was dispatched to the scene of the Kansas City tragedy to initiate a study. Preliminary facts highlighting the known hazards of blasting agents exposed to fire were sent to state fire marshals, metro fire chiefs and state training directors across the country, as well as to 17 allied fire protection organizations and the national fire press. This alert bulletin also was distributed to the Congressional Fire Services Caucus to keep Congress informed about this tragic event and its firesafety lessons. Coupled with the release of its final investigative report, the NFPA also provided testimony to the congressional subcommittee on employment and housing. Finally, preliminary findings of the study were provided to the NFPA Technical Committee on Explosives for its consideration in revising NFPA 495, *Code for the Manufacture, Transportation, Storage, and Use of Explosive Materials*.

The hazards of explosives and blasting agents exposed to fire are well documented in the literature. A few major incidents that have resulted in fire fighter fatalities have provided specific information that can improve fire fighter safety before and during such emergencies.

The *NFPA Fire Protection Handbook*, Section 5, Chapter 7, "Explosives and Blasting Agents," contains important information on fire fighting practices:

No attempt should be made to fight a fire involving Class A, B, or C explosives once the fire has actually reached the explosives. Fire fighting should be abandoned and the area evacuated. A distance of 2,000 ft (610 m) is considered reasonable. Remote control equipment may be left in position. The rules for blasting agents are the same except that, when not confined, incipient fires in blasting agents can be fought with large amounts of water. The water acts only to cool the burning mass to temperatures below the ignition temperature. When fires develop beyond the incipient stage, the only safe method for handling the situation is to abandon direct fire fighting methods and evacuate the area in anticipation of an explosion. The suggested evacuation distance

of 2,000 ft (610 m) should be observed for blasting agents as well.

Illustrative cases involving explosives and blasting agents include:

■ An August, 1959, truck explosion in Roseburg, Oreg., which killed 13 people and injured 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 not aware of the truck or its dangerous cargo. Fire exposure detonated the explosive materials, destroying a 12-block area. An assistant fire chief and a police officer were among those killed. Forty-five buildings were involved in the ensuing conflagration.

■ An incident at Marshalls Creek, Pa., in June 1964, in which 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 nitrocarbonate, dynamite, and blasting caps experienced two flat tires and then left the truck to seek assistance. The tires caught fire, exposing the trailer and its cargo, and an explosion occurred after the arrival of the fire department. Fire fighters did not know explosives were involved. The inadequacy of placarding was an issue in this incident.

The firesafety lessons learned and the improvements made following these cases and others focused on transportation-related issues, such as approved transportation routes for explosives, permits and regulations for explosives carriers, motor vehicle safety, and the placarding of vehicles carrying explosives. The Kansas City incident involved on-site storage, not transportation; however, the basic hazard lessons are the same.

The Kansas City explosion incident again reminds us that, though there are great risks associated with fire fighting, such tragic, multiple losses of life can be avoided. The hazards of blasting agents exposed to fire have been documented for several decades. Explosives, blasting agents such as ANFO, or other potentially hazardous materials can be extremely dangerous and can detonate when exposed to fire. We must revisit these lessons and review training materials, codes, standards and protocols to ensure that these lessons are taught to a whole new generation of fire fighters. Available codes and standards that require permits for blasting agents must be applied, along with standards and procedures that mark and adequately identify explosives and other hazardous materials. Prefire planning must be an integral activity of fire departments. Particular attention must be paid to the location and identification of hazardous materials—before the emergency. State-of-the-art training, planning, and procedures for hazardous materials response teams have become vital elements in ensuring fire fighter safety in today's fire service.

This article is based on information prepared by A. Elwood Willey, Assistant Vice President, Research and Fire Information Services, for testimony provided before the Employment and Housing Subcommittee, Committee on Government Operations. To obtain a copy of the alert bulletin, "Multiple Death Fire Fighter Fatality Incident," or the final investigative report of the Kansas City incident, call Laurie Ruszyk at (617) 770-3000.

Pumper 30, which would have traveled south on US 71 to reach the scene and would have passed very close to Pumper 41 at the pickup truck fire. Pumper 30 arrived on the scene at about 3:53 a.m.

At 3:57 a.m., Pumper 41 radioed the dispatch center, reported that the fires appeared to be arson, and requested that the police be sent. Moments later, the following transmissions were made:

"41 to dispatcher."

Dispatcher: "41."

41: "If you can get 30, tell them that there's the trailer on fire up there, stay away from it, and we better have (battalion chief) 107 out here. There's supposed to be explosives involved in this."

Dispatcher: "Do you want 107 emergency?"

41: "Yeah, you can send him emergency."

Dispatcher: "Car 107, make the alarm, the companies are . . . um . . . just south of Blue River and 71 Highway. Pumper 41's on the west side. Car 107, make the alarm, be just south of Blue River and 71 Highway on the west side."

At 3:59 a.m., Pumper 30 asked the dispatcher if he could confirm that there were explosives in the trailer. The dispatcher responded with the following statement:

"Pumper 41 advised that, and we have initial information on the original call that there were explosives in that area, to use caution."

Pumper 30 acknowledged the transmission and then asked to have 41 at its location when 41 was through. The dispatcher immediately asked 41 if it had received the message, and Pumper 41's crew members indicated that they had



PHOTOGRAPH BY WILLIAM D. WALL
The force of the blasts was so powerful that it blew the chassis of a light trailer into the side of Pumper 30 and almost through the other side of the engine.

and that they were en route to join Pumper 30.

Like Pumper 30, Pumper 41 used the north access road, drove up the hill, and parked between Trailer 1 and Trailer 2. Apparently, Trailer 1 was heavily involved in fire, and at 4:02 a.m., Pumper 41 made the following transmission to battalion chief 107:

41: "The way it looks right now, we're going to have to haul some water up in here with a squad or something. We've got a trailer, and part of a compressor goin' up here."

At 4:04:49 a.m., Pumper 41 had the following conversation with Car 107, which

was still en route to the scene:

41: "Apparently, this thing's already blown up, chief. He's got magnesium or somethin' burnin' up here."

107: "10-4. Are you back up in there now, or where are you?"

41: "Yeah, 10-4 both companies are back up in here."

Battalion chief 107 arrived on the scene at 4:06:21 a.m., drove up the north access road, and stopped near the guards who had parked their vehicle near the north end of the berm. From this position, about 340 feet away from the burning trailer, the chief could see a trailer glowing red and some fire fighters still pulling hose from one of the pumps. Others already had begun to apply water. The battalion chief's driver had left the car and was standing next to the other vehicle talking with the guards.

Having sized up the situation, the battalion chief was preparing to have the pumps leave the area when an explosion occurred. The blast was so powerful that it injured the battalion chief's driver and pushed the guard's vehicle back about 25 feet. The blast could be heard back at the dispatch center about nine miles from the scene.

At 4:08:15 a.m., battalion chief 107 made the following transmission:

" . . . Explosion just as we pulled up in here. Get us a . . . all kinds of ambulances in here, get us ambulances . . . and, uh, at least a couple of, three more companies."

The dispatcher asked if he was reporting an explosion and if he was going to need extra companies. Battalion chief 107 responded "10-4" and asked for ambulances. When the dispatcher asked if they were for fire fighters, he said:

107: "10-4. We blew the windshield clean out of our car and we're a quarter-

SUMMARY TIME LINE

- 3:40 a.m.** Guards at construction site report pickup truck fire and indicate that explosives are on fire on the hill.
- 3:42 a.m.** Pumper 41 is dispatched to pickup truck fire and is warned of the possibility of explosives being involved.
- 3:46 a.m.** Pumper 41 arrives on the scene.
- 3:47 a.m.** Pumper 41 reports two fires and requests assistance. Pumper 30 is dispatched to the scene.
- 3:53 a.m.** Pumper 30 arrives on the scene.
- 3:58 a.m.** Pumper 41 requests a battalion chief and warns Pumper 30 that there is a trailer on fire and that explosives are supposed to be involved. Pumper 30 acknowledges the information.
- 3:59 a.m.** Pumper 30 asks Pumper 41 to come to their location.
- 4:04 a.m.** Pumper 41 tells dispatcher that it appears that the trailer already had blown up and that there is magnesium or something burning.
- 4:06 a.m.** Battalion chief 107 is on scene.
- 4:08 a.m.** First explosion occurs and six fire fighters are killed.
- 4:48 a.m.** Second explosion occurs and no one is injured.
- 6:00-** Police and fire personnel enter the fire scene.
- 6:30 a.m.**



PHOTOGRAPH: MICHAEL S. ISSNER

The explosion of Trailer No. 2 left this crater in its wake.
mile away."

The dispatcher immediately sent two more pumpers, two quints, and a squad, and he also contacted the department chief to be sure he was aware of the explosion. In the same minute, the dispatcher reminded all responding companies to "use caution goin' in, apparently there are some explosives in the area."

Battalion chief 107 asked the dispatcher to confirm that Pumpers 30 and 41 had been at the scene fighting the fire. The dispatcher responded, "30's was, as far as we know, they were near the trailer. 41's was coming up to 'em." Battalion chief 107 then called to the pumpers over the radio and there was no response. A few moments later he gave these orders:

"Give us what haz-mat expertise you have out here. Notify everyone that we want to keep everyone back away from the area until we know more about it. And see if you can find someone from the, uh, people who are workin' here to see if we can find more about the area."

The dispatcher contacted the Kansas City, Kans., hazardous materials team and tried repeatedly to contact the crews of Pumpers 30 and 41, but no one responded.

A bright fire that was producing white sparks of light continued to burn vigorously on the hill. Because fire fighters were being held back, it was impossible to determine what was burning, what was being exposed to the fire, or how the fire was affecting the fire fighters from Pumpers 30 and 41. At 4:22 a.m., the dispatcher told the battalion chief that they had information that there might be more depots of explosives in the area that had not

This is all that remained of a pickup truck that was at the blast site, parked against the rear doors of one of the trailers.



PHOTOGRAPH: WILLIAM D. WALL

exploded. Upon receiving this information, all personnel and apparatus were withdrawn from the area. A command post and staging point was established approximately a half mile to the south at 95th Street.

Even with the knowledge that the pumper crews were still in the area of the fire and the hope that they might still be alive, fire fighters remained out of the area until they could be assured that the area was safe for entry. At 4:48 a.m., a second explosion occurred without injury to fire fighters. The bright fire continued to burn even after this blast.

About ten minutes after the second explosion, the Kansas City, Mo., hazardous materials officer attempted to observe the fire area from a helicopter and determine if fire fighters could enter the area safely. Because of smoke, darkness, and the need to stay at a safe distance, the officer in the helicopter could not see the blast area.

At about 5:20 a.m. and after his flight, the hazardous materials officer and another Kansas City Fire Department officer performed an on-the-ground reconnaissance of the blast area. They walked into the blast area, found the bodies of five of

the six fire fighters, observed that some of the unexploded material was scattered throughout the area and still burning, and left the area. Having confirmed the condition of the two pumper crews and being concerned about the presence of unexploded materials, the officers felt it best to keep all personnel out of the area until after sunrise.

Between 6:00 and 6:30 a.m., there was enough daylight to see any potential dangers in the area of the blasts; permission was granted to police and fire personnel to enter the fire scene. Most police officers entered the area from the north access road. The Kansas City fire chief, the two officers involved in the reconnaissance, battalion chief 107, and representatives of the state fire marshal's office entered the scene via the south access road. By the time the fire department officers entered the area, the police had declared the site a crime scene and had asked the fire department to limit its activities in order to preserve any evidence. Following the initial crime scene investigation by the po-

lice department, the bodies of the fallen fire fighters were removed.

Editor's note: Next month, Part 2 of "The Kansas City Tragedy" will address the casualties, the analysis, and the conclusion of this tragic incident.

Footnotes

1. Blasting Agent. Such materials or mixtures have been found to be so insensitive that there is little probability of accidental initiation of explosion or of transition from deflagration to detonation. The tests required by 49 CFR 173.114a include blasting cap sensitivity, differential thermal analysis, thermal stability, electrostatic sensitivity, impact sensitivity, and fire exposure. *Code for the Manufacture, Transportation, Storage, and Use of Explosive Materials*, NFPA 495, 1985 ed., Quincy, Mass.
2. Under normal blasting conditions, blasting agents require a large booster charge to detonate. The dynamite storage on the site was the material used as the booster, and the blasting caps were used to detonate the dynamite.
3. *Fertilizer Grade Ammonium Nitrate, Properties and Recommended Methods for Packaging, Handling, Transportation, Storage, and Use*, Fertilizer Institute, Washington, D.C., p. 3.
4. "The Texas City Disaster," *The Quarterly*, NFPA, July 1947, Vol. 41, No. 1, pp. 25-57.
5. Scott, G. S., and Grant, R. L., *Ammonium Nitrate: Its Properties and Fire and Explosion Hazards*, U.S. Department of the Interior, Bureau of Mines, I.C. 7463, June, 1948.
6. Greiner, M.L., "Ammonium Nitrate Hazards and Handling," *Fertilizer Progress*, January/February, 1983.
7. *Blasters' Handbook*, E.I. du Pont de Nemours & Company (Inc.), Wilmington, Del., 1977, p. 55.
8. Porter, S. J., Section 5, Chapter 7, *Fire Protection Handbook*, 16th ed., National Fire Protection Association, Quincy, Mass., 1986, p. 5-69.
9. *Blasters' Handbook*, E.I. du Pont de Nemours & Company (Inc.), Wilmington, Del., 1977, p. 54.
10. *Ibid.*, Table 4.1 (p. 57) and Table 6.1 (p. 81).
11. Porter, S. J., Section 5, Chapter 7, *Fire Protection Handbook*, 16th ed., National Fire Protection Association, Quincy, Mass., 1986, p. 5-75.
12. *Ibid.*, 1986, p. 5-75.
13. *Ibid.*
14. *Emergency Handling of Hazardous Materials in Surface Transportation*, Bureau of Explosives, April 1981, p. 29.
15. *Emergency Response Guidebook*, 1987 ed., U.S. Department of Transportation, DOT P5800.4, Guide 43.
16. NFPA 901, *Standard on Automotive Fire Apparatus, 1985*, defines a quintuple ladder truck as a ladder truck carrying the standard complement of ground ladders with the addition of a fire pump, water tank, hose body, and aerial ladder.

ABOUT THE DEPARTMENT

The Kansas City Fire Department protects a 320-square-mile community with a population of 448,000. The department's 751 operations officers and fire fighters are divided among three 24-hour shifts. The department has an additional 45 personnel in administrative, clerical, fire prevention, dispatch, and training positions. During the fiscal year ending on April 30, 1988, the department responded to 25,353 calls, 11,103 of which were medical while 5233 were fire-related. The remainder included false alarms, good intention, service, hazardous conditions, and miscellaneous.

The department has 32 fire stations and operates 33 pumpers, seven squads, and 15 trucks, including three quints,¹⁶ one aerial platform, and 11 ladder trucks. The pumpers typically are staffed with an officer, a fire apparatus operator, and a fire fighter. The squads have a crew of two fire fighters and the trucks typically have four personnel.

Individuals selected to be Kansas City fire fighters are required to complete a three-month-long introductory course on fire fighting fashioned after training courses developed by the National Fire Academy (NFA). The

course introduces personnel to fire fighting procedures, to fire prevention activities, and to the department's standard operating procedures (SOP).

The Kansas City Fire Department's SOP for handling hazardous materials, dated March 1, 1981, was in effect at the time of the explosion. This 12-page document outlines the duties and responsibilities of dispatchers, the first-in officer, the incident commander, and others. The SOP states that "the dispatcher will obtain answers to as many questions... as possible," and that "he/she will convey by radio, as the companies are en route, such information as amount and type of material involved, type and size of container,..." The SOP also states that the first officer on the scene will "advise other responding units of the situation and precautions to be taken" and will "notify dispatcher by radio of situation and action taken."

All six fire fighters who were killed had received the department's introductory hazardous materials training. Four of the six had received other hazardous materials field training, including the NFA course, "Recognizing and Identifying Hazardous Materials."

Two of these four, an officer and a fire fighter, also had completed a second NFA course, "Hazardous Materials Incident Analysis."

In addition to their training, the six fire fighters had many years of experience. The officer on the first responding pumper had been on the department for 29 years and the operator and fire fighter of this pumper for 20 and 12 years, respectively. The officer on the second pumper had 38 years of experience, and the operator and fire fighter had been on the department for 10 and 15 years, respectively.

In the year preceding this incident, the Kansas City Fire Department had been assembling a hazardous materials response team. Eighteen fire fighters and at least three battalion chiefs had received supplemental training regarding hazardous materials incident handling. The trained fire fighters were assigned randomly to shifts and were dispersed throughout the fire stations. However, every shift had one of the trained battalion chiefs. The department was in the process of equipping a truck for use as a hazardous materials response vehicle, but it was not operational at the time of this incident.