

F.A.C.E.

INVESTIGATION REPORT

Fatality Assessment and Control Evaluation Project

FACE #96-NJ-060-01
Fire Chief Dies 10 Days After Exposure
to Toxic Gases and Smoke



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FROM: Fatality Assessment and Control Evaluation (FACE) Project
New Jersey Department of Health & Senior Services (NJDHSS)

SUBJECT: Face Investigation #96-NJ-060-01
Fire Chief Dies 10 Days After Exposure to Toxic Gases and Smoke

DATE: March 25, 1997

SUMMARY

On August 14, 1996, a 59-year-old deputy fire chief was critically injured and two other fire officers received minor injuries after inhaling toxic gases at a fire scene. The incident occurred at a fast food restaurant when a fire broke out in the hamburger broiler. Spreading into the hood and exhaust ductwork above the broiler, the fire quickly spread to the roof of the building where it was drawn into the roof top air conditioning system. The heat apparently burst the air conditioner's cooling coils, releasing Freon gas into the fire that thermally decomposed into acid and phosgene gases. The toxic gases were drawn into the building and mixed with the smoke and other fire gases until the fire fighters began to ventilate the building and extinguish the fire. This pushed the smoke and gases out the rear of the building, surrounding the fire chief who was standing outside near the back door. The chief, who was not wearing an air mask, developed severe respiratory symptoms and was immediately taken to the local hospital where he was admitted and hospitalized for two days. Two other officers, the department chief and a fire captain, also received minor injuries after breathing the smoke. Both were examined at the hospital and released. After his release from the hospital, the deputy chief returned to doing administrative work but was prohibited from fire fighting. On August 24, 1996, ten days after the incident, the deputy chief collapsed at his home and died of complications related to his injury. NJ FACE investigators concluded that, to prevent similar incidents in the future, employers should follow these safety guidelines:

- o Fire departments should develop and implement an exterior perimeter policy for SCBA use.
- o Incident commanders should be notified of any potentially hazardous or unusual situations.

In addition, restaurant owners should take the following fire protection measures:

- o Restaurant owners should ensure that staff are trained in operating the emergency fire suppression system and that exhaust hoods are kept free of grease.

INTRODUCTION

On August 26, 1996, NJ FACE personnel were notified of this work-related fatality through a newspaper article. On September 4, 1996, a FACE investigator accompanied an NJDHSS Public Employees Occupational Safety and Health (PEOSH) program compliance officer who was investigating the fire department's compliance with state respiratory protection standards. The FACE investigator conducted a separate investigation of the incident, which included meeting with the employer and union representatives and examining and photographing the fire scene. Due to time limitations, a second site visit was conducted on September 6 to complete the interviews with management officials. On September 23, 1996, a third site visit was conducted with investigators from the NJ Department of Community Affairs (NJDCA) Division of Fire Safety. NJDCA and FACE investigators visited the incident site, interviewed the incident commander (chief) and truck crew present at the incident, and briefly examined the victim's protective turn-out gear. Additional information on the incident was obtained from the fire department's internal incident reports, the county medical examiner's report, and a newspaper article quoting the victim after the incident.

The employer was a municipal fire department that covered a suburban-industrialized area of nine square miles with a population of 55,000 people. The Department's 97 paid and 12 volunteer firefighters were divided into four engine companies and one truck company assigned to three fire stations. The department's command structure included one department chief, one deputy chief (the victim), and four battalion chiefs. The department had an extensive written training program. Training for new recruits include a 90 hour "Firefighter 1" course and Emergency Medical Technician D (defibulator) training. Ongoing training included scheduled monthly training and daily drills using IFSTA and NFPA manuals. All fire department personnel (including the chiefs) are fit tested for self-contained breathing apparatus (SCBA) and are required to don and doff an SCBA at least once a month. The department answered 3,036 alarms in 1995, including 734 emergency medical treatment calls.

The victim was a 59-year-old male deputy fire chief who had been with the department for 36 years. He joined the department in 1960 and served as a firefighter until he was promoted to captain in 1973. In 1991 he was made battalion chief and was later promoted to deputy chief in 1993. As deputy chief he was also the department's administrative and safety officer, and had the power to supersede orders at a fire scene for safety reasons. The department chief stated that the deceased worked out (exercised) often and was fit for firefighting duties.

INVESTIGATION

The fire occurred in a fast-food restaurant located off a major highway. The restaurant was a single story, 2,626 square foot building surrounded by a parking lot. The building was roughly divided into two halves: the kitchen area on the left and the dining area on the right. Entry through the front door led to a customer service area in front of the main counter. Directly

behind the main counter was the food cooking and preparation area, which held the hamburger broiler and french frier. Above the cooking area was a large exhaust hood equipped with an emergency fire-suppression system. This system could be manually activated at a pull box or automatically when a fusible link in the hood separates under the heat of a fire. Once activated, the hood is sprayed with a dry-chemical extinguishing agent for about 30 seconds. Behind the cooking area were the storage rooms and an exit door leading to the rear parking lot. The large dining area and restrooms took up most of the right half of the building.

The weather was clear on the day of the incident, with temperatures in the low 80's and winds moving N-NW at 10 m.p.h.. Sometime after 6:30 p.m., an employee at the fast-food restaurant was removing the filter baffles from the exhaust hood for cleaning. Another employee was feeding hamburgers into the broiler conveyor belt, which moved the hamburgers over an open gas flame. The employee noticed that there was too much fire in the broiler, which was beginning to flare up. A second employee tried to extinguish the fire with a small spray bottle of bleach solution while the first employee went for a fire extinguisher. The restaurant manager heard someone yell "fire!" and came out of his office to see the employee using the extinguisher on the fire. Seeing that the fire had spread to the french frier and the exhaust hood, the manager ordered the employees and patrons to evacuate the store. Fueled by the grease in the hood and ductwork, the fire spread up the exhaust stack and onto the roof. The exhaust hood emergency fire suppression system automatically activated but did not extinguish the fire.

The fire department was dispatched at 6:49 p.m. for a working fire at a restaurant. The first units arrived at 6:51 p.m. and reported heavy smoke and fire on the roof. After assessing the situation, the responding battalion chief (incident commander) called for more personnel and set up his command post near the front of the building. A ladder truck was positioned in the restaurant's rear parking lot as the engine companies laid hose from hydrants near the front of the building. Firefighters began to enter the front door and encountered heavy smoke inside the building. Several windows were broken out to provide ventilation and a smoke ejector (a large portable exhaust fan) was set up but not activated near the front door. A fire captain (first injured officer) arrived on the scene with an engine company. After assisting with ventilating the front of the building, he went to the rear parking lot where the ladder truck was stationed. The captain, who was wearing an SCBA but had not put on the mask, stepped through the back door to investigate. He found a moderate smoke condition and started to pull down some ceiling tiles when the smoke became "acrid and unbreathable." The captain immediately left the building and joined the truck crew in shutting off the gas line before going up on the roof.

The department chief (second injured officer) was at home when he heard the radio call and responded to the fire. On arriving, he went to the incident commander and told him that he would do a perimeter check of the building and report back to him. As he walked around the building, he saw heavy smoke but no visible fire through the windows. When he reached the

back of the building, he discussed setting up a roof ladder with the truck crew and told them to make sure the gas service was off. Before he went up on the roof, a cloud of smoke banked down on the department chief, who was not wearing an SCBA. The chief described breathing the smoke as like “someone grabbing me by the throat,” and that he had some throat irritation and trouble speaking for a short time afterward. The department chief led the captain (first injured officer) and truck crew up to the roof, where they quickly put out the fire. At this time the captain began to feel short of breath, coughing and vomiting from his earlier smoke exposure. While on the roof, the department chief looked down to see the deputy chief (the victim) being attended to by the EMS.

The deputy chief (victim) was also off-duty when he heard the radio call and responded from his home. No one saw him arrive, but he was there only a few minutes before he was exposed to the smoke. The deputy chief was last seen at the rear of the building, helping the truck crew shut down the gas meter. He was not wearing an SCBA. Apparently, the deputy chief was near the back door when a cloud of toxic smoke poured out of it. He stated in a newspaper article that he had inhaled some of it and held his breath as he walked out of the smoke. The deputy chief was next seen walking out of the cloud toward an ambulance. An EMT saw that he was in distress and started to administer oxygen. The ambulance crew called for the paramedics, but decided to immediately transport the victim to the hospital when he had trouble breathing. At the hospital emergency room he continued to worsen and was about to be placed on a ventilator when he started to recover. He was admitted to the hospital for two days and was released with the limitation that he must avoid smoke. The other injured officers (the department chief and fire captain) were also examined at the hospital and released without restrictions.

The deputy chief returned to doing light duty administrative work and appeared to be recovering until August 24, 1996 when he collapsed at his home. Fire department personnel responded and found him in cardiac arrest. They were unable to revive him despite use of a defibrillator and advanced life support. He was transported to the local hospital where he was pronounced dead at 9:42 a.m., ten days after he was exposed to the toxic smoke.

The fire department began an investigation immediately after the incident, following their SOP for serious injuries and deaths. They found that fire damage inside the building was confined to the cooking area, with moderate damage to the ceiling around the hood. On the roof, the hood’s exhaust fan and mushroom-shaped exhaust vent were destroyed. The tar roofing around the exhaust vent was badly burned, and a nearby air conditioning unit sustained heavy damage to the ductwork, cooling coils, and blower fan. One cooling coil shows evidence of bursting, while other coils apparently fell apart under the heat. The manufacture’s tag on the burned air conditioner was illegible, however, another similar unit on the roof held 12 pounds, 11 ounces of Freon 22 refrigerant. There were no devices to shut down the air conditioning units during a fire. No unusual chemicals were found in the building, although a small amount of bleach solution

(5.25% sodium hypochlorite) was sprayed on the burning broiler. Two or three ABC dry chemical fire extinguishers were used by restaurant workers on the fire in addition to the BC dry chemical extinguishing agent released from the hood fire suppression system.

Based on this information, the following scenario may explain the source of the toxic gases: After the fire spread into the exhaust hood, it continued up the exhaust stack to a mushroom-shaped exhaust vent on the roof. With the exhaust fan still operating, the fire was forced down against the tar roof, igniting it. Near the exhaust vent was the air intake to one of several air-conditioning units on the roof. As the fire spread to the roof, it was drawn into the operating air-conditioning unit and across the cooling coils. The heat burst the coils, releasing the Freon 22 (chlorodifluoromethane) directly into the fire. Chlorodifluoromethane decomposes under heat to form hydrofluoric acid, hydrochloric acid, phosgene, carbonyl fluoride and chloride gases. These acid and other decomposition gases were drawn into the building through the air-conditioning system and mixed with the smoke and other fire gases. When the firefighters entered and opened their hoselines, the expanding steam forced the toxic smoke and gas mixture out the rear of the building, surrounding the deputy chief who was by the back door.

CAUSE OF DEATH

The county medical examiner determined that the cause of death was “marked tracheobronchial inflammation, alveolar hemorrhage, and pulmonary edema due to smoke inhalation containing phosgene”.

RECOMMENDATIONS AND DISCUSSION

Recommendation #1: Fire departments should develop and implement an exterior perimeter policy for SCBA use.

Discussion: All the firefighters interviewed during this investigation described the fire as “routine.” The fire was relatively small and quickly extinguished, and it occurred at a restaurant where toxic chemicals were not expected. Although the department generally followed its SOP requiring SCBA for interior structural firefighting and overhaul, three department officers who were not wearing SCBA were exposed to the toxic smoke. To prevent future incidents, the department is considering an exterior perimeter system to require greater use of SCBA. The FACE program commends this and recommends setting up a safety perimeter around the exterior of a fire scene. All emergency personnel working inside the perimeter (including fire officers and EMS) would be required to wear an SCBA until the area is deemed safe. This policy should include using SCBA while working on roofs and during ventilation.

Recommendation #2: Incident commanders should be notified of any potentially hazardous or unusual situations.

Discussion: In this situation, both the department chief and the truck captain were exposed to the smoke and realized that it was unusually acrid. Both retreated immediately, but apparently did not feel that the situation was hazardous enough to warn the incident commander. FACE recommends that incident commanders should be notified of any potentially dangerous or unusual situations. It is not known if an early warning would have prevented this incident, however, good communication may help to control a hazardous situation.

In addition, restaurant owners should take the following fire protection measures:

Recommendation #3: Restaurant owners should ensure that staff are trained in operating the emergency fire suppression system and that exhaust hoods are kept free of grease.

Discussion: The restaurant staff acted quickly in trying to put out the fire with an extinguisher and evacuating the restaurant, but did not manually activate the hood's emergency fire suppression system. Also, the grease in the hood was heavy enough to block one of nozzles to the fire suppression system and helped fuel the fire's spread to the roof. To prevent future fires, FACE recommends that restaurants keep their exhaust hoods and cooking areas free of grease. FACE also recommends that all restaurant employees should be trained in the location and use of the emergency fire suppression pull boxes and fire extinguishers.

ATTACHMENTS

Chlorodifluoromethane: NJ Department of Health & Senior Services Hazardous Substance Fact Sheet; NJDHSS, Right-To-Know Program, CN 368, Trenton NJ.

REFERENCES

Chlorodifluoromethane: Cheminfo, Canadian Center for Occupational Health and Safety, CD-ROM Issue 96-3, August 1996.

SCBA, A Fire Service Guide to the Selection, Use, Care, and Maintenance of Self-Contained Breathing Apparatus. National Fire Protection Association, Quincy MA 02269.

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