

NEW JERSEY DIVISION OF FIRE SAFETY

Firefighter Fatality and Serious Injury Report Series

Seven Firefighters Injured When a Tractor Trailer On Fire Explodes

**Mansfield Township, New Jersey
May 31, 2012**

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**STATE OF NEW JERSEY
Chris Christie, Governor**



**DEPARTMENT OF COMMUNITY AFFAIRS
Richard E. Constable III, Commissioner**



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INTRODUCTION

The investigation of this incident was conducted by the New Jersey Division of Fire Safety / Office of the State Fire Marshal in conjunction with the New Jersey Department of Labor and the New Jersey Department of Health. This report was prepared in accordance with N.J.S.A. 52:27D – 25d, Duties of the Division.

The purpose of these firefighter casualty investigations is to report the causes of serious firefighter injuries or deaths and identify those measures which may be required to prevent the future occurrence of deaths and serious injuries under similar circumstances. In some cases new information may be developed, or old lessons reinforced, in an effort to prevent similar events in the future.

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GLOSSARY OF TERMS

Fire Apparatus Designations:

E – Engine
SQ – Squad

L – Ladder
R – Rescue

Personnel Designations:

FF – Firefighter
DC – Deputy Chief
SO – Safety Officer

BC – Battalion Chief
IC – Incident Commander
FM - Fire Marshal

CISD.....Critical Incident Stress Debriefing
EMS.....Emergency Medical Service
ICP.....Incident Command Post
IDLH.....Imminently Dangerous to Life & Health
IMS.....Incident Management System
NFPA.....National Fire Protection Association
PAR.....Personal Accountability Report
PASS.....Personal Alert Safety System
PEOSH.....Public Employees Occupational Safety & Health
PPE.....Personal Protection Equipment
RIC.....Rapid Intervention Crew
SCBA.....Self-Contained Breathing Apparatus
TIC.....Thermal Imaging Camera

EXECUTIVE SUMMARY

On May 31, 2012 at 13:31 hours, the Mansfield Township Franklin Fire Company #1 (MTFFC#1) Station 331 was dispatched for a reported tractor trailer fire near exit 52 on Interstate 295 southbound in Mansfield Township, Burlington County, New Jersey. Subsequently at 13:37 hours, a second dispatch was made for MTFFC#1 due to no response after six minutes. At 13:41 hours, the Florence Township Fire Departments (FTFD) Station 401 was dispatched as a back-up station due to no response from the MTFFC#1 Station 331. FTFD Chief 4000 was first to arrive on scene and reported that the rear of the trailer was involved with fire. Upon arrival of FTFD Engine 4013 at 13:51 hours, crews deployed a 1 3/4" hose line and began attacking the fire. The driver side rear door was pried open and a hose stream was then directed into the trailer. Approximately 1 minute 17 seconds later an explosion occurred inside the trailer while Fire Marshal Brian Richardson, a career firefighter/fire marshal with the FTFD, was using a hydraulic powered tool attempting to pry open the passenger side rear door of the trailer. The force of the explosion pushed the walls of the trailer outward and blew the right door open violently. The door struck and seriously injured 33 year old Richardson in the head. The force of the explosion also injured six other firefighters; although their injuries were not as serious as those of FM Richardson. The fire was then extinguished without further incident. FM Richardson was airlifted to the Capitol Medical Center Trauma Unit in Trenton for treatment of his injuries. He suffered severe head trauma which resulted in two subdural hematomas and partial loss of vision in his right eye.

It was determined that the truck was transporting Clementine's, a small citrus fruit similar to a tangerine from Staten Island, New York to Vineland, New Jersey.

The fire origin and cause investigation for this incident was conducted through a joint effort of the NJ State Police Arson/Bomb Unit along with the following agencies: the NJ Division of Fire Safety Arson/K-9 Unit and the Burlington County Fire Marshal's Office. The fire was determined to have originated in the right rear wheel of the trailer. The fire then spread to the interior of the trailer igniting the insulation and contents. The explosion was determined to have been caused by a backdraft. This occurred when the oxygen starved fire burning inside the tightly sealed refrigerated trailer received an adequate supply of oxygen when the trailer door was opened and the combustible smoke and superheated gases reached their explosive range. This caused the gases to combust explosively creating an overpressure condition that resulted in the trailer walls being pushed out and the door opening violently.

In order to minimize the risk of similar incidents, the New Jersey Division of Fire Safety identified key issues that must be addressed and remedies that should be implemented within all departments.

1. **FACTOR:** The truck was carrying fruit which is not a hazardous cargo. Therefore, the trailer was not required to be placarded as containing hazardous materials.

REMEDY: *Personnel responding to fires and other emergencies involving motor vehicles should always be vigilant especially when a vehicle is not placarded and the contents are not known. Further, every effort should be made to determine what might be carried in trucks. Tactics and strategy for mitigating the emergency should be strongly influenced by any information obtained.*

2. **FACTOR:** The explosion that resulted in the serious injuries to FM Richardson was caused as a result of a backdraft condition. A backdraft can occur in any tightly sealed space where a fire is burning in an oxygen deficient atmosphere when oxygen is rapidly introduced. Signs of a backdraft include smoke puffing at intervals from the enclosed space, pressurized smoke coming from small cracks, little visible flame from the exterior of the enclosed space, black smoke becoming dense gray/yellow, confinement and excessive heat.

REMEDY: *Backdrafts typically occur in buildings and firefighter training programs focus mainly on awareness of conditions in buildings that precipitate a backdraft. Emergency responders should always be aware of the signs of a potential backdraft not just at building fires but at any fire involving an enclosed space. Emergency responders however, must anticipate and act to minimize the risk of backdraft in any type of sealed container including but not limited to truck trailers and box type trucks. Ventilation may need to be considered just as it is in structures to allow superheated products of combustion to escape thereby reducing the potential for backdrafts.*

3. **FACTOR:** A delayed fire department response by the FTFD was caused by the MTFFC#1 not initially responding. This resulted in the FTFD not being dispatched until a significant amount of time had elapsed and allowed the fire to burn longer thus depleting the oxygen inside the trailer. This resulted in ideal conditions for a backdraft to occur upon the arrival of the FTFD and firefighters opening up the trailer.

REMEDY: *It was found at the time of the incident that Burlington County's fire service had not yet implemented a "highway box system" for Interstate*

295. *This permits dispatchers to dispatch fire companies in both directions of a limited access highway based on access to the highway simultaneously at the time of the initial alarm. Burlington County's, and in fact, all fire service agencies should consider the implementation a highway box system for all limited access highways that transverse the county. At the time of the incident a "highway box system" had been established for the New Jersey Turnpike.*

INVESTIGATION

The Incident

On May 31, 2012 at 13:31 hours, the Mansfield Township Franklin Fire Company #1 (MTFFC#1) Station 331 was dispatched for a reported truck fire near exit 52 on Interstate 295 northbound in Mansfield Township, Burlington County, New Jersey. Subsequently at 13:37 hours, a second dispatch was made for MTFFC#1 due to no response after six minutes. At 13:41 hours, the Florence Township Fire Department (FTFD) Station 401 was dispatched as a back-up station due to no response from the MTFFC#1. FTFD Chief 4000 was first to arrive on scene and reported that the rear of the trailer was involved with fire. Upon arrival of FTFD Engine 4013 at 13:51 hours, crews deployed 1 3/4" hose lines and began attacking the fire. FM Brian Richardson, a career firefighter with the FTFD, originally brought an axe and halligan bar to the scene to pry the rear doors of the tractor trailer open in order to gain access to extinguish the fire in the cargo compartment of the trailer. The driver side rear door was opened and a hose stream was then directed into the trailer. Upon the arrival of FTFD Rescue 4018, a hydraulic powered rescue tool was brought from that truck and FM Richardson went to work with this tool in order to pry open the passenger side rear door of the trailer. Approximately 1 minute 17 seconds later, an explosion occurred inside the trailer. The force of the explosion pushed the walls of the trailer outward and blew the right door open violently. The door struck and seriously injured 33 year old Richardson in the head. The force of the explosion also injured six other firefighters; although their injuries were not as serious as those of FM Richardson. The fire was then extinguished without further incident. FM Richardson was airlifted to the Capitol Medical Center Trauma Unit in Trenton for treatment of his injuries. He suffered severe head trauma which resulted in multiple non-displaced skull fractures and two subdural hematomas and partial loss of vision in his right eye. In addition FM Richardson lost his sense of taste and smell. He also has suffered memory loss and partial hearing loss. FM Richardson was out of work for approximately 17 months and returned to work after retraining on October 15, 2013. BC Kevin Mullen suffered a leg injury and concussion and he was transported to Lourdes Medical Center in Willingboro, Burlington County by ground ambulance. He was out of work for approximately two months. BC Mullen has returned to full duty without restriction.

Fire Investigation

Upon arrival at the scene, New Jersey Division of Fire Safety, Office of The State Fire Marshal, Arson/K-9 Unit members met with representatives of the Burlington County Fire Marshal's Office. The assistance of the New Jersey State Police Arson/Bomb Unit was also requested due to the explosion. Also assisting with

this investigation were representatives from the New Jersey State Police Crime Scene Unit and Fatal Accident Unit.

It was decided by the investigative agencies that the New Jersey State Police Arson/Bomb Unit would be the lead agency conducting the investigation into the origin and cause of the fire. Assisting with this investigation were the New Jersey Division of Fire Safety, Office of the State Fire Marshal's Office, Arson/K-9 Unit and the Burlington County Fire Marshal's Office.

The truck was identified as a red 1996 Kenworth tractor and the trailer was identified as 2003 Cheetah refrigerated trailer. It should be noted that the tractor was pulled away from the trailer by the driver prior to the arrival of fire department. Examination of the trailer revealed the refrigeration unit attached to the front of the trailer was partially pulled away from the trailer portion. The sides of the trailer were observed to be distorted outward and exhibited fire damage toward the rear of the trailer over the rear wheels. This was evident by fire patterns on the exterior of the trailer in this area and oxidation of the metal surface. The rear wheels also exhibited heavy damage due to fire with heavy oxidation of the rims and chassis frame. Partial consumption of the tires was also observed. The rear doors of the trailer were opened during fire suppression activities. On the ground behind the trailer were several boxes of clementine oranges which were the cargo from within the trailer along with pieces of the trailer itself. This debris field stretched several yards behind the trailer. Also located in the debris was a set of firefighter's gear which was determined to be FM Richardson's firefighting gear. This equipment was collected by the New Jersey State Police and turned over to representatives of the New Jersey Division of Fire Safety.



Figure 1 - Front of trailer damage to Refrigeration Unit



Figure 2 - Rear of trailer showing debris field

The interior of the trailer revealed it was loaded from the floor to within inches of the ceiling with cardboard boxes of clementines packed onto wooden pallets. The trailer ceiling was constructed of cardboard with holes in to allow air flow from the refrigeration unit. This cardboard was dislodged by the blast and exhibited some damage. The first two pallets of clementines remaining in the trailer after the blast nearest the rear doors were removed from the trailer. An examination of this area revealed an unknown oily residue on the trailer walls,

ceiling, and floor. On the floor, it was observed that the pallets protected some of the metal floor slat surface where they rested. The trailer wall, specifically on the driver side rear, exhibited partial consumption of the foam insulation material within the wall space between the exterior and interior metal. This was observed to be just inside the driver side rear trailer door. It was determined at this point due to lack of light, unsafe location, and lack of equipment that the trailer was to be secured and a tow company would remove the trailer to an impound yard located in Eastampton, New Jersey. The box portion of the trailer was lifted from the chassis for removal from the scene.

The chassis was observed to have sustained heavy damage in the area of the rear wheels. The tires on all rims were observed to be mostly consumed along with heavy oxidation of the rims. The frame rails on the chassis were observed to be distorted in some areas due to the fire. Due to lack of lighting, further examination of the chassis was to be conducted at a vehicle impound yard at a later date.

During the course of this investigation it was brought to the investigation team's attention by a representative of the NJ Department of Transportation, Incident Management Response Team that their traffic camera had captured the incident and included footage of when the explosion occurred. This representative obtained a copy of the footage and played it for the investigation team on his laptop computer. From the video footage, it was learned that the FTFD Engine 4013 arrived on location at 13:51 hours, 20 minutes after the initial dispatch. Fire suppression personnel were observed pulling a hose line and commencing fire suppression operations. All fire suppression personnel were observed in full PPE and SCBA. Flames were observed coming from under the truck along with black smoke. Smoke was also observed coming out of the trailer above the rear doors. Fire suppression personnel quickly knocked down the fire under the rear wheels of the trailer and were able to open the rear driver side door. Smoke continued to come out of the trailer, specifically high in the trailer. Fire suppression personnel began applying a water stream into the trailer while the passenger side rear door was in the process of being opened. It was observed that FM Richardson was utilizing a hydraulic powered rescue tool in an attempt to open the passenger side rear door. Approximately 1 minute 17 seconds after the driver side rear door was opened, a violent explosion occurred with FM Richardson taking the full force of the passenger side rear door when it blew open from the force of the explosion. This explosion resulted in the injuries to seven firefighters. It was observed that fire suppression activities continued as the injured firefighters were tended to.

On June 1, 2012 investigators from the New Jersey Division of Fire Safety, Office of the State Fire Marshal met with investigators from the New Jersey State Police Arson/Bomb Unit and Hazardous Materials Response Unit. Also present were investigators from the Burlington County Fire Marshal's Office. The investigation

team met at a vehicle impound yard located in Eastampton, New Jersey where the vehicle had been towed after it was removed from the highway.

The Hazardous Materials Response Unit took samples of the refrigerant from the refrigeration unit located on the front of the trailer. They also took samples of the oily residue located on the interior of the trailer. After laboratory analysis, the oily residue was later determined to be consistent with citrus oil.

The trailer was approximately 53' in length and had a maximum gross vehicle weight of 74,960 pounds. The exterior walls were constructed of aluminum with approximately two inch thick polyurethane foam insulation. The interior walls were covered with aluminum also. The roof and rear doors contained three inches of polyurethane foam insulation and two and one-half inches of insulation in the floor. The nose of the trailer contained approximately four inches of insulation. The trailer had a cardboard ceiling with holes in it to allow the cold air from the refrigeration system to circulate through the trailer. At the time of the fire the trailer contained 1440 cases of fresh Clementine's weighing approximately 23,472 KG (51,746 lbs.)



Figure 3 - Foam insulation in wall of trailer



Figure 4 - Cardboard ceiling in trailer



Figure 5 - Oily residues on interior walls of trailer

The area of origin was determined to be the passenger side rear wheels. The fire was determined to be accidental in nature. The exact cause of the fire is undetermined due to the fact that the investigation team was unable to identify the first material ignited as well as a possible mechanical failure.



Figure 6 - Area of origin

As to the explosion, it is the opinion of the investigation team that it was the result of a backdraft or smoke explosion. It is theorized that within the trailer, the unburned pyrolysis products and flammable products of combustion, confined in a cool trailer, mixed with air introduced when the driver side rear door was opened during fire suppression. The well mixed volume of fuel and air then reached a source of ignition; the fire; which in turn resulted in a violent explosion of the pre-mixed fuel gases and the air.



Figure 7 - Aerial view of the scene

The Casualty Scenario

Brian Richardson, a 33 year old career firefighter/fire marshal with the FTFD was struck in the head by the door of the trailer and was seriously injured. The force of the explosion also injured six other firefighters; although their injuries were not as serious as those of FM Richardson. FM Richardson was airlifted to the Capitol Medical Center Trauma Unit in Trenton for treatment of his injuries. He suffered severe head trauma which resulted in multiple non-displaced skull fractures to the forehead, right cheek and right eye socket, a broken nose and two subdural hematomas and partial loss of vision in his right eye. In addition FM Richardson lost his sense of taste and smell. He suffered memory loss and has no recollection of the incident. He also suffered partial hearing loss. FM Richardson was out of work for approximately 17 months and after retraining, returned to work full time on October 15, 2013.

BC Kevin Mullen suffered a leg injury and concussion and was out of work for approximately two months.

In addition five other firefighters received minor injuries. They were transported to Lourdes Medical Center in Willingboro, Burlington County and were treated and released.

ANALYSIS

Fire Department Profiles

The Mansfield Township Franklin Fire Company #1 (MTFFC#1) Station 331 is a volunteer fire company with approximately 30 firefighters, six company officers, three chief officers and a fire official operating under the direction of a fire chief. The MTFFC#1 serves a rural area with a population of approximately 8800 residing in an area of 22 square miles. The company operates two engines, one tender, one brush truck, and one rescue/lighting truck. At the time of the incident the company was dispatched by the Burlington County Central Communications. According to NFIRS records the MTFFC#1 responded to approximately 409 fire calls in 2011. EMS is provided by the Mansfield Township Ambulance Corps.

The Florence Township Fire Department (FTFD) is a combination fire department with five career personnel and approximately 50 volunteer firefighters, nine company officers and five chief officers. The FTFD serves a suburban population of approximately 12,100 people residing in an area of 9.6 square miles. The department operates out of one fire station, housing a fleet of two engines, one tower ladder, one rescue truck, one tender and two ambulances. At the time of the incident the department was dispatched by the Burlington County Central Communications. According to NFIRS records the FTFD responded to 619 fire calls and 1,940 EMS calls in 2011.

The following items are areas identified by investigators as impacting directly upon the outcome of this incident.

Cargo Transported in the Truck

It was determined that the truck involved in this incident was transporting clementines, a small citrus fruit similar to a tangerine from Staten Island to Vineland, New Jersey. Since the truck was carrying fruit which is not a hazardous cargo, the trailer was not required to be placarded as containing hazardous materials.

It should be noted however that within the rind of citrus fruit is a substance called limonene. Limonene takes its name from the lemon, as the rind of the lemon, like other citrus fruits, contains considerable amounts of this compound, which contributes to their odor. It is classified as a Class II combustible liquid with a flash point of 43°C (109°F) and a boiling point of 177°C (351°F).

Although not able to be conclusively proven, it is quite conceivable that due to the clementines being subjected to the heat of the fire, limonene may have been liberated as a liquid, then vaporized when it reached its boiling point.

Limonene vapor may have mixed with other gasses produced by the fire and added to the explosive force of the backdraft when it occurred.

Ventilation Considerations and Tactics

Ventilation is the systematic removal of smoke and heated fire gases from an enclosed space and is one of the most important fireground operations. Proper ventilation aids firefighters in all aspects of firefighting operations, including rescue, fire attack and overhaul. When backdraft conditions are present, the enclosed space must be vented at the highest and safest point above the fire before entry is made. This will allow the super-heated gases to escape and the flammable atmosphere to ignite in a more controlled manner.

While it is true that this incident involved a burning trailer, it never-the-less was a sealed container or compartment that was subject to the same forces and conditions normally associated with a typical structure such as a house.

In this case, the trailer was refrigerated and therefore well insulated to keep the inside as cold as possible relative to the outside temperature. This also means that under fire conditions, the trailer would also hold heat inside. The fact that the trailer is also well sealed to prevent warm air from entering and cold air from escaping also made it an ideal container in which backdraft conditions could develop. A backdraft or smoke explosion can occur when a fire is burning in a fairly well sealed space and over time oxygen in the space is consumed. Without adequate oxygen, combustion slows to a smoldering state. Smoldering fires are very inefficient fires in that the flammable gasses that are created by the fire and are normally consumed by a rapidly burning fire are not completely consumed. Rather, they collect inside the space, which continues to be superheated by the smoldering fire. Once a door or window is opened, a rush of oxygen is sucked in and the rate of burning of the fire increases dramatically. Simultaneously, the super-heated flammable gasses that have accumulated mix with the incoming oxygen until they reach an ideal ratio to oxygen and ignite explosively. The force of the explosion can be great enough to blow out walls of a structure or container. In this case, the rear trailer door that was not forcibly opened by the firefighters, opened violently; striking FM Richardson in the head and causing his serious injuries.

Fire Department Dispatch

At 13:30 hours the Burlington County Central Communications received a call from the driver of the truck reporting he had a flat tire on the trailer and it caught fire. He reported his location as Route 295 northbound by exit 52. Subsequently the communication center began receiving numerous calls reporting a truck on fire. The MTFFC#1 was dispatched at 13:31 hours for a truck fire on Route 295 northbound. After approximately six minutes MTFFC#1 did not respond and as is the Burlington County Central Communications (BCCC) established protocol

the MTFFC#1 was dispatched again at 13:37 hours. After another approximately four minutes had passed, MTFFC#1 still had not responded and BCCC added a second company; FTFD to the incident. Approximately 10 minutes had passed since the initial alarm was dispatched.

A delayed fire department response by the FTFD was caused by the MTFFC#1 not initially responding thus causing the FTFD to not be dispatched until a significant amount of time had elapsed. This allowed the fire to burn longer and deplete the oxygen inside the trailer. This resulted in ideal conditions for a backdraft to occur upon the arrival of the FTFD and firefighters opening up the trailer. An engine from MTFFC#1 did eventually arrive on location at 13:59 hours, 28 minutes after their initial dispatch.

It was found that the MTFD did not participate at the time of the incident in Burlington County's fire alarm "box system" that permits dispatchers to dispatch multiple fire departments simultaneously based upon geographic areas and fire hazards that are present within those areas.

Critical Incident Stress Debriefing (CISD) Team Usage

The purpose of a CISD Team is to provide individual counseling, group sessions and, if necessary, referrals to members of an emergency response organization involved in traumatic events. These events include death or serious injury of a co-worker, multiple deaths, or the death of a child. The teams are made up of specially trained fire, police and EMS personnel, along with mental health professionals who provide training and guidance to the team members and assist at the debriefing sessions. The assistance provided by the CISD Team helps to sensitize the firefighters to the possibility of stress reactions, hopefully avoiding future stress related problems. It allows the members to understand the range of normal reactions and provides a method to deal with the incident and its after-effects. CISD Teams are regionalized in New Jersey and are part of a statewide network.

PEOSH Inspections

All fire departments are subject to the mandatory reporting requirements under N.J.S.A. 34:6A-25 et seq. Public Employees' Occupational Safety and Health Act and Regulations specifically at N.J.A.C. 12:110-5.8. All work-related public employee (firefighter, career or volunteer) fatalities or three or more in-patient hospitalizations shall be reported orally and in writing, within eight hours of occurrence to the Commissioner of Labor or his or her designee by the public sector employer.

Following this incident, investigators from the NJDFS met with an investigator from the NJ Department of Labor and Workforce Development (DOLWD). A PEOSH inspection of FM Richardson's PPE and SCBA was performed. All PPE

was photographed and inspected at this time. All PPE and SCBA was found to be in compliance with all regulations and standards in place at the time of the incident. No violations of the PEOSH Respiratory Protection or the NJ Firefighter Standards were observed that may have contributed to the injuries of FM Richardson. However, since this incident did not meet the requirements of three or more in-patient hospitalizations or a fatality the DOLWD did not conduct a formal investigation.

Since it was determined that all PPE and SCBA was in compliance with all regulations and standards in place at the time of the incident and that the PPE did not contribute to the extent of FM Richardson's injuries there was no reason to retain this equipment. It was also determined that no additional testing of the equipment was necessary for this investigation. Therefore, after the inspection of the PPE and SCBA, all equipment was returned to the FTFD.

LESSONS LEARNED

The following items are areas identified as ways to correct issues regarding this incident and other general items designed to make incident scenes safer and more efficient.

Potential for Hazardous Materials

When fire departments are dispatched to incidents involving motor vehicles; especially cargo trucks; personnel need to be acutely aware of the potential presence of hazardous materials. Regardless of whether or not a truck is placarded in accordance with Federal Department of Transportation (USDOT) regulations, there is always the chance that a truck loaded with hazardous materials may not be properly placarded, may not have sufficient quantities to require placarding, or may not be placarded at all in violation of USDOT regulations. In this incident, hazardous materials were not present; however, the heat of the fire may have liberated limonene from the clementines which may or may not have contributed to the force of the backdraft explosion.

As stated previously in this report, within the rind of citrus fruit is a substance called limonene. Limonene takes its name from the lemon, as the rind of the lemon, like other citrus fruits, contains considerable amounts of this compound, which contributes to their odor. It is classified as a Class II combustible liquid with a flash point of 43°C (109°F) and a boiling point of 177°C (351°F).

In an attempt to prove whether the liberation of limonene's contributed to the force of the backdraft explosion the investigation team conducted several small scale tests. However, the investigation team was unable to duplicate the conditions present in the trailer at the time of the backdraft explosion.

Laboratory testing by the NJSPHMu of the oily residue located on the interior walls was positive for citrus oil indicating that the fruit had been sufficiently heated and was off-gassing; contributing to the production of smoke and gases inside the trailer. It should also be noted that the clementines were coated with food grade vegetable beeswax and/or lac-resin based wax or resin to maintain freshness. Thiabendazole and/or Imazalil were used as fungicides.

Although not able to be conclusively proven, it is quite conceivable that due to the clementines being subjected to the heat of the fire, limonene may have been liberated as a liquid, then vaporized when it reached its boiling point. Limonene vapor may have mixed with other gasses produced by the fire and added to the explosive force of the backdraft when it occurred.

Fire Department Dispatch

As was stated previously in this report, investigators found that the MTFFC#1 was originally dispatched at 13:31 hours for a truck fire on a limited access highway as a single company response. After approximately six minutes the MTFFC#1 did not respond. It was dispatched again at 13:37 hours and after approximately 10 minutes after the initial dispatch at 13:41 hours, the FTFD was dispatched to the scene. FTFD Engine 4013 arrived on the scene at 13:51 hours; a full 20 minutes after the call was initially dispatched.

The MTFFC#1 is a volunteer fire company that has approximately 30 firefighters and six company officers according to information contained in their fire department profile published by the NJDFS. As is typical with some volunteer fire companies, many of the volunteer members hold fulltime daytime employment outside of the fire department's response area. Therefore, many of the volunteer firefighters are not available for daytime response. This is not an issue that is unique to the MTFFC#1 but is a common concern to many volunteer fire companies throughout the State of New Jersey. Also, commercial motor vehicle fires generally require additional resources to fight such a fire as opposed to a personal motor vehicle fire.

The MTFFC#1 should establish "box assignments" with the Burlington County Central Communications. By adding additional companies on the initial dispatch, a prompt response by other fire departments can be assured should the MTFFC#1 not respond due to staffing shortages or other reasons. This will also allow dispatchers to dispatch multiple fire departments based on geographic areas and fire hazards that are present within those areas.

Ventilation Considerations

At this particular incident, firefighters were dealing with an enclosed space not unlike those found inside conventional structures. Of course outwardly, its appearance was quite different. However, the same forces and conditions were present; a fire that had been burning for an extended period of time due to the delayed response; a super-heated oxygen deficient atmosphere; and a well-insulated container. It is quite possible that if the first due fire department had responded without delay, the second due FTFD would not have been faced with those conditions. Be that as it may, ventilation, possibly through the side of the uppermost portion of the trailer wall prior to opening the rear doors could have been enough to remove super-heated gases from the trailer and thus alleviate the potential for a backdraft.

The decision to perform ventilation at any particular incident depends on several factors which can be determined by the proper coordination and communication between ventilation and fire suppression teams. These factors are as follows:

- *Ventilation must be needed* – This will be determined by the heat, smoke, and gas conditions experienced by the personnel.
- *Ventilation location must be determined* – Typically, ventilation should be performed as close to the seat of the fire as possible. A hose team must be positioned and ready to attack the seat of the fire in unison with the ventilation. Additionally, interior personnel must be advised of any change in ventilation location or method. Adequate-size ventilation holes must be cut and opened if ventilation is to be successful. Ventilation hole(s) of at least 10% of roof surface of the involved area is a rule of thumb to consider.
- *Ventilation method should be determined* – The decision to perform vertical or horizontal ventilation (or both) should be made by considering the anticipated effects the ventilation will have on both the fire and the interior personnel. In this particular incident, vertical ventilation on the roof of the trailer would most likely expose personnel to high risk since the integrity of the trailer's roof could not be conclusively ascertained. Trailer roofs are not constructed in such a way as to provide long term structural integrity under fire conditions. In this instance, horizontal ventilation performed as high as possible on one of the trailer's side walls would probably be the safest choice.
- *Personnel safety and ability is paramount* – This is especially true when dealing with lightweight truss construction.

When responding to relatively unconventional incidents such as this, firefighters should ensure that their thought processes and decisions are consistent with those made at “normal” structure fires. They must always keep in mind that similar conditions may exist and must be dealt with in the most expedient manner possible.

As can be seen, ventilation is a valuable tool for firefighters to use whenever they are operating at a structure or any type of enclosed space. When timed correctly and properly placed, ventilation can be the difference between operations that fail and those that succeed. Firefighters should not hesitate to learn, train and then implement ventilation as demanded by the types of fires they face.

Critical Incident Stress Debriefing (CISD)

The purpose of a CISD Team is to provide individual counseling, group sessions and, if necessary, referrals to members of an emergency response organization involved in traumatic events. The teams are made up of specially trained fire, police and EMS personnel, along with mental health professionals who provide training and guidance to the team members and assist at the debriefing sessions.

The assistance provided by the CISD Team helps to sensitize the FFs to the possibility of stress reactions, hopefully avoiding future stress related problems. It allows the members to understand the range of normal reactions and provides a method to deal with the incident and its after-effects. The use of a CISD Team in situations such as this is not a sign of weakness on the part of emergency personnel. Failure to deal completely with the emotional stress of such a traumatic occurrence can negatively affect both the professional and personal lives of those involved.

The Division of Fire Safety recommends the notification and use of CISD teams when the CISD trigger events are found to be present. Such significant events may include:

- *line of duty death of a co-worker*
- *mass casualty incidents*
- *death of a child*
- *death occurring after prolonged rescue efforts*
- *when a victim reminds an emergency worker of a loved one*
- *during highly dangerous or highly visible events*
- *when the emergency worker influences death or injury*
- *co-worker suicides*
- *any other unspecified highly traumatic event*

Currently, CISD Teams are regionalized in New Jersey and are part of a statewide network. These teams will respond on a 24-hour basis whenever requested. Emergency contact numbers for activation of a CISD team are as follows:

The Statewide CISD Network – (609) 394-3600

The NJ Fire & EMS Lifeline – (866) 653-3367

CONCLUSION

The injuries to Fire Marshal Richardson were found to be the result of several factors that combined and culminated in a backdraft explosion that caused the closed rear door of the trailer to open violently and strike him in the head. Among these factors was the delayed response of firefighting personnel that allowed the fire to progress unimpeded for an extended period of time; the lack of adequate ventilation of the fire in coordination with the fire attack; and the fact that the trailer was heavily insulated, thus holding heat within. The delayed response was through no fault of the FTFD but rather a result of the lack of a county-wide highway fire alarm box system for Interstate 295 as well as MTFFC#1 non-participation in the county's existing fire alarm box system. Considering conditions upon the FTFD's arrival, recognition of the visible signs of potential backdraft such as puffing yellowish/gray smoke and ventilation of the trailer prior to opening the rear doors for fire attack could have dramatically reduced the chances of a backdraft from occurring. Further, it is highly possible that the removal of any one of these factors could have prevented this event and the severe injuries suffered by Richardson.

Firefighting is one of the most hazardous occupations that exist today. Firefighters understand that every fire they respond to is different in many ways from others they have fought. However, there are also many similarities between nearly all fires that must be identified by firefighters. A major similarity is the way fire typically behaves. Fire in a container or space will progress vertically as far as it can until it meets vertical resistance, it will then begin to progress horizontally. It will burn rapidly until it either exhausts its supply of fuel or as in this case, exhausts its supply of oxygen; setting the stage for a potential backdraft.

It is the NJ Division of Fire Safety's sincere hope that the lessons learned from this and other similar incidents will serve to educate the fire service and inspire them to take all necessary measures to reduce firefighter injuries and deaths to the greatest extent possible.

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