



U.S. CHEMICAL SAFETY AND HAZARD INVESTIGATION BOARD

INVESTIGATION REPORT

LITTLE GENERAL STORE – PROPANE EXPLOSION

(Four Killed, Six Injured)



Photo courtesy of West Virginia State Fire Marshal

LITTLE GENERAL STORE, INC.

GHENT, WEST VIRGINIA

JANUARY 30, 2007

KEY ISSUES:

- EMERGENCY EVACUATION
- HAZARDOUS MATERIALS INCIDENT TRAINING FOR FIREFIGHTERS
- 911 CALL CENTER RESOURCES
- PROPANE COMPANY PROCEDURES
- PROPANE SERVICE TECHNICIAN TRAINING

REPORT NO. 2007-04-I-WV

SEPTEMBER 2008

Contents

EXECUTIVE SUMMARY 1

KEY FINDINGS 3

1.0 INTRODUCTION..... 4

1.1 Summary 4

1.2 Investigative Process 7

1.3 Little General Store, Inc. 8

1.4 Little General Store Propane Suppliers 8

1.5 West Virginia Emergency Service Organizations 9

1.6 Professional and Industry Organizations..... 12

2.0 INCIDENT DESCRIPTION 13

2.1 Events Preceding January 30, 2007 Explosion..... 13

2.2 Day of the Incident 14

2.3 Response to the Propane Release 17

3.0 PROPANE INCIDENT FREQUENCY 20

3.1 United States Hazardous Materials Incidents 2001 – 2006..... 20

3.2 Recent Propane Incidents 21

4.0 PROPANE SYSTEM FUNDAMENTALS 22

4.1 Propane Properties..... 22

4.2 System Features..... 22

4.3 Propane Standards 24

4.4 Propane Emergency Guidance 25

5.0 INCIDENT AND EMERGENCY RESPONSE ANALYSIS 27

5.1	Liquid Withdrawal Valve	27
5.2	Propane Tank Placement	30
5.3	Propane Service Technician Training and Response	36
5.4	Fire Department Response	41
5.5	911 Emergency Call Center Response	44
6.0	REGULATORY ANALYSIS	46
6.1	Occupational Safety and Health Administration	46
6.2	Environmental Protection Agency	46
6.3	West Virginia Fire Commission	47
7.0	FINDINGS	51
8.0	CAUSES	53
9.0	RECOMMENDATIONS	54
	Governor and Legislature of the State of West Virginia	54
	West Virginia Fire Commission	54
	West Virginia Office of Emergency Medical Services	54
	National Fire Protection Association	55
	Association of Public-Safety Communications Officials	55
	Propane Education and Research Council	55
	National Propane Gas Association	56
	West Virginia E911 Council	56
	Ferrellgas	57
	REFERENCES	58
	APPENDIX A FERRELLGAS INSTALLATION REVIEWS OF THE INCIDENT TANK	60
	APPENDIX B 911 CALL AND INITIAL FIRE DEPARTMENT DISPATCH	63

APPENDIX C RECENT PROPANE INCIDENTS 66

RECENT PROPANE INCIDENTS 67

1.0 PROPANE RELEASE INCIDENTS 67

1.1 Aberdeen, Washington 67

1.2 Lynchburg, Virginia 68

1.3 Bristow, Virginia 70

2.0 PROPANE RELEASE AND FIRE INCIDENTS 72

2.1 Sallis, Mississippi 72

2.2 Danville, Alabama 73

APPENDIX D TABLE OF STATE REQUIREMENTS FOR PROPANE SERVICE TECHNICIANS . 75

APPENDIX E UNITED STATES EPA - 40 CFR 311 77

List of Figures

Figure 1. Aerial photograph of Little General store and surrounding plot.	4
Figure 2. Site plan of Little General Store.	6
Figure 3. Liquid withdrawal valve.	15
Figure 4. Timeline of initial events.	17
Figure 5. Timeline of incident response.	19
Figure 6. Typical ASME propane tank.	23
Figure 7. Incident valve plug (Telltale circled).	27
Figure 8. Crack in valve seal.	29
Figure 9. Pre-incident photograph of the Ferrellgas tank.	30

List of Tables

Table 1. U.S. hazardous materials incidents 2001-2006.	20
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List of Acronyms and Abbreviations

ASME	American Society of Mechanical Engineers
APCO	Association of Public-Safety Communications Officials
CETP	Certified Employee Training Program
CFR	Code of Federal Regulations
CSB	U.S. Chemical Safety and Hazard Investigation Board
DOT	U.S. Department of Transportation
EMS	Emergency Medical Services
EMT	Emergency Medical Technician
EOC	Emergency Operations Center
EPA	U.S. Environmental Protection Agency
FIR	Ferrellgas Installation Review
HAZWOPER	Hazardous Waste Operations and Emergency Response
HVAC	Heating, Ventilation, and Air Conditioning
IC	Incident Commander
LP Gas	Liquefied Petroleum Gas
MSDS	Material Safety Data Sheet
NENA	National Emergency Number Association
NFIRS	National Fire Incident Reporting System
NFPA	National Fire Protection Association
NIMS	National Incident Management System
NPGA	National Propane Gas Association
OES	Raleigh County Office of Emergency Services
OSHA	U.S. Occupational Safety and Health Administration
PERC	Propane Education and Research Council
RESA	Regional Education Service Agency
SCGM	Service Center General Manager
STARS	Safety and Training Administrative Records System
WVC	West Virginia Code
WVCSR	West Virginia Code of State Rules

Executive Summary

On January 30, 2007, a propane explosion at the Little General Store in Ghent, West Virginia, killed two emergency responders and two propane service technicians, and injured six others. The explosion leveled the store, destroyed a responding ambulance, and damaged other nearby vehicles.

On the day of the incident, a junior propane service technician employed by Appalachian Heating was preparing to transfer liquid propane from an existing tank, owned by Ferrellgas, to a newly installed replacement tank. The existing tank was installed in 1994 directly next to the store's exterior back wall in violation of West Virginia and U.S. Occupational Safety and Health Administration regulations.

When the technician removed a plug from the existing tank's liquid withdrawal valve, liquid propane unexpectedly released. For guidance, he called his supervisor, a lead technician, who was offsite delivering propane. During this time propane continued releasing, forming a vapor cloud behind the store. The tank's placement next to the exterior wall and beneath the open roof overhang provided a direct path for the propane to enter the store.

About 15 minutes after the release began, the junior technician called 911. A captain from the Ghent Volunteer Fire Department subsequently arrived and ordered the business to close. Little General employees closed the store but remained inside. Additional emergency responders and the lead technician also arrived at the scene. Witnesses reported seeing two responders and the two technicians in the area of the tank, likely inside the propane vapor cloud, minutes before the explosion.

Minutes after the emergency responders and lead technician arrived, the propane inside the building ignited. The resulting explosion killed the propane service technicians and two emergency responders who were near the tank. The blast also injured four store employees inside the building as well as two other emergency responders outside the store.

The CSB identified the following causes:

1. The Ferrellgas inspection and audit program did not identify the tank location as a hazard.
Consequently, the tank remained against the building for more than 10 years.
2. Appalachian Heating did not formally train the junior technician, and on the day of incident he was working alone.
3. Emergency responders were not trained to recognize the need for immediate evacuation during liquid propane releases.

The CSB makes recommendations to the governor and legislature of the State of West Virginia, the West Virginia Fire Commission, the West Virginia Office of Emergency Medical Services, the National Fire Protection Association, the Association of Public-Safety Communications Officials, the Propane Education and Research Council, the National Propane Gas Association, the West Virginia E911 Council, and Ferrellgas.

Key Findings

1. The propane service technicians, emergency responders, and store employees did not evacuate the area as recommended by nationally accepted guidance for propane emergencies.
2. A defect in the existing tank's liquid withdrawal valve caused it to malfunction and remain in an open position.
3. The junior propane service technician who was servicing the tank on the day of the incident had no formal training and did not recognize the defect in the withdrawal valve. He was also working unsupervised, even though he had been on the job for only one and a half months.
4. The placement of the 500-gallon propane tank against the building's exterior back wall provided releasing propane a direct path into the store's interior.
5. The Occupational Safety and Health Administration's and National Fire Protection Association's propane standards require training but do not include curricula, practical exercises, or knowledge evaluation.
6. 911 operators in the United States lack propane emergency guidance to help them collect important information from callers, offer life-saving advice, and convey relevant information to first responders.
7. Firefighters in West Virginia are required to attend a minimum of four hours of hazardous materials emergency response training as part of their initial training sequence, but refresher training is not required. The responding Ghent Volunteer Fire Department captain last attended a hazardous materials response course in 1998.
8. Propane safety and emergency training is voluntary for fire department personnel in West Virginia. None of the responders from the Ghent Volunteer Fire Department had specific propane emergency training.

1.0 Introduction

1.1 Summary

At 10:53 am on January 30, 2007, a propane explosion leveled the Flat Top Little General Store (Little General) in Ghent, Raleigh County, West Virginia (Figure 1). The explosion killed four and injured six. The dead included two emergency responders (a fire department captain and an emergency medical technician, both from the Ghent Volunteer Fire Department) and two Appalachian Heating propane service technicians. The injured included the four Little General employees who remained inside the store, and two other Ghent Volunteer Fire Department emergency responders.



Figure 1. Aerial photograph of Little General store and surrounding plot.

The morning of the explosion, a junior propane service technician¹ (junior technician) from Appalachian Heating was preparing to transfer liquid propane from an existing tank owned by Ferrellgas to a newly installed tank² owned by Thompson Gas and Electric Services (Thompson). The Ferrellgas propane tank was installed in 1994 directly against the store's exterior back wall (Figure 2). At about 10:25 am, the junior technician, working alone, removed a threaded plug from the liquid withdrawal valve³ on the Ferrellgas tank and liquid propane began flowing uncontrollably. Liquid propane sprayed upward, against the roof overhang, and dense propane gas accumulated at ground level around the tank and the foundation of the building. Over the next 25 minutes, the escaping propane entered the Little General store through openings in the roof overhang.

Shortly after the release began, the junior technician called the lead technician to report the release and seek guidance. At 10:40 am, the junior technician called 911 to report the emergency and summon help. A captain and two emergency medical technicians from the Ghent Volunteer Fire Department were the first to arrive, followed by the lead technician and two other emergency responders. Shortly after their arrival, the propane in the store ignited, leveling it and killing two emergency responders (the fire captain and one of the emergency medical technicians) and the two Appalachian Heating propane service technicians.

¹ The report discusses the activities of two propane service technicians: a junior technician, who had been performing propane duties for one and a half months, and a lead technician, who had been performing propane duties for one and a half years. "Junior" and "lead" are used in this report to differentiate the technicians' relative experience in propane service.

² While commonly referred to as tanks, both of these were 500-gallon pressure vessels. The American Society of Mechanical Engineers (ASME) publishes the Boiler and Pressure Vessel code; generally, stationary propane tanks are considered unfired pressure vessels and manufactured in accordance with Section VIII of the code.

³ The liquid withdrawal valve was a RegO Chek-Lok valve model number 7572FC, which is no longer manufactured. Although the RegO name is still used on propane equipment, the company that manufactured this valve is no longer in business.

Fire departments from the neighboring communities of Beckley, Beaver, and Princeton responded to the explosion. Later that day a team from the West Virginia Office of the State Fire Marshal arrived to investigate, assisted by an agent from the U.S. Bureau of Alcohol, Tobacco, Firearms, and Explosives (ATF).

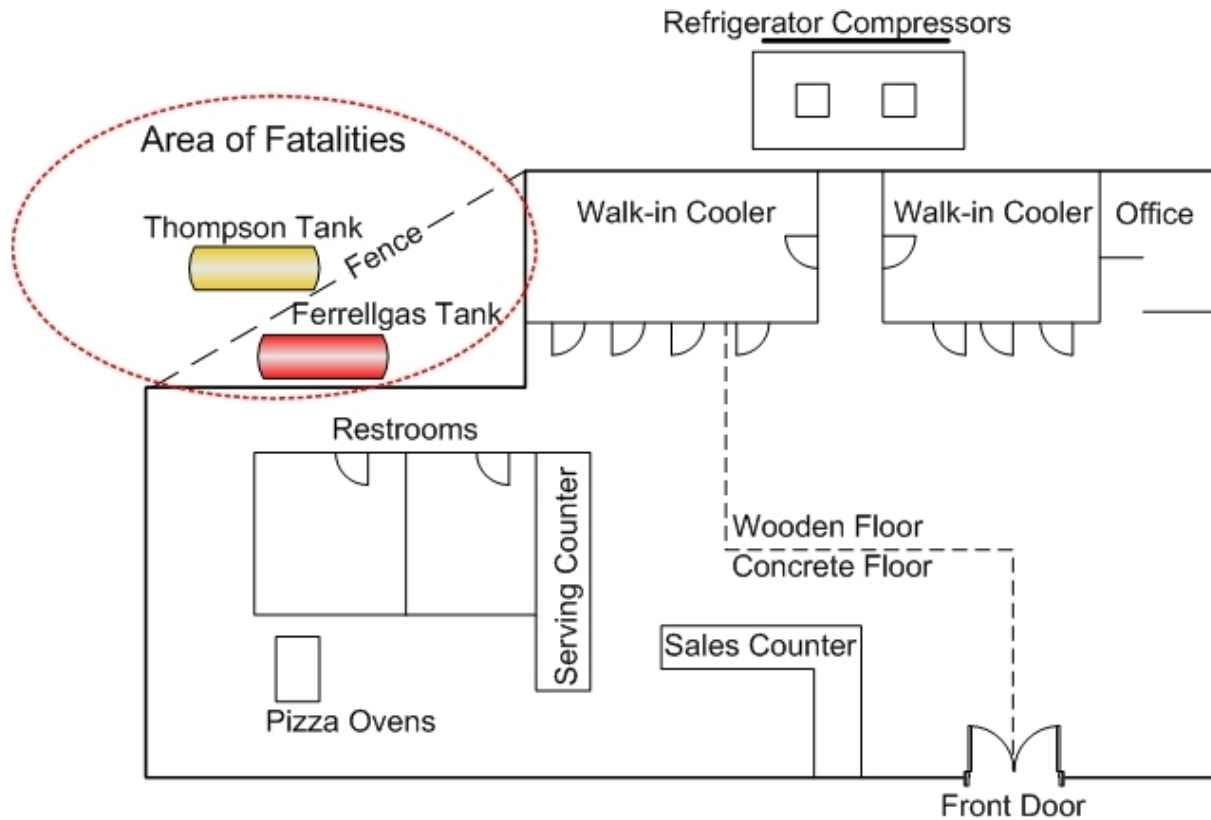


Figure 2. Site plan of Little General Store.

1.2 Investigative Process

The CSB investigation team arrived at the incident scene on January 31. They joined the Incident Command structure, in accordance with the National Incident Management System (NIMS),⁴ and began on-scene investigation activities. On February 2, 2007, Incident Command demobilized after the State Fire Marshal concluded that the incident was not a criminal act. The CSB investigation team remained, and with the help of Little General management, protected and preserved evidence, moving it to a secure storage locker.

The team interviewed employees of the companies involved, emergency responders, and officials from the West Virginia Office of the State Fire Marshal; The West Virginia Division of Labor; the Raleigh County Building Department; Regional Education Service Agency (RESA)⁵ Region I; the United States Fire Academy; the ATF; the Beckley and Beaver, West Virginia Fire Departments; the Occupational Safety and Health Administration (OSHA); the National Fire Protection Association (NFPA); the National Propane Gas Association (NPGA); and the Propane Education and Research Council (PERC).

In addition, the CSB tested and examined the valve that released the propane from the Ferrellgas tank. The test protocol included *in situ* examination and flow testing; removal of the liquid withdrawal valve assembly (valve, tank nozzle, and dip tube); photography and examination of the valve and dip tube, including removal of the dip tube; and dismantling and examination of the valve.

⁴ NIMS is a comprehensive approach to incident response management that provides a consistent, nationwide template to enable all response entities to work in concert during incidents. Implementation of NIMS is required by the US Department of Homeland Security in accordance with its authority in Homeland Security Presidential Directive 5 “*Management of Domestic Incidents.*” The State Fire Marshal reestablished an incident command system following the explosion.

⁵ Enacted by the West Virginia Legislature in 1972, RESA provides educational services to schools, including technical, professional, operational, and programmatic services. In addition to school-based programs, RESA coordinates much of West Virginia’s professional firefighter training program.

1.3 Little General Store, Inc.

Little General Store, Inc. operates 48 convenience stores throughout southern and central West Virginia and western Virginia. The Ghent store was a combination gasoline station and convenience market. At the time of the incident, the Ghent store and three others included pizzerias, which used propane for cooking.

1.4 Little General Store Propane Suppliers

1.4.1 Southern Sun

Southern Sun supplied propane to Little General beginning in late 1994. Southern Sun was a family-owned propane, heating oil, and ice supplier located in south central West Virginia. In 1996 Southern Sun sold its propane operations to Ferrellgas, which became the supplier to Little General.

1.4.2 Ferrellgas

Ferrellgas, headquartered in Overland Park, Kansas, is the second-largest propane marketer in the United States, with offices and customers in all 50 states. One of Ferrellgas' business strategies is to "expand operations through disciplined acquisitions and internal growth." Since 1986 Ferrellgas has acquired 166 propane distributors throughout the United States.

Late in 2006, Little General initiated a change in propane suppliers from Ferrellgas to ThompsonGas Propane Partners.

1.4.3 Thompson Gas and Electric Service, Inc.

Thompson is a privately held company that installs commercial and residential propane systems and delivers propane in the eastern and southeastern United States.

1.4.4 Appalachian Heating

Appalachian Heating is a family-owned heating, ventilation, air conditioning (HVAC), and plumbing company. Appalachian installs appliances, installs and maintains heating and cooling systems, and installs and repairs plumbing. Appalachian entered into a contract with Thompson in August 2005 to extend its business to include propane supply.

1.4.5 ThompsonGas Propane Partners, LLC

ThompsonGas Propane Partners is the limited liability company (LLC) formed between Thompson of Hagerstown, Maryland, and Appalachian Heating of Bradley, West Virginia. Under the agreement forming ThompsonGas Propane Partners, LLC, Appalachian Heating provides personnel to install propane systems and deliver propane; Thompson provides equipment, bulk propane, and technical support. The LLC has no employees.

1.5 West Virginia Emergency Service Organizations

1.5.1 West Virginia State Fire Commission

The West Virginia Fire Prevention and Control Act⁶ of 1975 established the West Virginia State Fire Commission and granted the commission authority to promulgate and establish a state fire code.⁷ The commission established the National Fire Codes⁸ as the minimum fire prevention and protection requirements for the state.

⁶ West Virginia Code Chapter 29, Article 3 “The Fire Prevention and Control Act.”

⁷ West Virginia Legislative Rule Title 87, Series 1, “State Fire Code.”

⁸ NFPA publishes the National Fire Codes annually. The National Fire Codes are a collection of all NFPA’s standards.

1.5.2 West Virginia State Fire Marshal

The West Virginia State Fire Marshal's Office, overseen by the State Fire Commission, has four divisions providing fire protection and regulatory services: regulation and licensing, public education, fire investigation, and regional response. The Fire Marshal enforces the rules of the State Fire Commission throughout West Virginia. Currently, the Fire Marshal's Office employs 12 code inspectors and 11 fire investigators.

1.5.3 Raleigh County Emergency Services

An executive group is responsible for emergency services management in Raleigh County, West Virginia. Group membership includes county commissioners; the district attorney; mayors of municipalities; the county sheriff; the Office of Emergency Services (OES); and the county public information officer.

Raleigh County emergency services encompass mutual aid management among municipal fire departments (career and volunteer); police; emergency medical transport services; and community-based support agencies. Services are coordinated under a unified command system at the Emergency Operations Center (EOC) located in Beckley.

Local municipalities are responsible primarily for emergency response activities within their areas.

County resources are available from the OES and coordinated through the EOC when emergencies exceed local response capabilities. The OES develops and maintains the Raleigh County Emergency Plan and manages the county's 911 emergency call center.

1.5.4 Ghent Volunteer Fire Department

The Ghent Volunteer Fire Department was incorporated in 1973 and has 28 members providing fire fighting, life protection, and ambulance service to residents in the Ghent area. Salaried Emergency

Medical Technicians (EMTs) are on duty at the fire station 24 hours a day, seven days a week.⁹ All Ghent area emergency 911 calls are routed to the Raleigh County EOC where operators dispatch the appropriate fire or emergency medical service.

1.5.5 West Virginia E911 Council

West Virginia established the E911 Council in 1986 to organize and implement the universal 911 emergency telephone number system. The council promotes, researches, plans, educates, develops funding streams, and proposes state legislation to ensure reliable 911 call service operations.

Representatives from West Virginia's 55 counties serve on the council, which meets monthly.

The council works closely with emergency response industry organizations including the National Emergency Number Association (NENA) and the Association of Public-Safety Communicators Officials (APCO). In addition, the council is involved in activities to promote and fund 911 systems statewide.

1.5.6 West Virginia Office of Emergency Medical Services

The West Virginia Office of Emergency Medical Services (EMS) is a division of the West Virginia State Trauma and Emergency Care System, administered by the West Virginia Department of Health and Human Resources. The Office of EMS was legislatively mandated in 1975 and tasked with operating a comprehensive statewide EMS program. It oversees licensing for EMS agencies and training and certification for responders.

⁹ The Ghent fire department comprises trained volunteer firefighters and paid emergency medical technicians. Many of the emergency medical technicians, including those who responded to the Little General propane release, also serve as volunteer firefighters.

1.6 Professional and Industry Organizations

1.6.1 National Fire Protection Association

The NFPA publishes consensus standards applicable to specific industries and activities, including the propane industry and hazardous materials incident response. These standards, while voluntary unless incorporated into state laws or regulations, provide safe practice guidelines for operations in the processes they address. West Virginia adopted the National Fire Codes into the State Fire Code.¹⁰

1.6.2 Propane Education and Research Council

Congress created the Propane Education and Research Council (PERC) in the Propane Education and Research Act of 1996. PERC's purpose is to promote the safe use of propane energy in the United States. Each gallon of odorized propane sold in the United States is assessed one-half of one cent to fund PERC. PERC estimates revenue of \$45,300,000 for the 2009 fiscal year.

PERC develops the curriculum for the Certified Employee Training Program (CETP), which is the propane industry's primary training method for service technicians, bulk plant operators, delivery truck drivers, and customer service representatives.

1.6.3 National Propane Gas Association

Founded in 1931, the National Propane Gas Association (NPGA) is the trade association representing all propane industry segments. It is located in Washington, D.C., and affiliated with 38 state and regional associations, including the West Virginia Propane Gas Association.

The NPGA administers CETP throughout the United States.

¹⁰ The CSB determined that the National Fire Codes were adopted by the West Virginia State Fire Marshal prior to 1967, although the exact date is unknown.

2.0 Incident Description

2.1 Events Preceding January 30, 2007 Explosion

Significant events preceding the January 30, 2007, explosion at the Ghent Little General Store include

1. 1988 - Southern Sun buys the incident tank and places it in propane service.
2. Late 1994 - Southern Sun relocates the incident tank from its original installation to the Little General Store in Ghent and installs it against the store's exterior back wall.¹¹
3. 1996 - Ferrellgas buys the Southern Sun propane business and performs a pre-acquisition review of the business and operations, including an inspection of some of Southern Sun's propane systems.
4. 1996 to 2007 - Ferrellgas drivers fill the incident tank about 14 times per year conducting about 140 pre-fill inspections.
5. April and June 2000 – Ferrellgas employees perform two Installation Reviews (Appendix A) on the propane system at Little General.
6. August 2005 – Thompson Gas and Electric Service, Inc. and Appalachian Heating form the business ThompsonGas Propane Partners, LLC.

¹¹ At the time of the installation, West Virginia and OSHA required 500-gallon propane tanks to be at least 10 feet from buildings; however, Raleigh County had no code enforcement mechanism at that time.

7. September 2006 – Appalachian Heating’s only propane service technician (the lead technician at the scene of the incident) completes training and becomes fully qualified (in accordance with CETP) to install propane tank systems.¹²
8. Fall 2006 – Little General Store, Inc., begins changing propane suppliers from Ferrellgas to ThompsonGas Propane Partners.
9. December 2006 – Appalachian Heating reassigns an HVAC technician to the propane business (the junior technician at the scene of the incident).
10. January 2007 – The two propane service technicians from Appalachian Heating began installing a new Thompson Gas tank and associated equipment at Little General.

2.2 Day of the Incident

On the morning of Tuesday, January 30, the two propane service technicians traveled separately to the Little General Store. At around 9:15 am, witnesses observed both of their trucks at the store. According to Appalachian Heating, the day’s work plan was to transfer the propane from the existing Ferrellgas tank to the newly installed Thompson tank and place the new propane system in service.

By 9:30 am the lead technician had left the store to make a delivery 31 miles northwest of Little General; the junior technician remained alone at the store. For the next hour, the junior technician worked alone while he prepared to transfer propane from the Ferrellgas tank to the Thompson tank.

¹² Thompson trained the lead technician on sections 1, 2, and 4 of CETP. The lead technician also spent nearly a full year working with experienced personnel from multiple Thompson offices.

Around 10:25 am, the junior technician removed a plug¹³ from the liquid withdrawal valve (Figure 3) on the Ferrellgas tank. When he removed the plug, liquid propane unexpectedly began spraying from the valve.

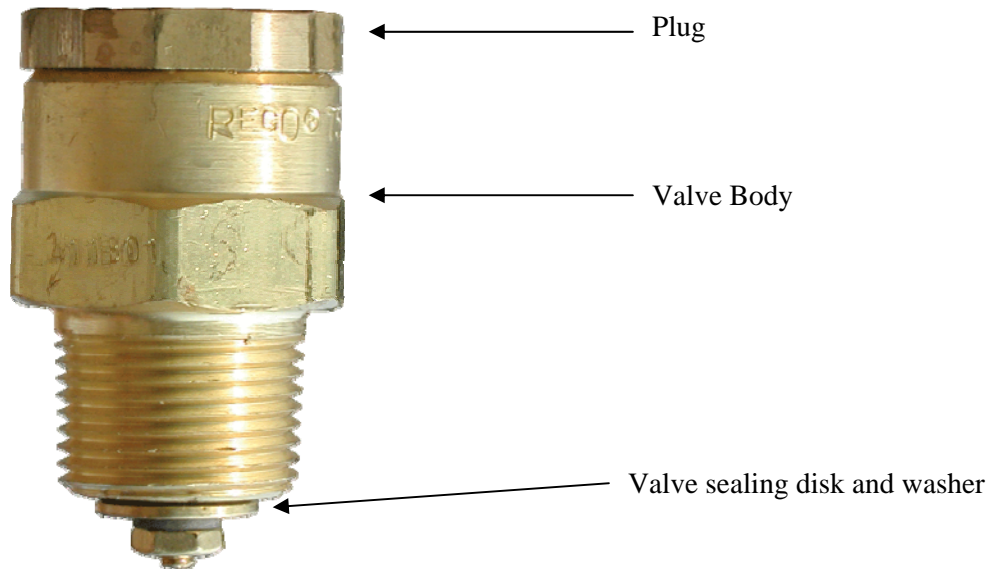


Figure 3. Liquid withdrawal valve.

At 10:28 am, the junior technician called¹⁴ the lead technician, who was still offsite, to report the problem. In response, at 10:31 am, the lead technician called Thompson technical support for guidance. After the call to technical support, the lead technician called the junior technician twice, most likely to relay the guidance from technical support and to encourage him to call 911.

¹³ The valve plug has two functions: to prevent a propane leak if the valve seat leaks and to prevent foreign materials' entering the valve mechanism. The withdrawal valve itself is spring-loaded and self-closing and should not leak; however, if it does, a telltale hole drilled through the threaded portion of the plug sprays a small amount of propane giving an early warning of a malfunction prior to completely removing the plug.

¹⁴ All telephone calls discussed throughout this report were from cellular phones.

A deliveryman in the store at about 10:30 am told the CSB that he smelled a strong odor and that the store employees' eyes were watering. The Little General cashier, concerned about the odor, went outside to check on the junior technician. The cashier told the CSB that she saw him standing between the tank and his service truck within a dense vapor cloud,¹⁵ but that he told her he was "okay."

At 10:40 am, the junior technician called 911 to summon help from emergency services (see transcript in Appendix B). He reported to the 911 operator that he had a leaking propane tank at the Little General in Ghent and needed the fire department's assistance to secure the area. The 911 operator collected this information, clarified the location, and ended the call.

After the 911 call, the junior technician called the lead technician again. The cashier checked on the junior technician a second time, finding him in the same location between the tank and truck. Figure 4 is an event timeline prior to the lead technician's return.

¹⁵ Propane is a colorless gas. A liquid release from a tank forms a dense white cloud of visible propane liquid droplets that then evaporate.

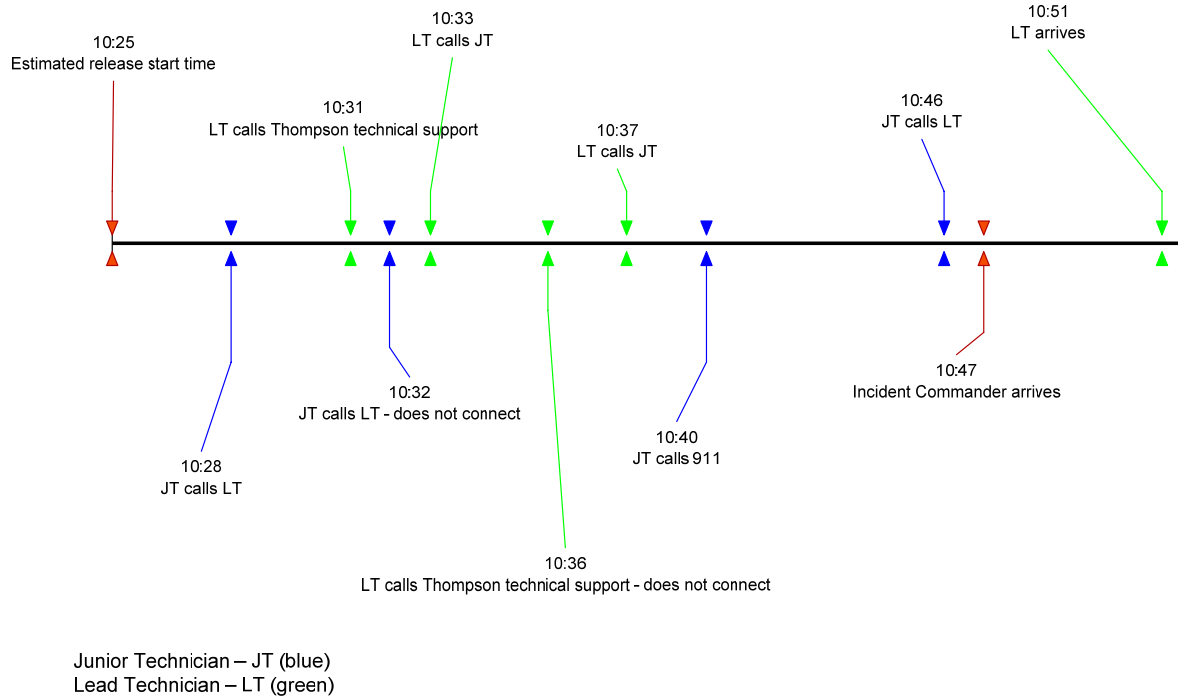


Figure 4. Timeline of initial events

2.3 Response to the Propane Release

After the junior technician’s call, Raleigh County Emergency Services dispatched the Ghent Volunteer Fire Department to the Little General (Appendix B).

The first to arrive, at about 10:47 am,¹⁶ was a captain from the Ghent Volunteer Fire Department. The captain assumed the role of incident commander (IC) in accordance with Ghent Volunteer Fire Department guidelines.¹⁷

¹⁶ As no record of precisely what time the captain arrived at the scene exists, the CSB estimated it from other known events.

¹⁷ Although functioning in accordance with the Ghent Volunteer Fire Department guidelines, the captain had no formal incident command training and did not establish command in accordance with NIMS.

Shortly thereafter, two EMTs arrived in an ambulance. The surviving EMT told investigators that he saw the IC at the store's front door when he arrived. According to the Little General store manager, the IC had ordered the business to close.¹⁸

The IC asked the EMTs to follow him behind the building to treat the junior technician for a burn on his forearm. The EMTs examined the junior technician and determined that the burn was frostbite likely from the releasing liquid propane.

Following the medical examination, the IC sent the EMTs to the front of the store to ensure that the business had closed, gasoline was not being pumped, and no one was smoking. One EMT walked to the store entrance and found it locked; however, he was able to speak to the Little General employees inside to confirm that the business was closed. The Little General employees had hung a small sign on the door to inform customers that the store was closed due to a gas leak. The EMT positioned himself in the parking lot and proceeded to direct traffic and customers away from the property.

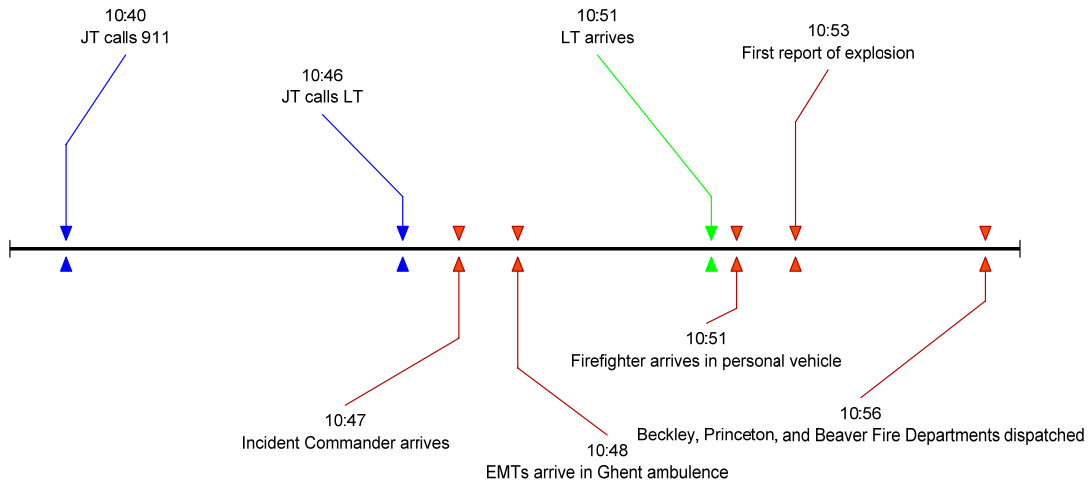
Just after 10:50 am, the lead technician returned to the store. He parked in front of the building and walked to the area of the tanks.

A firefighter arrived in his personal vehicle to assist with the emergency and checked in with the IC. The firefighter saw the IC and the two technicians working around the leaking tank; he could hear the escaping propane. The IC ordered him to "make sure everybody's out, okay?" However, as the firefighter began walking to the front of the store, the propane ignited and exploded.

¹⁸ When ordered to close, the Little General employees turned off the gasoline pumps, locked the doors, and remained in the building.

The explosion killed four near the tanks (the two technicians, the IC, and one EMT). The four workers inside the building and the firefighter survived but sustained serious injuries. The EMT, who was directing traffic and customers, suffered an arm injury.

The explosion leveled the building, destroyed a Ghent Volunteer Fire Department ambulance (cover photograph), and damaged many parked vehicles. The force of the blast threw the Ferrellgas tank about 80 feet and the Thompson tank about 50 feet. Figure 5 is an event timeline of the initial emergency response.



Key:
 Junior Technician – JT (blue)
 Lead Technician – LT (green)

Figure 5. Timeline of incident response.

3.0 Propane Incident Frequency

3.1 United States Hazardous Materials Incidents 2001 – 2006

The National Fire Incident Reporting System (NFIRS) is the United States Fire Administration's database of fire and emergency incidents. The CSB reviewed the NFIRS database for the years 2001 to 2006 to determine the frequency with which United States fire departments responded to propane incidents.

In this six-year period, the NFIRS database includes 36,744 hazardous materials responses in the United States.¹⁹ Of these responses, 35.3 percent were responses to releases of gasoline, natural gas, or propane.

Incidents involving propane occur nearly once per day.

Table 1. U.S. hazardous materials incidents 2001-2006.

	Gasoline	Natural Gas	Propane	Total hazardous materials incidents
2001	658	468	157	4154
2002	817	627	210	4661
2003	1084	830	263	5904
2004	1149	863	234	6307
2005	1423	1151	301	8301
2006	1406	997	317	7417
Total	6537	4936	1482	36,744

¹⁹ As not all states require participation in NFIRS data collection, the total number of hazardous materials responses may not be exhaustive; however, the CSB and the U.S. Fire Administration consider the types of responses representative of the United States as a whole.

3.2 Recent Propane Incidents

Since the explosion in Ghent, several similar propane release incidents have occurred in the United States.

The CSB researched five incidents similar to the Little General incident (see Appendix C).

Three incidents involved only propane releases and two involved releases and flash fires. In the three release-only incidents, both firefighters and propane service technicians responded. A propane service technician secured one of the incident tanks, and firefighters trained in hazardous materials response secured the other two. No injuries occurred in these incidents.

The two incidents involving releases and flash fires both occurred at sites where propane service technicians were involved in tank-to-tank transfers of liquid propane. In these cases, fire departments responded, and in both incidents destroyed the structures located nearest the propane tanks. One flash fire injured a person onsite. The other killed one propane service technician and severely injured two others.

Firefighters, propane service technicians, or both regularly respond to propane release incidents. The successful mitigation of a release depends on the training and experience of both groups.

Additionally, shortly before the Ghent incident, a liquid propane release and explosion occurred at the Falk Corporation facility in Milwaukee, Wisconsin on December 6, 2006. Employees discovered a pool of liquid propane near a propane pipeline. Most employees began evacuating; three remained to attempt to repair the leak. About 10 minutes after the pool of propane had been discovered, it ignited, killing the three employees and injuring over 40 others. OSHA cited Falk and its piping contractor for failing to prepare employees for emergencies involving liquid propane.

4.0 Propane System Fundamentals

4.1 Propane Properties

Propane is used extensively as a fuel for cooking and heating in residential, retail, and commercial applications.²⁰ It is a gas at ambient temperature and pressure but is transported and stored as a liquid.

Propane-air mixtures can be explosive when the atmospheric concentration of propane is between 2.4 and 9.5 percent by volume. Because propane is odorless and colorless, small quantities of an odorizing chemical (ethyl mercaptan) are added so leaks can be detected by smell.

Unlike natural gas, propane is heavier than air. Consequently, propane releases tend to accumulate at ground level or in other low points such as pits and basements.

4.2 System Features

The propane system at Little General consisted of a stationary 500-gallon storage tank (Figure 6) and two supply regulators to reduce the pressure of the propane for pizza ovens used in the store. The storage tank had five connections:

1. A fill connection fitted with an internal check valve;
2. A liquid level gage to measure the quantity of propane in the tank;
3. A relief valve (safety device) to prevent over-pressurization of the tank;
4. A service valve to supply gaseous propane to the regulators; and

5. A liquid withdrawal valve fitted to an internal dip tube for removing liquid propane when necessary.

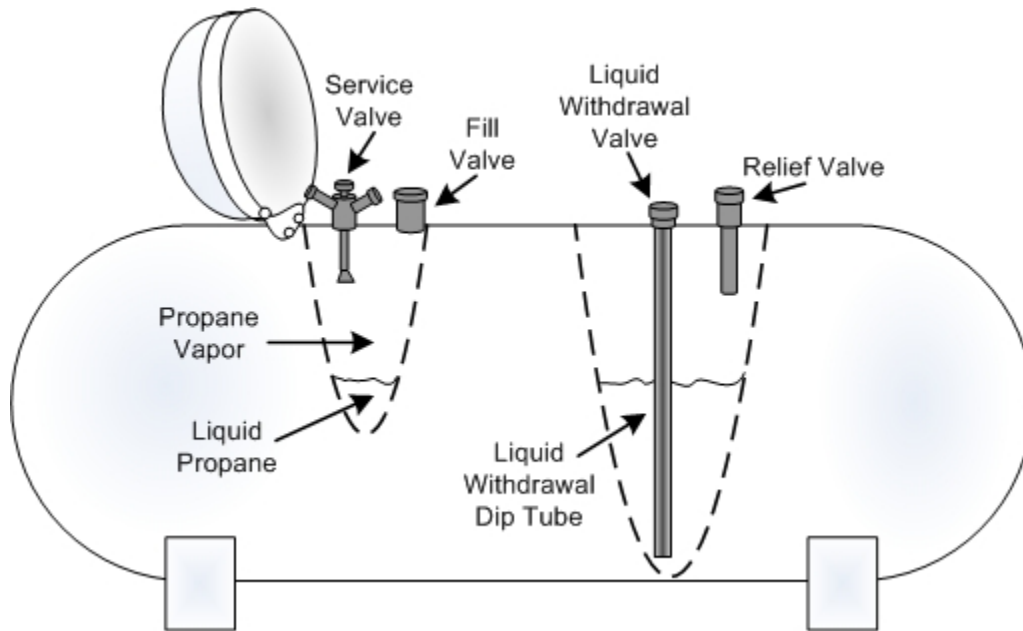


Figure 6. Typical ASME propane tank.

The liquid withdrawal valve incorporated several safety features:

1. A threaded valve plug to protect the valve from foreign material and provide a secondary seal if the primary valve were to leak.
2. A telltale in the threaded area on the valve plug. The telltale is exposed before the plug is completely removed. The telltale releases propane if the primary valve leaks allowing a propane service technician to check for valve leaks before completely removing the plug.
3. A special connector that, when screwed on, opens the valve.

²⁰ According to PERC, about 17.5 million U.S. households use propane as a heating or cooking fuel, excluding grills. About 3,500 companies market propane around the country.

4. An excess flow disk in the valve to limit flow should flow exceed a preset limit, such as during a hose rupture.

4.3 Propane Standards

4.3.1 Occupational Safety and Health Administration

The OSHA standard *Storage and Handling of Liquefied Petroleum Gases*²¹ establishes specific requirements for most workplaces²² storing and handling liquefied petroleum gases (LP gases)²³, including propane.

The standard's requirements include, but are not limited to, design, operation, technician training, safety devices, and tank placement. A 500-gallon tank, like the one at Little General, must be located at least 10 feet from buildings.

4.3.2 NFPA Propane Standards

Two NFPA standards address propane: the *National Fuel Gas Code* (NFPA 54), which applies to fixed gas-consuming (including propane) equipment attached to piping, and the *Liquefied Petroleum Gas Code* (NFPA 58), which applies to the storage, handling, transportation, and use of LP gas. NFPA 58 Chapter 6 addresses installing LP gas systems, including requirements for tank locations. NFPA 58 also requires a 500-gallon tank to be at least 10 feet from commercial and residential buildings.

²¹ 29 CFR 1910.110.

²² Little General is covered by OSHA's occupational safety and health standards.

²³ Liquefied petroleum gas is the general term for mixtures of hydrocarbon gases liquefied by pressure and used for cooking, heating, and vehicle fuel. Liquefied petroleum gas can be propane, butane, propylene, butylene or any mixture of these compounds.

4.4 Propane Emergency Guidance

4.4.1 Guidance for Consumers

Propane companies (including Ferrellgas and Thompson), NPGA, and PERC distribute literature and publish information on their websites guiding consumers on actions to take during propane emergencies such as leaks and releases. If consumers detect a propane leak, this guidance recommends that they:

- Extinguish smoking materials and discontinue the use of lights, appliances, phones, or any electrical or spark producing device.
- Evacuate the area or building immediately.
- If possible, turn off the gas supply at the tank or cylinder.
- Go to a neighbor's house and call the propane company or 911.
- Stay out of the area or building where the leak was detected.

4.4.2 Guidance for Emergency Responders

Propane Emergencies, published for the NPGA and PERC, is the primary text for training emergency responders to handle propane emergencies. The textbook outlines a process wherein the IC should perform a series of actions prior to attempting remediation of the propane emergency. The first step the textbook specifies is site control; it states that the IC must keep all responders and members of the public clear of the hazard until the scene and the hazard are fully understood.

The US DOT *Emergency Response Guidebook* recommends an immediate evacuation to at least 330 feet in all directions and ½-mile downwind for large spills. Responders are cautioned to keep all members of

the public away from the area surrounding the point of the release. In addition, the *Guidebook* states that propane gas is heavier than air and may settle in low or confined areas.

5.0 Incident and Emergency Response Analysis

5.1 Liquid Withdrawal Valve

Liquid withdrawal valves are rarely used. Technicians only open them when tanks must be completely emptied of liquid. The liquid withdrawal valves on most propane tanks may never be used. At Little General, the day of the incident was either the first or the second time that the plug had been removed from the liquid withdrawal valve in the tank's 19 years of propane service.

When the junior technician removed the plug from the liquid withdrawal valve, liquid propane released uncontrollably. The plug, though, has a telltale drilled through the threaded portion (Figure 7) which should have released a small stream of propane once the plug was partially backed out. This should have alerted the technician that the valve was leaking.

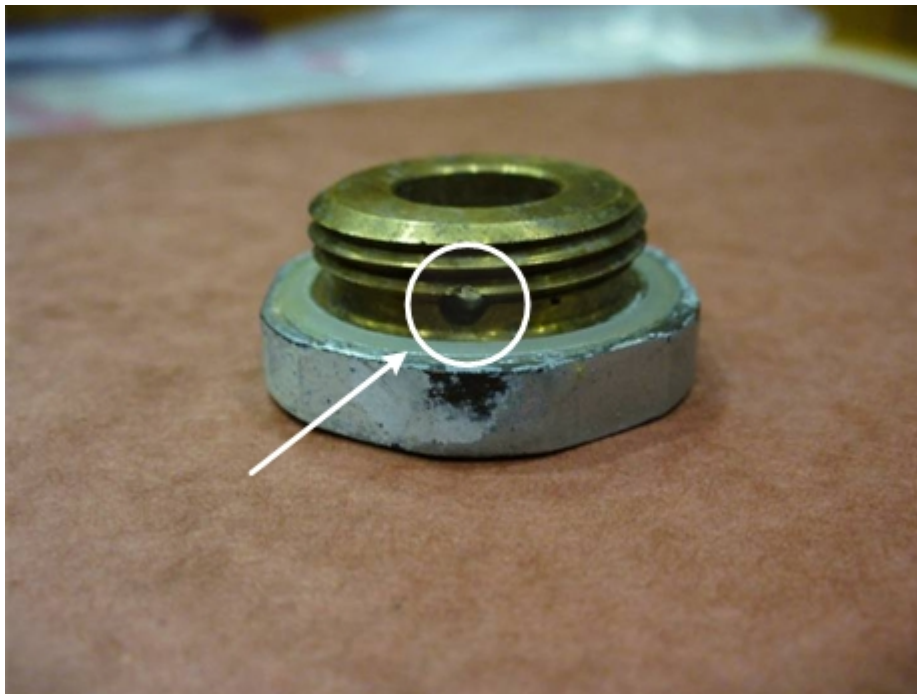


Figure 7. Incident valve plug (Telltale circled).

The CSB determined that the junior technician likely was unaware of the existence and function of the telltale due to inexperience and lack of training and removed the plug completely. Although the CSB determined that it is highly unlikely the telltale hole was obstructed at the time of the incident, CETP training could have made the junior technician aware of and prepared for the possibility of an obstruction of the telltale. The CETP section on liquid withdrawal valves states:

In some cases, a damaged seat may allow an excessive amount of liquid to be discharged when the closing cap [plug]²⁴ is loosened. A bleed hole [telltale] in the closing cap has been provided to vent the liquid before the cap is completely unscrewed. If a significant amount of liquid continues to be blown from under the closing cap for more than 30 seconds, it can be assumed that the internal seat will not prevent a dangerous amount of gas from escaping. IF IN DOUBT, DO NOT REMOVE THE CLOSING CAP. [CETP 2.2.13]

In addition to the information on the valve above, the CETP procedure for transferring liquid propane from a tank to a truck states:²⁵

While removing the plug, if an excessive volume of propane leaks from the valve, reinstall the plug and follow manufacturer's instructions. [CETP 2.2.13]

The CSB initially tested and examined the tank and valve in its "as-found" condition. The CSB determined that the liquid withdrawal valve leaked when the tank was pressurized.²⁶ Following this examination and test, the CSB removed the valve from the tank, performed additional examinations and

²⁴ Plug (external threads) closures are no longer used with liquid withdrawal valves; therefore CETP refers only to cap (internal threads) closures.

²⁵ CETP contains step-by-step procedures for liquid propane transfer from a stationary tank to a tank truck. Liquid propane transfer from a stationary tank to a second stationary tank is not described in CETP.

²⁶ Nitrogen was used to pressurize the tank since it is inert and allowed this test to be conducted safely.

tests, and partially disassembled the valve. The CSB found the valve jammed, likely because of a manufacturing defect,²⁷ and the valve seal cracked (Figure 8). With the valve jammed in an open position, only the plug stopped the liquid propane from escaping. When the junior technician removed the plug, propane began uncontrollably releasing. Cracks in the seal material likely prevented the excess flow feature from limiting the release.

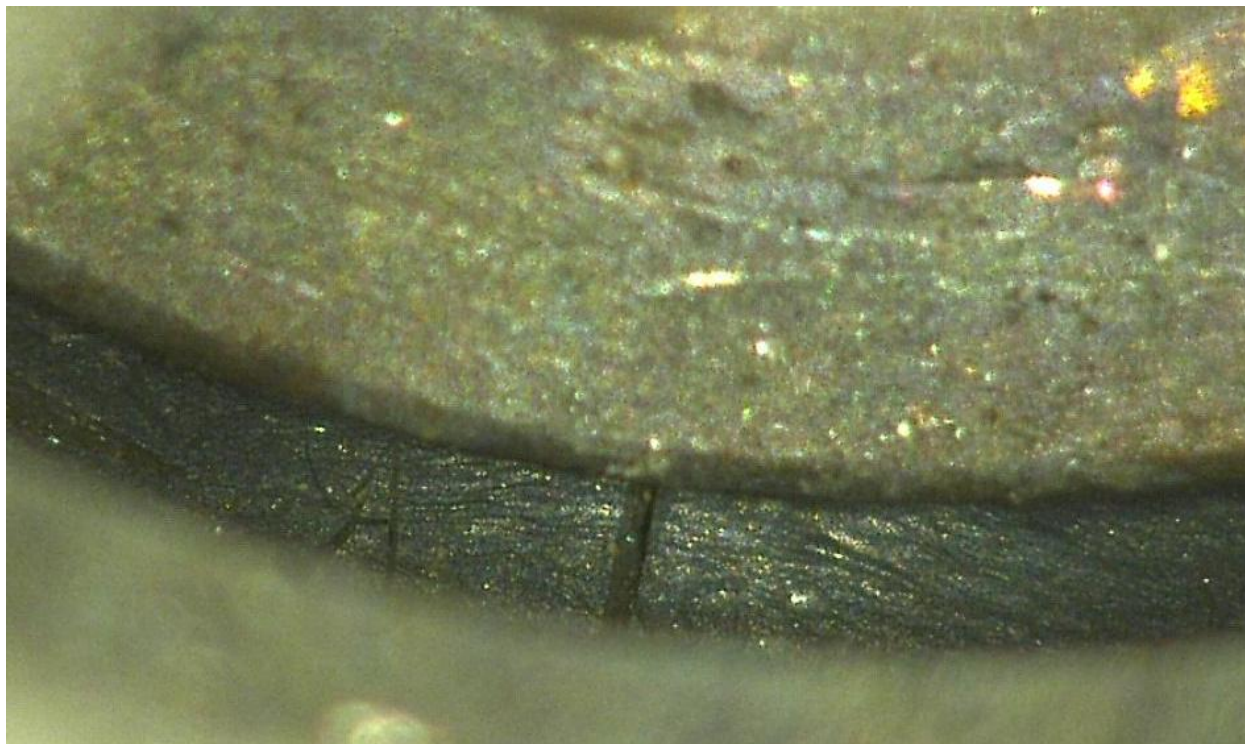


Figure 8. Crack in valve seal.

²⁷ A hole bored through the center of the lower guide through which the valve stem moves was determined to be too small for the valve stem to move freely.

5.2 Propane Tank Placement

In 1994, Southern Sun installed the 500-gallon propane tank directly against the Little General store's exterior back wall. The tank remained in this position and in operation until the day of the incident. The position of the tank was contrary to both the West Virginia Fire Code and the OSHA LP gas standard. Figure 9 shows a 2003 photograph of the building with the propane tank visible behind a wooden fence.



Photo courtesy of Little General Store, Inc.

Figure 9. Pre-incident photograph of the Ferrellgas tank.

Multiple witnesses told the CSB that Southern Sun placed the tank against the back wall. Paint patterns on the tank corroborate this: the outward facing side of the tank was painted with the Ferrellgas color and logo, while the side of the tank facing the building was painted with the Southern Sun name and logo (Figure 10). This suggests that Ferrellgas painted only the side of the tank that was accessible.



Figure 10. Incident tank side facing building.

During the release, witnesses described seeing billowing white clouds striking the building and roof overhang and cascading toward the ground, which is consistent with the known behavior of propane vapor following a liquid release. The peaked roof of the store overhung the exterior walls. The overhang was open to allow ventilation in the store's attic space; restroom exhaust ducts terminated inside the overhang directly above the incident tank. The open overhang and restroom exhaust ducts provided a direct pathway for propane to enter the building. The CSB found that if the tank were placed at least 10 feet from the store, propane likely would not have entered the store in large quantities.

5.2.1 Southern Sun Acquisition

Ferrellgas' acquisition of Southern Sun included a pre-acquisition review of Southern Sun's business and operations, which included inspections of propane systems at select Southern Sun customer locations. In addition, Ferrellgas was allowed to identify and request correction of any deficiencies discovered in the year following the acquisition. According to Southern Sun, only two propane tanks were returned, both

because of illegible or missing tank nameplates. Ferrellgas first filled the tank at the Little General soon after the acquisition, and did not identify the tank placement as deficient.²⁸

5.2.2 Ferrellgas Inspection and Quality Review Program

5.2.2.1 Ferrellgas Inspections

The Ferrellgas inspection program for propane systems at customer locations consists of two separate activities: the driver's pre-fill inspection, where delivery personnel visually inspect the system and the Ferrellgas Installation Review (FIR), where an experienced service technician visually inspects the system and records the findings.

1) Drivers' Pre-Fill Inspection

Drivers perform pre-fill inspections prior to each propane delivery at a customer location. This visual inspection includes the tank, visible piping, regulators, and the area around the tank. Ferrellgas trains drivers to inspect the installation for potential deficiencies such as tank damage or corrosion, accumulations of combustible materials near the tank, fitness of piping and regulators, tank placement and new structures near the tank, and tank labeling. The driver does not record the results of the pre-fill inspection, but does have the authority to remove the system from service upon finding unsafe conditions. The driver must also report unsafe conditions to management so that a service technician can fix any noted problems. Ferrellgas training materials for delivery drivers discuss tank placement and clearly state that 500-gallon propane tanks must be at least 10 feet from buildings.

²⁸ The week prior to the incident, Appalachian Heating had also replaced another Ferrellgas tank that was placed less than 10 feet from a different Little General Store location.

Ferrellgas filled the tank at Little General Store about 14 times per year; in the 10 years that Ferrellgas owned the tank, drivers would have performed more than 100 pre-fill inspections. The CSB interviewed several drivers who filled the Little General tank and performed the required inspections. All drivers stated that they believed the tank was permitted to be directly against the building's exterior back wall either because it was "grandfathered,"²⁹ the installer had received a variance from local authorities,³⁰ or there was no other place to install the tank.

2) Ferrellgas Installation Review

The Ferrellgas Installation Review (FIR)³¹ is a visual inspection of the installation at a customer's site. The FIR includes the same topics as the driver's pre-fill inspection; however, the inspector records the results either on a form or handheld computer. The service center receives the results of the FIR, records deficiencies, and dispatches service technicians to repair noted problems.

Ferrellgas performed two FIRs on the Little General Store installation in 2000, four years after acquiring the tank (Appendix A). These inspections were two months apart; neither inspector noted the placement of the tank on the form.³² Both inspectors told CSB that they could remember neither the inspections nor the reasons for not reporting the tank's placement in the FIR.

²⁹ They believed that the tank installation predated the 10-foot clearance requirement, and was permitted to remain next to the building under some previous set of rules.

³⁰ Local authorities issue formal waivers from code requirements such as the tank placement distances, which are known as variances. Ferrellgas training materials reference the possibility of obtaining a variance from local authorities; however, a variance was not issued for the placement of the tank at Little General.

³¹ Ferrellgas called this inspection program the FIR during the time it owned the incident tank. The review has been renamed and is now called the Product Installation Review. The methodology for inspection has not changed.

³² Checking the location of an installed tank is step one in the FIR procedures, which states that tanks that do not meet the 10-foot placement requirement must have a written variance from local authorities.

5.2.2.2 Ferrellgas Quality Review Program

Ferrellgas's Quality Review program³³ comprises two annual internal audits; each reviews safety and quality at a Ferrellgas service center location. Each service center's general manager (SCGM) conducts one audit (the SCGM audit), and a regional technical analyst conducts the other (the regional technical analyst audit).

1. Service Center General Manager's Audit

Since 2005, Ferrellgas has required its SCGM to perform quarterly audits of his service center. Each SCGM uses a standard checklist-based procedure to audit specific segments of the business according to the following schedule:

- First Quarter: Administration, including delivery, installation, and training documentation, operating procedures, and inspection results;
- Second Quarter: Plant operations, including piping, tanks, system and container integrity, and operator proficiency;
- Third Quarter: Delivery operations, including delivery trucks' integrity and roadworthiness, and driver proficiency; and
- Fourth Quarter: Customer installations, including inspection of 10 old and 10 new systems.³⁴

³³ The Quality Review program is independent of the FIR and the driver's pre-fill inspection. Neither audit is scheduled to coincide with a system installation or propane delivery.

³⁴ New installations might be placed by Ferrellgas during the year or be acquired by buying other preexisting propane systems.

The CSB requested all SCGM audits from the Princeton and Beckley, West Virginia, service centers for the 10 years preceding the incident. Ferrellgas provided SCGM audits from 2005 and 2006 but provided no documentation of any customer installation audits.

2. Regional Technical Analyst Audit

At least once annually, regional technical analysts (known as operations managers prior to 2005) conduct compliance and safety audits at Ferrellgas service centers in their respective regions. The audit is similar to the SCGM quarterly audit in that the technical analyst examines delivery operations, administration, plant operations, and customer installations, using a checklist to guide the audit and record the results. The only apparent difference is that the technical analyst performs all four segments of the audit within one to two days and the SCGM examines one segment per quarter.

5.2.3 Ferrellgas Inspection and Quality Review Program Analysis

At least six Ferrellgas delivery drivers and service technicians were in a position to identify and report the incorrect placement of the tank behind Little General; none did. Although Ferrellgas training materials discuss correct tank placement and list tank placement as an inspection criterion for which drivers and technicians may remove tanks from service, the employees who filled and inspected the tank believed that its location was approved.³⁵

The SCGM customer installation audits for the Beckley and Princeton offices were likely not conducted.³⁶ Had managers performed these audits, it is still possible that because of the sampling methods used they

³⁵ All Ferrellgas drivers and technicians reported to the CSB that they had received training in accordance with Ferrellgas procedures.

³⁶ Ferrellgas was unable to provide any documentation of customer installation audits for the ten years preceding the incident.

would not have detected the improper installation at Little General. Ferrellgas' instructions on conducting audits merely recommend SCGMs inspect customer installations that were filled on the day prior to the review or inspect those that the manager is driving past. These methods of sampling provide no way to systematically review all installations over time.

SCGMs' and regional technical analysts' audits focus primarily on identifying and correcting deficiencies at facilities and customer locations. Only those installations that are spot-checked during the quality review are corrected; therefore broader systemic problems may remain undetected. In contrast, generally recognized and accepted practices for auditing safety management systems focus on assessing and verifying system effectiveness.³⁷ These practices include using statistical sampling, trend analysis, management system review, and corrective action to detect systemic problems and ensure ongoing hazard control throughout the organization.³⁸

5.3 Propane Service Technician Training and Response

5.3.1 Propane Service Technician Training

5.3.1.1 Federal and State Training Requirements

The United States Department of Transportation (DOT) and OSHA regulations have limited propane service technician training requirements. DOT requires training only for propane personnel who engage in transportation activities. OSHA requires training for propane service technicians but does not elaborate on this requirement (Section 6.1).

³⁷ Standard safety texts describe audits as systematic, independent reviews that determine conformance to company and industry standards whereas inspections are physical inspection of installations and facilities.

³⁸ CCPS, 1993; Petersen, D., 1996; Weinstein, M.B., 1997

Some form of state-mandated training and/or testing requirement for propane service technicians exists in 14 states, and 10 of those have specific training requirements; however, the depth of training required varies broadly. No states require emergency response training for propane service technicians.

Three states require licensing for propane service technicians. States use licensing to establish and enforce minimum competency standards for technicians; collect funds for inspection, compliance, and training programs; and communicate technician qualifications to consumers. In the states that license propane service technicians, CETP is an accepted training program. Additionally, at least 10 states have licensing programs applicable to propane and natural gas appliance installers. Recurrent licensing requirements, based on state-established standards of training, testing, and/or experience, aim to ensure that only qualified personnel work on indoor propane and natural gas systems.

West Virginia does not require propane service technicians to be trained, certified, or licensed. Appendix D contains a table of the state requirements.³⁹

5.3.1.2 NFPA 58 Training Recommendations

NFPA 58 recommends training for propane industry employees who perform activities within its scope, which includes those who transport and transfer LP gas. The standard states that these employees “shall be trained in proper handling procedures. Refresher training must occur at least every 3 years. The training shall be documented.”⁴⁰ An appendix note states that refresher training may be less intensive than original training. However, NFPA 58 does not elaborate on what constitutes initial training. It includes no guidance suggesting a scope, timeframe, or testing component for facilitating an enforceable training standard for states that have adopted NFPA 58, including West Virginia.

³⁹ Information on state training requirements was provided to the CSB by PERC.

⁴⁰ NFPA 58 – 2008 Section 4.4 “Qualifications of Personnel.”

5.3.1.3 Propane Industry Training Program

PERC and the NPGA developed its comprehensive training curriculum for propane industry employees, CETP, in 1988. Although CETP is voluntary in most states, many employers in the propane industry use it to train and certify employees. PERC offers the task-based modular curriculum both in instructor-led settings and as a computerized self-teaching program, and sells course materials to employers for in-house training and preparation for CETP certification tests.

CETP consists of eight modules. Applicable training modules include

- Propane “basics,” including properties of propane, industry standards and organizations, bulk plant and delivery vehicle identification, safe work practices, and reacting to interruptions of customer gas service;
- Propane delivery, including equipment and operating procedures, loading and unloading, inspecting delivery trucks and installed propane systems, responding to customer calls, and evacuating propane tanks; and
- Propane vapor distribution system installation, including transporting tanks and cylinders, installing aboveground and underground tanks, installing regulators and piping, performing leak checks, documenting installations, and communicating safety information to customers.

Employers may select topics as appropriate to address job tasks for individual employees, who may then take certification exams in those areas for which they have completed training. For example, customer service representatives often complete the propane basics module, and delivery drivers complete the

propane basics and propane delivery modules. Companies may also augment the curriculum to include company-specific policies and information.⁴¹

An important part of the CETP curriculum is its skills testing component. The training program itemizes basic propane procedures; within 12 months of passing the CETP certification exam, certification candidates must demonstrate these procedures and be evaluated. The CETP curriculum includes skills assessment forms; a trainer or other supervisor with sufficient experience must observe a certification candidate perform or simulate procedures correctly, document performance evaluations for each set of procedures, and forward the documentation to PERC before the candidate is certified to work alone.

The junior technician at Little General was preparing for a tank-to-tank transfer of liquid propane. Although a CETP module provides step-by-step procedures for liquid transfers to and from bulk delivery trucks, such procedures do not exist for tank-to-tank transfers. While some propane companies may develop their own instructions for this task, the junior technician had no written procedure for his activities on the day of the incident.

5.3.1.4 Propane Service Technician Emergency Response Training

A propane incident involving fire department response occurs nearly once per day in the United States (see Table 1). The CSB found that propane service technicians routinely respond to these emergencies. When the lead technician returned to the Little General store in response to the emergency, he was functioning as a specialist responder, with expertise in propane and propane systems. By the time he arrived, a hazardous materials release had been underway for at least 20 minutes. However, his training had not included an emergency response component.

⁴¹ PERC offers the Safety and Training Administrative Records System (STARS), a computer-based program for record keeping and training management, which also allows employers to add their own policies to modules.

The CSB found a number of other incidents in which propane service technicians assisted first responders in emergencies involving their companies' equipment and product. First responders consider propane service technicians to be "product and container specialists" who have more experience dealing with propane and its systems than firefighters, police, paramedics, and EMTs.⁴² Although propane service technicians are not trained to take action to mitigate a hazardous materials emergency without specific training,⁴³ emergency responders often seek their advice and assistance.

PERC and the NPGA provide a Propane Emergencies training curriculum for first responders that addresses the role of propane service technicians in the incident command structure (see Section 5.3). However, CETP only briefly addresses emergencies at bulk plants and traffic accidents involving delivery vehicles. No CETP module specifically addresses the potential emergencies service technicians encounter or the basics of hazardous materials incident response.

5.3.2 Thompson Gas/Appalachian Heating Employee Training

Thompson Gas Propane Partners, LLC required all propane service technicians to be CETP-trained to the appropriate level for their jobs. The 2005 contract with Appalachian Heating defines responsibilities, including employee training: Appalachian is responsible for ensuring that all employees working with propane are qualified "as defined in NFPA 54 and 58" and CETP-trained for their particular jobs. The specific requirements include completion of CETP 1.0, Basic Principles and Practices, within 30 calendar days of first working for Appalachian/Thompson, and completion of other applicable modules within one year. Additionally, Appalachian Heating must maintain all training records and certifications, provide ongoing training, and update the staff list for Thompson Gas before any new employees begin working.

⁴² *Propane Emergencies*, PERC and NPGA, 3rd edition, page 44.

⁴³ HAZWOPER Standard, 29 CFR 1910.120(q).

Thompson provided CETP training for Appalachian's lead technician in 2006, including the basic principles, delivery, and vapor distribution system installation modules. Experienced Thompson trainers directly supervised his performance of propane service and delivery tasks for nearly a year. This was combined with the CETP classroom training to ensure that he was able to demonstrate proficiency and pass certification examinations prior to working unsupervised.

The junior technician began working in the propane business in mid-December, about 45 days prior to the incident. However, Appalachian did not inform Thompson of the new employee. At the time of the incident the junior technician had not trained with CETP and had not received any other formal propane service training.

Had Appalachian Heating implemented the training procedures required by the contract, the junior technician would have, via CETP, become familiar with a range of procedures and situations that might occur in the course of working with propane including operation of the liquid withdrawal valve.

5.4 Fire Department Response

The IC arrived at the Little General store shortly after the initial dispatch call. In the approximately five minutes from his arrival until the explosion at 10:53 am, the IC took several actions. He:

- Assessed the frostbite injury to the junior technician;
- Ordered the business to close;
- Directed the EMTs to the rear of the building to treat the junior technician's frostbite;
- Ordered the EMTs to ensure that the business was closed, that no one was smoking, and that no gasoline was being pumped; and
- Ordered the firefighter to ensure that everyone was out of the building.

Guidance for emergency responders in hazardous materials emergencies recommends evacuating and evaluating the situation from a safe distance as the first task. However, the IC's final direction, to ensure that everyone was out of the building, came too late. Within about 30 seconds of the order, the propane ignited and the building exploded.

Based on witness statements and the IC's known actions, the CSB determined that the IC allowed the propane service technician to try to correct the propane release while the IC managed the scene.

However, the IC was likely unaware of two critical facts:

- The junior technician, upon whom the IC was relying to correct the release, was neither trained nor experienced in propane transfer operations and propane emergencies (Section 5.3).
- The building was filling with a flammable mixture of propane and air. While the IC was concerned with ignition sources outside such as cigarettes and vehicles, ignition sources inside the building remained uncontrolled during the release.

Without knowledge of these facts, the IC was likely unable to fully understand the severity of the emergency at Little General, even though he was fully trained in accordance with the rules of the West Virginia Fire Commission.

5.4.1 Hazardous Materials Incident Training for Firefighters

West Virginia requires all firefighters to receive basic training in hazardous materials incident response. This training is required prior to working as a firefighter and therefore is generally conducted only once,

early in a firefighter's career. In contrast, chemical facilities and refineries in the United States that maintain hazardous materials response teams are required to train team members annually.⁴⁴

The required hazardous materials incident response training teaches firefighters to identify hazardous materials and incidents involving hazardous materials, use DOT's *Emergency Response Guidebook*, and recognize when additional resources are necessary. The training instructs firefighters to take only defensive actions when encountering a hazardous materials incident; it does not give firefighters the knowledge or skills to enter the area of the release and attempt to stop the release. This action is reserved for organized hazardous materials response teams.

The IC at Little General attended a hazardous materials incident response course in 1998. This was a higher-level course than required (see Section 6.3 for requirements), and included topics such as incident risk assessment, selection of personal protective equipment, and control techniques, and a practical exercise. However, this training occurred nine years before the Little General incident, and the CSB found no documentation that the IC had attended refresher training or practical exercises. Unrehearsed knowledge decays over time; hazardous materials incident response skills acquired in training are more difficult to retain without regular refresher training or practice.⁴⁵

5.4.2 Propane Industry Training for Emergency Responders

The Propane Emergencies training program offered by PERC and the NPGA is free to fire departments around the United States. The program trains first responders to recognize the specific hazards of a

⁴⁴ 29 CFR 1910.120 requires industrial hazardous materials incident responders to attend eight hours of refresher training annually.

⁴⁵ For a full discussion of skill loss, see Arthur Jr., W., Bennett Jr., W., Stanush, P., & McNelly, T. (1998). "Factors That Influence Skill Decay and Retention: A Quantitative Review and Analysis," *Human Performance*, Vol. 11, pp. 57-101.

propane release and treat it as a hazardous materials incident. It emphasizes the importance of evacuating the incident area and evaluating the hazards from a safe distance prior to taking other actions.

Additionally, it addresses incident command structure implementation and the advisory role of propane service technicians. None of the Ghent Volunteer Firefighters had participated in this program.

5.5 911 Emergency Call Center Response

At many 911 call centers around the United States, operators use quick-reference guide cards to help them evaluate caller emergencies, gather pertinent incident details, and convey life-saving information to callers. Several organizations in the United States produce pre-written guide cards for 911 centers to purchase.⁴⁶ These guide cards provide easy-to-access information for operators, including questions relevant to the emergency and instructions to be given to the caller prior to emergency services' arrival. Specific sets of guide cards exist for health and injury, fire service, and police response emergencies. Raleigh County 911 uses guide cards for health emergencies and injuries only.

At 10:40 am on the day of the incident, the propane service technician called Raleigh County 911 to report the release and summon emergency services. The operator who received the call did not have a guide card or protocol to help evaluate the situation, collect pertinent information, and provide guidance to the caller.

⁴⁶ Guide cards are available as printed or electronic references and kept at each operator's station.

The propane industry developed a model questionnaire and script to use in situations where customers report propane emergencies such as leaks or releases. The questionnaire prompts personnel answering calls to ask questions such as

- Where is the leak?
- Do you hear gas escaping?
- Is the leak near any building?
- Is there an odor of gas in the building?

An affirmative answer to these and other questions prompts the gas company operator to read a script that instructs the caller to eliminate ignition sources, evacuate the building to a safe distance, and wait for gas professionals or fire service personnel.

Equipping 911 operators with such a prewritten guide can potentially improve safety by initiating important first response actions such as evacuation.

6.0 Regulatory Analysis

6.1 Occupational Safety and Health Administration

The OSHA standard regulating propane systems requires that all personnel “performing installation, removal, operation, and maintenance of propane equipment shall be properly trained in such function.”⁴⁷

However, neither the standard, its preamble, nor letters of interpretation define or interpret “properly trained,” nor does it provide for specific training standards, requirements for recurrent training, written testing, or skills testing. OSHA only requires employers to develop training programs they deem appropriate without providing any performance criteria such as those under the industry’s program.

Additionally, the OSHA standard requires that owners of propane tank(s) be notified prior to work being done on their tank(s) by others.⁴⁸ Although Appalachian Heating employees removed the liquid withdrawal valve plug from the Ferrellgas tank, Appalachian Heating did not notify Ferrellgas.

6.2 Environmental Protection Agency

Firefighters and emergency medical personnel are typically the first responders to hazardous materials spills and releases, like the incident at Little General. However, in 26 states (including West Virginia), state and municipal employees are not covered by the OSHA health and safety regulations that require first responder hazardous materials training.⁴⁹ In an attempt to close the gap, the U.S. Environmental Protection Agency (EPA) promulgated the *Worker Protection* standard (Appendix E)⁵⁰ for municipal and state emergency responders.

⁴⁷ 29 CFR 1910.110(b)(16).

⁴⁸ 29 CFR 1910.110(b)(14)(ii).

⁴⁹ See CSB Report No. 2006-03-I-FL “Bethune Point Wastewater Treatment Plant” for a full discussion.

⁵⁰ 40 CFR 311.

The *Worker Protection* standard requires states and municipalities to prepare employees for hazardous materials emergencies in accordance with OSHA's *Hazardous Waste Operations and Emergency Response* standard.⁵¹ The standard's requirements apply to career and volunteer fire companies, and public emergency medical response agencies. The United States Fire Administration and PERC⁵² both cite the *Worker Protection* standard in their incident response training courses for firefighters. The rules for firefighters and emergency medical personnel in West Virginia, however, do not specifically incorporate the EPA requirements under the *Worker Protection* standard.

6.3 West Virginia Fire Commission

The primary role of the Fire Commission in West Virginia is the promulgation of the state fire code and certification requirements for fire departments.

6.3.1 Requirements for Fire Departments⁵³

The West Virginia Fire Commission certifies fire departments every five years based on

- location, size and boundaries of the fire protection district;
- number of active and available personnel and their level of training;
- quantity and type of equipment;
- administrative procedures and policies including chain-of-command;

⁵¹ 29 CFR 1910.120 – *Hazardous Waste Operations and Emergency Response* generally requires employers to develop emergency response and health and safety plans that address worker training, preparedness, and health monitoring. The regulation applies to both long-term hazardous waste clean-up operations in addition to emergency response for incidents involving any hazardous material (not limited to hazardous wastes). The standard requires initial training and annual refresher training.

⁵² *Propane Emergencies*, 3rd ed., p. 41.

⁵³WVC 29-3-2.

- 911 service and mutual aid agreements for the area served;
- the department's record of response to emergency calls; and
- recordkeeping and NFIRS reporting.⁵⁴

On April 1, 2005, the Fire Commission published an administrative policy to assist it in its evaluation of fire departments.⁵⁵ The policy addresses certifying and training active personnel in fire departments, requiring them to attend Firefighter Level I, first aid, cardio-pulmonary resuscitation (CPR), and hazardous materials response training.

The Fire Commission's policy specifically requires the following for hazardous materials response:

Fire department members and officers shall be trained in NFPA Standard No. 472, *Professional Competence of Responders to Hazardous Materials Incidents*.⁵⁶ All Fire Department personnel shall be certified at the Awareness level. Fire Department personnel that operate at hazardous materials incidents must minimally meet U.S. Environmental Protection Agency and U.S. Occupational Safety and Health Administration requirements for response at the Operations level. Additional training should be at the discretion of the fire chief based on possible involvement with hazardous materials incidents unless otherwise directed by federal or state statutes, rules and/or regulations. [WVC 29-3-9(i)]

Unlike requirements for industrial hazardous materials incident responders, this Fire Commission requirement does not specifically address recurrent training. All active industrial hazardous materials

⁵⁴ The criteria are located in WVR 87-6-5.

⁵⁵ The administrative policy is found at WVC 29-3-9(i).

⁵⁶ NFPA 472 was renamed the *Standard for Competence of Responders to Hazardous Materials/Weapons of Mass Destruction Incidents* in the 2008 revision.

responders in the United States are required to undergo an annual refresher course. Yet firefighters, who are likely to respond to many incidents involving gasoline, natural gas, or propane—all hazardous materials—in any given year, are not specifically required by the West Virginia Code to complete an annual refresher course or perform regular response drills. As discussed in Section 5.4, the IC in the Ghent incident had not trained for or practiced hazardous materials emergency response in almost 10 years.

6.3.2 West Virginia Fire Code

West Virginia has a comprehensive statewide fire code.⁵⁷ The fire code incorporates, by reference, the majority of the NFPA's standards and guides. Incorporated standards include NFPA 472, which addresses response to hazardous materials incidents. NFPA 472 defines the levels of response to hazardous materials incidents—awareness, operations, technician, incident commander, and specialist employee—and outlines basic expectations for responders at each level.

The NFPA's definition of awareness level personnel is consistent with OSHA's definition:⁵⁸ awareness level personnel are those who, during the course of their normal job functions, could encounter emergencies involving hazardous materials. These persons must be able to recognize hazardous materials emergencies, protect themselves, call for trained assistance, and secure the area.⁵⁹ Awareness level would apply to propane service technicians like the junior technician at Little General when the release began, since they may encounter propane emergencies during the course of their duties.

Operations level personnel respond to already-discovered hazardous materials incidents, taking actions to protect people, the environment, and property from the effects of the release. They are qualified to take

⁵⁷ West Virginia Rule Title 87 Series 1 Fire Code.

⁵⁸ 29 CFR 1910.120

⁵⁹ NFPA 472 Chapter 4

defensive actions to mitigate the damage caused by a hazardous materials incident, but not to actively handle or attempt to contain the hazardous material(s). This type of action might include assessing the scene and planning a response, establishing evacuation perimeters, setting up communications, and initiating the incident command system. The operations level designation applies to anyone arriving at the scene in response to a hazardous materials emergency; in Ghent, the lead technician, the EMTs, and the fire department personnel acted at an operations level by arriving at the Little General in response to the junior technician's phone call.

Hazardous materials technicians, in contrast, are those qualified to take defensive and offensive actions in response to an incident. Offensive actions entail entering the incident "hot zone" to attempt to control a release, and require additional training beyond the operations level.⁶⁰ Additionally, hazardous materials responders may seek the help of specialists: industry employees familiar with and trained in the hazards and systems of a given material, like propane. Specialist employees must also meet specific NFPA 472 competencies to be qualified to perform release control actions. Propane service employees who assist emergency responders physically secure releases must meet at least these competencies. Although the evidence and witness statements indicate that the Appalachian Heating employees and Ghent Volunteer Fire Department personnel were standing in the vapor cloud and attempting stop the release, none were trained to the technician or specialist level.

⁶⁰ Technician level training corresponds to 29 CFR 1910.120 40-hour HAZWOPER training.

7.0 Findings

1. The propane service technicians, emergency responders, and store employees did not evacuate the area as recommended by nationally accepted guidance for propane emergencies. In fact, emergency responders and the propane service technicians were observed standing in the propane vapor cloud.
2. Propane companies, the National Propane Gas Association, and the U.S. Department of Transportation recommend evacuation to a safe distance as the first action in response to a propane release.
3. The fire department captain, the propane service technicians, and the Little General Store employees were unaware of the dangerous propane accumulation inside the building.
4. A defect in the existing tank's liquid withdrawal valve caused it to malfunction and remain in an open position.
5. About 25 minutes elapsed from the time the release began until the explosion.
6. Both the U.S. Occupational Safety and Health Administration's and the West Virginia Fire Commission's propane standards require a distance of at least 10 feet between 500-gallon propane tanks and buildings such as the Little General Store. However, when the Southern Sun propane company installed the propane tank in 1994 it was placed directly against the Little General Store's exterior back wall.
7. Ferrellgas, which acquired Southern Sun in 1996, allowed the tank to remain against the building's exterior wall for more than 10 years.
8. The placement of the 500-gallon propane tank against the building's exterior wall provided propane a direct pathway into the store's interior during the release.
9. Ferrellgas management's quality review program functions as a basic safety inspection rather than a management systems audit.

10. The junior propane service technician who was servicing to the tank on the day of the incident had no formal training and did not recognize the defect in the withdrawal valve. He was also working alone even though he had been on the job for only one and a half months.
11. Propane service technicians commonly do not receive emergency response training.
12. The propane industry's primary training curriculum (the Certified Employee Training Program) consists of procedures and materials for performing routine (non-emergency) tasks only.
13. The Occupational Safety and Health Administration's and National Fire Protection Association's propane standards require training but do not include curricula, practical exercises, emergency actions, or knowledge evaluation tools.
14. A propane emergency significant enough for fire department response is reported nearly everyday in the United States. Only gasoline and natural gas are involved in more hazardous materials emergencies.
15. 911 operators in the United States lack propane emergency guidance to help them collect important information from callers, offer life-saving advice, and convey relevant information to first responders.
16. Minimal information on the nature of the incident was exchanged between the propane service technician and the 911 operator. Therefore, the only information the 911 operator provided the Ghent Volunteer Fire Department responders was the incident location and the "report of a propane leak."
17. Firefighters in West Virginia are required to attend a minimum of four hours of hazardous materials emergency response training as part of their initial training sequence but refresher training is not required. The responding Ghent Volunteer Fire Department captain last attended a hazardous materials response course in 1998.
18. Propane safety and emergency training is voluntary for fire department personnel in West Virginia. None of the responders from the Ghent Volunteer Fire Department had specific training relating to propane emergencies.

8.0 Causes

1. The Ferrellgas inspection and audit program did not identify the tank location as a hazard.
Consequently, the tank remained against the building for more than 10 years.
2. Appalachian Heating did not formally train the junior technician, and on the day of the incident he was working alone.
3. Emergency responders were not trained to recognize the need for immediate evacuation during liquid propane releases.

9.0 Recommendations

Governor and Legislature of the State of West Virginia

2007-04-I-WV-R1

Require training and qualification of individuals who operate bulk propane plants, dispense and deliver propane, install and service propane systems, and install propane appliances. The training and qualification requirements should be comparable to those of existing propane industry programs such as the Certified Employee Training Program.

West Virginia Fire Commission

2007-04-I-WV-R2

Revise the Fire Commission rules and codes to require annual hazardous materials response refresher training for all firefighters in West Virginia.

2007-04-I-WV-R3

Revise the Fire Commission rules and codes to require that all West Virginia fire departments perform at least one hazardous material response drill annually.

West Virginia Office of Emergency Medical Services

2007-04-I-WV-R4

Revise the Office of Emergency Medical Services rules and codes to require annual hazardous materials response refresher training for all emergency medical personnel in West Virginia.

National Fire Protection Association

2007-04-I-WV-R5

In the Liquefied Petroleum Gas Code (NFPA 58) “Qualifications for Personnel” section, specify training requirements (including supervised on-the-job training), training curricula, competencies, and testing through written examination and performance evaluation, or reference a nationally recognized curriculum for these requirements.

Association of Public-Safety Communications Officials

2007-04-I-WV-R6

Develop a guide card for propane emergencies to assist 911 operators in the collection of pertinent information on propane emergencies. The questionnaire in Section 1.9.1 in the Propane Education and Research Council’s Certified Employee Training Program may be used as a model.

Propane Education and Research Council

2007-04-I-WV-R7

Revise the Certified Employee Training Program to include

- Procedures for transfer of liquid propane from tank to tank, or
- The prohibition of the transfer of liquid propane from tank to tank.

2007-04-I-WV-R8

Revise the Certified Employee Training Program to include emergency response guidance for propane service technicians who respond to propane emergencies similar to guidance provided to emergency responders in the Propane Emergencies program.

National Propane Gas Association

2007-04-I-WV-R9

Submit a request to the United States Occupational Safety and Health Administration for a letter of interpretation to determine if the Certified Employee Training Program curriculum meets the training requirements in 29 CFR 1910.110.

2007-04-I-WV-R10

Work with the West Virginia E911 Council with development of propane emergency guidance by providing the Council with the customer leak questionnaire located in Section 1.9.1 of the Certified Employee Training Program and technical assistance.

West Virginia E911 Council

2007-04-I-WV-R11

Work with the National Propane Gas Association to develop and distribute propane emergency guidance for use by all county and municipal 911 communication centers in West Virginia.

Ferrellgas

2007-04-I-WV-R12

Establish and implement a comprehensive safety management system that includes at a minimum:

- An auditing program developed in accordance with generally accepted methodologies to monitor the performance and effectiveness of safety management systems and personnel at all levels,
- An inspection program that uses NFPA 58 as a guide to systematically inspect all customer propane systems and identify all deficiencies,
- A means of tracking audits and inspections and identified deficiencies,
- A means of tracking corrective actions,
- A means of collecting and using audit and inspection data for trend analysis and organizational learning,
- A means of periodically reporting audit and inspection trends to the Board of Directors and Managing Board, and
- A provision for periodic safety management system audits conducted by a third party competent in the requirements of NFPA 58.

By the

U.S. Chemical Safety and Hazard Investigation Board

John S. Bresland

Chair

Gary Visscher

Member

William Wark

Member

William Wright

Member

Date of Board Approval

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Appendix A

Ferrellgas Installation Reviews of the Incident Tank



Account number 400088
 Customer name Little General
 Address P.O. box 988
 City Berkeley State CA ZIP 94701

Ferrellgas Installation Review

Component checks:

Containers, valves, and/or meters Piping and fittings Regulator Odor check/ Metered system
 Tank 500 Size SN 518063 Mfr. Trinity
 Tank _____ Size SN _____ Mfr. _____

Discrepancies noted _____

System red tagged? No Yes

- The Ferrellgas Installation Review (FIR) has been completed on my gas system if indicated above.
- I know how to turn off gas in case of emergency.
- I have smelled propane and can detect its odor.
- I have received the consumer safety information and material.
- I understand propane is flammable and can be explosive.
- I know what to do when I smell gas.
- I have had gas system deficiencies and/or corrections, if any, clearly explained to me.
- I have reviewed the safety information and recommendations on the back of this form.

Customer smelled odorized propane and was shown shutdown procedure?
 Yes Declined Customer not available

Propane Safety Plan (OPR-1171) Left at residence Mailed to Customer
 _____ Left at residence Mailed to Customer

Customer at home? No Yes

See important safety information on back

Customer signature [Signature] Date 4-18-08
 Ferrellgas representative _____ Date _____

OPR-1150
 Rev. 11/99

MARKET FILE COPY



Account number 480088
 Customer name Little General
 Address P.O. Box 908
 City Bankton State NC ZIP _____

Ferrellgas Installation Review

Component checks:

Containers, valves, and/or meters Piping and fittings Regulator Odor check/ Metered system
 Tank 30 Size S/N 518003 Mfr. _____

Tank _____ Size _____ S/N _____ Mfr. _____

Discrepancies noted _____

System red tagged? No Yes

- The Ferrellgas Installation Review (FIR) has been completed on my gas system if indicated above.
- I know how to turn off gas in case of emergency.
- I have smelled propane and can detect its odor.
- I have received the consumer safety information and material.
- I understand propane is flammable and can be explosive.
- I know what to do when I smell gas.
- I have had gas system deficiencies and/or corrections, if any, clearly explained to me.
- I have reviewed the safety information and recommendations on the back of this form.

Customer smelled odorized propane and was shown shutdown procedure?
 Yes Declined Customer not available

Propane Safety Plan (OPR-1171) Left at residence Mailed to Customer
 Left at residence Mailed to Customer

Customer at home? No Yes

See important safety information on back

Customer signature _____ Date _____
 Ferrellgas representative _____ Date _____

OPR-1150
 Rev. 11/99

MARKET FILE COPY

Appendix B

911 Call and Initial Fire Department Dispatch

Emergency 911 Call – Report of Release

AUTOMATED VOICE: Conversation recorded on January 30th, 2007, at 10:40, on Channel 7.

DISPATCHER: 9-1-1, where is your emergency?

CALLER: Yes, ma'am. I need to -- I need a fire department down at the Little General Store in Ghent. I need a -- I got a propane leak -- I need their help to secure the area.

DISPATCHER: A propane leak?

CALLER: Yes, ma'am.

DISPATCHER: What's the address? Is that the one on Odd Road?

CALLER: No, ma'am. It's the one actually on, uh -- the one going towards Shady Springs. With the Godfather's Pizza.

DISPATCHER: Do you know the address?

CALLER: No, I don't, ma'am. Right in front of Flat Top Lake.

DISPATCHER: Flat Top Lake.

CALLER: Yes, ma'am.

DISPATCHER: And this is Little General, right?

CALLER: Yes, ma'am.

DISPATCHER: And this is a propane leak? What is your name?

CALLER: XXXXXXXXXXXXXXXX;¹ I work for Appalachian Heating; we've had a dysfunction in the tanks, and I have a leaky tank.

DISPATCHER: Okay. All right, I'll get the fire department out there for you.

CALLER: Thank you. Bye-bye.

DISPATCHER: Thank you.

Emergency Dispatch – Initial Dispatch Notification to Ghent Volunteer Fire Department

AUTOMATED VOICE: Conversation recorded on January 30th, 2007, at 10:43, on Channel 21. (Fire tones.)

DISPATCHER: Raleigh Control, Station 110 -- Station 110 -- you need to respond to Flat Top Road in Ghent, the Little General, across from Flat Top Lake; report of a propane leak. Repeating, Station 110, need units to respond to Flat Top Road at the Little General, report of a propane leak. WGC808, 10:44.

¹ Name removed.

Appendix C

Recent Propane Incidents

Recent Propane Incidents

CSB identified the following incidents for further research based on their similarity to the Little General incident. The CSB interviewed the propane companies, emergency responders, and local investigators involved in these incidents to collect relevant information. The CSB did not conduct an independent investigation.

1.0 Propane Release Incidents

1.1 Aberdeen, Washington

1.1.1 Incident Description

On October 23, 2007, the Southshore Mall in Aberdeen, Washington, was evacuated due to a vapor release from a 1,150-gallon propane tank. The tank was located in a utility yard approximately 25 feet from the mall restaurants for which it supplied heat and fuel. Shortly after 2:00 pm, a mall employee heard a “pop” and, upon going outside to investigate, discovered the leaking tank. The fire department responded, evacuated the mall, and isolated the scene.

The fire department called the propane company that owned the tank for incident support. The company sent one service technician to assist the fire department. The responding technician found the release was from the tank’s fill valve, which had become stuck partially open. The technician installed a double-check valve on the leaking fill valve to stop the release. The fire department lifted the evacuation order by 2:45 pm.

1.1.2 Incident Responders

The propane company involved in this incident reported having a preexisting working relationship with the fire department. All the propane company’s employees train on job procedures with CETP and

practice emergency response scenarios. The service technician who was sent to assist the fire department had both CETP training on all propane service and delivery procedures and on-the-job experience as a service technician and a delivery driver.

In emergency response cases like this one, the fire department is in charge of the scene, with the gas company employees on the scene to assist and advise the fire department as necessary. Occasionally, propane service technicians responding at the request of a fire department take offensive steps to stop a release—in this case, by installing a valve. The fire department's decision to allow the propane service technician to repair the tank was different from the Ghent incident in several important ways:

- The fire department had evacuated and secured the scene prior to the technician's entry.
- The vapor release from the leaking fill valve was much less severe than the liquid propane release in Ghent, requiring only a small repair for the tank to remain in service safely.
- The technician was CETP-certified and experienced, had drilled on emergency response scenarios, and had previously worked with the fire department on propane incidents.

When emergency responders and service technicians have clearly established and rehearsed roles in an incident command structure, both groups are better equipped to implement their training.

1.2 Lynchburg, Virginia

1.2.1 Incident Description

At about 1:00 pm on November 26, 2007, a traffic accident caused a vehicle to crash into a 1,000-gallon propane tank used for filling cylinders, located outside of a True Value Hardware store in Lynchburg, Virginia. When the vehicle struck the tank, the inch-and-a-half liquid line connecting a pump and the tank was severed. The tank settled on top of the severed pipe, which in turn prevented the excess-flow valve from seating, resulting in a liquid propane release. Hardware store employees called 911 and the

propane company that owned the tank. Although the 911 operator dispatched the hazardous materials response team to the incident as a gas leak, a citizen driving past called the team to clarify that it was a propane release.

The team arrived and secured the area, evacuating shoppers from the rear of the hardware store on foot. Since the valve could not be repaired, the response team used water spray to disperse the vapor cloud formed by the liquid release, while keeping the area evacuated. Once most of the propane in the tank had been released, the response team approached the tank and used a strap to completely seal it. They then loaded the sealed tank onto a truck for removal from the area. The release lasted two hours.

Propane service technicians from the company that owned the tank also responded. They arrived after the hazardous materials response team, and attempted to approach the tank. Response team members removed the technicians to the incident command post, outside of the release area.

1.2.2 Incident Responders

The responding hazardous materials team is an all-career unit, with all members trained to technician level (40-hour) training, which qualifies them to take offensive action in response to releases. According to responders, propane incidents occur frequently in the area; although most involve residential propane cylinders, the hazmat team has responded to several major incidents. As a result of the prevalence of propane in the area, its hazards are a focus in training sessions. With this training, responders were able to quickly assess the uncontrolled release and evacuate the area.

All propane service technicians at the company that owned the tank, a small locally owned business, receive CETP training. Additionally, the company has trained with the fire department in CETP procedures to help emergency responders understand propane systems. However, the CETP program has no emergency response component, and propane service technicians do not train with responders the incident command system or other aspects of hazmat response. As in Ghent, propane service technicians

attempted to take an active role in release mitigation without hazardous materials or emergency response training. However, unlike Ghent, fire department responders in this incident were trained and experienced in the hazards of propane releases, and evacuated everyone, including technicians, from the area.

1.3 Bristow, Virginia

1.3.1 Incident Description

On May 19, 2008, the Linton Hall School in Bristow, Virginia, was evacuated due to a vapor release from a 500-gallon propane tank. The tank was located 15 to 20 feet from the school, near the cafeteria kitchen. At about 11:20 am, a trash truck backed into a chain connecting the tank to a light pole,

¹ overturning the tank and shearing off its service valve, causing a propane vapor release. School administrators called 911 and the propane company that owned the tank, and evacuated the 205 students and 30 faculty members according to routine fire drill procedures.

The 911 operator who received the call dispatched the county fire department to the incident as an outside gas leak. The first responding fire engine company arrived on scene, assessed the situation, and revised the call to an inside gas leak due to the tank's proximity to the school kitchen and water heater, dispatching the hazardous materials response team.² When the team arrived, it sprayed water in a fog pattern to push released vapor down and away from the school, then used a wooden dowel and a towel to plug the leak. Propane service technicians from the company that owns the tank arrived after the team had secured the release and moved the tank to a large open parking lot away from the school to repair the

¹ A "No Parking" sign hung from the chain.

² The dispatching system in this county requires the hazardous materials unit to respond to all interior gas leaks.

valve. No one was injured. Students remained at a church across the street until parents arrived to take them home.

1.3.2 Incident Responders

The hazardous materials team involved in this incident has responded to several propane incidents in the last year, all of which have been vapor releases. They receive technical information from propane service technicians, but take release mitigation actions themselves. To protect propane service technicians from entering the release area, the team uses methods including

- taking digital photographs of tank damage so that technicians can see and assess the damage on a remote laptop computer,
- bringing similar tanks or other equipment to the scene so that technicians can point out features the team will find on the incident tank, and
- escorting technicians to the edge of the secured release area to point out potential leak sources for team members.

Additionally, the hazardous materials response team trains local 911 operators to use follow-up questions to elicit needed information from callers reporting hazardous materials incidents. In this incident, as in Ghent, the 911 operator conveyed little information to the fire department. However, unlike Ghent responders, the first fire engine company to arrive immediately recognized the danger posed by the release's proximity to a building and called for hazardous materials backup.

The propane service technicians responding to this incident were branch employees of a national propane company that uses CETP. In the event of a propane emergency, whichever technicians are working nearest the incident stop work immediately and respond. Since these responders are all trained with CETP, they are familiar with what types of incidents they can mitigate using normal propane procedures.

In this case, propane service technicians attempted to repair the tank only after the fire department had secured it and removed it from nearby buildings.

2.0 Propane Release and Fire Incidents

2.1 Sallis, Mississippi

2.1.1 Incident Description

On May 13, 2007, a propane explosion occurred at the Longhorn's Steak House in Sallis, Mississippi, while the restaurant was closed and two propane service technicians were transferring propane from an old 500-gallon tank into a new 500-gallon tank behind the building. The transfer procedure had been completed and the new tank was leak-tested and placed in service. The technicians next planned to remove the old tank (which still contained some propane) from the premises, but were unable to load it onto the service truck. They left and returned later in the day with a trailer. As the technicians were loading the old tank onto the trailer, it slid to one side, severing a valve at the bottom of the tank. The technicians heard a loud noise and saw liquid propane releasing from the bottom of the tank and forming a vapor cloud along the ground. They immediately ran toward the front of the building; the propane reached an unknown ignition source and a flash fire occurred seconds later. Another person who was near the front door of the restaurant at the time was badly burned in the flash fire. The building and a pickup truck parked in front were destroyed. Local volunteer fire departments responded, and the Mississippi State Fire Marshal's office investigated.

2.1.2 Incident Responders

The propane service technicians were from a local propane company. Although they had already completed a tank-to-tank transfer without incident, they immediately realized the danger of a liquid propane release from the damaged tank. Since the propane reached an ignition source only seconds after

the release began, the technicians were unable to evacuate the person in front of the restaurant before the flash fire. Both reported to investigators that they had attempted to do so.

Local firefighters responded and reported the incident as a structure fire. The county sheriff's department informed the State Fire Marshal's Office that propane was involved, and LP Gas Division investigators completed the state's report.

2.2 Danville, Alabama

2.2.1 Incident Description

On May 20, 2008, three propane service technicians were attempting to perform a tank-to-tank transfer of liquid propane at a farm in Danville, Alabama, when a propane vapor release caused a flash fire. A 1,000-gallon propane tank at a chicken house was reported by property owners to be leaking around the pressure relief valve. Technicians were to replace the half-full tank with a new tank and transfer the remaining propane.

The technicians removed the leaking tank from its installed location and placed it to the side, then set the new tank in its place. Employees next used the service truck boom to suspend the leaking tank upside down and at an angle, near the new tank. They planned to use the filler valve to evacuate the old tank, hooking it to a hose with a filler valve adaptor. However, damage to the filler valve caused it to stick in an open position and release propane vapor. The vapor reached the service truck, idling near the transfer location, and ignited setting fire to the chicken house.

The town's volunteer fire department was dispatched to a structure fire. When firefighters arrived, they discovered that the fire was due to a propane release. The firefighters then moved the three injured technicians away from the fire, used water to cool the propane tank, and approached the tank in full protective equipment to attempt to close the valve. They discovered that the valve had been sheared off entirely and withdrew, continuing to contain the fire to prevent it from reaching other propane tanks

located 25 to 30 feet away. The firefighters called for the nearest hazardous materials response team to assist them in using thermal imaging to determine how much propane remained in the tanks. The incident tank was empty; no other tanks released. The chicken house was destroyed. All three propane service technicians were severely burned; one died in hospital.

2.2.2 Incident Responders

The volunteer firefighters in Danville are all trained using the Propane Emergencies curriculum, which is offered through the state fire college as a two-day program. The fire chief requires that they complete the program twice before responding to propane incidents. This training includes practice on controlled propane releases and fires, and allows the fire department to mitigate propane emergencies without relying on propane companies. If firefighters cannot contain a release, they may let propane service technicians work on the tank, but only if no fire is involved and the area has been secured.

Appendix D

Table of State Training, Testing, and Licensing Requirements for Propane Service Technicians

For Propane Service Technicians, this state	Arkansas	Alabama	Colorado	Florida	Iowa	Maine	Maryland	Michigan	Missouri	Nebraska	New Jersey	Oklahoma	Texas	Vermont
Requires training	x		x		x	x	x	x	x	x	x			x
Requires testing		x		x		x		x	x		x	x	x	x
Requires recurrent training	x*			x	x				x	x		x*	x	
Accepts CETP			x	x	x	x	x			x			x	
Requires CETP†					x†			x	x†	x	x			x
Requires License				x		x	x							

* Only safety training required on a recurrent basis

† CETP or equivalent training required

Appendix E

United States EPA - 40 CFR 311

311.1 Scope and application.

The substantive provisions found at 29 CFR 1910.120 on and after March 6, 1990, and before March 6, 1990, found at 54 FR 9317 (March 6, 1989), apply to State and local government employees engaged in hazardous waste operations, as defined in 29 CFR 1910.120(a), in States that do not have a State plan approved under section 18 of the Occupational Safety and Health Act of 1970.

311.2 Definition of employee.

Employee in Sec. 311.1 is defined as a compensated or noncompensated worker who is controlled directly by a State or local government, as contrasted to an independent contractor.