AUTOMOTIVE SERVICE STATION GAS EXPLOSION

Portland, ME

May 23, 1986

FIRE INVESTIGATIONS

NATIONAL FIRE PROTECTION ASSOCIATION

1 Batterymarch Park, PO Box 9101, Quincy, MA 02269-9101 USA
Telephone: 1-617-984-7263 E-mail: investigations@nfpa.org

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Fire Investigation Report

Gasoline Tank Explosion
Portland, Maine
May 23, 1986

Prepared By

Greg Kyte
Fire Protection Specialist

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ABSTRACT

At approximately 1:22 p.m. on May 23, 1986, an explosion and subsequent fire occurred at an abandoned automotive service station located in downtown Portland, Maine. The blast caused extensive glass breakage to surrounding buildings and left one person dead and three injured.

The last of three underground gasoline storage tanks was in the process of being removed from the premises at the time by a firm regularly engaged in such work. An accumulation of gasoline vapors apparently ignited when a vehicle ignition was turned on, resulting in an explosion of a nearby tank being freed of flammable vapors. The tank end separated from the shell and both segments were propelled in opposite directions. One worker died as a result of being struck by a segment of the tank and others were injured either from flying debris or burned from the resulting fire.

The significant factor contributing to the loss of life in this incident is considered to be the accumulation of gasoline vapors in proximity to a potential source of ignition while freeing a tank of flammable vapors.

Introduction

The National Fire Protection Association investigated the gasoline tank explosion which occurred in Portland, Maine, in order to document and analyze significant factors that resulted in the loss of life. Greg Kyte, Fire Protection Specialist in the NFPA Fire Investigations and Applied Research Division, and Robert Benedetti, Flammable Liquids Field Service Specialist in the Engineering Field Services Division of NFPA, traveled to Portland to document the facts related to this incident.

This report is another of NFPA's studies of incidents having particularly important educational or technical interest. The information presented is based on the best data available immediately after the fire and that obtained during subsequent follow-up. It is not the NFPA's intention that this report pass judgment on, or fix liability for, the loss of life that occurred in this incident.

The cooperation and assistance of the Portland Fire Department, Maine State Fire Marshal's Office, and the U.S. Department of Labor/Occupational Safety and Health Administration (OSHA) are greatly appreciated.

Background

The Gibbs Service Station, located at 17 Washington Avenue in downtown Portland, Maine had not operated since its closing in December, 1985. As there were no plans to continue operation as an automotive service station[1], the owners were required to remove the underground fuel storage tanks from the

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[1]Automotive service station refers to a property where liquids used as motor fuels are stored and dispensed from fixed equipment into the fuel tanks of motor vehicles or approved containers. (Reference: Section 1-2, NFPA 30A, Automotive and Marine Service Station Code - 1984 edition.)

site. An option to tank removal allowed by NFPA 30, Flammable and Combustible Liquids Code, but not permissible by law in the State of Maine is abandonment of the tanks in place.[2]

The service station was situated at the intersection of Washington and Cumberland Avenues at an intown location where structures were in close proximity to one another. The site contained (three) fourteen-year-old underground gasoline storage tanks, each having a reported capacity of 6,000 gallons. Permits were not obtained from the City of Portland to cover the work involved prior to the commencement of tank removal activities.

The first task in the removal process was to suction out as much of the fuel from the tanks as possible. This was accomplished by utilizing a "vacuum truck" equipped with a pump to facilitate the transfer of fuel from the underground tanks to the tank mounted on the vacuum truck. Once as much fuel as possible had been removed from the tanks, a back-hoe was used to excavate the earthen fill surrounding them in preparation for removal from the ground. The tanks were raised out of the ground and placed on grade level where they were freed of flammable vapors prior to transportation to another location for disposal.

To rid the tanks of flammable vapors, it was necessary for personnel to enter them in order to facilitate the removal of sludge and other residue that harbored residual flammable liquid. After holes were drilled, a reciprocating saw was used to cut a manway of sufficient size to provide access for personnel to enter and perform cleaning tasks. The sawing operation had the potential to generate sparks, providing a possible source of ignition. Once

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[2]Appendix B of NFPA 30 states that, in order to properly abandon an underground tank in place all flammable or combustible liquid must be removed from the tank and connecting lines. In addition, the suction, inlet, gage, and vent lines, must be disconnected and remaining underground piping capped. Finally, the tank must be completely filled an inert solid material.

the manway was made, a person wearing self-contained breathing apparatus entered the tanks to clean them thoroughly. Constant ventilation was provided by the vacuum truck during this process in order that the tanks be rendered vapor free prior to being moved to another site for disposal.

It is not an unusual practice for such work to be performed on tanks when the atmosphere inside them is too rich to support combustion. That is, the flammable vapors present in the tank are above the Upper Flammable Limit (UFL).[3] NFPA 325M, Fire Hazard Properties of Flammable Liquids, Gases, and Volatile Solids, indicates the upper flammable limit for gasoline to be 7.6 percent by volume and lower flammable limit to be 1.5 percent by volume. Note, however, that values may vary considerably for different grades of gasoline.

The Incident

At approximately 8:00 a.m. on the morning of May 23, 1986, work crews began the process of removing the underground gasoline storage tanks located at the former automotive service station. Two companies were involved in the operation. The first, a company contracted to excavate and remove the tanks, consisted of three persons with equipment such as a back-hoe, loader, and trucks with flat bed trailers. The second company, contracted to remove the fuel from the tanks and free them of flammable vapors, was comprised of four persons, a vacuum truck, and pickup truck.

Weather conditions that day were damp and humid with an occasional light breeze from the east. However, since the work area was somewhat sheltered by the surrounding buildings, there was little if any air circulation.

Before 9:00 a.m., all three tanks had been pumped out to the extent that no more liquid could be suctioned from them. By 11:00 a.m., the first tank

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[3]Upper Flammable Limit (UFL) is the maximum vapor-to-air concentration above which propagation of flame will not occur.

removed from the ground had been freed of flammable vapors and loaded onto a flat bed trailer. The second tank had also been taken out of the ground and stabilized in preparation for being freed of flammable vapors.

By 1:00 p.m. that afternoon, the second tank had been rendered free of gasoline vapors and loaded onto a second flat bed trailer and the final tank had been removed from the ground and connected to the vacuum truck. The suctioning process was continued so as to provide ventilation by drawing in fresh air while removing flammable vapors.

The vacuum truck was utilized for two purposes. First, to remove the product from the tanks and, second, to ventilate the tanks to rid them of gasoline vapors. Since the vacuum truck had no way to contain or filter out the vapors being drawn from the tank, they were discharged near street level beneath the truck. Due to the absence of air movement caused by the weather and the sheltered location, gasoline vapors were able to accumulate low to the ground in the area where the nearby pickup truck was parked.

During the time immediately preceding the explosions, a manway had been partially cut into the tank; however, work was temporarily halted in order to obtain additional saw blades from another location. One of the laborers was directed to radio for more saw blades. He got into the pickup truck, closed the door, and turned on the ignition switch to operate the radio. When he did, an explosion occurred, first under the hood of the pickup truck and, almost instantaneously, at the gasoline storage tank.

One tank end blew out and the main body of the tank spun around striking a worker and killing him. The explosion of the tank resulted in considerable glass breakage from windows in surrounding buildings and injury to three persons in the vicinity. Fires that ensued involved the vacuum truck and a small pickup truck in the area.

The Portland Fire Department received notification of the fire and explosion at 1:22 p.m. from box alarm 316 located at the intersection of Cumberland and Washington Avenues. The first arriving engine company reported fire showing at the Gibbs Service Station and sounded the "all hands" alarm at 1:23 p.m. At 1:24 p.m., a second alarm was ordered.

Fire fighters rapidly deployed hoselines in an effort to bring the fires under control. Five 1 1/2-inch handlines, two 1 3/4-inch handlines, and two deluge guns providing master streams were put into service. At 1:40 p.m., the fires were marked under control and by 1:50 p.m. personnel from the State Fire Marshal's Office had arrived to begin the investigation of the incident.

Four persons were transported from the scene by emergency personnel to the Maine Medical Center. Two persons suffered from lacerations, one from burns and lacerations, and one received fatal injuries.

Analysis

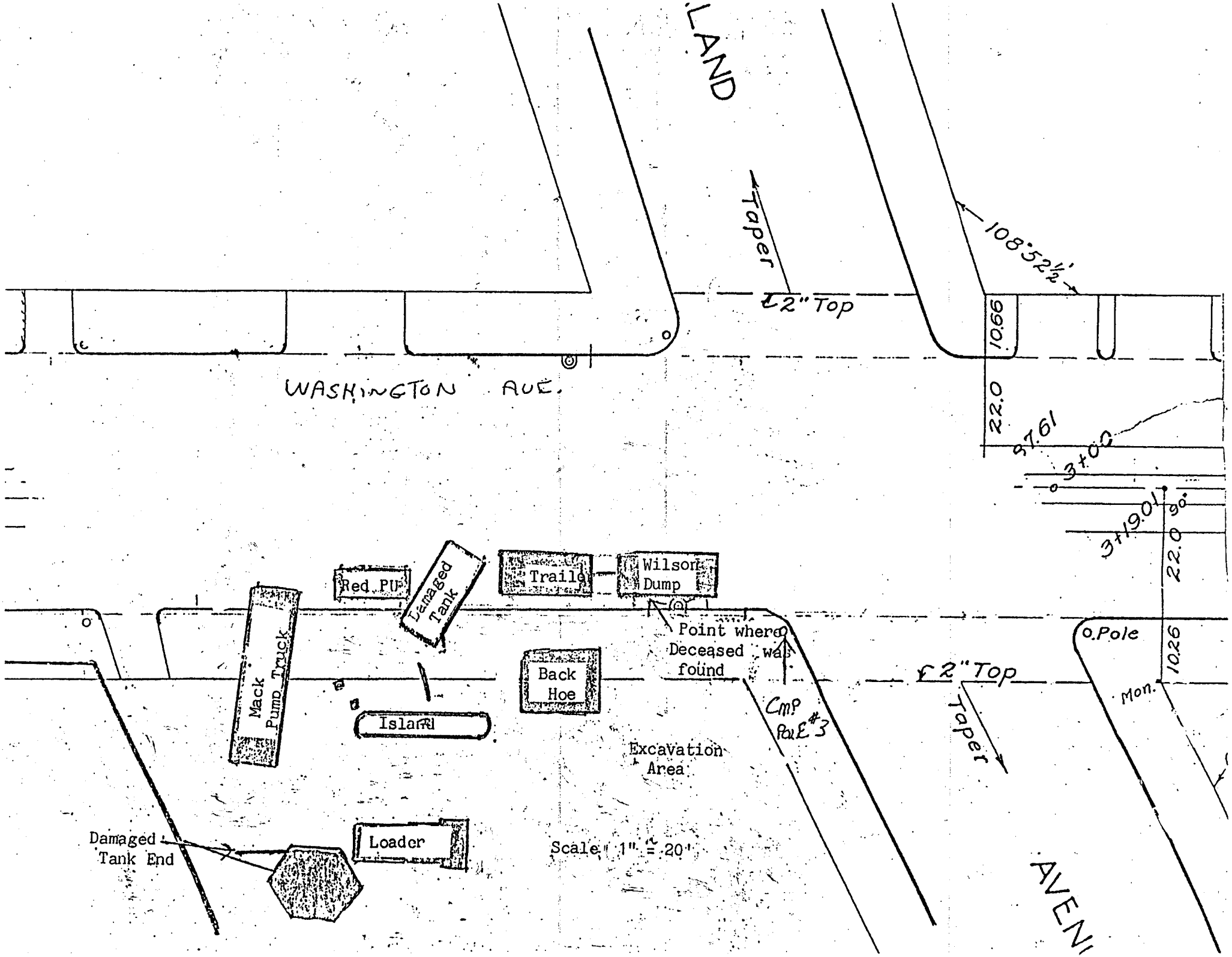
This incident was the result of having potential sources of ignition in an area where flammable gasoline vapors were accumulating. During the process of suctioning flammable vapors from the inside of the tank, the vapors were discharged very near to the ground at the vacuum truck. The vapor-to-air mixture that accumulated around the adjacent pickup truck was within the flammable limits of gasoline. The ignition source, determined by the State Fire Marshal to have been the pickup truck, ignited the flammable mixture and produced an explosion under the hood of the truck.

A trail of vapors leading from the vacuum truck to the tank facilitated the rapid fire spread to the tank interior. Ignition of vapors inside the tank caused a rapid build-up of pressure that resulted in tank failure. This failure coupled with the ensuing fire resulted in the injury to three persons and death to another.

Tests for the presence of flammable vapors constitute one of the most important phases of work when dealing with flammable liquids. Frequent tests made with a combustible gas indicator by persons experienced in its use can be used to determine whether or not a hazardous condition exists.

In combination with the use of a combustible gas indicator, special care must also be exercised to eliminate any source of ignition in the vicinity of an area containing flammable vapors. Vapors should not be allowed to accumulate at low levels, but should be discharged upward and at some elevation above grade. Where necessary, bonding should be used where static electricity could be produced. In addition, all electrical equipment including inspection lights and motors should be designed for use in such areas. The aforementioned safeguards are commonly accepted industry practice when dealing with flammable liquids.

In the aftermath of this tragic occurrence, the Maine Department of Environmental Protection and the State Fire Marshal's Office have begun to develop a detailed protocol to facilitate the safe removal of underground gasoline storage tanks within the state.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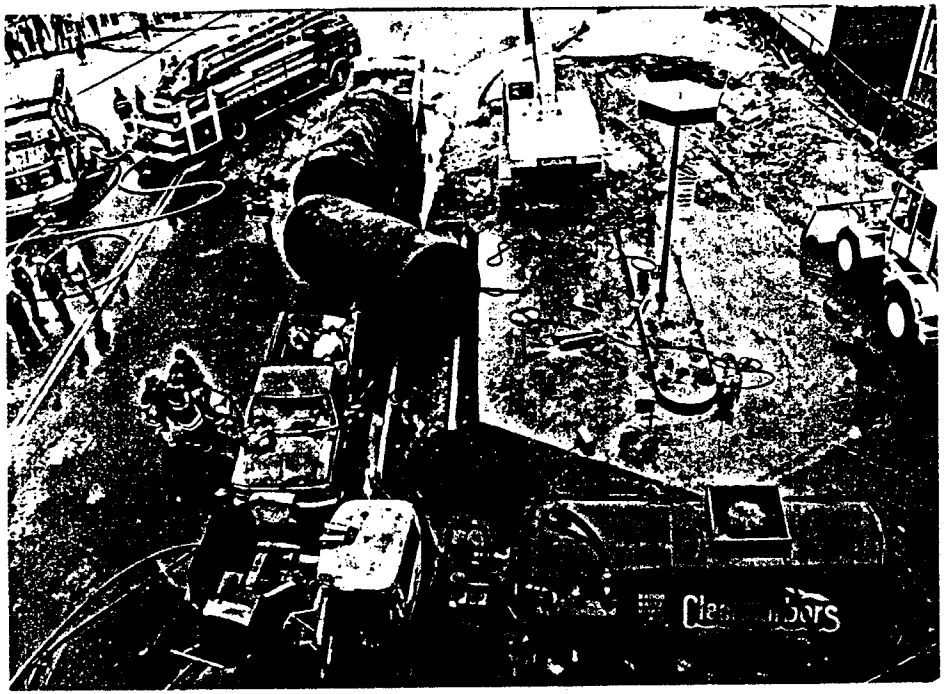

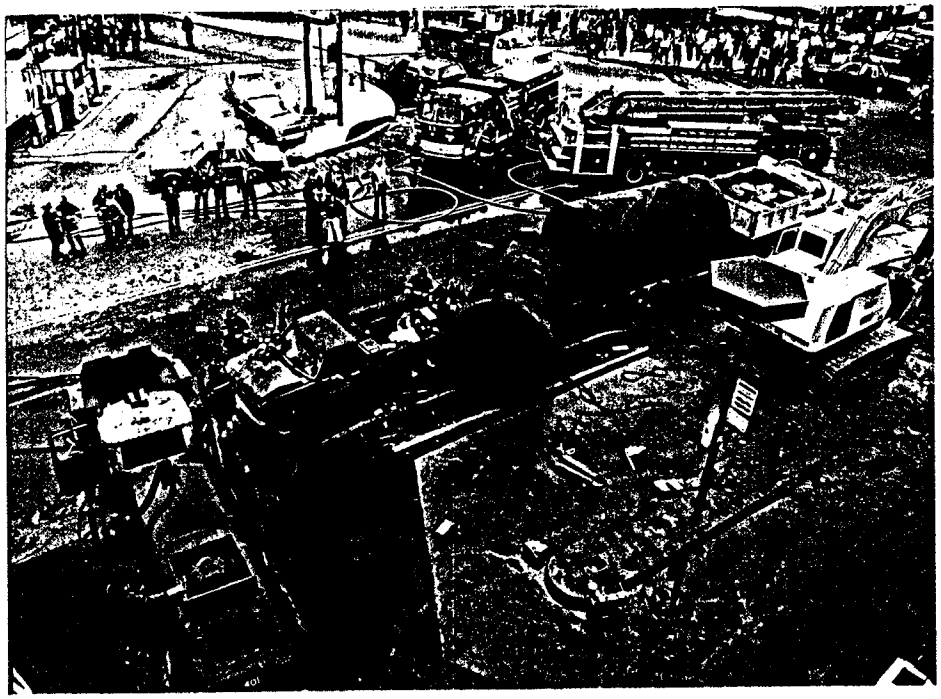


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