



NURSING HOME FIRE

Woburn, MA

October 30, 1992



**FIRE
INVESTIGATIONS**

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FIRE INVESTIGATION REPORT

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Prepared by

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ABSTRACT

On Friday, October 30, 1992, an explosion and fire resulted in the total evacuation of the Woburn Nursing Center, a 101-bed facility, in Woburn, Massachusetts. The explosion occurred when natural gas was accidentally released during construction activities at the facility. The natural gas filled combustible concealed spaces in the building's core area and was ignited by some undetermined heat source. When ignited, the gas-fed fire spread vertically from the basement to the third floor and blew off a section of the building's roof. Twenty-one sprinklers operated, controlling the fire while staff members evacuated all of the patients. Construction workers, neighbors, and others provided limited, but valuable assistance during the evacuation. Since the evacuation activities were already in progress when they arrived, most of the first-alarm fire fighters were able to concentrate on fire suppression. Twenty-one civilians and two fire fighters sustained injuries, though most of these injuries were minor. The damage to the building and its contents was estimated at \$1.5 million.

Based on the NFPA's investigation and analysis of this fire, the following significant factors contributed to the success of the fire response at the Woburn Nursing Center:

- The installation and operation of a supervised and approved automatic sprinkler system,
- The existence of and administrative commitment to programs and procedures describing **staff** emergency response,
- The immediate actions of trained **staff** members following the explosion,
- The quick response of fire department, emergency medical, and other personnel who, through a coordinated effort, were able to perform their respective tasks as well as assist the nursing home staff in the care of evacuated residents.

I. INTRODUCTION

The National Fire Protection Association (NFPA) investigated the Woburn Nursing Center fire in order to document and analyze significant factors that contributed to the successful outcome of this incident. The study was funded by the NFPA as part of its on-going program to investigate technically significant incidents. The NFPA's Fire Investigations Department documents and analyzes incident details so that it can report lessons learned for life safety and property loss prevention purposes.

The NFPA became aware of the Woburn Nursing Center fire on the day it occurred, and Michael S. Isner, Fire Protection Engineer in the NFPA Fire Investigations Department, visited the facility to perform an on-site study of this incident. That 2-day, on-site documentation and the subsequent analysis were the basis for this report. Entry to the fire scene and data collection activities were made possible by the cooperation of the Woburn Fire Department and the Woburn Nursing Center.

This report is another of the NFPA's studies of fires having particular important educational or technical interest. All information and details regarding fire safety conditions are based on the best available data and observations made during the on-site data collection phase, and on any additional information provided during the report development process. It is not the NFPA's intention that this report pass judgment on, or fix liability for, the loss of property resulting from the October 30, 1992 fire. Rather, the NFPA intends that its report present the findings of the NFPA data collection and analysis effort and highlight factors that contributed to the successful outcome.

Current codes and standards were used as criteria for this analysis so that conditions at the Woburn Nursing Center on the day of the fire could be compared with state-of-the-art fire protection practices. It is recognized, however, that these codes and standards may not have been in effect during construction or operation of the facility. The NFPA has not analyzed the Woburn Nursing Center's compliance with the codes and standards that were in existence when the facility was built or during its operation.

Also, the cooperation and assistance of Fire Chief Robert Doherty of the Woburn Fire Department, and of Mr. Richard Salter, Administrator/Owner, of the Woburn Nursing Center, are greatly appreciated.

II. BACKGROUND

The Building

The building housing the Woburn Nursing Center varied in height from two to four stories, and had been expanded through the construction of several additions. (See Figure 1.) The original structure was a two-story-plus-attic, wood-frame dwelling that was converted for use as a nursing home. The first of five additions was constructed in 1962. All of the additions were of light noncombustible construction, and the additions were so located that the original structure was eventually surrounded by new wings. Thus, the old wood-frame structure became the core area for the facility.

At the time of the fire, the patient rooms were located on the wings that were separated from the original structure (now the core area) by slab-to-slab walls. Self-closing fire-rated doors protected the openings in these separation walls. Slab-to-slab walls also separated the patient rooms from the corridor, and all patient rooms had solid-core wood doors. Some patient rooms shared a common bathroom with an adjacent patient room; other patient rooms had common doors connecting the rooms. These common doors enabled people to move from one part of a wing to another part of the same wing without entering the corridor (proving valuable in this incident).

Fire Protection Systems

The entire facility was protected by an approved automatic sprinkler system using standard 160°F sprinklers. In addition, smoke detectors were installed in patient rooms and corridors, and heat detectors were located in utility areas, i.e., electrical rooms, laundry, and kitchen. The operation of the sprinkler system, any smoke detector, or any heat detector would initiate a building-wide alarm, automatically notify the fire department, and release magnetic hold-open devices for fire doors. Fire extinguishers were also located throughout the facility and emergency lighting fixtures were connected to an emergency power system powered by a natural-gas-driven generator located in the basement.

The Woburn Nursing Center owners and administrators worked closely with the Woburn Fire Department when designing and planning the newest addition to

the facility. As a result of this cooperation, several fire protection enhancements were made to the property. Before construction began, a new 8-inch water main was installed in the street to ensure an adequate water supply for the building's sprinkler systems, and two new fire hydrants were installed on the property for manual fire suppression. During the October 30, 1992 explosion and fire, the enhanced water distribution system readily met the demands of the operating sprinklers, and the additional fire hydrants contributed to efficient fire ground operations. A new access road was also constructed specifically to allow fire apparatus to drive to and position at the rear of the building if necessary. Similar to the additional hydrants, the access road contributed to the efficiency of the fire ground operations.

The nursing home's management had in place many programs, policies, and procedures intended to enhance fire safety at the facility. For example, they prepared a "fire and disaster" plan and ensured that staff personnel were trained regarding fire safety. As part of their initial orientation training, new employees were instructed about the center's fire and disaster plan. All staff received regular fire safety training that included such topics as fire extinguisher operation, review of alarm system operation, and evacuation techniques. This training came in addition to the quarterly fire drills that were held for all shifts. Fire safety training and fire drills were documented, and training records were periodically reviewed to ensure that all staff received the required training. In addition to using in-house fire protection expertise, the nursing home staff worked closely with the Woburn Fire Department fire prevention bureau to develop fire safety programs and to perform fire safety training.

Building Occupants

On the afternoon of the fire, all 101 beds in the facility were filled and there were approximately 22 staff in the building. The staff included nurses, aides, kitchen personnel, a receptionist, a development specialist, an activities specialist, and a maintenance person. In addition to the nursing home staff, there were approximately 4 to 6 construction workers in the building and another 4 workers outside in the general area of the nursing home.

weather conditions

On the morning of Friday, October **30, 1992**, light rains passed through Woburn. By that afternoon, however, the rain had stopped and the skies were overcast. The high temperatures for the day were in the low fifties, and the temperature dropped as the day progressed to evening.

III. THE FIRE

Ignition and Initial Occupant Response

The nursing staff shift-change occurred at approximately 3:00 p.m. At this time, most residents were in their respective rooms, and a few residents had visitors in their rooms. During the next hour, the on-coming nursing staff began their normal activities, which included taking residents down to the first-floor dining room for the evening meal.

Meanwhile, a plumber was working on a **2-inch-diameter** branch line for natural gas that had been installed by other plumbers at some previous time. Upon completing his work, the plumber charged the branch line with natural gas. Reportedly, the natural gas branch line would not maintain a stable pressure, and the plumber began to look for a possible leak in the piping system.

An off-duty Woburn Fire Department lieutenant was visiting his mother, a resident in the home. As he and his mother walked in the corridor, the officer noticed an odor of natural gas, and when they approached the nurses' station the odor became more noticeable. The officer mentioned the smell to a staff person. He was told that maintenance personnel had been notified and that they were checking into the problem. A little while later, the fire officer was again pushing his mother in a wheelchair and he smelled natural gas in the area of the nurses' station; this time the odor of gas was stronger. A staff person repeated that maintenance personnel had been notified. It was at about this time that the officer suggested that someone open a few windows, and while the **staff** began to open windows, the officer pushed his mother back to her room.

The fire officer and his mother were in the corridor about 20 feet from her room when they felt and heard a loud explosion. The officer pushed his mother back into her room and told her to stay with her husband (the officer's father) in the room near the window. He went back into the corridor and saw two staff members coming from the nurses' station area. One was holding her head and the other was holding her leg. They told him that the damage was "all out there" (meaning the area around the nurses station). He looked through the doorway through which the two injured people had come and he saw extensive destruction. The area was full of dust and smoke; ceilings were down, walls were open, wires were hanging down, and water was running. Knowing that there had recently been a third **staff** member at the nurses' station only a few moments before the explosion, the fire officer took a few moments to locate that staff person and ensure that she was safe.

The fire officer recalled hearing nurses and aides yelling to close doors, which they did as quickly as possible, and for a while he assisted **staff** members who immediately began to evacuate patients from rooms closest to the explosion area. In addition to the staff, construction workers both inside and outside the facility and a few neighbors came as quickly as possible to assist the nursing **staff**.

The fire officer recalled that while he was attempting to rescue occupants the lights went out. Since all the doors to patient rooms were closed, the corridors were immersed in darkness, making movement through the corridors difficult.

Fire Department Notification and Response

The Woburn Fire Department dispatch center received an automatic alarm from the Woburn Nursing Center at 4:07 p.m., and during a subsequent telephone call it was reported that a generator had exploded and that part of the building's roof had been blown off. Three engines, a tower, and a rescue were dispatched. Since the initial report indicated that there had been an explosion, the chief of the Woburn Fire Department also responded. The officer on the first arriving engine company immediately reported heavy smoke and fire showing from the roof. He requested a second alarm, and another engine and a truck were dispatched.

A subsequent arriving engine company went to the rear of the building and found elderly residents being assisted down a rear fire escape. At 4:11 p.m., the officer on this engine requested a third alarm, ambulances, and a bus. The department chief arrived on the scene at 4:11 p.m. and observed a severely burned victim (the plumber who was working on the natural gas branch line). He confirmed that there was heavy smoke and fire at roof level, and he received a report of heavy fire in the second-floor ceiling. Based on this information, the department chief ordered a fourth alarm at 4:12 p.m.

During his initial size-up, the chief assessed the fire as being quite severe, but he also believed that the nursing home staff were managing the evacuation activities. As a result, he had most first-alarm companies concentrate on attacking the fire and performing a primary search of the facility. The fire fighters advanced 2 handlines to the second floor where the heavy fire had been reported, and a third line was advanced to the third floor because there was also a report of a person possibly being trapped on that floor. Some of the first-alarm fire fighters were also assigned to assist in the evacuation of residents.

Second-alarm companies established the water supply for the first-alarm crews involved in the fire attack. In addition, second-alarm fire fighters became involved in the primary search of the building, fire fighting activities on the first and second floors and on the roof level, and resident evacuation. One mutual-aid engine company, which responded to the third alarm, advanced a **hoseline** into the first floor to suppress fire in that area. The other third-and fourth-alarm companies were assigned to assist in operations such as the secondary search of the building, fire suppression operations, and evacuation of residents.

The fire was considered “under control” at 4:35 p.m.; however, fire fighters needed to open many walls and areas in the ceiling assemblies to verify that there was no fire extension in these areas. Final extinguishment was completed at approximately 5: 15 p.m.

Staff Response and Resident Evacuation

Immediately following the explosion, a maintenance person shut off the primary natural gas control valve for the building and went up to the patient areas. He showed patients and staff on one wing an entrance to the construction area. This

area was clear of combustion products and served as a good temporary refuge. **In** addition, the maintenance person told the arriving fire chief of the severe fire conditions **affecting** the second-floor core area. He also continued to assist in the evacuation of patients.

Staff personnel closed patient room doors and immediately evacuated those closest to the fire area. Due to the severity of the explosion and the presence of smoke in areas on the wings, the staff also moved patients to areas outside the building. The second-floor, core area conditions prohibited travel through that part of the building. Since many of the patient rooms had a door between rooms, staff were able to move residents through the rooms to an area in the corridor that was close to a fire exit. At this point they entered corridors that were gradually filling with smoke as they went to the exits. Though all exit stairways were used during the evacuation, most of the second-floor residents were evacuated down an open outside stairway at the rear of the building.

Many people assisted **staff** members to evacuate patients. For example, the **4** or **5** construction workers who were in the building and not injured by the explosion helped to carry many patients out of the building. Similarly, family members visiting relatives, such as the Woburn Fire Department lieutenant, assisted as much as they could. In addition, **4** construction workers who were on an adjacent property and **3** or **4** neighbors ran to the facility when they heard the explosion, and like the others, assisted the **staff** during the evacuation.

Most patients were moved on wheelchairs. However, **staff** members recalled that in a few cases patients were removed by staff or by construction workers using carries such as the “two-man” carry and the “blanket carry.” In addition, two police officers used a “cardiac” chair to remove at least one patient. Through the combined efforts of staff members and those who came to assist, all 101 patients were removed **from** the building in approximately 15 to 20 minutes.

The fire department established a triage area in a rear parking lot near the northwest corner of the building since most patients were being removed through exits toward the back of the building. In this area, the patients were identified and monitored by staff and emergency personnel. Some fire fighters inside the building threw blankets out of windows so that they could be used by the patients

in the triage area. Approximately 1/2 hour into the incident a school bus passing by on a nearby street was stopped by a police officer and brought to the fire scene so patients could be placed onto the bus. This attempt to get patients into an inside area was not effective because the bus had to be parked on a steeply sloped driveway, and it was difficult to move wheelchair patients onto the bus. Approximately 30 patients were moved to a nearby house when a neighbor offered his home as an ad hoc shelter for the patients.

As ambulances and other means of transportation began to arrive, patients were moved to a school, which became the formal shelter for patients. Approximately 50 percent of the residents were transported to the school by 5:15 p.m., and all residents and their medical records arrived at the shelter by 6:30 p.m. Staff members made arrangements to relocate residents to area hospitals for more permanent housing, and all patients were transferred to the hospitals by 11:05 p.m.

Casualties and Damage

Twenty-three people were injured during this explosion and fire. The most severely injured person was the plumber, who had burns on his hands, arms, and head. Nine residents sustained injuries that included chest pain, burns on the back, smoke inhalation, bruises, lacerations, and hypertension. Ten staff were injured, and their injuries included smoke inhalation, back strain, bruises, shock, and a burned neck. Two fire fighters and one construction worker sustained a smoke-inhalation-related injury, a bruised leg, and a bruised back and hand, respectively.

Most of the explosion and fire damage occurred in the wood-frame core area of the building. (See Figure 2.) In this area, similar types of explosion damage occurred from the basement to the third (top) floor, i.e., ceilings collapsed, walls were damaged, and combustible materials inside the wall, ceiling, and roof assemblies were burned. Similar to the explosion damage, most of the fire damage occurred in the core area, and it was severe inside the floor/ceiling assemblies and wall assemblies.

IV. ANALYSIS

Cause and Origin

The Woburn Fire Department investigators determined that explosion and fire occurred after a plumber completed the installation of a 2-inch natural gas main and turned on the natural gas for that main. The newly installed main had an unplugged, 1-inch orifice in a 2-inch x 2-inch x 1-inch tee located above the ceiling in a basement electrical room below the nursing home's original wood-frame structure. The investigators believe the gas flowed freely for 15 to 20 minutes, allowing an estimated 300 to 500 cubic feet of natural gas to leak out of the main and to spread to various areas in the building.

Though the exact ignition source was not determined, investigators indicated that the ignition source most likely involved electrical equipment since the leak occurred in close proximity to the electrical room.

Fire Spread

Before the explosion, natural gas spread into several basement rooms through cracks between doors and their respective frames, through corridors, and through natural voids and cavities such as joist channels in the ceiling/floor assembly between the basement and the first floor. The natural gas, which is lighter than air, also spread vertically and accumulated in an attic area adjacent to a third-floor office area. The primary avenue through which the gas spread from the basement to the attic was a non-fire-stopped pipe chase that was enclosed in wood-frame wall assemblies and not accessible from the occupied areas on the intermediate floors. However, there was also evidence that some of the natural gas also spread vertically through stud channels and miscellaneous other openings within the walls.

Once the ignition occurred, the explosion and the subsequent fire propagated along the same paths through which the natural gas had previously spread. Over-pressurization during the explosion resulted in the extensive damage to wall and ceiling floor assemblies in the core area. The ignition of the accumulated natural gas in the attic space caused the explosion, blowing a section of roof off the

building. Combustible materials inside wall and ceiling/floor assemblies were ignited and continued to burn after the explosion had subsided.

Fire and Safety Equipment Performance

Twenty-one sprinklers operated during the explosion and subsequent fire. The operating sprinklers controlled the fire in the core area of the building and, in conjunction with the fire barriers between the core area and the wings, prevented the fire from spreading to areas not directly impacted by the explosion. Even though the sprinkler system was able to control the fire, final extinguishment had to be accomplished by fire fighters because the fire was spreading inside the combustible wall and ceiling/floor assemblies.

Emergency lighting and other emergency systems were powered by electricity from a natural-gas fired emergency generator. When the maintenance person shut off the main natural gas control valve in response to the explosion, he also shut off the only fuel supply to the emergency generators. The most significant result of the loss of emergency power was the immediate failure of emergency lighting in the building which, in turn, increased the difficulty of evacuation and rescue operations.

Staff Performance

The administrators at the Woburn Nursing Center had over the years emphasized fire safety programs for the facility and fire safety training for all staff members. This training provided the staff with the knowledge and confidence to perform a complete evacuation of the darkened building while an extremely serious fire was in progress. Not only was this evacuation performed with a minimum of resident injuries, but it was accomplished in approximately 15 to 20 minutes.

Following the removal of all residents from the building, the major concern of the nursing staff, and emergency personnel who were assisting the staff was managing the medical and other needs of the 101 residents. A triage area was first established on the property, and residents were brought to this area where they could be evaluated and protected from the weather as best as possible. As soon as the opportunity became available, residents in the triage area were

transported to the school being used as a shelter. Due to limited transportation and other organizational difficulties, some of the residents remained at the fire scene for up to 1 hour before being transported to the shelter. During the period when residents were being transferred to the shelter, accounting for all residents was a confusing and difficult task. Because staff members were able to organize activities at the temporary shelter, they were able to effectively account for all residents. Another problem experienced by staff personnel was ensuring that medical records were retrieved and that these records accompanied each patient being relocated to other hospitals. Staff personnel were able to resolve this problem before the residents were transported from the temporary shelter.

Code Analysis

In the interest of comparing conditions and other details of this incident current NFPA codes and standards, such as the 1992 edition of NFPA 1, *Fire Prevention Code*, were used as the basis for this comparison. It was recognized, however, that the current codes were not part of the legal requirements governing life safety at the Woburn Nursing Center. The following discussion concerns requirements that have particular relevance to this fire. It is not intended to be a complete description of all parts of the codes that could be applied to this health care facility.

The fire potential during construction projects is inherently greater than that in a completed structure. This increased hazard is the direct result of large quantities of combustible materials and combustible debris and the presence of numerous ignition sources, such as temporary heating devices, cutting/welding/plumbers' torch operations, open fires, and smoking. In order to minimize the fire risk and protect occupants of buildings under construction, NFPA 1, *Fire Prevention Code*, (paragraph 41-2.16.8) requires that fire protection systems remain operational at all times, all required exit components be maintained, and fire-resistive assemblies and construction also be maintained. The requirements are established in NFPA 241, *Standard for Safeguarding Construction, Alteration, and Demolition Operations*, 1993 edition.

Events during the Woburn Nursing Center fire corroborated the value and importance of the NFPA requirements for maintaining fire protection provisions during construction and renovation activities. Specifically, the operating sprinkler systems, in conjunction with the fire-rated doors and walls, controlled

the fire at the nursing home and prevented the fire from spreading to patient wings. In addition, residents were able to evacuate through alternate exits, even though the *core* area was filled with fire, because both the primary and the alternate exits were maintained during the construction activities.

The NFPA considers administrative policies and staff personnel to be an integral of the life safety provisions in a health care facility. Accordingly, Chapter 31 of NFPA 101®, *Life Safety Code (LSC)*, 1991 edition, requires that administrators of health care facilities have in place a written plan addressing the protection of all persons in the event of a fire. This chapter also requires that staff members be instructed regarding their duties under the plan and also regarding life safety procedures. The fire safety provisions at the Woburn Nursing Center appeared to be consistent with these NFPA requirements, and the staff members at the center felt that their training helped them to respond effectively during the evacuation of residents.

The total evacuation of a health care facility, which occurred during this incident, is not a common response to a fire emergency in a health care facility. Fire emergency plans typically address events that affect only a small part of the facility at any time. As a result, evacuation and other response plans commonly anticipate that patients will be relocated to areas within the building that are not directly involved in the event. Rarely do incidents require that an entire building be evacuated, and in such situations staff members and administrators must spontaneously adapt their emergency procedures to meet the challenges of the complete building evacuation. Apparently, the management of residents after they were safely evacuated presented the greatest challenge to the administrators and staff during the Woburn Nursing Center fire.

NFPA 99, *Standard for Health Care Facilities*, provides guidelines that can help health care emergency planners prepare for the complete evacuation of their facilities. Recognizing that health care facilities may have to provide services during large-scale disasters (such as an incident causing a large influx of people needing medical services, a hurricane, or bomb resulting in the total evacuation of the facility), NFPA 99 includes an annex that provides useful disaster procedures and guidelines for establishing a disaster plan. With such a disaster plan established, trained health care administrators and staff may be able to

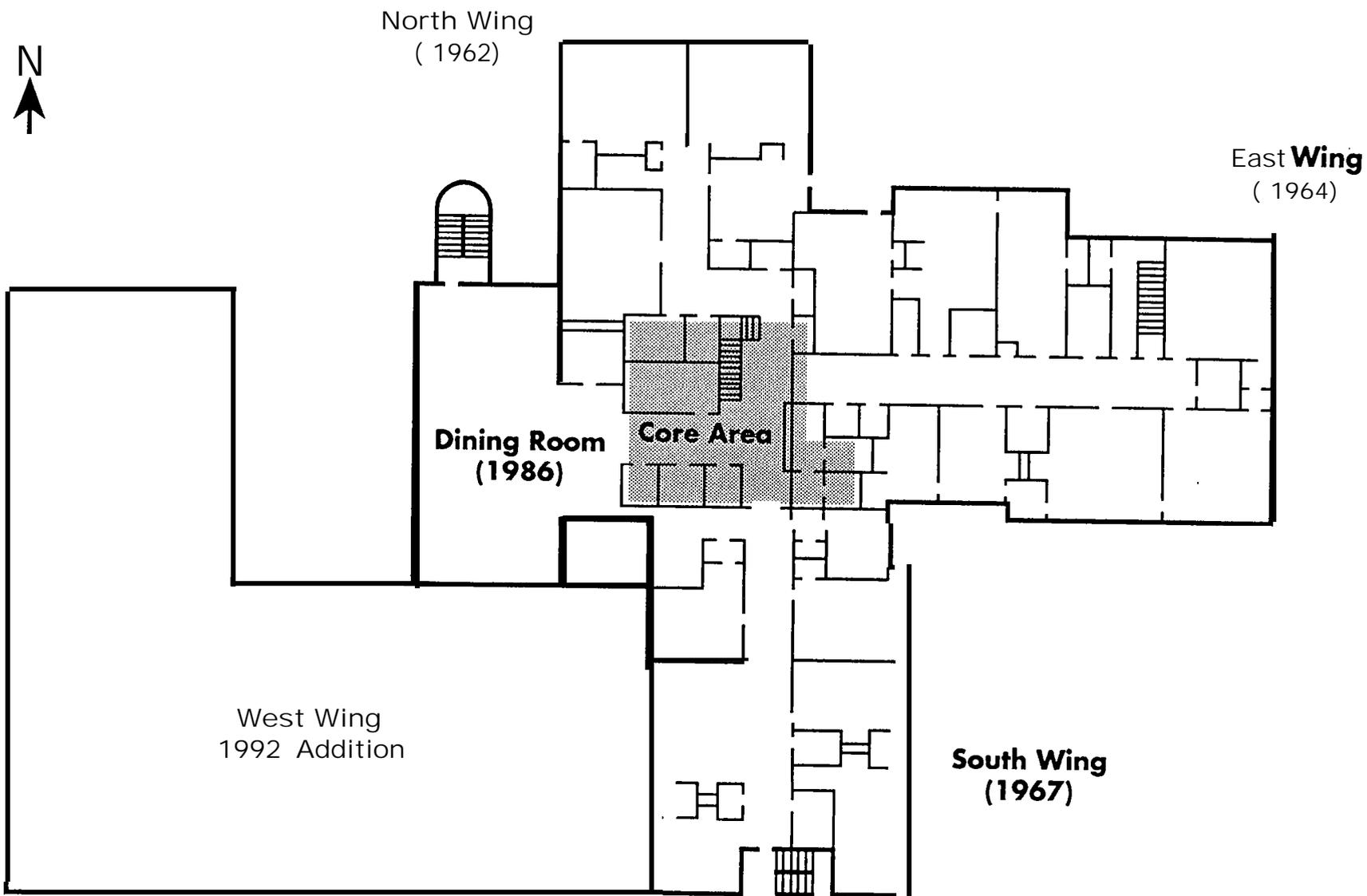
adapt the disaster policies and procedures to fire emergency response totally beyond or above those reasonably anticipated or expected.

V. DISCUSSION

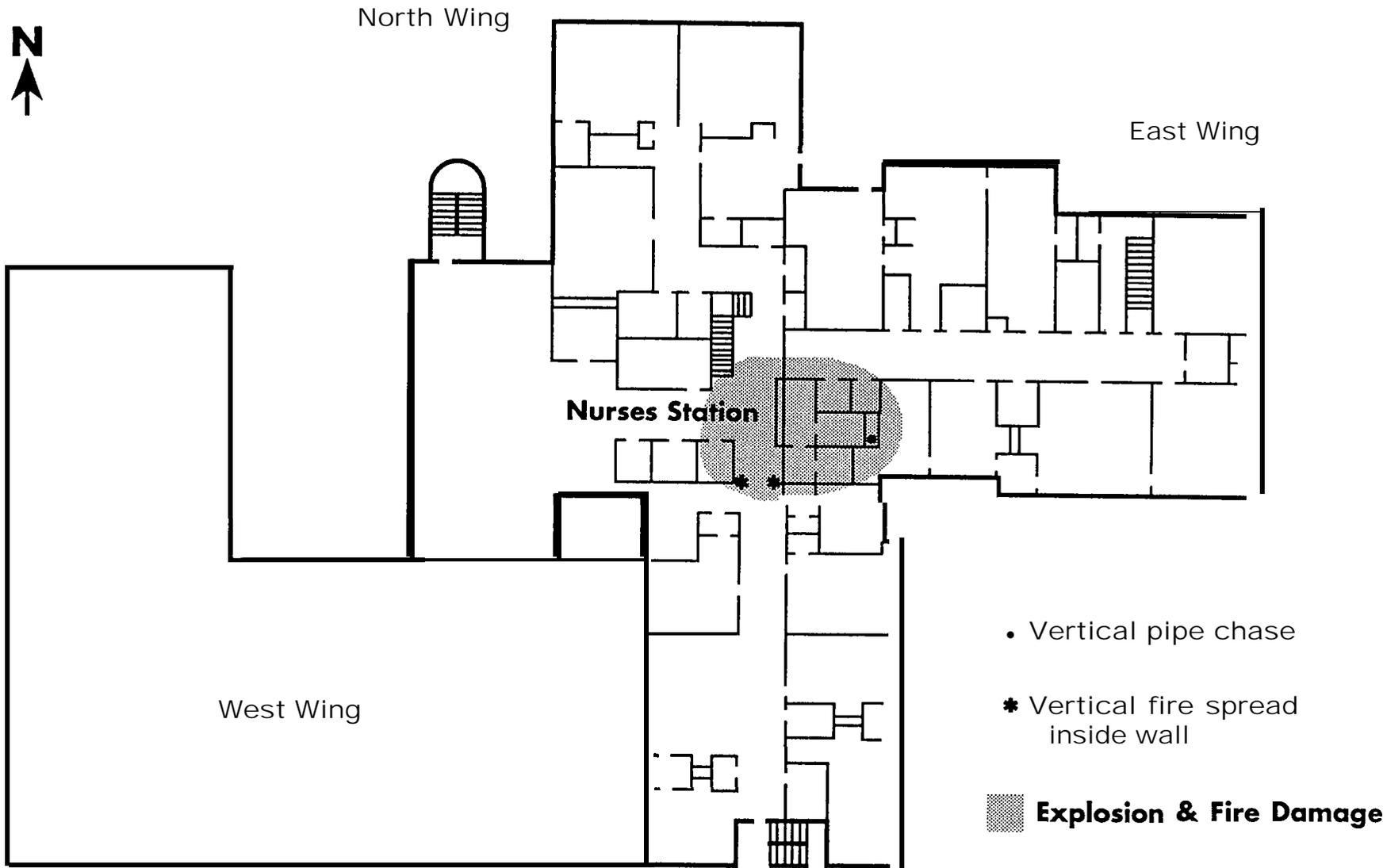
The **NFPA's** investigation and analysis revealed that the following significant factors contributed to the success of the fire response at the Woburn Nursing Center:

- The installation and operation of a supervised and approved automatic sprinkler system,
- The existence of and administrative commitment to programs and procedures describing **staff** emergency response,
- The immediate actions of trained staff members following the explosion,
- The quick response of fire department, emergency medical, and other personnel who, through a coordinated effort, were able to perform their respective tasks as well as assist the nursing home staff in the care of evacuated residents.

The fire at the Woburn Nursing Center was notably different from other fires that the NFPA has investigated where fire safety deficiencies have been documented resulting in patient deaths and extensive damage. Moreover, this fire shows that compliance with fire safety code requirements, training of **staff**, and the use of automatic sprinklers in health care facilities can significantly reduce the potential for life loss and large property losses.



Woburn Nursing Home Plan (Floor **1**)
FIGURE 1



Woburn Nursing Home Plan (Explosion & Fire Damage)
 FIGURE 2