NURSING HOME FIRE
Dardanelle, ARK
March 13, 1990

NFPA
FIRE INVESTIGATIONS
NATIONAL FIRE PROTECTION ASSOCIATION

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FIRE INVESTIGATION REPORT

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DARDANELLE, ARKANSAS
MARCH 13, 1990

Prepared by
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National Fire Protection Association

Publishers of the National Fire Codes® and National Electrical Code®
A non-profit membership organization dedicated to promoting safety from fire, electricity, and related hazards through research, codes and standards, technical advisory services, and public education since 1896.
ABSTRACT

On Tuesday, March 13, 1990, a fire of an undetermined cause struck the 90-bed Dardanelle Nursing Home in Dardanelle, Arkansas. This home was a skilled nursing facility and was licensed and inspected by the State of Arkansas. Of the 85 patients in the building, four died and at least ten others were sent to the hospital.

The building, which was constructed in 1969, was designed for use as a nursing home. The one story, noncombustible structure had poured concrete floor slabs and concrete block exterior and interior walls. Most of the walls for the corridor extended from the floor slab to within a few inches of the underside of the roof decking, and walls between rooms extended a few inches above the non fire-rated, noncombustible suspended ceiling assembly. The building's built-up roof was constructed over corrugated metal pans supported by unprotected steel bar joists that were set on top of the corridor and exterior walls.

Two slab-to-slab, concrete-block fire walls divided the building into three areas (west wing, center section, and east wing). Corridor openings in the fire wall were protected with 1 1/2-hr fire-rated doors equipped with magnetic hold-open devices. The doors were also equipped with a coordinator for proper sequencing during closing. Room doors were nonrated, solid core, wood doors with positive latching hardware.

The nonsprinklered building had a fire detection/alarm system that included smoke detectors in the corridor and resident rooms, audible local alarms, alarm lights outside of each patient room, manual pull stations, and interlocks to the HVAC system and the magnetic door holders. In addition, fire extinguishers and emergency lighting were provided. A partial automatic sprinkler system was provided protecting the kitchen area, an adjacent storage room, a soiled linen storage room, and the laundry.

The cause of the fire was not determined. It appears, however, that the first materials ignited were the contents of a clean-linen cart in a linen storage room. The fire then spread into the space above the room's suspended ceiling. Once in the void space above the ceiling, the hot gases and flames caused the asphalt in the built-up roof assembly to melt. Combustible material dripped, and flammable vapors vented into the void space, intensifying the fire and causing heavy smoke.

The following factors appear to have contributed to the loss of life and property:

1. The absence of a complete automatic sprinkler system.
2. The failure of the compartment of origin to contain the fire.
3. The spread of fire and smoke through concealed space.
INTRODUCTION

The National Fire Protection Association (NFPA) investigated the Dardanelle Nursing Center fire to document and analyze significant factors that resulted in the loss of life and property.

The study was funded by the NFPA as part of its ongoing program to investigate technically significant incidents. The NFPA's Fire Investigation Division documents and analyzes incident details so that it may report lessons learned for life safety and property loss prevention purposes.

The NFPA became aware of this fire on March 14, 1990, the day after it occurred. Michael S. Isner, Fire Protection Engineer in the NFPA Fire Investigations Division, traveled to Dardanelle, Arkansas to document the facts related to this fire. His three days of on-site study and subsequent analysis of the event were the basis for this report. Entry to the fire scene and data collection activities were made possible through the cooperation of the Dardanelle Fire Department.

This report is another of the NFPA's studies of fires having particularly important educational or technical interest. All information and details regarding firesafety conditions are based on the best data available and on observations made during the on-site data collection phase and 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 life or property resulting
from the Dardanelle Nursing Center fire. Rather, the NFPA intends its report to present the findings of the NFPA data collection and analysis effort and to highlight factors that contributed to the loss of life or property.

Current codes and standards were used as criteria for this analysis so that conditions at the 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 Dardanelle Nursing Center. The NFPA has not analyzed the facility regarding its compliance with the codes and standards that were in existence when the building was constructed or during its operation.

The cooperation and assistance of Fire Chief Doyle McEntyre of the Dardanelle Volunteer Fire Department is greatly appreciated.

In addition, we acknowledge the assistance of representatives for the Arkansas State Fire Marshal’s Office, the Arkansas Attorney General’s Office, the Arkansas Department of Human Services Office of Long Term Care, the American Health Care Association, and the National Institute of Standards and Technology and Health Care Financing Administration.

Finally, we recognize the cooperation of the Dardanelle Nursing Center staff, administrators, and owner.

Special thanks are given to Maureen DiTullio, Division Secretary, for her assistance during the preparation of this report.
BACKGROUND

Licensing
The Arkansas Department of Health initially licensed the Dardanelle Nursing Center as a 90-bed skilled nursing facility in 1969 and performed inspections through 1978. In 1979, the Arkansas Department of Human Services Office of Long Term Care assumed the responsibility for licensing and inspecting nursing homes. As a result, the facility's license has been maintained by this office and inspectors from the Office of Long Term Care have made annual inspections of the Center since that time. The state inspection guidelines for the Dardanelle Nursing Center were based on the 1967 Life Safety Code.®

The Building
The Dardanelle Nursing Center was constructed in 1969 and was a single story building. This 290-ft long and 50-ft wide structure had three small areas extending out of the north side and one area extending out of the south side (see Figure 1). These areas provided additional space for kitchen, laundry, lounges, administrative areas, and other rooms.

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The facility had been administratively divided into three areas: the west wing, the center/laundry, and the east wing. Each of the wings contained 18 patient rooms, a nurse’s station, a lounge, a "hopper" room\textsuperscript{1}, clean-linen room, several closets for storage, and other rooms. A small corridor located next to the "hopper" room was referred to by staff as the "hopper" room corridor. This corridor served two closets and the clean-linen storage room. In the west wing only, the corridor had a door leading directly to the outside.

The floor for this noncombustible building was a poured-in-place concrete slab on grade. The roof assembly was supported by both the exterior and interior bearing walls that were constructed with 8-in. by 8-in. by 16-in. concrete blocks. In addition to supporting the roof, the interior bearing walls formed a central corridor. There was a 2-to-3-in. opening between the top of corridor walls and the roof deck, and this opening was the result of the top chord of the roof bar joists being laid on top of the corridor walls. Therefore, the corridor walls were neither an effective smoke barrier nor fire barrier.

The walls between patient rooms and enclosing other rooms, including the clean-linen storage room, were made of 3-in. concrete block and extended only a few inches above the finished ceiling. These walls did not have any fire-resistance rating.

\textsuperscript{1} The "hopper" room was a small janitor’s closet with a sink for washing mops and other equipment. The sink was referred to as the "hopper," thus giving the room its name.
Two fire walls divided the building into three distinct fire zones. The walls were constructed with 8-in. by 8-in. by 16-in. concrete blocks, extended from the floor slab to the underside of the roof deck, and had mortar sealing holes and penetrations. On each wing, these walls were located between Room 8 and the storage rooms along the hopper room corridor.

The ceiling throughout the building is a suspended type with 2-by-4-ft noncombustible tiles. The metal grid that holds the ceiling tiles was supported by wires that were secured to the roof assembly. Light fixtures, ventilation discharges, and other ceiling-mounted equipment were supported by the metal grid that held the ceiling tiles. A layer of 6-in.-thick fiberglass insulation was placed over the tiles to insulate the occupied space from the area above, which was not climatically controlled.

The building had two roof systems. The first and original roof system was a typical flat composite assembly supported by metal bar joists carrying the roof loads to the exterior and interior bearing walls. The assembly was secured to corrugated metal decking with combustible adhesive material and consisted of 1-in.-thick fiberboard insulation, several layers of adhesive and paper, and a tar and gravel finish. Several years after installation, a watertight membrane was placed directly on top of the stone surface and became the second roof system covering the facility.
**Building Classification**

The building was originally classified as a "protected noncombustible structure" [Type II (111)] by inspectors from the Arkansas Department of Health.\(^2\) This classification has been maintained by the Arkansas Department of Human Services inspectors and appeared on their latest firesafety survey report.

The building, however, most resembled Type II (000) construction as described by NFPA 220-1985, *Standard on Types of Building Construction* at the time of the fire. No design information was available regarding the intended fire-resistance rating of the wall, ceiling, or roof assemblies. However, investigators noted that the suspended ceiling tiles were not secured by clips, that ceiling mounted equipment such as light fixtures were not supported by the roof structural members, and that roof structural members were not protected with any fire-resistive material. These construction details indicate that the ceiling roof assembly probably was not fire rated; therefore, the building would not be classified as a protected non-combustible structure.

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\(^2\) NFPA 220, *Standard on Types of Building Construction*, 1985 edition. A Type II (111) structure will have a 1-hr fire rating for the exterior bearing walls (first digit); a 1-hr fire rating for structural frame or columns and girders supporting loads for more than one floor (second digit); and a 1-hr fire rating for the floor assembly (third digit).
**Interior Finish**

The building had primarily noncombustible interior finishes throughout. The walls enclosing the patient rooms were painted, and the corridor walls had a skim coat of plaster and a single layer of vinyl wall covering. Incidental combustible materials in the form of wood handrails on corridor walls, wood veneers on doors, and vinyl baseboards comprised less than 10 percent of the wall area.

**Means of Egress**

Each of the three fire divisions in the building was provided with two or more exits. In the west wing, there were doors adjacent to the lounge, at the end of the hopper room corridor, and at the west end of the main corridor. All of these doors opened directly to the outside. The occupants on the west wing could also exit through the horizontal exit in the fire wall located at the east end of the main corridor. The occupants in the center core area could use exits in the dining room, the building’s main entrance, and the horizontal exits leading to the two wings. The exit arrangement on the east wing was similar to that in the west wing, except the east wing did not have an exit door at the end of the hopper room corridor.

The main exit access corridor had a clear opening of 84 in., and the hopper room corridor had a clear opening of 48 in. Exits were illuminated by ceiling-mounted fluorescent lights. Battery-operated emergency lights and internally illuminated exit signs operated with the loss of normal electrical power.
The corridor exit doors that discharged directly to the building exterior were more than 36 in. in width, and the corridor doors in the fire wall provided the only access between fire divisions. The doors in the fire wall had a 1 1/2-hr fire rating, were in pairs providing a combined opening of 70 in., were equipped with an astragal, and had a coordinator to ensure that the doors close in the proper sequence. The patient-room doors were 36 in. wide and were equipped with positive latching hardware.

**Room of Fire Origin**

The fire originated in the west-wing clean-linen closet, which was approximately 5 1/2 ft deep, 6 ft wide, and 8 1/2 ft high. Three of the four walls had five wooden shelves supported by a wood frame. These shelves were filled with blankets, sheets, pillow cases, towels, mattress pads, and washcloths. All of the items were made of cotton or cotton-blend materials. In addition to the shelves, a three-shelf metal cart filled with clean linen was parked in the closet. It contained sheets and mattress pads on the top shelf; sheets, pillowcases, towels, and washcloths on the middle shelf; and blankets and three rolled decubitus pads on the bottom shelf.

The clean-linen storage room was vented directly to the outside of the building. An electric fan that was interlocked with the light in the room was mounted in the room's suspended ceiling assembly. It was apparently connected to an exterior roof-mounted vent. The type of duct connecting the vent and the fan is not known because no remaining evidence of the duct was observed after the fire. The seam between the metal roof deck and the
liner for the penetration hole did not appear to be sealed against vapor leakage. A second penetration hole was approximately 18 in. from the first, and, like the other hole, it did not appear to be sealed against vapor leakage. The two holes were six to eight in. in diameter.

**Fire Protection Systems**

Smoke detectors were spaced approximately 30 ft apart along the length of the corridor and were also provided in the patient rooms. In addition, detectors were adjacent to the fire doors separating building sections. These detectors, however, functioned both as smoke detectors and fixed-temperature heat detectors.

Manual pull stations were installed next to exit doors. The use of any pull station or the activation of any detector initiated an audible signal throughout the building and caused a visual signal on an annunciator panel at the west-wing nurses' station. This signal indicated the zone — that is, west wing, center/laundry, or east wing — in which the activated initiating device was located. In addition to sounding a local alarm and illuminating a display on the annunciator panel, smoke detectors in the patient rooms illuminated a ceiling-mounted fire warning light in the corridor directly outside the patient room. There was no direct connection between the alarm system and the fire/police departments, central station service, or any other supervisory facility.

Dry chemical ABC fire extinguishers were provided throughout the facility, and a partial automatic sprinkler system was provided in the kitchen, laundry, soiled-linen room, and a storage room near the kitchen. In
addition, the kitchen cooking equipment was protected with a dry chemical extinguishing system.

**Heating, Ventilation, and Air Conditioning (HVAC)**

Each of the three building sections was heated by similar, but separate, systems. The west wing had three gas-fired furnaces in a closet near the lounge; the gas for these furnaces was transported from the kitchen area through piping located above the suspended ceiling assembly. Warm air was supplied to all rooms in the heating zone through metal ducts also installed above the suspended ceiling. The heating systems in the other two zones — the center core and east wing — were similar to the system in the west wing. Air-conditioning equipment for each zone was mounted on the building’s roof and supplies cool air through the same ducts as the heating system. The HVAC equipment was interlocked with the alarm system.

**Staff Training**

All new employees received fire safety training as part of their incoming orientation. That training included instructions regarding the facility's fire emergency procedures and use of fire extinguishers. In addition, aides were required to complete a state-required course regarding patient care and other responsibilities. Students in this course also received fire emergency-response training. One of the aides on duty had completed the state training about one week before the fire occurred.

Periodic in-service training focused on fire safety, and the last such in-service training was completed December 20, 1989. Of the nine staff members who were on duty, three attended that class.
The facility also conducted monthly fire drills, and the staff's performance was recorded in the facility's training records. A fire drill was conducted on all three shifts at least once each quarter. The last fire drill held before this fire occurred on February 15, 1990, and five of the seven staff who were on duty during the fire had also attended that drill.

**Occupant Activities**

On the evening of this incident, all personnel for the normal shift, which included six nurse's aides and two licensed practical nurses, were on duty. Three aides and one nurse were assigned to each wing. In addition, one nurse's aide from the 11-pm-to-7-am shift had reported to work early and at about 9:30 pm had assumed duties on the east wing. One woman was also working in the laundry, bringing the total number of staff in the building to ten.

While the facility was licensed for 90 patients, only 87 people were registered as patients at the time of the fire. Two registered patients were in a hospital, leaving a total of 85 registered patients in the building. Reportedly, most of the patients were in their respective rooms, and many were already in bed when the fire occurred.

**THE FIRE**

**Discovery and Staff Response**
Between 9:22 pm and 9:27 pm, the west-wing staff were in their respective wing tending to the 44 patients that resided in that area. The licensed practical nurse (LPN) responsible for the west wing was in the lounge with one patient, two aides were in Room 14, and one aide was in the main corridor near the west-wing hopper room (see Figure 2). This aide first saw smoke in the building. She described it as light gray smoke at ceiling level, near the double doors. She yelled to the east-wing LPN who was walking near Rooms 6 and 8 in the west wing and told her about the smoke. The aide then ran to the west-wing nurses' station to report the fire to the west-wing LPN. About this time, the building fire alarm activated, and the corridor smoke doors were released.

The west-wing LPN ran to her nurses' station and saw that the annunciator panel showed a “fire” indication for the west wing. She silenced the alarm in order to use the public address system, and then made the announcement, “Code Red, west wing.” When she turned around, the annunciator panel showed a second “fire” indication — this one was for the center/laundry area. The LPN made another Code Red announcement for the laundry area, and then she took a fire extinguisher to that location.

After closing their patient room doors, the three west-wing aides joined the LPN at the intersection between the hopper room corridor and the main corridor. The LPN had some trouble attempting to remove the pin from the fire extinguisher, so the aide who had originally discovered the fire took the ABC extinguisher from her and removed the pin.
Though each of these staff members had slightly different descriptions of the fire, all of them agreed that the door to the linen closet was open and that the flames were primarily inside the room. It appears that the base of the fire was low in the room and might even have been on the floor. In addition, the fire was extending upward, and flames might have been the full height of the door opening. Most of the smoke was in the hopper room corridor when the staff (LPN) member arrived at the fire area, and the ceiling-level smoke extended down to about mid-height of the corridor walls. In addition, some smoke was seeping into the main corridor.

The aide who had taken the extinguisher from the LPN went a few feet into the hopper room corridor and discharged the fire extinguisher. When the dry chemical extinguishing agent contacted the fire, flames came “flying out of the linen room like a blast” according to the aide, and then thick, black smoke dropped down to about waist level. The aide discharged the extinguisher a second time, and even more thick black smoke came out of the clean-linen room.

After learning of the fire, the east-wing LPN got a fire extinguisher and brought it to the laundry. The staff person in the laundry told the LPN that there was no fire in the laundry, and the two women then went to the west wing. They smelled smoke as they left the laundry and saw smoke in the main corridor by the dining hall. As they approached the west-wing fire doors, the smoke became thicker. When the east wing LPN went through the fire doors, she found that conditions were deteriorating rapidly and found that the staff was not able to extinguish the fire in the clean-linen
storage room. She left the west wing and went to the east-wing nurses' station where she called the fire department.

Extremely thick black smoke forced all of the staff members to leave the west wing before they could close the door to the room of origin and evacuate patients from the area west of the corridor doors. The nurses did, however, remove patients from rooms east of the corridor smoke doors, even though smoke density in that area was increasing. Some west-wing nurses also helped evacuate patients from the east wing.

**Fire Department Response**

The Dardanelle police/fire dispatcher received the telephone call reporting the fire at the Dardanelle Nursing Center at approximately 9:27 p.m. He immediately activated the “fire department tones” opening the fire fighters radio monitors and dispatched fire department personnel to the reported fire at the nursing center.

Some fire fighters went directly to the fire scene from their homes. As the first fire fighter to reach the scene approached the building from the east, he could see staff members evacuating patients through the east-wing door and the front door. The Dardanelle Fire Chief drove past the fire station on

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3 Because a record-keeping error occurred at the Dardanelle Police/Fire Dispatch Center, there was no official time record for events and activities during this incident. The times provided in this report are only approximate.
his way to the scene and saw that fire fighters were opening the vehicle bay doors at the fire station, which was approximately 1/2 mile away from the nursing center. As the chief approached the Dardanelle Nursing Center, he saw smoke above the west wing.

The Dardanelle Fire Chief met the fire fighter who was already at the scene and told him to help the incoming engine company connect to the hydrant. The chief then went inside and found smoke in the center section where he began to assist nurses who were evacuating patients in that area.

Fire fighters on the first Dardanelle engine on the scene arrived between 9:32 p.m. and 9:34 p.m, connected a hose to a hydrant, and laid a supply line to the front entrance of the building. After connecting the water supply to the engine’s fire pump, the driver/operator turned over control of the vehicle to another fire fighter who had arrived on-scene without protective gear, donned his own protective gear including self-contained breathing apparatus (SCBA), and entered the building. It was about this time that one of the fire officers at the scene requested the assistance of Dardanelle Rural Fire Department because they had more air cylinders.

A fire department captain also responded in his car, and when he was about two blocks away, the officer saw a low smoke cloud in the facility’s parking lot. He immediately radioed the dispatcher and requested assistance from the Russelville Fire Department. This request was made at approximately 9:29 p.m. When this fire captain reached the scene, he put on his protective clothing and got an SCBA from the engine at the front of the building. He found smoke in the center section of the building, where
nurses were still evacuating patients. One of the nurses told him there were patients in the area west of the corridor smoke doors, so he went to that area.

As the captain approached the west wing, he noted that one of the corridor doors was open slightly, and when he entered the fire area, he found that the corridor was filled with smoke. After taking about five steps into the area, he saw a glow, and as he got a little closer, he saw a large fire at ceiling level. He immediately left the area to get a hose line.

The second Dardanelle engine which arrived at almost the same time as the first engine, stopped at the west end of the building. The driver/operator found heavy smoke coming out of the west exit door that one of the staff had propped open. He removed some equipment from the engine for other fire fighters to use and then helped the fire fighters who had begun to break windows and remove patients through the windows.

Another fire fighter on the second engine went to the engine at the front of the building and brought a hose line from it into the building through the front entrance. He met the fire captain, who was coming for the hose line, and the two men brought it to the west wing, where they began the initial attack on the west-wing fire.

As these fire fighters began their fire attack, they could hear patients in the west wing calling for help. The officer left the hose line and removed one man from his bed in Room 10. He brought the patient to the east side of the corridor doors, returned to the fire area, and went to assist a woman in
Room 12. The officer removed the restraints securing the patient to her bed but was still unable to move her. He had the nozzleman give the hose line to another fire fighter and helped him evacuate the patient from her room. After this rescue, the officer left the building to change his air cylinder, after which he briefly attacked the fire with the hose line and then continued down the corridor to rescue other patients.

When the Russelville engine with five fire fighters arrived at 9:36 p.m., its crew first helped evacuate the west wing, where they primarily removed patients near the west wing lounge. Later, the Russelville fire fighters pulled ceilings in Rooms 10 and 12 and assisted in other overhaul activities.

As more fire fighters and equipment arrived on the scene, the Dardanelle fire chief became less involved with rescue activities and began to coordinate the emergency personnel. He directed the incoming Dardanelle Rural fire fighters to the north side and also directed the second-arriving Dardanelle engine to leave its position at the west end of the building and reposition on the north side of the building.

The Dardanelle Rural Fire Department engine arrived at about 9:37 p.m. When the crew went to the north side of the building, they found flames venting out the window of Room 10, and using a 1 3/4-in. hose line, began an exterior attack against that fire. Fire fighters from the Dardanelle engine that had been repositioned assisted them.

Many fire fighters and emergency medical personnel in the region were listening to radio transmissions from units responding to the Dardanelle
Nursing Center⁴. As the magnitude of this incident became evident, neighboring communities sent personnel and equipment, even though some never received a formal request from the Dardanelle Fire Department. In addition, many people in the community who initially came to the fire scene to watch became involved with caring for evacuees and other activities.

Fire fighters removed the last survivor from the west wing by 9:50 p.m. Using a total of four hose lines, fire fighters were able to control the fire in approximately 30 min, and the fire was declared out at approximately 10:00 pm. The search for hot spots and overhaul operations continued for approximately an hour.

In addition to the Dardanelle fire fighters, six Dardanelle Rural fire fighters, five Russellville fire fighters, and fire fighters from four other communities responded to the Nursing Center fire. These emergency personnel were assisted by eight EMS personnel, other agencies including Yell County Mounted Patrol, Arkansas State Police, Dardanelle City Police, Yell County Police, and several civilians.

⁴ On the evening of the fire, a disaster drill was planned for a local nuclear power plant. Because most of the emergency agencies in the region were expecting to be involved in the drill, many fire fighters, emergency medical personnel, and others were waiting to be dispatched to the plant.

Casualties
Four patients died of smoke inhalation in this fire. One was found in Room 10 in the bed closest to the corridor (see Figure 3) and another was found in Room 12 in the bed closest to the window. The third victim, who was originally in Room 15, was found in a corridor, and the fourth victim was rescued from Room 14 but later died in the hospital.

It appears that only two survivors from the west wing were evacuated by fire fighters through the building's corridors. Fire fighters rescued the remainder of the west-wing survivors through windows in patient rooms. Several fire fighters stated that patient restraints increased the amount of time needed to remove the patients.

Approximately 41 patients were sent to hospitals for observation or because of injuries. Only a few patients were admitted to the hospital as a result of injuries that were sustained in the fire. However, at least 25 other patients remained hospitalized for several days because no other facilities in the area had the immediate ability to house the patients displaced by the fire.

One fire fighter, age 55, was hospitalized because of smoke inhalation.

**Damage**

The combustible materials in the room of origin, the west-wing clean-linen storage room, were almost completely incinerated by fire. Only a few materials remained, such as charred remnants of the wood frame for the shelves, and these materials were buried in a pile of ashes on the floor of that room. The ceilings above the room of origin, the adjacent storage rooms, and the hopper room corridor were heavily damaged by fire.
Rooms 10 and 12 and the lounge for the beauty shop were also heavily damaged by fire. The ceiling in Room 10 was completely destroyed, and at least three steel bar joists were deflected. Most of the contents of this room were burned but not totally consumed. A lesser amount of the contents of Room 12 burned, and though the ceiling was damaged by the fire, it appeared that much of the ceiling damage was the result of fire fighter actions. Like Rooms 10 and 12, the ceiling in the beauty shop lounge was heavily damaged by the fire, and its contents were damaged by the fire but not totally consumed.

The concealed space above the ceiling in Room 14 had heavy sooty deposits caked onto all surfaces. In addition, molten tar that dripped from seams in the roof deck had resolidified on the west wall of the room leaving long trails that extended down from roof level. The resolidified tar also had accumulated on the west side of the many bar joists above Rooms 12 and 14 because it was shielded from the heat originating in Room 10 and 12. None of the contents of Room 14 were burned.

Fire damage in the west-wing main corridor extended from the hopper room corridor 5 to 10 ft in the east direction (toward fire doors) and 10 to 12 ft in the west direction. However, the smoke that filled the corridor left heavy black stains in the entire east/west part of the corridor, in the west nurses' station, and on the exit door at the west end of the corridor. The north/south corridor near the nurses' station and the west lounge had lighter soot deposits covering all exposed surfaces.
All of the patient rooms west of the corridor fire doors had smoke stains on upper wall surfaces and soot deposits on all other surfaces. The heaviest soot deposits occurred in the concealed space above the ceilings in these rooms. The smoke stains above rooms close to the fire had a "baked-on" appearance, indicating that the atmosphere had been very hot. However, the soot accumulations above the most westerly rooms, such as Rooms 16 and 17, formed coarse granules and even large strings similar to spider webs. This suggests that the smoke here had been cold, and the particulate matter in the smoke was coagulating in these areas.

Even though the fire and heat damage was limited to the area west of the corridor doors, some smoke damage occurred in areas east of those doors. Room 8 had heavy black soot stains where smoke seeped through small cracks in the fire wall. In addition, there were heavy soot deposits in the main corridor on the east side of the west-wing smoke doors. Though the amount of soot quickly decreased in the center/laundry area main corridor, this corridor contained soot over most surfaces. Reportedly, some smoke seeped through the east-wing smoke doors and could be seen in that area. However, after the fire, there was no observable evidence of smoke in the east wing.
**Time Line**

<table>
<thead>
<tr>
<th>Time</th>
<th>Activity</th>
</tr>
</thead>
<tbody>
<tr>
<td>9:22 pm- 9:27 pm</td>
<td>Nurse’s aide discovers fire in west-wing clean-linen closet, yells to the east-wing LPN, and goes to the west-wing nurses' station to inform the other LPN. Building alarm system operates and west-wing LPN makes PA announcements regarding the fire. Aides begin to close patient room doors. West-wing LPN brings fire extinguisher to fire area, and east-wing LPN brings fire extinguisher to the laundry area. West-wing nurse's aides and LPN start to attack the fire with extinguishers. East-wing nurse's aides begin patient evacuation. East-wing LPN brings fire extinguisher to fire area and then goes to the east-wing nurses' station to call the fire department.</td>
</tr>
<tr>
<td>9:27 pm</td>
<td>Dardanelle Fire Department receives phone call from the east-wing LPN. Dispatch of fire fighters is started. All staff are forced off the west wing by heavy smoke in the corridor. Dardanelle Fire Chief arrives on scene and finds a smoke cloud above the building.</td>
</tr>
<tr>
<td>9:29 pm</td>
<td>A Dardanelle fire captain is two blocks away from the building and calls for assistance from Russelville Fire Department. One Russelville engine is dispatched.</td>
</tr>
<tr>
<td>9:32 pm- 9:34 pm</td>
<td>The two Dardanelle Fire Department engines arrive at the nursing center. Fire fighters assist in rescue and begin suppression activities.</td>
</tr>
<tr>
<td>Time</td>
<td>Event</td>
</tr>
<tr>
<td>--------------</td>
<td>----------------------------------------------------------------------</td>
</tr>
<tr>
<td>9:36 pm</td>
<td>Russelville fire fighters arrive and assist in evacuation of the west wing.</td>
</tr>
<tr>
<td>9:37 pm</td>
<td>Dardanelle rural fire fighters arrive and begin an exterior attack against the fire in Room 10.</td>
</tr>
<tr>
<td>9:50 pm</td>
<td>Last survivor is rescued from west wing.</td>
</tr>
<tr>
<td>10:00 pm</td>
<td>Fire is declared out.</td>
</tr>
</tbody>
</table>
| 2:30 am (3/14/90) | Overhaul and search for victims is completed.  
                      | All fire equipment is released.                                      |
ANALYSIS

Cause and Origin
Fire investigators representing both the Arkansas State Police and the Arkansas Attorney General’s offices have listed the cause of this fire as undetermined. During their work, however, the investigators did establish that the fire most likely started in the west-wing clean-linen closet.

Fire Growth and Spread
Investigators believe that the contents of the linen cart — that is, clean sheets, pillow cases, towels, blankets, washcloths, and decubitus pads — were the first materials ignited. Staff members described the fire that they first saw as having a base that was close to the floor and that the flames were reaching up possibly to the full height of the door. This description indicates that the fire was probably well-established at the time of discovery and may have been approaching full room involvement because the clean-linen closet was so small.

As the fire grew, smoke and heat escaped from the room of origin into the hopper room corridor (see Figure 4). Some smoke even spread into the main corridor and activated the smoke detector near the corridor smoke doors. Staff members were unable to close the door to the room of origin because the fire and smoke coming out of the room prevented them from reaching the door. Since the staff was unable to suppress the fire, combustion products continued to enter the corridors, eventually forcing all staff members from the fire area. When fire fighters entered the fire area,
they found that flames had filled the hopper room corridor and were extending into the main corridor at ceiling level.

The nonrated suspended ceiling in the clean-linen storage room probably remained in place for a short period of time, keeping most of the heat and smoke in the occupant space. Once the ceiling failed, hot gases and flames impinged on the underside of the roof decking, heating that assembly. This caused adhesives and other materials used in the construction of the roof to release flammable vapors. Since there were two unsealed exterior vent holes directly above the room of origin, the vapors had a means to enter the fire area. In addition to allowing the gases to vent into the fire, the holes vented smoke to the outside, and this probably accounts for most of the smoke that the fire chief observed as he approached the building.

The east wall enclosing the clean-linen closet was a fire wall and prevented the fire from spreading toward the east. However, the other three walls enclosing the closet did not extend up to the roof slab, and the fire was able to spread in all other directions, though the primary fire spread appears to have been toward the west in the concealed space above the ceilings in Rooms 10, 12, and 14. The most severe burning in these three rooms occurred in Room 10. This was the only patient room in which metal bar joists were deformed, indicating that a large portion of the heat in this fire was being released in Room 10. There was little or no accumulated soot on the underside of the roof decking, bar joists, and upper wall surfaces, but there was extensive evidence of burning in these areas. The lack of soot deposits indicates that the fire in these areas was probably very hot, well-ventilated, and transporting excess fuel to other areas in the form of smoke.
Fire also spread into the hopper room corridor through the open closet door and extended into the main corridor. It was this fire that the fire fighters initially attacked. But the main body of fire was in the concealed space above the clean-linen closet, above the hopper room corridor, and above Room 10. This fire continued to burn, virtually unaffected by the fire fighters' initial suppression efforts.

The absence of soot accumulations on many surfaces in Room 12 and the physical damage in that room indicate, as in Room 10, that some burning occurred in the concealed space above the ceiling. However, heavy soot stains were also present in Room 12. These stains primarily occurred in perimeter areas near the north and south walls and appeared to be baked onto surfaces. The entire area above the concealed space for Room 14 also had heavy baked-on soot stains, and there were no surfaces that were burned clean of carbon deposits. This suggests that the vitiated atmosphere above the ceiling in Rooms 12 and 14 reduced the burning efficiency and may have even prevented combustion in areas.

Smoke and fire in the concealed space above the room of origin also spread into the concealed space above the main corridor. This spread occurred because the main corridor wall was not continuous through the intersection between the main and hopper room corridors. The opening at this intersection extended from the floor slab up to the roof assembly leaving clear openings both above the suspended ceiling and in the occupant space through which smoke could spread.
The entrance into the beauty-shop area, which was across the main corridor from the hopper-room corridor, also had a slab-to-slab opening in the main corridor wall. Smoke above the main corridor ceiling readily entered the concealed space above the beauty shop. Like the east wall of the clean-linen closet, the east wall of the beauty shop was a fire wall and stopped smoke from traveling toward the east in the building. However, the wall between the beauty shop and Room 9 did not extend up to the roof assembly, and smoke spread toward the west over the odd-numbered rooms.

When the smoke began to accumulate in the west wing's main corridor, one of the staff propped the west-exit door open. The open exit door was the largest single vent to the exterior since the patient room windows were closed and other doors were completely or partially closed. Accordingly, much of the smoke being generated in the fire area traveled through the corridor and vented out the open door.

Some smoke also vented into the center/laundry area through the fire-rated corridor doors in the fire wall. Each time a fire fighter or staff member opened the corridor doors, smoke was released from the west wing. In addition, the coordinator for corridor doors malfunctioned and prevented one door from closing completely. Smoke from the west wing was able to travel through the resulting opening, which was the full height of the door and about 4 in. wide.
Factors Limiting Smoke and Fire Spread

Several walls enclosing Rooms 10, 12, and 14 restricted the movement of the heated smoke and caused it to accumulate above those rooms. The connection between the roof assembly and exterior walls was sealed to prevent weather penetration, and as a result, only small amounts of smoke could escape through this means. The south wall for the three rooms was the main corridor wall, and the top of the wall was within 2 or 3 in. of the roof deck. As a result, smoke escaped through the void, but the flow was restricted. The west wall for Room 14 was also a corridor wall, but it was parallel with the roof bar joists; as a result, the top of this wall was less than 1 in. below the roof deck. The westerly spread of smoke was also impeded by this small void. Thus, the only opening through which the smoke could easily spread out of the fire area was the opening for the hopper room corridor.

Ventilation in combustion areas also appears to have affected the fire. The suspended ceiling and the layer of insulation in Room 12 remained relatively intact and was undisturbed in Room 14. It appears that the insulation and ceiling tiles together captured the hot smoke in the concealed space and allowed only a small amount of smoke to seep through the ceiling assembly into the room. In addition, the ceiling assembly probably reduced the flow of oxygen to the hot smoke in the concealed space.
No information was available regarding the design specifications or fire classification of the metal-deck composite roof. It is possible that the roof was designed and constructed in a manner that would minimize the vapors being released when exposed to fire. The severity of this fire and the extent of fire spread were much less than that occurring in other metal-deck roof fires described by Francis Brannigan in *Building Construction for the Fire Service*. Nonetheless, the metal-deck roof clearly contributed to this fire.

**Occupant Activities**

One patient, who had been in Room 15 in the west wing reportedly attempted to leave the building by himself. Fire fighters removed his body from one of the west wing corridors.

Other west-wing patients did not attempt to evacuate through the corridors or escape out of their window. Several patients who were restrained in their beds could not have evacuated even if they had had the ability to do so. Thus, the survival of these patients depended completely on the fire protection provisions in the facility, the abilities of the staff, and the assistance of fire fighters.

Patients in the center/laundry area rooms were exposed to light smoke and were cooperative during the evacuation. However, a few patients in the east wing were reluctant to leave their rooms, and some were reportedly combative. During the evacuation of this wing, there was little or no smoke present and no other indications of an actual fire.

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When the fire was discovered, all the staff members responded with planned actions that are addressed in the *Life Safety Code*\(^6\). The aide who discovered the fire immediately reported the fire to other staff members and then went to close doors. Aides on both wings initially closed doors, and then some went to the fire area while others began to evacuate patients. The west-wing LPN initially made a PA fire announcement, and then took a fire extinguisher to the fire area. The east-wing LPN also got an extinguisher and responded to the report of fire in the laundry. Finding no fire in the laundry, she then brought the extinguisher to the fire area in the west-wing. Some of the staff even attempted to suppress the fire with the extinguishers.

Even though staff initially responded with most emergency actions contained in Chapter 31 of the *Life Safety Code*, the fire department was not notified of the fire as soon as it was discovered. The facility's alarm system did not have the capability to automatically notify emergency forces, an alarm system function that has been required by the *Life Safety Code* since 1976. It was only after the east-wing nurse responded to the west wing and recognized the severity of the fire that she called the fire department. This sequence of activities resulted in an estimated 2 to 5-min delay in fire department notification and the initiation of their response.

The significance of the delay in notification becomes apparent when one notes that the rapidly deteriorating conditions in the west wing forced nurses and aides out of the fire area before they could remove the patients. More important, the patients had to remain in the smoky wing until fire fighters could rescue them. Earlier fire department notification would therefore have initiated the response of fire fighters sooner, potentially reducing the total time that patients were exposed to the smoke.

Code Analysis

In the interest of comparing problems in this incident with the national consensus standards, the 1988 edition of the NFPA Life Safety Code will be used as the basis for comparison. It is recognized, however, that this edition of the code was not required as the governing standard for life safety provisions at the Dardanelle Nursing Center.7 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 code that pertain to this nursing home.

Table 13-1.6.2 of Chapter 13 of the Code, "Existing Health Care Occupancies," indicates that a single story, Type II (000) building, the appropriate construction classification of the Dardanelle Nursing Center,

7 The Arkansas Department of Health enforced the relevant federal regulations at the time the facility was constructed; therefore the 1967 Life Safety Code was applied to the Dardanelle Nursing Center.

The Arkansas Department of Human Services Office of Long Term Care was enforcing the 1967 Life Safety Code requirements at the time of the fire because federal regulations do not require the existing buildings to comply to later codes.
is permitted only if the facility is protected throughout with an approved automatic sprinkler system. Had such a system been installed, it would have controlled and possibly extinguished the fire early in the sequence of events, mitigating the hazard to occupants.

Paragraph 13-3.4.5 in Chapter 13 requires that smoke detectors only be installed in corridors of existing limited care facilities. Since the Dardanelle Nursing Center was not an existing limited care facility, the smoke detection system, which included detectors in both the patient rooms and in the main corridor, would not have been required by the 1988 Life Safety Code.8

Paragraph 13-3.6.2 of Chapter 13 requires that corridor walls, which would include one wall for the clean-linen storage room, be continuous from floor to the underside of the floor or roof deck above and to have at least a 20-min fire-resistance rating. Chapter 6 of the Life Safety Code also requires that openings in a 20-min fire barrier have opening protectives with a 20-min fire protection rating. In other words, all of the storage rooms along the hopper room corridor, including the clean-linen storage room, would have been required to have a door with a 20-min fire resistance rating.

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8 Patient room smoke detectors had been installed in accordance to an Arkansas State code requirement which has since been repealed.
A fire-rated door with a closing device, if operating properly, would have contained the fire to the room of origin for a period of time. In addition, continuous walls for the hopper room corridor would have contained the fire to the space above the suspended ceiling for the storage rooms along the hopper room corridor. This containment would have provided both staff and fire fighters with more time for their emergency response.
Discussion

The NFPA has investigated other health care facility fires that have grown rapidly and have prevented staff members from completing their emergency procedures. The investigations include the December 1985 fire at a Southfield, Michigan hospice where eight patients died; the December 1986 fire at a Kansas City, Missouri hospital where two patients died; and the October 1989 fire at a Norfolk, Virginia nursing home where 12 patients died. In all three incidents, the contents of a patient's room were ignited, full room involvement or flashover occurred in 4 to 5 min and combustion products spread from the room of origin through doors that were not closed.

The Dardanelle Nursing Center fire differs from the Southfield, Kansas City, and Norfolk incidents in two ways. First, the room of origin in the Dardanelle incident was not a patient room, and the fuels included both the contents of the clean-linen closet and vapors from the heated roof assembly. Second, the most severe burning at the nursing center occurred in a concealed space above the patient rooms, and the fire spread through openings because walls did not extend up to the roof slab. In the three previously documented incidents, the most severe burning occurred in the patient rooms, and the fire traveled through open patient room doors.

10 NFPA Fire Investigation Report, "Hospital Fire, Kansas City, Missouri, December 30, 1986."
Despite these differences, a common thread connects all of these incidents. In each case, the staff members were trained and responded quickly upon discovery of the fire, but they were unable to successful remove or isolate all the patients.

The following factors appear to have contributed to the loss of life at the Dardanelle Nursing Center and at the other three facilities:

1. **The absence of complete, automatic sprinkler protection.**

A complete automatic sprinkler system as required by the construction type would have placed at least one sprinkler head in patient rooms and utility spaces, including the clean-linen room. Sprinklers so installed would have controlled and probably extinguished the fire while it was still small in each incident.

2. **The failure of compartment of origin to contain the fire.**

The hopper room corridor walls that extended up only a few inches above the suspended ceiling, allowed combustion products to enter the concealed space above ceiling panels, and the open door to the clean-linen room also allowed fire and smoke to spread through the corridors. In all three of the previously documented fires, combustion products traveled out of the room of origin primarily through open doors.

3. **The spread of fire and smoke through concealed space.**

Due to the arrangement of the corridor and room walls, fire and smoke entered the concealed space above the west-wing corridors and rooms. Flammable vapors from the heated roof assembly contributed to the fire extension in the concealed space, and the smoke and toxic gases generated in the concealed space filled the occupied patient rooms.
Figure 2

DISCOVERY
ROOM OF FIRE ORIGIN *

FIRE AT TIME OF
Figure 3

SMOKE AND FIRE DAMAGE

Light Smoke
Moderate Smoke
Heavy Smoke

Light Fire
Moderate Fire
Heavy Fire

Fire Origin
Room of
Fatalties
Figure 4

FIRE AND SMOKE SPREAD

Room of Origin

In Corridor

Above Ceiling

Linen Storage

Room

Hopper Room

Corridor

Beauty Shop

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