INVESTIGATION REPORT ON THE LAS VEGAS HILTON HOTEL FIRE
At approximately 8:00 pm on Tuesday, February 10, 1981, eight people died and 350 were injured as a result of an incendiary fire at the Las Vegas Hilton Hotel in Las Vegas, Nevada. This fire is of great technical significance because of exterior, vertical fire spread that involved 22 floors of the 30-story building. It was the second multiple-fatality fire to occur in a Las Vegas area hotel in a 2½-month period; the first fire, at the MGM Grand Hotel on November 21, 1980, resulted in 85 deaths and almost 700 injuries.

The most significant factors that contributed to the fire spread and subsequent fatalities, injuries, and damage at the Las Vegas Hilton were: 1) failure to extinguish the fire in its incipient stage, and 2) the presence of highly combustible carpeting on the walls and ceilings of the involved elevator lobbies, which contributed to the exterior fire spread. The resulting fire spread exposed a large number of the building's occupants on multiple floors to the blaze.

The Las Vegas Hilton was a large hotel complex adjacent to the Las Vegas Convention Center. The hotel had 2,783 guest rooms. Construction had recently been started for a 400-room addition. The 30-story building was constructed in three stages. The original Central Tower, which had been started in 1967, opened in July 1969. The East Tower opened in 1975, and the North Tower opened in 1979. This resulted in different provisions for firesafety in each of the three towers because of differences in building code requirements, technology, and construction techniques (see Figures 2 and 3 on pages 54 and 55).

The building consisted of large ground- and second-floor areas that contained a casino, restaurants, showrooms, a large number of assembly rooms, offices, service and mechanical spaces, and other function areas. The third through twenty-ninth floors consisted of guest rooms, with additional assembly and function areas on the thirtieth floor. This report is primarily concerned with the guest-room floors of the building; the lower floors were not directly affected by the fire.

The building was constructed of reinforced concrete. When classified according to NFPA 220 — 1979, Standard on Types of Building Construction, it would be categorized at least as Type I-332, and more likely as Type I-443. These designations would indicate fire-resistant construction, with the Arabic numbers indicating the fire-resistive rating of exterior bearing walls, supporting elements (frame or columns and girders), and floor construction.1

Interior, nonbearing partitions were constructed of gypsum wallboard on steel studs. Exit access corridor walls consisted of ¾-inch, fire-rated gypsum wallboard on both sides of steel studs. This assembly, assuming proper construction techniques, would provide a nominal, 1-hour fire-resistance rating.

Guest-room doors were of 1¾-inch solid wood composite construction, with applied decorative trim. Self-closing devices were provided on these doors in the North Tower, but not on doors in the Central or East Towers.

At the point where the original Central Tower ended and the new North Tower began, glass doors (not wired glass) were installed within the corridors on each floor. These doors were held open by electromagnetic devices that released the doors when the North Tower's fire alarm system was activated. Additional compartmentation was provided by automatic-closing fire doors that protected the opening from the corridor into the North

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1 See NFPA 220 — 1979, Table 3, p. 9.
Tower elevator lobby, creating a fire-rated elevator vestibule. These doors were arranged to close on activation of smoke detectors or manual pull stations. The elevator lobbies in the Central and East Towers were not arranged in this manner and did not have elevator vestibules.

The interior finish of the guest-room corridors consisted of plastered ceilings, heavy vinyl wall covering, and carpeted floors. Sections of the East Tower ceiling were also covered with vinyl. The elevator lobbies in the Central and North Towers had vinyl wall coverings.

In the East Tower (where the fire occurred), the interior finishes of the walls and ceilings in the elevator lobbies were all similar. These lobbies were significantly different from the other common areas on guest-room floors; both the walls and ceilings in the lobbies were covered with carpeting comprised of mixed wool and nylon fibers. This carpeting was glued directly to the noncombustible plaster and gypsum wallboard surfaces of the ceiling, and stretched and stapled along the walls; there was no pad. Each lobby contained a total of approximately 455 square feet of this carpeting; the ceiling area of each lobby was 220 square feet, with the balance of the carpeting on the walls. The carpeting on the floor was the same as that provided in the corridors, and did not appear to be the same as carpeting applied to elevator-lobby walls and ceilings.

The East Tower elevator lobbies contained four elevators, two on each side. Each pair was in an individual hoistway. On the exterior wall, three 3-foot-by-6-foot windows of double-strength plate glass created a large glass area 6 feet by 9 feet (see Figure 1). The lights (panels) of glass were recessed 18 inches and were separated vertically by a 3½-foot spandrel (see elevator-lobby detail in Figure 2).

The spandrel was a prefabricated assembly of masonry, plaster, and gypsum wallboard on steel stud, with no apparent evidence of any combustible material, such as foam plastic insulation. The spandrel unit was attached to the reinforced-concrete building structure. The type of caulking used was undetermined.

The furnishings in the elevator lobbies consisted of a small wooden bench with a polyurethane foam plastic cushion in front of the window; the bench was approximately 18 inches wide, 54 inches long, and 2 inches thick. Draperies were hung on both sides of the window. The north end of the elevator lobbies (opposite the glass) contained a piece of furniture—small tables, on most of the floors, although some of the more luxuriously furnished floors had larger wooden cabinets and hutches of various designs.

On the twenty-eighth floor, the furnishings and the exterior construction were unlike those on other floors. Instead of the bench in front of the window, there was an inner spring couch with foam plastic padding, and the ceiling had large, recessed, mirrored light fixtures. There was also carpeting on the walls and ceiling. Furthermore, a balcony extended out from the twenty-ninth floor, creating a nine-foot concrete overhang above the window opening of the twenty-eighth floor.

The means of egress from the guest-room floors included three smokeproof towers and two enclosed interior stairways. The smokeproof towers were located at the ends of each of the three wings of the original Central Tower (see Figure 3). The vestibules for the smokeproof towers were the mechanical ventilation type, rather than the natural ventilation type. The equipment was report-
edly arranged with exhaust capacity at least 150 percent of the supply, with more than one air change per minute in the vestibules. In addition, these stairways were reported to be pressurized. This could not be verified at the scene. The vestibules were constructed with smoke traps, i.e., the ceilings were several inches higher than the door openings, which would allow smoke and heat to collect in this area and not spread to the stairs. The exhaust grills were located within these smoke trap areas.

Enclosed interior stairways with fire-rated door assemblies were located at the east end of the East Tower and the north end of the North Tower. The interior stairway at the end of the North Tower was reportedly pressurized. The enclosures of these interior stairways did not appear to be impared.

The detection devices and evacuation alarms that were provided varied from tower to tower. The original Central Tower had manual pull stations as initiating devices and bells as alarm-sounding devices, plus two smoke detectors, one in the service-elevator lobby and one in the corridor adjacent to the North Tower. In the East Tower there were two ionization-type smoke detectors, one on each side of the East Tower elevator lobby. Alarm-sounding devices were speakers. All of the elevators were provided with manual fire department controls.

The North Tower was equipped with 110-volt, AC-powered, single-station smoke detectors in the guest rooms, plus smoke detectors spaced 30 feet apart in the corridor. This tower had combination "slow whoop" and voice communication sounding devices.

As a result of the different construction dates, the fire alarm systems in each tower were essentially independent. Each of the systems had remote annunciators in both the Security Room and the PBX Room. With the exception of the North Tower system, the systems were presignal systems, without automatically sounding evacuation alarms or fire department notification. The North Tower system was arranged to automatically sound evacuation alarms on three floors (the fire floor, plus one floor above and one floor below the fire).

Automatic sprinklers were provided in some portions of the first and second floors of the hotel complex; a detailed review of the sprinkler coverage was not conducted. There were no sprinklers in the guest rooms or in corridors on the guest-room floors.

Manual suppression equipment included fire hose cabinets with 1½-inch occupant-use hose and standpipes with 2½-inch fire department connections in the stairways. The hotel had a fire brigade, consisting of security personnel. Although the brigade was not provided with protective clothing, it was equipped with self-contained breathing apparatus and a cart supplied with various types of portable fire extinguishers.

The mechanical systems for the guest-room towers supplied conditioned air to the corridors from a mechanical equipment penthouse. There was no return air from

Figure 3.
the corridors. Large air-handling units that supplied conditioned air to tower floors reportedly were equipped with duct-type smoke detectors arranged to indicate an alarm condition and automatically shut down the fans in the units.

Make-up air for guest rooms was provided from the corridors through a grill-fire damper assembly in the corridor wall, through a duct, to individual fan-coil units. The fan-coil units were equipped with chilled water piping and an electric heating coil and, while in operation, recycled a portion of the guest-room air. Toilet exhaust was through ducts and shafts from each guest room.

The number of people in the hotel complex at the time of the fire was undetermined; however, approximately 80 percent of the 2,783 guest rooms were rented.

At approximately 8:00 pm on the night of the fire, the weather at McCarran Airport was cloudy, with a temperature of 51°F, humidity of 63 percent, and a wind of 7 mph from the west-southwest.

FIRE DISCOVERY

At 8:05 pm on February 10, 1981, the dispatcher in the hotel’s Security Office received a telephone call from an employee reporting a fire on the eighth floor in the vicinity of the East Tower elevator lobby. Two security officers were sent from the Security Office to the eighth floor by way of the service elevators in the Central Tower. Immediately after they left, an alarm indicating a fire on the East Tower’s eighth floor appeared on a remote annunciator panel in the Security Room. At some point, the hotel’s fire brigade was alerted, but the exact time has not been verified.

When they reached the eighth floor, the security officers located the fire and notified the dispatcher by two-way radio, asking him to call the fire department.

The Clark County Fire Department received the alarm at 8:07 pm. Clark County Fire Station 18 is adjacent to the hotel complex, and fire fighters leaving the station for the hotel could see fire on the exterior of the building, coming from two floors. When they arrived, the fire had extended to a third and fourth floor.

FIRE FIGHTING AND RESCUE

First-arriving engine companies set up apparatus to supply standpipes in the building as fire fighters with self-contained breathing apparatus and standpipe packs entered the hotel. Additional alarms were sounded and incoming fire fighters were directed to conduct rescue efforts, emergency medical services, and fire suppression.

A ladder pipe was set up on the exterior of the building and used to knock down a portion of the fire. The ladder pipe was also directed into some of the East Tower elevator lobbies up to the sixteenth or seventeenth floor. This ladder was used to knock down a very dramatic exterior fire spread that was rapidly advancing up the building before fire fighters in the interior could get above and ahead of it. Fire fighters on the outside saw hundreds of occupants appear at their room windows because they were trapped, and watched one person jump or fall from the twelfth floor. At that time, they did not know if the interior fire-fighting effort taking place on multiple floors was gaining any headway.

The Chief of Department established a command post in the parking lot east of the East Tower. An interior command post and initial casualty triage center was established on the seventh floor. Additional interior sector commands were set up on the fourteenth and twentieth floors and on the roof.

Fire fighters involved in the interior fire fighting used the closest smokeproof tower and the interior stairway at the east end of the East Tower for staging areas. Movement up and down the stairs was greatly hampered by the hose lines and large numbers of fire fighters and their equipment in the stairways for the multi-floor interior attack. Hotel guests were also using the smokeproof tower stairway for evacuation early in the fire.

The interior stairway on the east end of the East Tower became completely smoke-filled from the eighth floor to the top floor during the interior fire-fighting efforts. The proximity to the heavy fire in the East Tower elevator lobby and the necessity of keeping the stairway door open because of hose lines connected to the standpipe on several floors allowed a great deal of smoke and heat to enter the stairway and travel upward. This diminished the value of the stairway as a staging area and made fire suppression efforts extremely difficult.

Public and service elevators in the East and Central Towers were all brought to the first floor and placed under manual control. Three groups of fire fighters were taken up to the seventh floor on an East Tower service elevator manned by hotel security personnel. Because of smoke conditions, fire fighters who climbed the East stairway had to use their self-contained breathing apparatus. Many fire fighters in this stairway suffered smoke inhalation injuries when they exhausted their supply of air.

During the fire-fighting and rescue efforts, two (possibly three) additional, separate fire ignitions were found. These ignitions apparently occurred well after the initial arrival of fire fighters - sometime during the evacuation of guests and employees. These separate fires occurred in a second-floor linen and storage room and in a third-floor service elevator lobby. There was a possible third ignition in an East Tower hose cabinet on the ninth floor. However, it is also possible that this was an extension or rekindle of the original fire. All three relatively minor fires were easily controlled by fire fighters.

A total of 23 engine companies, 6 ladders, 2 snorkels, 9 rescue units, 2 air cascade units, and 12 helicopters were utilized during fire-fighting and rescue operations.
EVACUATION

At some time after the fire department was notified, evacuation alarms were manually and automatically activated in the hotel, although many occupants reported that they did not hear any alarms. It is possible that the alarm system in the East Tower failed early in the fire due to fire damage. Fire fighters used the voice communication system to notify the hotel's occupants of their presence and tell them what actions to take.

Occupants either evacuated the building by way of the stairways, were trapped in their rooms by the fire, or waited out the fire in their rooms. Many people encountered smoke in the stairways, especially in the East Tower east interior stairway. Some people in the stairways were able to get to the roof, where they were rescued by helicopters.

Occupants who were trapped in or who remained in their rooms and telephoned the hotel operators were told to place wet towels and sheets around the doors and wait for the fire department personnel. Most of the smoke inhalation injuries occurred when guests opened their room doors or tried to leave the building.

One guest reported using an elevator in the Central Tower to evacuate. However, the elevator (which was not connected to the smoke detectors) opened at the eighth floor (the floor of origin), which was filled with smoke. The guest was able to crawl down the corridor and bang on guest-room doors. One door was opened, and the guest waited out the fire in that room. There were other people on the same elevator car who were later found dead in the eighth-floor elevator lobby.

One guest who was trapped in his room reported that smoke had come in through the fan coil unit for several minutes. He heard a sound like a door closing, and then the smoke stopped. This sound was probably the fire damper in the grill in the corridor wall closing due to the melting of the fusible link.

Fifteen hundred people in a first-floor showroom evacuated in an orderly manner and without incident after dancer Juliet Prowse had started her show, when they were told of a "problem" in the hotel. The word "fire" was specifically omitted from the announcement.

CASUALTIES AND DAMAGE

The fire caused eight fatalities and approximately 350 injuries. Forty-eight of those injured were fire fighters. One fire fighter suffered a severe heart attack in the hospital as a direct result of smoke inhalation.

All eight of the victims were hotel guests. Three were found in the Central Tower elevator lobby on the eighth floor. The body of one of these three was halfway out of an open elevator door. One victim jumped or fell from a twelfth-floor room that was very close to the East Tower elevator lobby (Room 1263). There was evidence that the room's door to the corridor had been left open.

The other four victims were found in guest rooms in the East Tower. All of the rooms had either open doors to the corridor or evidence that corridor doors had been opened. Two of these four victims were found in a room on the tenth floor at the easternmost end of the East Tower (Room 1069). One body was found in the corridor on the twenty-first floor and dragged into Room 2178, which was halfway between the East Tower elevator lobby and the smokeproof tower. One victim was found on the twenty-fourth floor in Room 2464, which was separated from the East Tower elevator lobby by a room containing an ice machine.

There were no fatalities in rooms where occupants had kept their door closed and waited out the fire or waited for rescue. Partitions between the corridor and guest rooms, like the doors, did resist the fire, even though some had severe fire exposure. Fire dampers in the grills in corridor walls that were exposed to heat in the East Tower appeared to have closed and helped limit the fire spread.

Doors to some guest rooms had been left open by evacuating guests. These rooms either received extensive smoke damage or heat damage, or in some cases, the fire spread from the corridor into them, causing room burnout.

The fire spread for varying distances down the corridors, consuming the vinyl wall covering and carpeting on the floor. Table 1 indicates the approximate distances that received actual fire exposure. These variations were most probably caused by interior fire-fighting

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<th>Floor</th>
<th>Length (in feet) of Flame Exposure in Corridor</th>
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(Continued on page 62)
effectiveness, the time from ignition to water application, and the impact of ladder pipe-stream penetration into the East Tower elevator lobbies. The nine-foot overhanging balcony of the twenty-ninth floor created a large heat collector that forced a great amount of the fire from the building's exterior into the elevator lobby on the twenty-eighth floor.

The smoke spread throughout the East and Central Towers. The North Tower received little damage, if any, because of the glass doors with electromagnetic releases, located at the end of the original Central Tower.

**DISCUSSION**

Clark County fire officials and Metropolitan Las Vegas police officials determined that the fire ignitions were of incendiary origin. The person who initially called the fire alarm to the security dispatcher was arrested, charged, and indicted on eight counts of homicide and arson. He was a hotel room-service busboy who had been employed by the Hilton for only a few weeks.

At the time this report was written, the most probable ignition scenario had not been released. However, initial reports do not indicate any large amounts of accelerant present or any other evidence indicating anything other than a small, open-flame ignition source.

Once ignition occurred in the East Tower eighth-floor elevator lobby, the fire most likely rapidly involved the furnishings and carpeting on the walls and ceiling. After flashover took place, the exterior plate-glass window broke, allowing a flame front to extend vertically on the exterior of the building. The fire continued to spread horizontally in the East Tower corridor, with the vinyl covering on the walls and some ceiling areas contributing to the fuel load.

The fire progressed vertically up the exterior of the building, floor by floor. It is likely that the process accelerated as more floors became involved and the fire was reaching the upper portion of the building. After the eighth floor became involved, it is estimated (based on eyewitness accounts of fire fighters) that the vertical exterior spread took 20 to 25 minutes to reach the top of the 30-story building.²

The vertically extending flame on the building's exterior probably involved two mechanisms of heat transfer to the glass and elevator lobby on each succeeding level as it progressed. A great deal of radiant thermal energy would have been transferred through the glass, possibly igniting the draperies, wooden bench, and foam plastic cushion. These would have acted as kindling fuels that soon ignited the carpeting on the walls and ceiling.

In addition to the radiant heat transfer, the recessed plate glass and the shape of the spandrels (triangular cross-section) would most likely have caused the flow of flame and heated gases to create turbulence and a rolling effect, causing direct flame contact with the glass. This would have contributed to the heat transfer into the elevator lobby, as well as early failure of the glass.

The combustible carpeting material applied to the East Tower elevator lobbies appears to have been a major factor in the formation of a flame front on the exterior and the subsequent floor-to-floor fire spread. Interior finish as a factor contributing to flame emission from windows has been documented in research literature.³

The National Bureau of Standards' Center for Fire Research tested samples of carpet material from an undamaged East Tower lobby in order to determine an estimated flame spread classification. Two samples were tested by the Radiant Panel Test Method, ASTM E-162 (an appropriate test method for wall or ceiling interior finish materials). Results indicated flame spread indexes of 244 and 234, with an average of 239. The carpet tested would be classified as Class C (flame spread 76 to 200) or Class D (greater than 200). These results were indeterminant, i.e., a specific flame spread classification was not determined, as the ASTM E-162 Test Method does not correlate well with NFPA 255 (ASTM E-84), Method of Test of Surface Burning Characteristics of Building Materials. Materials analysis indicated that the carpet was of mixed wool and nylon fibers; the percentage of each fiber was not determined. NFPA 101 — 1981, the Life Safety Code, references the NFPA 255 (ASTM E-84) Test Method, and requires that carpeting applied to walls and ceiling have a Class A flame spread rating (0–25). See the Code Review section that follows for details on flame spread classification requirements.

The only vertical fire spread during this incident was by way of the exterior of the building. There was some evidence of smoke and heat travel in the elevator hoistways of the East Tower, but this would be considered very minor compared to the exterior vertical spread.

**CODE REVIEW**

In order to compare life-safety problems exemplified in this incident with current national consensus standards, the 1981 edition of NFPA 101, the Life Safety Code (the Code), was used for analysis purposes, although it has not been adopted in Clark County.

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The following summary of requirements from the Code is particularly relevant to this fire. The requirements cited in this section are for existing hotels, unless otherwise indicated. In the Code, requirements for new hotels are contained in Section 16-3.4; those for existing hotels are in Section 17-3.4. The following section is not intended to be a complete description of all parts of the Code that pertain to this hotel fire, nor is it to imply that the 1981 Code had been adopted in Clark County.

Interior Finish

17-3.3.1 This section establishes requirements for interior finish on walls and ceilings for various areas within existing hotels subject to the limitations and modifications specified in Section 6-5. These requirements are:
   a) Vertical exits — Class A or B
   b) Exit access — Class A or B
   c) Lobbies, corridors that are not exit access — Class A, B, or C
   d) Places of assembly (sec. 9-3.3)
   e) Individual guest rooms and other rooms — Class A, B, or C.

6-5.6.2 "Materials such as carpeting having a napped, tufted, looped, or similar surface, when applied on walls or ceilings, shall meet the requirements of Class A interior finish."

Alarm and Communications Systems

Manual alarm systems are required for both new and existing hotels accommodating 15 or more guests. Unless sprinklered, new hotels are required to have a corridor smoke detection system connected to the alarm initiation system. Unless prohibited by the authority having jurisdiction, presignal systems are allowed.

Compartmentation of Corridors

17-3.6.2 Guest-room doors that open onto an interior corridor shall have at least a 20-minute rating or 1¾-inch solid bonded wood-core doors.

17-3.6.3 Doors between guest rooms and corridors are required to be self-closing and meet the requirements of 17-3.6.2.

17-3.6.4 "Unprotected openings shall be prohibited in partitions of interior corridors serving as exit access from guest rooms."

17-3.6.6 "Transfer grills, whether protected by fusible link operated dampers or not, shall not be used in these walls or doors."

There are two exceptions: one, if there is a corridor smoke detection system and, two, if automatic sprinklers are provided. In either case, the grills must be located in the lower third of the wall or door height.

The 1981 Life Safety Code has no requirement for the subdivision of exit access corridors.

Building Services

Section 17-5.2 of NFPA 101 — 1981 requires heating, ventilating, and air conditioning (HVAC) equipment to comply with Section 7-2, except as otherwise required in the chapter on existing hotels.

Section 7-2 of NFPA 101 requires equipment to be installed in accordance with NFPA 90A, Standard for the Installation of Air Conditioning and Ventilating Systems, or NFPA 90B, Standard for the Installation of Warm Air Heating and Air Conditioning Systems, as applicable.

A significant exception is that existing installations may be continued in service, subject to approval by the authority having jurisdiction.

The 1978 edition of NFPA 90A contains the following section:

2-2.2 "Public corridors in health care, penal, and residential occupancies shall not be used as a portion of a supply, return, or exhaust air system serving adjoining areas other than toilet rooms, bathrooms, shower rooms, sink closets, and similar auxiliary spaces opening directly on the corridor. Air transfer because of pressure differential in health care occupancies and infiltration into residential occupancies from corridors is acceptable, provided door clearances shall not exceed those specified for fire doors in the Standard for Fire Doors and Windows, NFPA 80. Further, doors and/or wall grills shall not be used."

Section 17-5.3 of NFPA 101 requires elevators to comply with the provisions of Section 7-4. Section 7-4 references the Safety Code for Elevators, Dumbwaiters, Escalators, and Moving Walks, ANSI A17.1. Existing installations may be continued in service subject to approval by the authority having jurisdiction.

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Photo on page 52, top, by Ray Welch.