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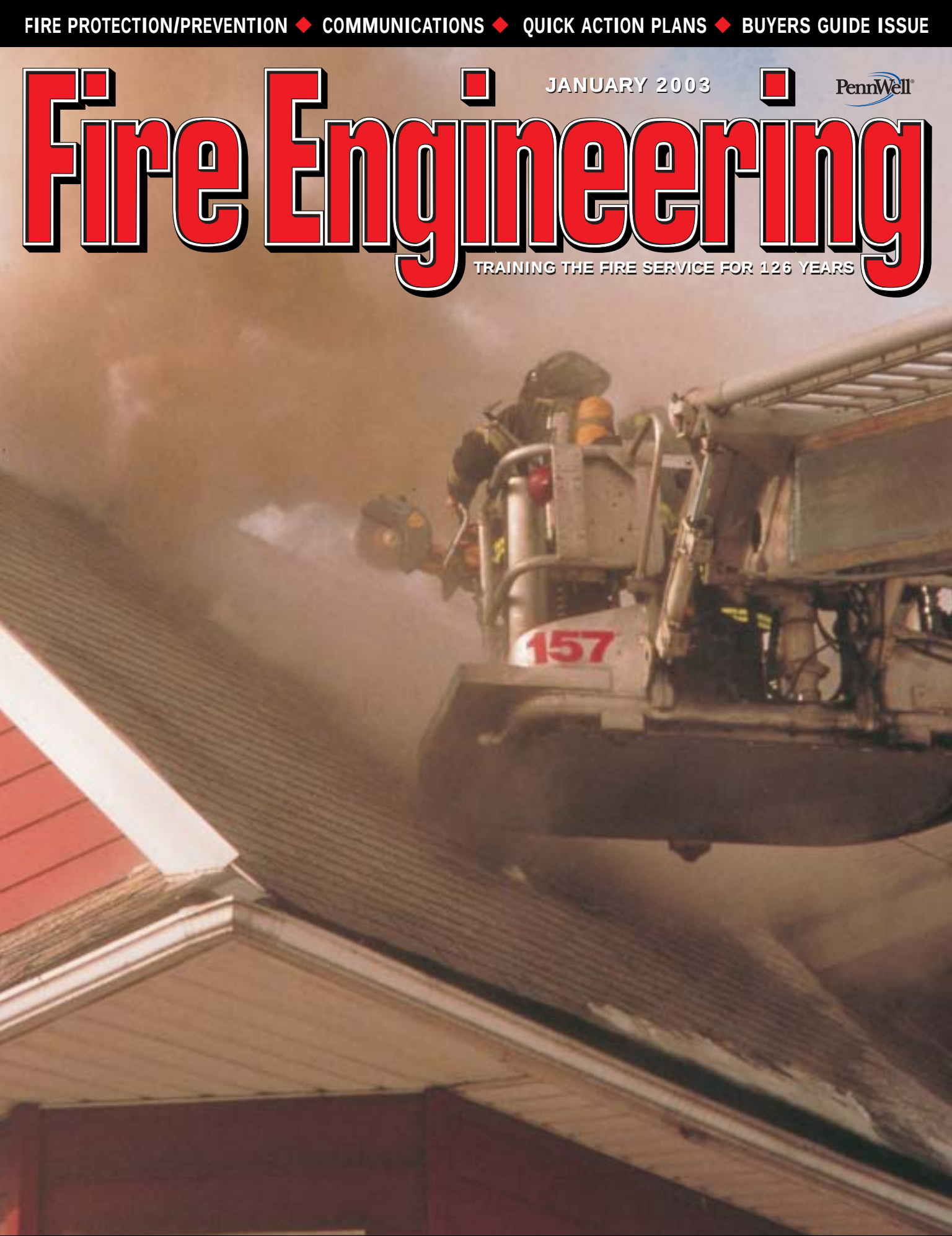

Technology Today

BY ED COMEAU

RESCUE AIR SYSTEM: "STANDPIPE FOR AIR"

HIGH-RISE BUILDINGS ARE becoming more and more commonplace across the landscape. Ranging from a relatively modest seven-story apartment building to the mega-complexes found in urban areas, they present a significant challenge for the fire service. The commonly accepted definition of a high-rise building is one that is 75 feet (23 meters) high, or approximately seven stories. While within these buildings there can be a variety of occupancies, the National Fire Protection Association (NFPA) reports that there are four specific occupancy types that dominate the fire statistics: office buildings, hotels and motels, apartment buildings, and hospitals.

Just how many fires occur in these occupancies? According to the NFPA, apartment high-rises represent the greatest number of fires. Residential occupancies, which includes apartments, are the biggest part of the fire problem in the United States in general, so it would make sense that high-rise residential occupancies would also be a significant part of the high-rise fire problem.

Today, many high-rise buildings are equipped with a variety of fire protection features (e.g., automatic fire sprinklers, fire detection and alarm systems, and construction) that help to control the spread of fire. According to NFPA statistics, fires in high-rise buildings tend to be limited to the room of origin more than 94 percent of the time.

However, even though the fire itself may be limited to the room of origin, the smoke can spread far beyond the seat of the fire, presenting a risk to occupants in remote locations. In fact, smoke spread beyond the room in approximately one-third of the high-rise fires. In most fires, the smoke kills people, not the fire.

CHALLENGE FOR THE FIRE SERVICE

One of the primary objectives at any fire is to limit the fire to the room of origin. If it should spread beyond the room of origin and begin to involve the floor, then the resources needed to extinguish the fire increase dramatically. If the fire spreads vertically beyond the floor of origin, then the fire can easily overwhelm the fire department's resources for controlling the fire or safeguarding the occupants.

The personnel and equipment needed at a high-rise fire can tax even the largest fire departments. Although the fire itself may be similar to one in a one-story building, additional resources are needed for these specialized buildings.

"Firefighting operations at a high-rise fire are the same as those at a normal fire in terms of primary and secondary searches," said Ben Klaene, retired district chief with the Cincinnati (OH) Fire Division and co-author of the textbook *Structural Firefighting*. "However, when you add in the complexities of a high-rise building and the lack of rescue options (such as multiple access and egress avenues), the picture can change dramatically."

"Some of the special situations that you have in a high-rise fire include a staging area two or three floors below the fire, reliance on a standpipe for suppression operations, the lack of exterior ladder rescue on the upper floors, and the logistics of moving equipment and personnel to the upper floors of the building," added Klaene. Among the critically needed equipment that must be moved upward are air cylinders, so that firefighters can have a supply sufficient to enable them to safely attack the fire and rescue trapped victims.

For a "typical" fire in a high-rise on an upper floor, Klaene outlined the absolute minimum number of crews that would be needed. Depending on the size of the fire and the com-

High-Rise Building Fire Experience for 1998

Occupancy Type	*Fires*	*Civilian Deaths*	*Civilian Injuries*	*Direct Property Damage (in millions)*	*Percentage of High-Rise Fires Among All Occupancy Fires*
Apartment	8,100	35	569	$22.7	9%
Hotels and Motels	800	0	18	$10.5	19%
Hospitals and Other Facilities That Care for the Sick	600	2	80	$4.4	29%
Office Buildings	500	0	13	$3.5	9%
Totals	10,000	37	680	$41.1	

Source: High-Rise Building Fires, John R. Hall, NFPA Fire Analysis and Research Division, September 2001.

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plexity of the building, these numbers could grow dramatically.

- A crew to advance a hoseline to the fire.
- A backup crew on the fire floor.
- A crew assigned to the floor above the fire floor for possible suppression and search and rescue.
- A crew assigned below the fire floor for salvage.

Other areas that would have to be staffed include staging, lobby control, utilities, ventilation, water supply, air supply, and rehab.

According to Don Ciucci, training chief for the Daly City (CA) Fire Department, "It takes three companies to put one company on the fire floor: one on the fire floor, one as a backup, and one in staging. And this does not include all of the other companies needed for support operations." You also have to think about rotating crews through rehab, said Klaene, which will require additional personnel on the scene.

If injured civilians need to be rescued, that will require a minimum of a full crew per victim to get the victim off the floor and to a location for treatment, according to Assistant Chief Steve Kreis of the Phoenix (AZ) Fire Department.

In the past, firefighters would avoid using the elevators to gain access to the upper floors of the building because they were not comfortable with the operation of the elevators. They would use the stairwells to move themselves and equipment up into the building. This presented a problem in terms of fatigue. "There is a law of diminishing returns," said Klaene. "A well-equipped firefighter in good condition can make the first five floors; but as you get higher, the fatigue factor sets in. You have a slowing ascent as you move up the floors."

Elevators are being used in some jurisdictions, however, simply because it is not possible to move equipment and personnel quickly and efficiently any other way. In Phoenix, Kreis reported, the fire department has gone to using the elevators to move personnel and equipment upward but only after ensuring that the elevators are operating properly and that the shaft is clear of smoke.

One function that requires many firefighters is moving equipment up and down the stairwells and elevators. Hoselines, tools, and especially SCBA cylinders are needed throughout the operation. Because of the physical efforts of climbing stairs in a high-rise, the duration of an SCBA can be greatly diminished, reducing the amount of time that a firefighter has available to conduct suppression or rescue operations. Furthermore, the stairways are critically important if occupants have to be rescued or evacuated. It may be difficult, if not impossible, to use a stairway for both firefighting operations and evacuation and rescue activities.

At the First Interstate Bank Building fire in Los Angeles in 1988, 383 firefighters and 600 air cylinders were used throughout the operation. Air cylinders are among the critical logistical factors that must be addressed to ensure that firefighters can fight the fire safely and effectively.

Administrative Chief and Fire Marshal Louis Vella from the Redwood City (CA) Fire Department was on the scene in Los Angeles shortly after the fire to gain insight into the operations. "The most evident thing," reported Vella, "was the number of firefighters they had to use to bring full fresh air bottles up to the 10th floor (staging) and to bring down empty cylinders." According to Vella, "This was a misuse of highly trained, very capable firefighters. That (moving bottles) is something that anyone can do. They could have been used in a more critical area rather than carting bottles up and down the stairs."

DEVELOPMENT OF THE SYSTEM

Vella's observations at the First Interstate Bank fire, and a particularly vexing problem in his own jurisdiction in Redwood City, led to the development of a "standpipe for air" that was permanently installed inside the building. "We had a situation where a building was being proposed where the developer wanted to use one side of the building for water access," Vella explained. This would have seriously hampered the fire department's ability to access the building, so an alternative solution was needed that would allow the design the developer wanted yet still provide the same level of access and fire control the fire department needed.

By installing a rescue air system in the building, Redwood City was able to free the personnel that would normally be required to shuttle air cylinders from the ground level up to the fire floor. These fire crews could then be used more effectively, according to Vella, in other areas for which they had been trained, such as suppression and search and rescue.

The system involves having piping that will carry breathing air running vertically the height of the building. On specific floors are outlets fire crews can use to recharge their air cylinders, eliminating the need for shuttling them down to an air supply vehicle in the street.

In Reno, Nevada, several systems are in operation. The first one was installed about seven years ago, according to Inspector Bob Lovett of the Reno (NV) Fire Department. Equipment rooms are located every fifth floor in the high-rise buildings. "Initially we called them 'cache rooms,' " reported Lovett, "but we had to change the name to equipment rooms because these were going into casinos." Within each equipment room are the rescue air system fill station, extra bottles, hoselines, and tools. "Whoever gets there first sets it up as a staging area. They would already have hoselines and equipment there so they wouldn't have to pack everything up," Lovett added.

An on-site storage system permanently located in the basement of the high-rise can refill 40 SCBA cylinders. However, once the department's air truck attaches an airline to the manifold connection on the exterior of the building, it is possible to continuously fill cylinders without depleting the system.

An integral part of the rescue air system is an emergency electrical conduit running up the same chaseway. This electrical system is separate from the building's system. It can be energized only by the department's utility truck, and it provides an isolated source of emergency power should it be necessary to shut down the building's power.

In addition to Redwood City, rescue air systems have been installed in a number of other municipalities. In most jurisdictions, the requirements for these systems have been written into the local codes, such as in Daly City.

"If you have a fire, it can take two to three engine companies to mule bottles up and down the stairs," estimated David Dewey, fire marshal for the Daly City Fire Department. The lack of staffing to dedicate to these operations was the incentive for proposing an ordinance requiring the installation of rescue air systems. To convince city officials, Dewey set up a demonstration.

"We got two 45-minute air bottles, put them in a sling, and asked a city official to carry them up 10 stories," reported Dewey. "After he had hefted a couple of bottles, we asked him if he had full protective gear and a breathing apparatus on, how long could he do it before having to go to rehab?" The

Extent of Smoke and Fire Damage in High-Rise Occupancies, Annual Average, 1994 to 1998

Occupancy	*Damage confined to the room of origin*		*Damage beyond the room of origin but confined to the floor of origin*		*Damage beyond the floor of damage*	
	Flame	**Smoke**	**Flame**	**Smoke**	**Flame**	**Smoke**
Apartments	94%	45%	4%	28%	2%	14%
Hotels or Motels	96%	56%	2%	16%	3%	13%
Hospitals	98%	60%	2%	15%	<1%	6%
Offices	94%	48%	3%	17%	3%	20%

Source: High Rise Building Fires, John R. Hall; NFPA Fire Analysis and Research Division, September 2001, Table 7 and 8.

end result was that the city passed an ordinance in 1998 requiring the installation of rescue air systems in high-rise buildings. High-rise firefighting is an "extremely labor-intensive operation," stated Dewey. Using a rescue air system allows the fire department to use its already limited resources far more effectively than may have been possible before.

Maintaining the quality of the air within the rescue air system is critically important. This can be easily done by having a regular maintenance, testing, and certification program in place—just like for any other life-safety or fire-protection system.

Other municipalities are embracing the concept of rescue air systems to help improve fireground operations. Fremont, California, had its first one installed in 2001; six others are presently being built. In most cases, it has required an ordinance to mandate the installation; but in other cases, it has just made practical sense, even though it was not required.

"We are a state property and do not have to follow the ordinances of the City of Sacramento, which would have required a rescue air system," said Fire Marshal Weston Arvin from the University of California at Davis Fire Department. "However, we decided to follow the ordinance because, from a practical standpoint, you want to be able to mitigate the fire as quickly as possible, and one of the things is to refill cylinders as close to the fire floor as possible."

The building that Arvin is describing is a 14-story, 200-foot hospital. In addition to the treatment and operating rooms and patient areas that would typically be found in a hospital, there is also a helicopter pad on the roof. "We wanted to have the rescue air system installed if they have to fight a fire on the roof," he added. Even though it was not a mandated system, the hospital's director supported the effort 100 percent, reported Arvin.

While there is certainly a cost associated with the installation of air rescue systems, there has not been any noticeable resistance to the systems in Redwood City. "When you have a multimillion-dollar building, the cost of the system is not that significant," said Vella.

Rescue air systems have moved from beyond the "innovative" stage to where fire departments are now calling for their installation as a method of dramatically improving the effectiveness and safety of fireground personnel. By freeing companies that would previously have been involved in shuttling air cylinders, faster fire control possibly can be achieved and lives and property saved more quickly than before.

These systems provide an uninterrupted, safe, and reliable source of breathing air within a structure. Much as standpipes eliminated the need for advancing hoselines up stairwells into a building, a rescue air system provides an alternative that allows firefighters to be used for what they are trained to do—fight fires and save lives. ■

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