COMMUNITY FIRE PROTECTION

Who decides?

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May 2009

ABSTRACT

In Pennsylvania, a number of significant changes occurred that may have a profound effect on fire protection within the Commonwealth. With the passage of Act 7 of 2008, and its companion bills, municipalities, for the first time in history, are required to provide for fire protection services. In addition, the International Code Council has included the requirement for residential sprinklers in the 2009 edition of the International Residential Code. If the purpose of providing for fire service is to save lives, we must determine at which point the fire becomes deadly and intervene prior to that point. Research has shown that a fire becomes deadly at a point known as "flashover" and that the traditional interdiction method, fire department response, may not be able to intervene prior to that point. On the other hand, sprinklers have proven to be an effective flashover prevention system. There are those, however, who are attempting to block the requirement for residential sprinklers; they have fought each community who has attempted to require them and, it is feared, they will attempt to influence the state legislature to delete the requirement when the International Residential Code becomes part of the Commonwealth's Uniform Construction Code. These groups, however, have no background in community fire protection; while other groups, who are directly involved in community fire protection,

advocate the use of sprinklers. The legislature has seen fit to give the responsibility for providing fire services to local governments; the legislature should not limit the options for local governments by prohibiting, or even limiting, their choices in providing the state-mandated fire protection services.

INTRODUCTION

Significant changes occurred in both the national fire protection arena and the local fire protection arena during 2008. First and foremost, the International Code Council voted to include residential sprinkler requirements in the 2009 edition of the International Residential Code. Second, the Commonwealth of Pennsylvania, for the first time in its history, required local governments to provide for fire protection within their borders.

Unfortunately, there are those who are attempting to influence the state legislature to limit the authority of local governments in Pennsylvania in their state-mandated obligation to provide fire protection for their communities and constituents.

BACKGROUND AND SIGNIFICANCE

Prior to Pennsylvania Act 7 of 2008, there was no constitutional right to fire protection in the Commonwealth of Pennsylvania. Section 1803 of the Second Class Township Code stated that local governments "may" appropriate monies for fire companies; "may" make rules and regulations for the government of fire companies within their jurisdictions and "may" contract with fire companies adjacent to their jurisdictions to provide for fire

department response (p. 18:1-2). The key word in that code was "may;" although the Second Class Township Code authorized local governments to provide for some level of fire protection, it was not a "shall;" it was not mandated.

All of this changed with the passage of Act 7 of 2008 by the Commonwealth of Pennsylvania Legislature. The language was changed to read: "The Township shall be responsible for ensuring that fire and emergency medical services are provided within the Township by the means and to the extent determined by the Township…" (p. 2). The simple change of wording from "may" to "shall" revolutionized the role of local governments concerning fire protection. It went from something local governments "could" do to something they "must" do.

What purpose is to be served by local governments providing fire protection? Hopefully, it would be to save the lives of their constituents. In order to determine the best way to do that, a number of questions need be answered; the most important of which is to determine when a fire becomes deadly, for if one intervenes prior to that point, lives will be saved. Many have answered that question; James Milke (1984) stated:

> The onset of flashover is of interest to all individuals concerned with building fire safety. This interest is

> motivated by the fact that, typically, flashover is considered as the point of transition from a "small fire" involving a small number of objects in the room to a "large fire" involving all objects in the room. Once a fully developed room fire exists, life safety for occupants within that room is no longer of concern because the room is obviously untenable after flashover (p.8-2).

In 1997, T.T. Lie echoed that thought, reporting: "During flashover, however, the temperature rises very sharply to such a level that survival of persons still in the room at that stage becomes unlikely. Thus the time interval between the start of the fire and the occurrence of flashover is a major factor in the time that is available for safe evacuation of the fire area" (p. 4-205).

Concerning the toxic effects of fire at the time of flashover, the 20th edition of the National Fire Protection Association's Fire Protection Handbook contains a number of statements which underline the dangers which occur at flashover. Alpert (2008), discussing the measurement of fire gases states "A mathematical correction is made to the analytical measurements to account for the increase in CO production in post flashover fires. This is important because the majority of U.S. fire deaths occur

remote from the fire room, especially for fires that proceeded past flashover" (p. 2-45).

So what is "flashover? In 1997, Edward Budnick, David Evans and Harold Nelson stated:

> A critical point in room fire growth is an event often referred to as "flashover." While a universal definition does not exist, this event is generally associated with a rapid transition in fire behavior from localized burning of fuel to involvement of all the combustibles in the enclosure (p. 11-101).

Richard Custer (1997) has provided a more scientific definition of the phenomenon of flashover. He described the triggering conditions for the flashover to be:

1. The temperature of the upper gas layer in the compartment or enclosure is approximately 600° C and,
2. The radiant flux on unignited materials in the compartment or enclosure is approximately 20kW/meter^2 (p. 1-89).

And what of the time it takes to produce flashover? According to Francis Brannigan (1992):

> In 1980, the National Bureau of Standards conducted fire tests of typical residential basement recreation rooms. The word "basement" could easily be dropped from this description as immaterial. The room could be a living room, motel room, a fire station recreation room, a doctor's office, a reception area or elevator lobby in a hotel…In less than four minutes, heavy flame was pouring out the full height of the doorway. Six minutes after ignition, the average gas temperature was reported as 700°C (p. 404).

Richard Custer (1986) served as Technical Director for the movie Fire Power (1986), available from the NFPA. In this film, a fire was documented within a living room of a single family dwelling. He reports the time from first flame to flashover took only 3 minutes and 41 seconds.

In an unattributed by-line in the August 1986 edition of Fire Command magazine, the author describes, and includes photographs, of the making of the NFPA movie Fire: Countdown to disaster. In it, flashover occurs within a bedroom in 2 minutes twelve seconds from first ignition.

The National Institute of Standards and Technology conducted tests in March 2001. These tests showed a living room with a dry scotch pine Christmas tree as its fuel source reaching flashover in less than 1 minute after ignition. The second test showed a typical living room with the couch as the material first ignited; in this fire the living room achieved flashover in approximately 3 minutes 14 seconds. The final test in this series chronicled a fire in a typical office cubical; it reached flashover in about 5 minutes 20 seconds.

In March of 2005, NIST released a report regarding a February 2003 nightclub fire that occurred in Rhode Island, killing 100 people. The report states:

- Approximately 40 seconds after ignition, an off-duty police officer at the scene radio-contacted his dispatcher to report a fire at the nightclub.
- The closest station as less than ½ mile from the nightclub.
- The first engine arrived on-scene within 3 minutes of dispatch and approximately 5.5 minutes after ignition.

Both computer simulation and an actual mock-up were used to determine fire growth. "At 60 seconds after ignition, flashover has already

occurred in the experiment and flashover is about to occur in the simulation" (p. 5-11).

Also of interest concerning time, in 2008, Underwriters Laboratories conducted tests concerning the time to collapse for floor assemblies of TGI's, or engineered wooden I-beams. Their testing demonstrated a collapse time of 5 minutes – 57 seconds, utilizing the standard time-temperature curve as their control. Anyone truly interested in fire behavior should access the video of this test and study it closely.

So, if local government is mandated to provide for fire protection and the objective is to save the lives of their constituents, what resources are needed for the for the fire department to respond in such a manner as to apply extinguishing agent on the burning material prior to the critical point at which the fire becomes deadly, previously determined as flashover? In order to determine this we must focus on the element of time.

Rexford Wilson (1994) stated, "From the moment of ignition, to the moment it goes out, there is a continuum of time" (p. 3). He then went on to describe 9 steps from ignition to extinguishment, listed as:

1. Free burn step
2. Permitted burn step
3. Notification step

4. Alarm Processing step
5. Turn-out step
6. Travel step
7. Set up step and agent application
8. Combat Step
9. Extinguishment (p.2-3)

So, in order to calculate our interdiction time, we must calculate:

1. The time is takes for the alarm to arrive at the central station alarm processing center, plus
2. The time it takes for the emergency services dispatching center to handle the alarm and dispatch the fire department, plus
3. The time it takes for the fire department to mobilize and hit the street with a piece of fire apparatus, plus
4. The time it takes to travel to the scene of the emergency, plus
5. The time it takes from arrival at the fire scene to set up an attack and apply water to the burning material.

Most of these times are, for the most part, fixed. With the exception of travel times, these times should not vary considerably. The key to the issue should be travel time, which is a direct function of travel distance.

According to Gale Gordon, director of operations for the Protection Bureau (personal communications, May 2009), an alarm company in Southeastern Pennsylvania, an alarm from a directly connected alarm system will take approximately 25 seconds to arrive at the central station. The central station operator then takes about 90 seconds to verify the problem and contact the local emergency services dispatch agency. This totals 115 seconds for the emergency services dispatching center to receive the alarm once it has been tripped.

Dispatching would be the next step in the continuum. Charles Rule (1998) reported on a survey of 57 fire agencies. These responding agencies protect a population of 11.4 million people. For the purposes of dispatching, a total of 271,403 alarms were reviewed. For the purposes of turn-out, a total of 91,027 runs were reviewed.

For alarm processing in staffed departments, the following times were tallied:

Mean	53.7 seconds
Median	49.0 seconds
Mode	60.0 seconds

For alarm processing in unstaffed (volunteer) departments, the following times were tallied:

Mean 59.0 seconds

Median 45.0 seconds

Mode 90.0 seconds (p. 7-8)

Regarding the turn-out times in staffed departments, the following times were tallied:

Mean 57.5 seconds

Median 55.0 seconds

Mode 45.0 seconds

In unstaffed departments, the turn-out times were significantly different, tallying:

Mean 184.3 seconds

Median 180.0 seconds

Mode 120.0 seconds (p. 7-8)

Now, let us look at travel times. Jack Hausner (1975), working for the Rand Institute under contract for the Office of Policy Development and Research, Department of Housing and Urban Development provides mathematical equations concerning travel times as a function of distance. In these equations, travel time is expressed as "T," distance is expressed as "D." The equations:

$T = 1.93 \times D^{-2}$ where $D < .32$ miles

$T = .55 + 1.71D$ where $D \geq .32$ miles

As an example, if we desired our travel time to be 10 minutes, our travel distance would need to be no more than 5.52 miles. If we desired to have our travel time be 1 minute, our travel distance would need to be no more than .7 miles (p. 93).

Following the time it takes to travel to the scene of the fire, time continues to march forward while the fire department arrives on the scene and sets-up to apply water to the fuel package. To determine the time it takes for set-up and agent application, a limited time/motion study was conducted. This exercise was meant to determine the time from the arrival of the fire apparatus on-scene to agent application.

The study was conducted at the Haverford Township Fire Training Grounds on a warm, dry evening in the fall of 1998. Utilizing a crew of 4 (driver/operator, officer and two firefighters) and a 1991 Pierce with pre-connected 1 3/4" attack lines, the following scenario was followed:

1. The apparatus was driven up to the training tower, stopping 35 feet from the door. This distance approximated the average front yard zoning set-back for a single-family dwelling in Upper Merion Township. The stopwatch was started when the max-brakes were applied.

2. The crew, in full turnout gear, but not wearing their SCBA masks, disembarked the apparatus and dragged the attack line to the front door of the building.
3. After the entire hoseload of attack line was removed from its bed, the operator charged the line.
4. The attack crew, now standing at the door to the building, donned their SCBA masks, bled the air out of the attack line and advanced into the building and up the interior stairs.
5. When the hose stream was observed from the second floor window of the building, the exercise was terminated.

This scenario was repeated six (6) times and the resulting times recorded. The times for each repetition were within seven (7) seconds of each other and averaged 98 seconds.

The author is indebted to Chief Kevin Kramer, Deputy Chief Sam Berry and the crew of the Bon Air Fire Company, Haverford Township Fire Department, for their hard work and assistance in conducting these studies.

Limitations and Assumptions

For the purposes of this paper, and in order to be as conservative as possible, we must assume that the building in which our study fire will occur is equipped with smoke detectors on each level and in each bedroom. This

is consistent with the requirements of the 2009 International Code Council's International Residential Code, wherein "Smoke alarms shall be installed in each sleeping room, outside of each separate sleeping area in the immediate vicinity of the bedrooms and on each additional story of the dwelling…" (p. 62). We will also assume that this system is directly connected to a central station alarm processing center, although this is NOT a requirement of the code.

Let us now look at an elapsed time calculation for fire department response to a fictitious fire in the second floor bedroom of a residential structure, time provided in seconds.

	Time	Elapsed Time
Ignition	0	0
Smoke detector activates Admittedly ambitious, but I wanted to be conservative	30	30
Alarm arrived at central station	25	55
Alarm transmitted to fire dispatch	90	145
Fire dispatched Average of the average, Of staffed and unstaffed	47	292

Turn-out time	Staffed	55	347
	Unstaffed	180	472
Set-up Time		98	445 staffed
As a result of the time/motion Studies conducted in conjunction With the Bon Air Fire Company.			570 unstaffed
Total staffed departments:			7.4 minutes
Total unstaffed departments:			9.5 minutes

Without including travel time, we are already looking at 7.4 minutes for staffed departments and 9.5 minutes for those departments without full-time staff. And, this is assuming that the smoke detector activated within 30 seconds of ignition!

Definitions

Flashover is generally defined as the transition from a growing fire to a fully developed fire in which all combustible items in the compartment are involved in fire. (Walton & Thomas, 1995)

Ignition is the first open flame. Smoldering and non-flaming burning is important pre-ignition work. (Wilson, 1994)

Mean is the statistical average of responses (total value divided by number of responses).

Median is the value at which half of the responses were higher and half were lower.

Mode is the value most frequently observed.

DISCUSSION

At the outset of this essay, it was determined that local governments are now responsible, at least in Pennsylvania, for providing fire protection services to their community and constituents. Much of that which followed is a discussion of fire behavior and that which it would take to intervene in the fire sequence in order to save lives.

To recap, Dougal Drysdale (1996) stated "Prior to flashover, a fire can be extinguished with relative ease and damage will be minor, but extinction of a post-flashover fire requires major resources and will be accompanied by major damage, if not the complete destruction of the contents and combustible linings" (p.18). Hirschler, M. (2008a) put it quite succinctly when he observed "The key issue in terms of fire hazard is to ensure that a fire does not become self-propagating and remains small. At the **very least, it is critical to ensure that flashover does not occur**" (p. 6-50).

Allen Ratzloff (1992) observed, and rightly so, "…it is virtually impossible for us to respond fast enough to prevent flashover. Therefore, a change in focus is in order" (p. 4). Bill Manning (1990), editor of Fire Engineering Magazine observed that "Flashover is what happens when people build boxes out of wood or brick or whatever and cram them full of

furniture and furnishings that burn hot and fast when exposed to the heat of the fire" (p. 6).

It appears that that which is needed is a flashover prevention system, but will fire department response fulfill the need? From the study of fire behavior and the comparison with the time study, the answer appears to be "no." With local governments now mandated to provide fire protection, should fire department response be the only choice local governments' have in discharging their mandate? This author believes not. Fixed fire protection is, and must be, recognized as a vital part of a community's fire protection plan. Yet there are those who would prohibit increased requirements for fixed protection within a community. The Pennsylvania Homebuilders Association and others are attempting, ***with no education or background on the subject***, to limit fire protection decisions on the local municipalities who are now mandated to provide said fire protection. Local governments should not be hamstrung in their mandated fire protection responsibility by legislation that would forbid them to use all of the resources needed to combat their fire problem, namely fire sprinkler systems.

Over twenty (20) years ago, the United States Fire Administration (1987) observed "Failing to convince elected officials of the seriousness of

the fire death, injury and loss statistics was considered the most serious problem because it is the path to resolving many other problems" (p. 54). Now, in 2009, we have those with ***no expertise in fire protection*** attempting to convince elected officials to either, a) delete the sections of the residential code that would require proven fire protection systems from being included in the code, and, b) to prohibit local elected officials, who the legislature just made responsible for community fire protection, from requiring those same proven fire protection systems.

CONCLUSIONS

According to Hirschler (2008b), "The best fire protection strategy for buildings is one that limits fires to a small size" (p. 18-23). Although it may seem axiomatic, the smaller the fire, the smaller the force needed to meet the fire threat. Battin, Cooper, Gallagher, Sweeney, & Waters, J. (1988) believed that sentiment over twenty (20) years ago when they observed "Automatic suppression equipment can have a definitive effect on the number and size of fire apparatus and manpower needed for public fire protection" (p. 5).

Numerous organizations have pledged their support of residential sprinklers; they include:

- ✓ Montgomery County Municipal Fire Officials Association
- ✓ The International Association of Fire Chiefs
- ✓ The International Association of Fire Chiefs – Eastern Division
- ✓ Pennsylvania Career Fire Chiefs Association
- ✓ and more.

Those who are pushing to have residential sprinklers deleted from the code are not responsible for fire protection in their communities, yet they are claiming themselves to be experts in fire safety and they are advising elected officials, *who are now responsible*, to ignore the long-term impact that the installation of sprinklers can have. Over twenty (20) years ago, Battin, et al (1988) stated "Local government officials should pay attention to the fire experts in their communities…" (p. 2); things have not changed.

RECOMMENDATIONS

1. Community Fire Protection – Who decides? That decision has been handed down by the state legislature – local government.

2. Since the legally adopted 2009 edition of the International Residential Code requires residential sprinklers, efforts to lessen the requirements of the code should be carefully weighed using expert testimony, not self-serving opinion.
3. Since the Pennsylvania Legislature has made local governments responsible for providing fire protection within their respective communities, that same legislature should not limit the options local government has in fulfilling that obligation. Once given responsibility, authority to fulfill those obligations must follow.
4. At the very least, if the legislature should decide to eliminate the provisions for sprinklers in the 2009 edition of the International Code, local governments should have the right, without arguing "unique local conditions," to restore those minimum requirements based on their own decisions as to the best method to provide for the protection of their citizens.

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