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On Residential Fire Detection

Rexford Wilson

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ON
RESIDENTIAL
FIRE DETECTION

PRESENTATION TO THE BUILDING CODE COMMISSION
COMMONWEALTH OF MASSACHUSETTS

January 20, 1976

Gardner Auditorium
Boston, Massachusetts

by

Rexford Wilson, MSFPE

Member, Fire Prevention - Fire Protection Board
Commonwealth of Massachusetts

To Duane Peasall
for his vision in
product, and lives
saved by that vision
Rexford Wilson
1.25.77

Mr. Chairman, Members of the Building Code Commission and Ladies and Gentlemen:

My name is Rexford Wilson. I am a member of the Fire Prevention - Fire Protection Board, and, at their request, am here to present our Board's unanimous recommendation for a code change affecting detection systems in residential property----paragraph 1218.211 of our code.

After an extended nation-wide search for all facts and data available, after a non-emotional study of these facts, WE HAVE CONCLUDED THAT THE IMPROVING SMOKE DETECTOR TECHNOLOGY NOW OFFERS A DEGREE OF LIFE SAFETY NOT BEFORE AVAILABLE. The Life Safety Index (Figure 1)----compiled from the response of 1974 vintage fire detectors----all available for sale in the Commonwealth of Massachusetts---- indicates the relative effectiveness of four systems for dwelling fire detection available to us. We will discuss this Index in a few minutes.

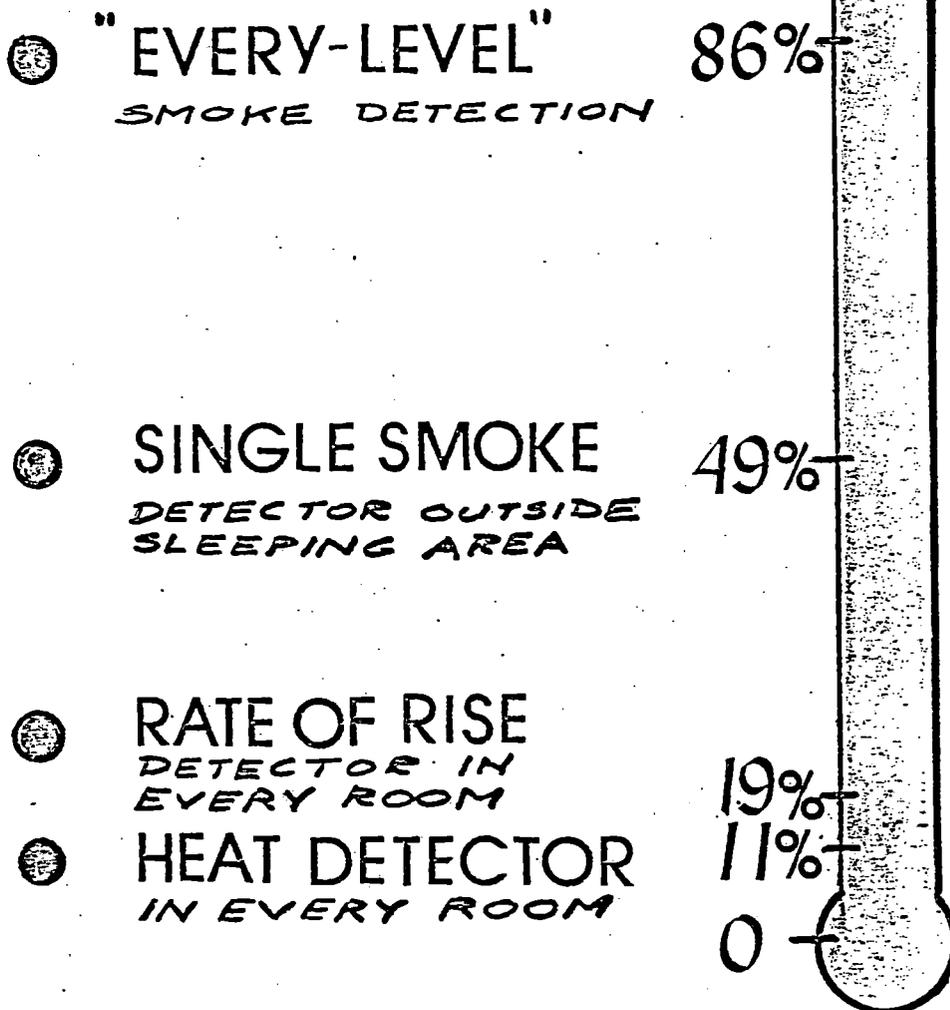
There are three parts to our brief presentation.

First, a summary of the facts and data we received before reaching our decision and since.

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DATA: NATIONAL BUREAU OF STANDARDS

FIGURE 1

Second, a brief review of the proposal for new one- and two-family dwellings----the L-3 occupancy----and a parallel set of advisory guidelines for existing dwellings.

Finally, a review of the proposal for other New residential buildings----the so-called L-1, L-2 occupancy----with a parallel set of advisory guidelines for existing multi-family residential occupancies.

First----the facts and data:

It has long been known that over 80 percent of the U. S. Fire Deaths in buildings occur in Low-Rise residential buildings, most in dwellings.

It has also been known that correcting the dangerous exit design in dwellings, the dangerous wall coverings in some dwellings, and the dangerous open stairways would cost thousands of dollars per dwelling. Detection is widely accepted as the best solution. But what type of detection?

Chief Raymond Hill of the Los Angeles Fire Department clearly demonstrated----in a test series conducted in 1960 and published in the NFPA Quarterly in 1963----that smoke detection in the home was required for the life safety of occupants. Low cost smoke detectors for the home were not available at that time.

Chief Hill ordered these tests because he knew that Fire Chiefs and firefighters rarely get to see a fire start. To see a fire before the alarm sounds, tests are required.

The National Research Council of Canada studied fatal fires in one-family dwellings during the years 1956-1960. Their "Report No. 9", published in December, 1962, was important in revealing two facts.

First, there are individuals in dwellings who have a low probability of escaping, even with a detection system. These persons include unattended children, physically inconvenienced persons, clothing fire victims, and the very old.

This Report also indicated----for the first time----that the life saving power of an "Every-Level" smoke detection system, using 1962 equipment was greater than that of a heat detection system. The report estimates the life saving power of "Every-Level" smoke detection----at approximately five times (41 percent to 8 percent) that of a system with a heat detector in every room. Again, low cost smoke detectors for dwellings were not available.

In 1969, Chief Rolland Rueger at the Bloomington Fire Department in Minnesota----curious about home fire safety----conducted tests in a two-story and basement dwelling with both a heat detection system and an "Every-Level" smoke detection system. Chief Rueger's study, published in the NFPA Fire Journal, showed that the first alarm was always received by "Every-Level" smoke detectors in the halls----ahead of any alarm by the heat or rate-of-rise detector in the room with the fire. Yet, low cost smoke detectors for dwellings were still not available for the home.

The 1973 report of the President's Commission on Fire Prevention and Control----"America Burning"----recognizes the advanced life saving potential of smoke detection. This report states, "The Commission urges Americans to protect themselves and their families by installing approved early warning detectors and alarms in their homes". Early warning was previously referenced as "Every-Level" smoke detection.

In 1973, the National Bureau of Standards in Washington appointed Mr. Richard Bright to head its Fire detection Project.

Mr. Bright authored the definitive article on the advances in the state of the art of residential smoke detection published in the respected NFPA Fire Journal in November, 1974. In this report, Mr. Bright stated: "Smoke detector technology has advanced to the point where the judicious use of one or two smoke detectors could be more effective than a house full of heat detectors in alerting dwelling occupants to fire."

Indiana Dunes Tests

In 1974, the National Bureau of Standards, in cooperation with the National Park Service, obtained several test dwellings in the expansion of the Indiana Dunes National Park.

Mr. Bright contracted with Underwriters' Laboratories Incorporated and the Illinois Institute of Technology to put all four separate detection systems in dwellings at Indiana Dunes and run comparative tests on 40 fires. The fires were selected to match NFPA records. Each system would have both experimental detectors and field available detectors. Each system would be tested by the same fire. Each detector would be separately clocked.

A report of these tests has been received. A computer analysis of these tests has been completed for the Fire Prevention - Fire Protection Board. Only Data on the detector types available for sale in Massachusetts today was used in this analysis. The Life Safety Index shows the result.

This Index confirms the findings of the Los Angeles Fire Department, the Bloomington Fire Department, and the National Commission on Fire Prevention and Control.

Remember, every system will work some of the time.

The real question then is----How do we best get 3 minutes to escape?

The Life Safety Index

On the Life Safety Index, with no fire detection system, there can be no alarm. People will still escape from fires, but three minutes of escape time cannot be guaranteed.

If a heat detector is installed in every room and space of the dwelling, 11 percent of the fires will be detected with three minutes or more to escape.

If the heat detectors are removed and rate-of-rise detectors installed throughout the dwelling, 19 percent of the fires will be sensed with three minutes or more to escape.

If all heat and rate-of-rise detectors are removed and just one smoke detector is installed outside the bedroom area, 49 percent of the time an alarm will be sounded before the three minute escape time is lost.

If a smoke detector is installed on each level of the home, three minutes to escape will be available in 86 percent of the fires----a five time improvement over a rate-of-rise detection system with a detector in every room and a seven time improvement over a system of heat detectors in each room.

The Indiana Dunes tests----Real fires selected to represent the killer fires reported by the NFPA----in real homes, conducted by objective researchers, confirm the life saving power of "Every-Level" smoke detection predicted in 1962 by the National Research Council.

Meanwhile, in the Fire Detection industry, real action has been taking place. Up to and through 1970, the only smoke detectors available for home use were modified industrial and commercial type detection equipment. The cost of these ran from \$80 to nearly \$300 each.

Then, in 1971, the first smoke detector specifically designed for one- and two-family dwellings became available at less than \$40.

In 1972, the NFPA Standard No. 74 on one- and two-family dwelling detection systems, permitted the monitored battery for the first time. This was a set of batteries inside the detector housing that would sound a 7-day trouble signal before it failed. This year we will see the third generation of steady improvement in these battery monitoring circuits----because they were permitted.

In 1975, we saw several manufacturers introduce concentric detection chambers and LED light sources for added reliability and improved false alarm freedom. We are seeing new reliability of circuits never before experienced.

As of yesterday Noon-time, there are 18 manufacturers of Single or multiple station devices listed by U.L. Three of these are in the approval process for U.L. 217. As in the past, most manufacturers wait for new listings until they have to act.

Like the gasoline engine in 1910, and the calculator of 1965, we will continue to see improvement, lower cost, higher reliability and better circuits as the manufacturers compete freely in a growing market.

In the model code environment, action has also been taking place.

In 1972, the Uniform Building Code adopted a single smoke detector outside the separate sleeping area. The Basic Building Code soon followed suit. The Standard Building Code then adopted the single unit and lately has added a requirement for a basement detector, if a basement is present.

In the laboratory testing field, action has also been taking place. In 1972, the Factory Mutual Laboratories adopted a policy to test home fire equipment for the first time. The initial product approved was a home

smoke detector.

In 1975, Underwriters' Laboratories working with the smoke detection industry, started to upgrade the reliability and quality of "single station smoke detectors" and "multiple station smoke detectors". This effort led to a new testing standard----UL Standard No. 217----This new standard was officially adopted December 5, 1975, and its printing date was January 2, 1976. UL 217 is a major step forward in smoke detector quality control, and we are recommending its use. UL 217 smoke detectors from 8 separate manufacturers are expected to be available within 1 year.

While we realize that Massachusetts men led this nation in 1776, and while we recognize that Massachusetts Fire Chiefs in Quincy, Randolph, Milton, and other Massachusetts cities have led this nation in the late 50's and early 60's by requiring heat and rate-of-rise detection equipment----the only equipment then available----we also recognize that the technology is changing. We have equipment available today with a demonstrated capability to provide a higher index of life safety in residential buildings----through the proposal you have before you----than was available with older technology.

Our study committee had 28 regulations from various communities and areas in Massachusetts. We had at our disposal all the NFPA background data. We sought to find a way to get 3 minutes of escape time----reasonably and reliably.

L-3 occupancy protection

The key parts of the regulation for New one- and two-family dwellings can be outlined as follows:

- One smoke detector is required on the highest habitable level of the home and each level, story, or floor below.
- These detectors must be located on ceilings of the exit passageways :
 - a) Outside each separate sleeping area,
 - b) Not closer than 6 feet to the kitchen,
 - c) On the ceiling at the bottom of stairs with a door at the top.
- These detectors must be UL 217 type and interconnected in some manner so that when one detects they all will sound.

We know that there are some who feel that less protection is required.

We know that there are some others who feel that more protection is desirable.

Great help has been received from members of the Society of Fire Protection Engineers, the Fire Prevention Officers in the Massachusetts Fire Prevention Association, and members of the Massachusetts Fire Chiefs Association in reviewing each and every facet of this regulation.

There have been a number of issues.

For example, an outside bell. An outside bell appears on the surface to be a good idea. But as the National Research Council Study showed there are those----clothing fire victims, unattended infants, the inebriated smoker in bed----who may not be saved by an alarm inside or outside. An outside bell gains very little in real protection. Testing a system with an outside bell is a problem----either the neighbor calls in a false alarm, or ignores it----In either case, the outside bell is ineffective. At 3 AM, the escape time of 3 minutes from alarm depends on action inside rather than a bell outside. We simply could not justify this particular feature as a mandatory requirement for all new dwellings in the Commonwealth.

Another example, heat detection. The data and facts when analyzed do not support a heat detection system when joined with a smoke detection system as adding significant Life Safety. If you add either a complete heat or rate-of-rise detection system to a single smoke detector, an 8 percent improvement is made. Add the same heat or rate-of-rise detection to an "Every-Level" smoke detection system and no increase in the Life Safety Index results (Figures 2 and 3). Again, we could not justify adding heat detectors to the "Every-Level" smoke system for all new dwellings in the Commonwealth.

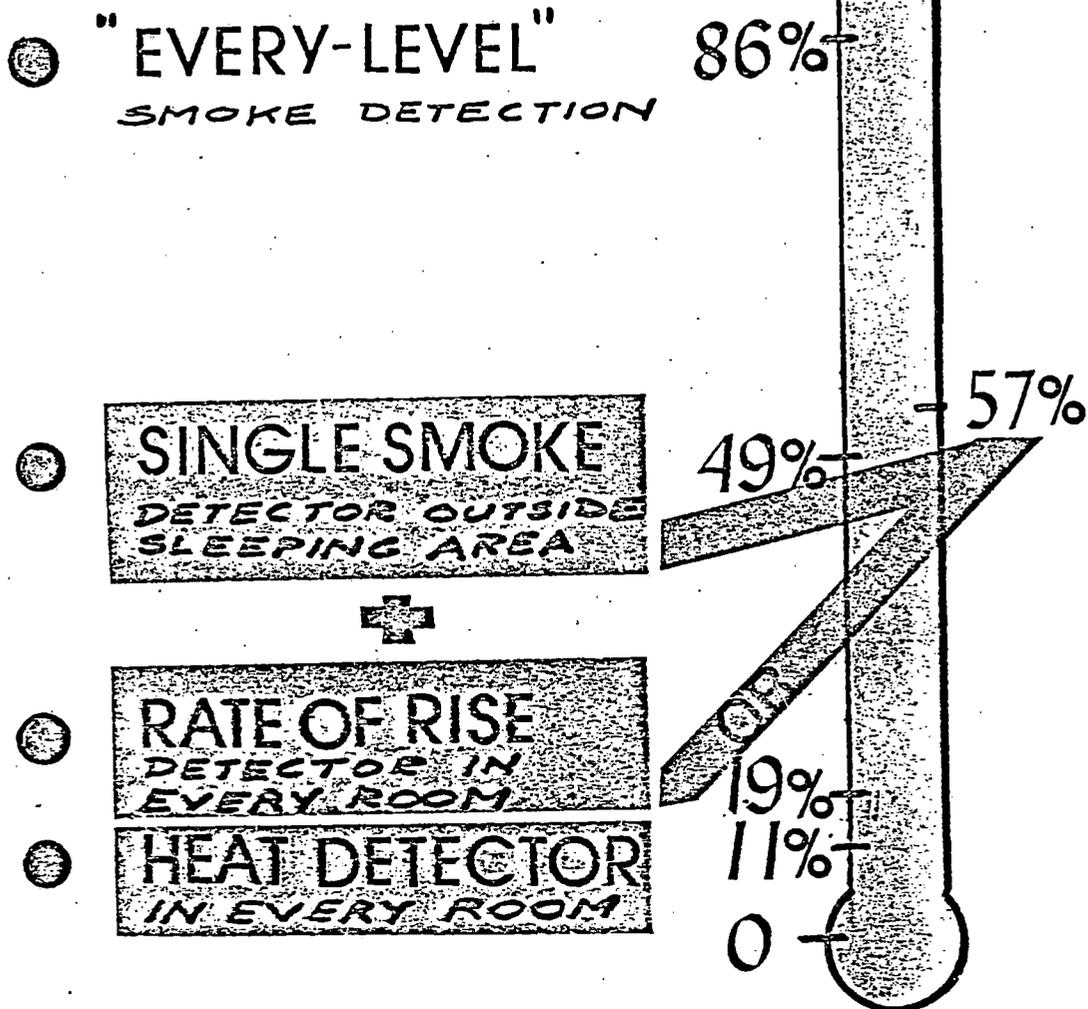
And there's standby power. In areas with weak public power, monitored batteries can be used. Monitored battery devices are already available for existing buildings and are expected for new buildings by year's end. In areas with good power continuity, we could not justify requiring all new dwellings in Massachusetts to require standby power. We do expect a manufacturer in the next year or two to offer AC powered multiple-station detectors with monitored battery backup for new construction----if this regulation is adopted.

Then there's the garage issue, the attic issue, the coverage issue, the bedroom issue, and many others.

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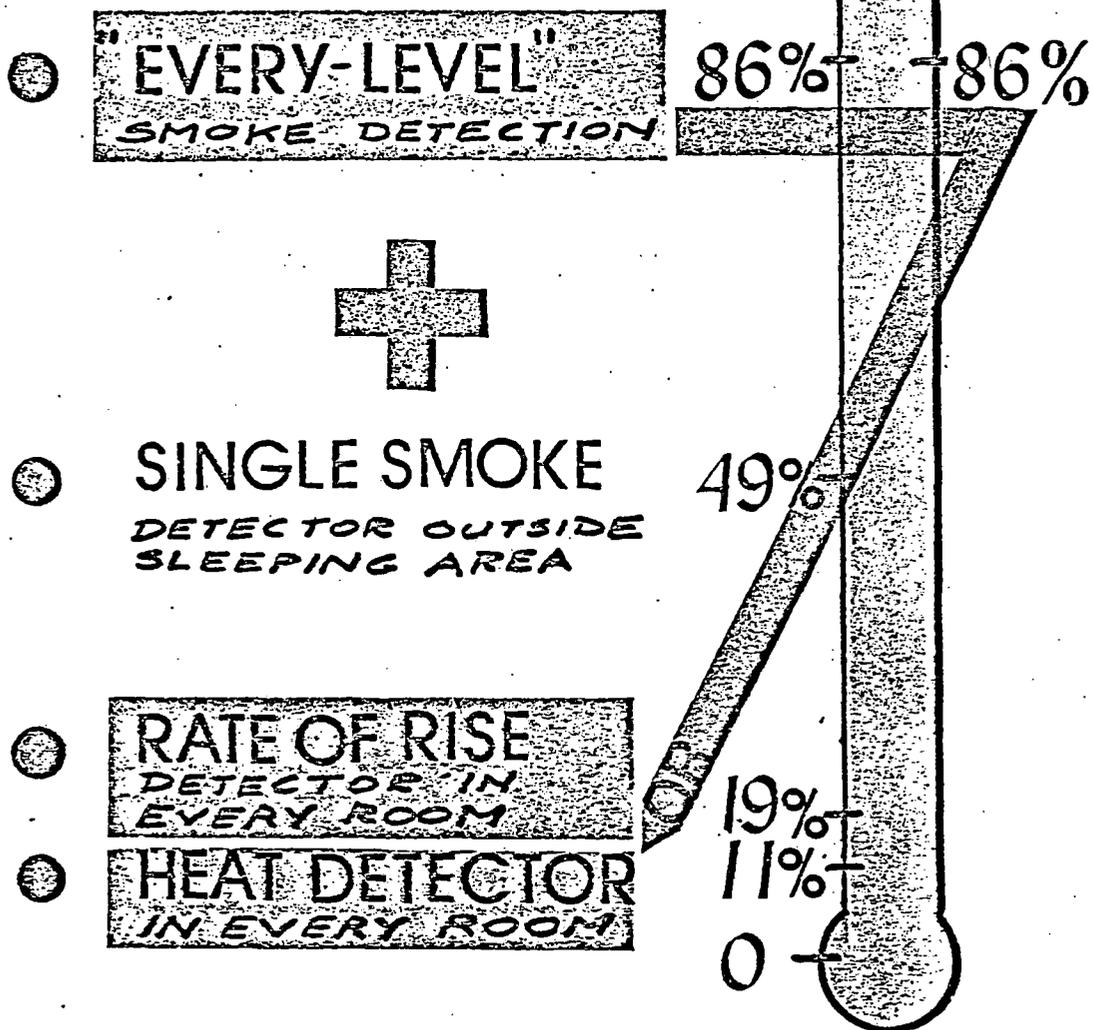
DATA: NATIONAL BUREAU OF STANDARDS

FIGURE 2

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DATA: NATIONAL BUREAU OF STANDARDS

FIGURE 3

Each and every issue that's been brought to our attention since the promulgation of these rules at noon, December 3, 1975, has been reviewed. We have yet to hear of a single technical fact or technical detail which was not considered during our deliberations on the proposed recommendation. We continue in the judgement that a U.L. 217 smoke detector on each level of Massachusetts dwellings will provide the highest reasonable Index of Life Safety available today.

Further, this regulation will permit----the Fire Chiefs and Fire Prevention Officers of Massachusetts to recommend; the contractors to supply; and the home owners of Massachusetts to purchase----additional features that they feel are required by their specific problem in their specific area. The basic protection, however, is the "Every-Level" smoke detection system. Adoption of this system for Massachusetts homes can save a considerable number of lives. This will be a major step forward in dwelling fire protection nationwide.

L-1 and L-2 occupancies

In the L-1 and L-2 occupancy, that is, multi-family or multi-person residential occupancies, we are recommending the "Dual-level" detection system.

The first level of protection is for the person inside the unit of fire origin. This protection within each living or dwelling unit is a U.L. 217 single station smoke detector for units under 1200 sq. ft.: Multiple station smoke detectors will be required in units over 1200 sq. ft---- one for each 1200 sq. ft. or part thereof. This protection will provide the same degree of safety to the occupant as in the home.

The second level of the "Dual level" system is to protect others in the building. A heat detector in the unit connected to the building alarm system provides automatic warning to the other building occupants if a small fire has not been treated early by the occupant or his neighbors.

With air feeding from the hall into the room as in many new residential buildings, we cannot guarantee an early alarm from the corridor smoke detection system. The heat detector inside the door----and the door is the weakest element of protection of that compartment----will assure an alarm on the building system to a high reliability.

The corridor smoke detection system connected to the building alarm system, the manual pull stations connected to the building alarm system, the standby power, and

the zoning requirements are designed to provide life safety for the people in that building. Requirements for the "Dual-level" system are scaled by the number of living units.

As with dwellings, there are additional features available, but they have not proven necessary for the life safety of the occupants of that building so we have omitted them.

The Fire Prevention - Fire Protection Board clearly recognizes that in many of the existing multiple-family Residential buildings in the Commonwealth there are major violations of life safety requirements. These violations are the open stairwell, the open elevator shaft, and combustible corridor linings such as plywood. We recognize that a detection system will not necessarily save occupants of these killer buildings. In existing residential buildings with safe interior finish lining the corridors and with proper enclosure of stairways and elevator shafts, detection systems can save many lives.

There is much more, but you have copies of the official Fire Prevention - Fire Protection Board report and copies of the wording of the proposed section 1218.211.

We, the members of the Fire Prevention - Fire Protection Board, and the members of the study committee that reported to it----are here and stand ready to assist you by answering any questions you may have. We also stand ready to provide data that you need to evaluate suggestions which will be presented to you later.

In summary, it is our studied judgement that the highest level of life safety for the citizens of this Commonwealth ----at this time----is the "Every-Level" smoke detection system for the home and the "Dual-level" detection system for other residential buildings. Therefore, we unanimously recommend adoption of proposed Section 1218.211.

Thank you.