AN ENGINEERING ANALYSIS OF THE INDIANA DUNES TESTS

by: Richard M Patton, F.P.E.

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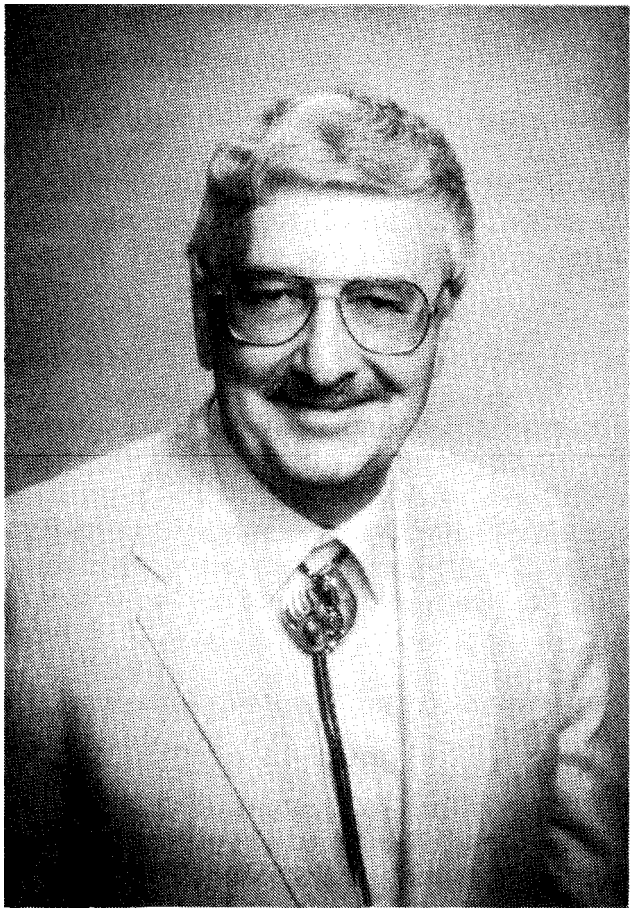

A PROFESSIONAL FIRE PROTECTION ENGINEER

AND A FIRE SAFETY CRUSADER

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May 20, 1991

TO: Whom It May Concern

RE: Fire Life Safety In The American Home

INTRODUCTION (BACKGROUND)

Research was conducted during the years 1974, 1975 and 1976. The research occurred in two homes located in the Indiana Dunes Wildlife Preserve. Hence, we call this research "The Dunes Tests". There were two test programs which we call Dunes I and Dunes II.

There were 40 live fire tests during Dunes I, 36 during Dunes II,

Appropriate instrumentation was installed in the homes. Both smoke and heat detectors were installed.

Following each program a report was written. Published information was massive. Data for each one of the tests was separated into 11 Different report sections. To find all data pertinent to test No. 4, for an example, would require a step-by-step journey through all sections, A to J.

Thus, an in-depth analysis of the basic data within the report would be extremely difficult.

However, presumably, further analysis of the data would be unnecessary. Presumably, the researchers themselves had properly conducted the necessary evaluations and studies, and they had prepared their conclusions and recommendations. The presumption of the reader would normally be that the conclusions were scientific, unbiased, and valid.

The conclusions, distilled to the essentials, were.

1. Smoke detectors would warn in time to *save* life in the home.
2. Heat detectors would likely riot operate in time to save life.

These conclusions seemingly justified changes already taking place within the National Fire Protection Association (NFPA) Code No, 74 which defined a fire detection system for the home.

In time, the conclusions were also entered into proceedings of the Federal Trade Commission (FTC).

Essentially, the FTC findings were that heat detector does not provide reliable warning of fire in a home in time to prevent loss of life. Accordingly, any person marketing heat detectors, or for that matter combination systems employing both heat and smoke detectors, while claiming that the heat detector has value *for the purpose of protecting human life in the home,* must be guilty of deception.

The findings that emanated from the FTC were not founded on the Dunes Tests only, but the Dunes Tests were by far the most comprehensive and influential testing available at the time, related to the issues.

As a graduate and licensed fire protection engineer, in 1976, upon first reviewing a Dunes Test synopsis, I concluded that the researchers' conclusions had been improper and inconsistent with the test data.

At the time I wrote a strong rebuttal to the conclusions, and was very surprised that the fire protection community, as a whole, accepted the conclusions put forth by the researchers without serious challenge.

To a very great extent, because of the Dunes Research, and the changes that came about within the NFPA Code No. 74, American homes became protected not with complete fire detection systems, involving both heat and smoke detectors, and with detectors located in every room, but rather with usually only one or two smoke detectors protecting a home.

Even though an estimated 80% of all U.S. homes became protected with smoke detectors, no major reduction in fire deaths developed over the years.

During 1990 and 1991, I contracted to make a new and far more thorough examination of the basic test data developed during the Dunes research.

This study is now completed.

STUDY FINDINGS

The two Dunes research reports contain false, misleading, dangerous conclusions that are quite inconsistent with the raw data produced by the testing.

The researchers concluded: the heat detector has little if any value for protecting life in a dwelling. This conclusion is not supported at all by the data.

The truth is, the researchers caused the heat detector to "fail" by using two methods of testing which were certain to produce "failures".

One method of testing (that produced "heat detector failures") was to test the heat detector against fires that were either of a purely smoldering nature or producing so little heat, that the ceiling temperature of the fire room did not rise to the operating temperature of the heat detector.

The second test method (that produced "failures" of the heat detector) was the physical removal of the heat detector from the fire room prior to conducting the fire test.

During Dunes Program II, for example, six fires were set that raised the temperature in the fire room to above 200°F. In five of those six tests, the researchers had removed the heat detectors. But, in the conclusions, when mentioning that the heat detector "failed", the researchers did not explain that the heat detectors were not present.

There are two conditions required for a heat detector to perform in a satisfactory manner in a home. They are:

1. The fire must be a flaming type fire that produces a significant amount of heat. (This is the type of fire that usually kills.)

2. The heat detector must be present.

In every case, during the Dunes Tests, when the above two conditions were met, the heat detector performed well. But, the researchers concealed that fact by devious wording in the conclusions.

The researchers also interpreted the raw data improperly relative to the performance of the smoke detector.

A smoke detector, if of the high quality and reliable type, is an important component of a complete fire detection system.

But the researchers overstated the value of the smoke detector, and concealed what had been revealed in the testing as serious deficiencies.

Clearly, the smoke detector, and especially the ion detector, proved to be very slow to respond to a smoldering fire, often requiring in excess of one hour.

Since this finding was in sharp variance to the published claims of the smoke detector manufacturers at the time, this information should have been far more prominently brought forth in the conclusions.

Clearly, the testing revealed that only one or two smoke detectors in a home represented insufficient protection and would not provide reliable early warning under many fire conditions. This, too, should have been more prominently brought forth.

Further, the extremely dangerous type fire, the very fast spreading hot fire, which quickly produces enormous quantities of toxic gases, was never employed during the tests. None of the test fires produced ceiling temperatures of 1000°F and above, as is typical of the fires that so often kill in the home. Thus, neither the heat nor the smoke detector was examined against the fast and hot fire.

Not only did the researchers not reveal this major omission in the test program, but seemingly, the reports were worded so as to imply that such testing had actually occurred.

So, on the whole, this engineer finds that the conclusions were seriously flawed, and quite inconsistent with the data produced by the tests.

Further, it is appropriate here to make note of these related facts.

The very detailed performance record of the fire sprinkler system over a time frame exceeding 80 years had been prepared and published by Harry Marryotte of the Australian

Fire Protection Association. Similar, if not as complete, studies had been made in the U. S., most notably the National Fire Protection Association.

The number of deaths that had occurred in sprinklered residential buildings since the turn of the century had been incredibly few.

Thus, there was *absolute proof* available to the researchers that the sprinkler head would indeed operate in time to save human life, nearly 100% of the time.

The sprinkler head was a heat detector, and an extremely sluggish one (slow to operate) at the time.

So, even as the researchers structured the testing, and their conclusions, so as to convince others that the heat detector would be unlikely to save life in the home, the evidence that the heat detector had been performing in a near perfect manner, to warn before

death would occur, was undoubtedly already known to them.

My overall conclusion regarding the Dunes Research, therefore, is that the research was flawed, it eventually had very deadly results, and the falsifications were intentional.

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RESEARCHING

THE

DUNES TESTS

A 1990's Analysis

Of A

1970's Fire Test Program

That

Examined Heat And Smoke Detectors

And

Ways to Protect The American Family From Fire

By: Richard M. Patton, Fire Protection Engineer
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Date: May 22, 1991

FOREWORD

Beginning September 9, 1974 through May 11, 1976, live fire research was conducted within abandoned but real homes on federal land known as the "Indiana Dunes Wildlife Preserve".

This research is referred to as the "Dunes Tests".

During the first program, called Dunes I, there were 40 tests. During the second program, called Dunes II, there were 36 tests.

According to the Abstract of the Program I report, the test program "was undertaken to investigate the operation of residential smoke detectors under actual field conditions". This quote, and other wording at the beginning of the Dunes research report implied that the main intent was to investigate siting requirements for smoke detectors only, *not heat detectors.*

However, even though the research was not structured to test heat detectors, the outcome would profoundly affect the future marketing of heat detectors throughout the U.S.

The final conclusions of the test program could be condensed into two sentences. "In general, all smoke

detectors responded well to all fires."

"The results of the experiments indicate that these heat detectors, including the one in the room of fire origin, failed to respond to the majority of fires."

The smoke detectors worked. The heat detectors did not. That's what the researchers told all who would read the report's conclusions.

The Dunes research reports and conclusions provided a "scientific stamp of approval" for some changes that were *already occurring* within the N.F.P.A: 74 code.

As a result, in time, a massive smoke detector promotional program came into existence. Eventually, more than 80% of all homes in the United States were to become equipped with smoke detectors.

Also, as a result of the Dunes tests and the conclusions of the researchers, that segment of the heat detector industry that marketed to the homeowner was all but destroyed.

Despite a program that put smoke detectors into 80% of the homes in America, the fire deaths never went down.

Accordingly, the purpose of this *new* research (of the *former* research) is to examine the fundamental data within the Dunes report, and determine whether or not the conclusions of the researchers were justified by the test data.

PART ONE

PRIOR EVENTS AND THEORIES

THAT HAD A BEARING ON

THE DUNES RESEARCH

CODE MAKING EVENTS
LEADING UP TO THE DUNES RESEARCH

The most prolific and influential fire code maker in the U.S. is the National Fire Protection Association (NFPA).

The NFPA was founded in 1896. Going into the 1960's the NFPA had never produce a fire detection code or a fire sprinkler code for the dwelling.

Thus the dwelling, where the great majority of fire deaths occurred, was all I completely ignored by the fire code system until the 1960's.

In the mid 1960's a code defining a residential fire detection system was created, a adopted by NFPA. It became NFPA-74.

This code required detectors throughout the home. The heat detector was I common accepted fire detector of the time.

In 1973, the NFPA requested Mr. Richard Bright of the National Bureau of Standard to become chairman of NFPA-74. Mr. Bright has stated that it was explained to him, at 1 time the position was offered, that there should be more emphasis within the code on 1 use of the smoke detector, and less for the heat detector.

At the time when the Dunes testing began, the upgrading of the smoke detector a downgrading of the heat detector was already in progress.

Mr. Bright was both the chairman of the NFPA-74 code and the "Technical Monitor within the National Bureau of Standards (NBS), overseeing the Dunes Research Program

I consider these circumstances relative to the fire code to be appropriate to brought forth, within this evaluation of the Dunes testing.

"FIRE SCIENCE"
AS DEFINED BY THE SMOKE DETECTOR INDUSTRY

For approximately a decade prior to the Dunes research, within the fire protection *community, it had been customary to speak of two fire types, the smoldering fire and the flaming* fire.

These classifications of fire were defined, and promoted as being very significant, by people who were marketing smoke detectors.

The following ideas were first promoted by smoke detector advocates in the mid 1960's.

1. Most fires (75%, it was claimed) began as smoldering fires. (This statistic, which was beneficial to the smoke detector promotions, apparently was developed by the Los Angeles fire department.)

2. Since the smoldering fire will produce no significant amount of heat, the heat detector will not detect it. Therefore, a smoke detector was necessary so that the smokey, low heat fire would be detected early.

3. The heat detector will, of course, detect the flaming fire. However, the smoldering fire (it was claimed) will likely become lethal prior to the transition to flaming.

The bottom line of such reasoning was that the smoke detector would detect a smoldering fire extremely early, in plenty of time to save lives, but the heat detector would not detect the smoldering fire and therefore fail to save lives.

The smoke detector industry theorists carried their concepts further. They made these claims:

The ionization type smoke detector was so extremely fast that it would sound even before the smoke would become visible.

Further, because the ions, which were the triggering agent, moved rapidly throughout the entire building (the home), the ion type smoke detector would sound extremely rapidly, *even when remote from where the fire initiated.* At the time, as I recall, it came to be widely believed that an operating air handling system would help move the ions rapidly to the ion detector.
Put all the above ideas together, and seemingly the following "truths" held:

The smoke detector, even if only one or two were installed, would sound early, thus providing great safety.

A complete heat detector system (with at least one detector *installed in every room! n the home) probably would not respond in* time to save lives.

Under this logic there was no contest. The smoke detector worked, and worker extremely well. The heat detector was false security.
When one closely examines the Dunes Test researchers' conclusions, it is apparent that the conclusions fit very neatly into the *promoted fire science of the smoke detects manufacturers.*

The main issue here, then, is this: Were the researchers correctly interpreting the tests, or were the prior promoted ideas of the smoke detector industry incorporated into the report contrary to what actually occurred?

That the smoke detector manufacturers promoted a "fire science" advantageous to their own interests is without question.

The promotions were distortions of the facts.

True, *a smoldering* fire could be detected by a smoke detector, and not by a heat detector. But, it was not true that the smoke detector was an "early warning" device relative to the smoldering fire. The smoke detector in a real home environment rarely, if ever, detected a smoldering fire before the smoke became visible.

As we will see from the data in the Dunes report, the smoke detector was surprisingly slow to detect the smoldering fire, often requiring in excess of an hour to be triggered by a smoldering - non-heat producing fire.

Also, the smoke detector manufacturers' claim that the smoldering fire would quickly produce toxic gases in quantities necessary to kill, was a great distortion. The amount of toxic gases produced by a fire is, to a large degree, a function of fire size. A smoldering fire usually is a very small and an extremely slow developing fire.

So, as a strategy to aid in the marketing of the smoke detector, the smoke detector advocates *overstated* the dangers of the smoldering fire, they *understated* the danger of the fast developing fire, and they made exaggerated claims relative to the speed of operation of the smoke detector.

PART TWO

THE CATEGORIES OF FIRE

THE CATEGORIES OF FIRE

In order to properly test both smoke and heat detectors in relation to their need and value within a home, it is first necessary to categorize the fires that are likely to occur, and to evaluate the relative dangers of the expected fires.

If fire is to be graded, relative to human fire death potential, it would seem the following logic should hold.

The faster the fire grows, and the hotter it becomes, the more dangerous it is to the occupants of the home. A fast fire is a danger because the time for escape is short. And, to a very great degree, the amount and toxicity of the gases produced are proportional to the size of the fire.

Rapid growing fires quickly create deadly conditions, from both a heat and toxic gas viewpoint. The big fire quickly consumes the available oxygen, and then produces much carbon monoxide. This combination of low oxygen and high carbon monoxide concentrations is the primary cause of death in a fire.

True, it is possible for a very slow fire to eventually produce a deadly environment; but here the time allowed for both detection and escape is far more generous.

If the above logic is reasonable, just how should the fire categories be defined? The defining of the rate of growth of fire must be arbitrary.

The fire that was featured in the NFPA film entitled "Fire Power" produced a 500°F temperature within the fire room in 3 minutes and 3 seconds, and a 1400°F temperature in less than four minutes.

This was a very fast fire. But the very fast fire is a very common type fire in the home.

Accordingly, it would be expected that a major government funded research project, conducted so as to evaluate fire detection devices, would include all expected type fires, and most assuredly the very fast and deadly fire.

Did the Dunes test do this? Were all types of fire detectors tested against all types of fires?

In order to make such an evaluation, first it was necessary to define the fire types.

Perhaps the best way to do this would be by the *rate of heat release,* (in British Thermal Units [BTU's] per minute) over a given time period. The problem here, however, is that the Dunes research reports do not provide data relative to heat release in BTU's.

Obviously, there is nothing to be gained by defining the various fire categories in a way that can not be related to the research to be analyzed.

Accordingly, I did what was possible. I categorized the fires relative to the maximum
ceiling temperature produced in the fire room over a given time frame. Then, the detector performance was evaluated in relation to fire category.

This was less than perfect science. But as will be seen, it proved to be an extreme useful tool for comparative purposes.

The first two categories I defined were *smoldering* fires. A Category 1 fire w, defined as afire that smoldered for one hour or more prior to flaming. A Category 2 fire w, defined as a fire that smoldered for more than 15 minutes, but less than an hour, prior flaming or self-extinguishing.

Avery long duration (Category 1) fire may well produce *lethal conditions,* especial in the fire room, and possibly throughout the house.

A Category 2 fire which smolders for less than one hour, is far less likely to produce a lethal environment

while within the smoldering stage.

When a smoldering fire went to flaming in 15 minutes or less, it was considered flaming fire. Fifteen minutes or less of smoldering will usually not produce conditions that would prevent escape, or cause a reduced ability to escape.

The flaming fire categories become more dangerous as the number increases. TI definitions are as follows:

CATEGORY 3: LOW ENERGY FLAMING FIRE
The fire fails to produce 200°F at the ceiling of the fire room within 15 minutes
.
CATEGORY 4 SLOW GROWTH FLAMING FIRE
The fire fails to produce 500°F at the ceiling of the fire room within 15 minutes of ignition.

CATEGORY 5: MODERATE GROWTH FLAMING FIRE
Fire goes to 1500°F at the ceiling and enters the flashover stage, or otherwise becomes a major threat to life outside the fire room, within 15 minutes of ignition.

CATEGORY 6: FAST GROWTH FLAMING FIRE
Same as Category 5, except the time to 1500°F and/or flashover is but 5 minutes.

CATEGORY 7: FLASH FIRE
Fire proceeds to 1500°F/flashover within two minutes of ignition. This may be a typical flammable gas or liquid fire.

Having defined the potential home fires, from extremely slow to extremely fast, now we have a method of categorizing the fires employed by the researchers during the Dunes tests.

Tables 1 and 2 summarize the fires as related to the categories defined above.

THE NFPA FIRE

The National Fire Protection Association produced a film called "Fire Power" which dramatically showed the progress of a real (test) fire in a real two-story home. It was a clear illustration of the type of fire that was *NOT* represented during the Dunes testing

The narrative of this fire is included here because it defines the kind of fire whey value of the heat detector is the greatest.

Early in the presentation the narrator appears in front of the home and make: following statement...

"No one likes to think that fire might destroy his home or his family yet each year fire claims more than 5,000 lives and causes nearly three billion dollars in damage to homes. In the next few minutes you're going to see exactly what happens when this home is involved in a fire. You'll see how rapidly events can unfold. How overpowering and deadly smoke can be. The tremendous impact of fire. And you'll grow to understand the role smoke detectors and sprinkler systems can play in saving young life and young family. But most important you'll see what action you can take in surviving a fire in young own home."

The scene shifts to the inside of the home where the narrator takes the audience a tour of the home, including the children's bedroom on the second floor.

The fire is initiated by dropping the contents of an ashtray, cigarettes still smoking, into a wastebasket filled with paper, set right beside a sofa in the living room.

The sequence than skips an unknown time frame until the smoldering mat causes flames to appear within the wastebasket. The appearance of the flames begin: fire countdown. The narrator's comments, illustrating fire progress are quoted below

0:00	Flaming initiates.
0:30	Thirty seconds from first flame the sofa ignites. From this point fire grows rapidly. If you discover afire, leave immediately and call the fire department from a neighbor's house.
1:04	One Minute and four seconds from first flame polyurethane cushioning from the couch starts to melt spreading fire to the rug. Smoke begins to fill the room.
1:23	The stairway to upstairs is still clear. (Child's bedroom scene.) Things look safe here in the kid's room, but downstairs the fire continues to accelerate.
1:35	The smoke layer in the living room descends rapidly. Gases flowing out of this room now exceed 190°F.
1:47	Light smoke begins to move to the second floor.
1:50	The smoke detector at the foot of the stairs sounds an alarm providing warning before exits are blocked.
	Take action immediately, crawl low where the air is cleaner.
2:30	The temperature above the couch is now 400°F. That's over 200 degrees celcius.
2:48	Smoke pours into the dining room, now only 4' above the floor.
3:03	Melted polyurethane burns under the couch. Suddenly the lamp shade ignites. The temperature 3' above the floor in this room now is over 500° fahrenheit. No one could survive.
3:20	The upstairs hall is beginning to fill with black acrid smoke making escape more difficult. From the outside there may be no evidence of the inferno inside.
3:41	The energy in the room suddenly ignites everything. Within one minute the temperature

has risen to over 1,400 degrees. FLASHOVER. The living room windows break out. The entire room fills with flames, forcing huge amounts of smoke and toxic gases throughout the house.

Only 2 minutes after the smoke detector sounded the lower hallway is dark and filled with smoke, the upstairs hall and stairs now impassable. A second escape route is your only way out.

4:33 Only now are flames visible from outside the house. If this fire occurred at night, when most fatal fires happen, this would be the first exterior evidence of fire in progress.

(Sirens sound) Flames climb up the outside of the house, entering the guest room window. Fire grows so fast that the fire department may not be able to rescue anyone trapped inside.

Firefigthers wearing protective clothing enter to search the house and to combat the fire. They begin to control the fire causing steam to pour out of the first floor. Reaching the second floor, firefighters break windows to release heat and vent smoke.

Not all fires behave like this one, some will move slower and some faster. But if afire starts in your home get out immediately, and stay out.

You have just seen the power of an uncontrolled fire. **END OF THE NARRATIVE**

The NFPA filmed fire, depicted as described above, has significance to this research of prior research in several respects.

It is a realistic illustration of the way fire actually behaves in a home.

The narrator, at the end states, "Not all fires behave like this one, some will move slower and some faster."

The film shows that the role of the flaming and fast fire !swell recognized by the NFPA fire specialists as an especially deadly type of fire in the home.

Researchers, if anything, have more knowledge relative to the very fast fires than the NFPA people do. So, one must wonder, why was this type of fire not used to evaluate detector performance during the Dunes tests?

And if, for some reason the testing of this common and deadly type fire was considered to not be necessary, why did not the researchers explain this omission, and also hasten to explain that the heat detector would provide a very prompt warning for such fires?

For example, the narration of the NFPA fire reveals that the smoke detector at the foot of the stairs sounded at 1 minute, 50 seconds into the fire.

But, it is obvious from the narrative, and the fire size observed, that a 135° heat detector located within the fire room would have sounded prior to 1 minute 35 seconds into the test (190°F. gases flowing out of the room) and possibly prior to the 1:23 mark.

This approximate 1/4 to 1/2 minute gain in time (heat detector within room vs central smoke detector) could be the difference between death and survival.

Thus, the NFPA film, "Fire Power" reveals that, for some reason, the Dunes Testing omitted the fast fire. And for some reason the NFPA omitted any mention of the heat detector in the film.

Yet the reality is, the heat detector operation would have preceded the smoke detector operation during the portrayed fire.

The bias against the heat detector not only is evident in the research, but it is also evident in the NFPA, "Fire Power".

TABLE #1
DUNES TEST-PROGRAM I
SUMMARY OF
FIRE TYPES-TIMES TO TEMPERATURE-HEAT DETECTOR ACTIVATION

Test #	Fire Category	Room	Fire Type (Ignition)	Time (Minutes) Until Temperature In Fire Room Reaches		Time of Operation of Heat Detector in Fire Room	Description of fire
				200°F	500°F		
1	3	Living Room	Smoldering	34	Never	None in F.R.	Upholstered chair. Flames at 3 1/2 minutes
2	1	"	"	Never	"	"	Sectional sofa piece/cotton stuffing
3	2	"	"	"	"	"	Sectional sofa piece/ polyurethane foam
4	1	Bedroom	"	"	"	"	Mattress (cotton)
5	2	"	"	"	"	"	Mattress (cotton)
6	1	"	"	"	"	"	Mattress cut in half (two tests per one mattress)
7	3	"	Flaming	"	"	"	1/2 mattress
8	4	Kitchen	Flaming	1 (60 seconds)	"	" (1)	Jet fuel (JP4) in 8 inch diam. pan on stove

Test #	Fire Category	Room	Fire Type (Ignition)	Time (Minutes) Until Temperature In Fire Room Reaches		Time of Operation of Heat Detector in Fire Room	Description of fire
				200°F	500°F		
9	4	Kitchen	Flaming	1 (60 seconds)	Never	None in F.R. (2)	jet fuel in 8" pan
10	1	Basement	Smoldering	Never	"	None in F.R.	mattress (full)
11	1	"	"	130	"	"	Heavily padded box springs
12	1	"	"	Never	"	"	Double size mattress
13	3	"	"	17	"	"	Upholstered chair plus newspaper in wastebasket
14	1	Living Room	"	Never	"	Not Operate	Chair/cotton, rayon
15	1	"	"	"	"	"	Chair/cotton, rayon
16	3	"	Flaming	"	"	"	chair/cotton, wool wastepaper basket with paper
17	1	Bedroom	Smoldering	"	"	"	Cotton mattress
18	1	"	"	"	"	"	Cotton mattress

Test #	Fire Category	Room	Fire Type (Ignition)	Time (Minutes) Until Temperature In Fire Room Reaches		Time of Operation of Heat Detector in Fire Room	Description of fire
				200°F	500°F		
19	1	Bedroom	Smoldering	Never	Never	Not Operate	Cotton mattress
20	3		Flaming	"	"	"	Draped cloth over cotton mattress & box spring. Wastebasket plus paper
21	4	"	"	10	"	3.8	Same as test 20
22	2	Basement	Smoldering	53	"	27	Chair/cotton, rayon
23	3	"	Flaming	Never	"	Not Operate	Chair plus wastebasket plus draped folded newspaper
24	1	"	Smoldering	111	"	111.6	One section of sofa cotton/nylon/ metalic
25	3	"	Flaming	Never	"	16.7	Chair. Cotton/rayon/ metalic
26	1	"	Smoldering	"	"	Not Operate	Couch. Cotton/rayon/ nylon/metalic

Test #	Fire Category	Room	Fire Type (Ignition)	Time (Minutes) Until Temperature In Fire Room Reaches		Time of Operation of Heat Detector in Fire Room	Description of fire
				200°F	500°F		
27	3	Basement	Flaming	Never	Never	2.6	Mattress plus sheet wastebasket
28	1	Study	Smoldering	(3)	"	129	Chair. Cotton/rayon nylon pile
29	2	"	"	Never	"	42	Chair. Cotton
30	1	Bedroom	Smoldering	(3)	"	70	Chair. Cotton/rayon/ wool
31	1	Living Room	"	(4)	"	66	Chair. Cotton
32	2	"	"	Never	"	46	Chair Cotton/rayon
33	3	"	Flaming	"	"	Not Operate	Two chairs. Cotton/rayon Wastebasket between newspaper.
34	1	Basement	Smoldering	"	"	"	Mattress

Test #	Fire Category	Room	Fire Type (Ignition)	Time (Minutes) Until Temperature In Fire Room Reaches		Time of Operation of Heat Detector in Fire Room	Description of fire
				200°F	500°F		
35	3	Basement	Flaming	"	"	"	Sofa. Foam rubber cushion. Newspaper in Wastebasket.
36	1	"	Smoldering	Never	Never	72	Mattress
37	3	Kitchen	Electric Overload	"	"	Not Operate	1/3 hp electric motor (refrigerator size) overloaded
38	3	"	Electric Overload	"	"	"	Fifty feet of overloaded lamp cord PVC insulation.
39	3	"	"	"	"	"	Same as No 38 but wool carpet laid on top of wire.
40	4	"	Grease Fire	(3)	"	28.4	Three pounds of solid shortening in 4 qt pot with lid. Lid removed at 28 minutes.

Notes: (1) ROR detector in hallway operates at 1.5 minutes.
(2) ROR detector in hallway operates at 1.4 minutes.
(3) Maximum Temperature exceeded 200°F. But Time is not given.
(4) Temperature peaked at 200°F. But Time is not given.

TABLE #2
DUNES TEST-PROGRAM II
SUMMARY OF
FIRE TYPES-TIMES TO TEMPERATURE-HEAT DETECTOR ACTIVATION

Test #	Fire Category	Room	Fire Type (Ignition)	Time (Minutes) until Temperature In Fire Room Reaches:		Time To Operation Heat Detector/Room of Fire		Description of Fire
				200°	500°	Wind Up	Horn	
41	1	Living Room	Smoldering	Never	Never	Did Not Operate	Did Not Operate	Back of Sofa (cotton)
42	1	"	"	"	"	"	"	Back of sofa (cotton)
43	1	"	"	"	"	"	"	Sofa (cotton)
44	3	"	Flaming	"	"	"	"	Flaming ignition of cotton/wool pile chair
45	3	"	"	"	"	"	"	Flaming ignition of cotton/jute sofa section
46	1	"	Smoldering	"	"	"	"	Cotton/jute couch
47	1	Bedroom	"	"	"	"	"	Cotton spread on mattress

Test #	Fire Category	Room	Fire Type (Ignition)	Time (Minutes) until Temperature In Fire Room Reaches:		Time To Operation Heat Detector/Room of Fire		Description of Fire
				200°	500°	Wind Up	Horn	
48	1	Bedroom	Smoldering	Never	Never	Did Not Operate	Did Not Operate	Clothing on top of cotton mattress
49	3	"	Flaming	"	"	"	"	Flaming ignition of mattress
50	3	"	"	"	"	"	"	Clothing & spread on cotton mattress
51	1	"	Smoldering	"	"	124	124	Mattress
52	1	"	"	"	"	Did Not Operate	Did Not Operate	Mattress
53	2	Living Room	"	"	"	"	"	Sofa/cotton, rayon
54	1	Basement	"	"	"	"	"	Sofa/acetate pile, cotton rayon base
55	(1)	"	Flaming	(1)	(1)	(1)	(1)	(1)
56	1	"	Smoldering	115	Never	114	114	Rocking chair/cotton, rayon, nylon

Test #	Fire Category	Room	Fire Type (Ignition)	Time (Minutes) until Temperature In Fire Room Reaches:		Time To Operation Heat Detector/Room of Fire		Description of Fire
				200°	500°	Wind Up	Horn	
57	2	Basement	Smoldering	62.6	Never	61.5	61.1	Sofa section, cotton of aminal hair
58	3	"	Flaming	Never	"	Did Not Operate	Did Not Operate	Two chairs/cotton, jute, rayon
59	4	"	"	8.7	"	7.2	6.7	Flaming ignition of two chairs plus trash and newspapers
60	2	Living Room	Smoldering	Never	"	57.3	57.3	Recliner chair/cotton, rayon
61	1	"	"	131	"	131	126	Recliner/cotton, rayon, nylon
62	1	"	"	86.6	"	83	83.7	Rocking chair/cotton, rayon

Test #	Fire Category	Room	Fire Type (Ignition)	Time (Minutes) until Temperature In Fire Room Reaches:		Time To Operation Heat Detector/Room of Fire		Description of Fire
				200°	500°	Wind Up	Horn	
63	3	Living Room	Flaming	Never	Never	12.9	13.0	Flaming ignition of chair/cotton, rayon
64	3	"	"	29.3	"	Detector Not Installed	Detector Not Installed	Flaming ignition of chair polyurethane foam, rayon, acetate, cotton
65	2	"	Smoldering	41.6	"	Detector Not Installed	Detector Not Installed	Chair similar to above
66	3	"	Flaming	17.3	"	Detector Not Installed	Detector Not Installed	Flaming ignition of rocking chair/nylon, cotton, polyurethane
67	1	"	Smoldering	78.3	"	Detector Not Installed	Detector Not Installed	Sofa section/cotton, rayon, nylon

Test #	Fire Category	Room	Fire Type (Ignition)	Time (Minutes) until Temperature In Fire Room Reaches:		Time To Operation Heat Detector/Room of Fire		Description of Fire
				200°	500°	Wind Up	Horn	
68	4	Living Room	Flaming	2.2	Never	Detector Not Installed	Detector Not Installed	Flaming ignition of eight sheets of polyurethane foam-12x12x3 inches
69	4	"	"	3.9	"	Detector Not Installed	Detector Not Installed	Flaming ignition of 24x60 inch sheet of polyurethane foam
70	4	"	"	3.5	"	Detector Not Installed	Detector Not Installed	Flaming ignition of 24x60 inch sheet of polyurethane covered two cotton blankets

Test #	Fire Category	Room	Fire Type (Ignition)	Time (Minutes) until Temperature In Fire Room Reaches:		Time To Operation Heat Detector/Room of Fire		Description of Fire
				200°	500°	Wind Up	Horn	
71	4	Living Room	Flaming	3.1	Never	Detector Not Installed	Detector Not Installed	Flaming ignition of 4 inch thick sheets of polyurethane foam
72	1	Bedroom	Smoldering	Never	"	Detector Not Installed	Detector Not Installed	Cotton innerspring mattress covered with blankets & clothing
73	1	"	"	"	"	Detector Not Installed	Detector Not Installed	Clothing and "bedding" on top of cotton innerspring mattress
74	3	"	Flaming	26	"	Detector Not Installed	Detector Not Installed	Flaming ignition of cotton innerspring mattress with clothing on top

PART THREE

THE PERFORMANCE OF THE

HEAT DETECTOR

THE PERFORMANCE OF THE HEAT DETECTOR
DUNES RESEARCH PROGRAM NO. I

There were 40 test fires set within two homes in the Indiana Dunes Wildlife Preserve, beginning September 9, 1974 and concluding on February 27, 1975.

During Dunes Program I, fixed temperature heat detectors were not installed.

Only *rate of rise* (ROR) heat detectors, set to operate upon a 15 degree temperature rise per minute, were tested. The ROR detectors were *not* placed within the fire room for tests 1 through 13. ROR detectors *were* installed in the fire room for tests numbers 14 through 40.

Table 3 provides information relative to the responses of these detectors, and also the types of fires they were tested against.

In order to *properly evaluate* the performance of the ROR heat detectors as installed, and as tested, the variety of fires that are normal to a home were defined and categorized into seven classifications. Then, the detectors' responses were properly related to the fire types.

Contrary to the conclusions within the report, the **responses of these detectors were perfect. *There were no failures* of** the heat detector during the Dunes Tests.

In each case where a test fire was employed, which increased the temperature at the ceiling (where the detector was located) by a 15 degree rise per minute, the detector operated.

To further explore the issues involved, let us first examine the "CATEGORY 3" fires. A category 3 fire is a flaming fire that produces so little energy that it is only but one small notch above a smoldering fire.

During the category 3 fires, of which there were 13, in 4 instances the heat detector in the fire room operated. During three of these thirteen tests, a heat detector was *not* installed in the fire room. That leaves 6 other "category 3" fires.

The rate of rise heat detector did *not* operate during the first 15 minutes of these six fires. The reason for non operation was simple. Sufficient heat to operate the ROR detectors *was not produced* by the fires that were set.

Three of these six very low energy "flaming" fires failed to raise the ceiling During one test, where the heat detector was at the top of the cellar stairs, thetemperature above 80°F, one failed to raise it above 90°F, and one failed to raise it above 130°F.

temperature profile was not included in the data. Accordingly, it is assumed the temperature rise produced was insufficient to trip the detector.

Now lets examine the category 4 fires. A category 4 fire is a slow, low energy fire, but it *will* produce ceiling temperatures *above* 200°F within the fire room within 15 minutes. Only four such fires were employed by the researchers.

In each case the rate of rise heat detector operated properly.

It is very significant that of the 40 fires set by the researchers, there was not one fire that produced a ceiling temperature in excess of 500°F within the fire test room.

The conclusion must be that during Dunes Test Program I, the rate of rise heat detector, which was the only type of heat detector installed, *performed exactly as it was designed to perform.*

Table 3 which follows, provides information relative to fire test categories and the performance of the heat detectors during Dunes I.

TABLE #3
DUNES TESTS-PROGRAM I

CATEGORIES OF FIRE
AND
HEAT DETECTOR OPERATION

Fire Categories	Test Fires & Heat Detector Response
No1: Long Duration Smoldering Smolders for 1 hour or more.	2x,4x,6x,10x,11x,12x,14,15,17, 18,19,24,26,28,30,31,34,36 Total of Category-18
No2: Short Duration Smoldering Smolders for more than 15 minutes, less than 1 hour.	3x,5x,22,29,32 Total of Category-5
No3: Low Energy Flaming Fire Fire fails to produce 200°F Temperature at ceiling of fire room within 15 minutes of flaming ignition or transition.	1x,7x,13x,16,20,23,25,27,33,35 ,37,38,39 Total of Category-13 Heat detector response during first 15 minutes-4
No4: Slow Growth Flaming Fire Fire fails to produce 500°F Temperature at ceiling of fire room within 15 minutes of ignition.	8,9,21,40 Total of Category-4 Heat detector response during first 15 minutes-4
No5: Moderate Growth Flaming Fire Fire goes to flashover, and/or becomes major threat to life outside of fire room within 15 minutes of ignition.	No test fires of this type.
No6: Fast Growth Flaming Fire Fire goes to Flashover and/or becomes a major threat to life outside fire room within 5 minutes of ignition.	No test fires of this type. Note: This type fire is portrayed in National Fire Protection movie entitled "Fire Power".

Fire Categories	Test Fires & Heat Detector Response
No7: Flash Fire Fire goes to flashover and/or becomes a major threat to life outside of fire room within 2 minutes of ignition.	No test fires of this type.

Notes: 1x denotes that a heat detector was not installed within the fire room during this fire test.

23 denotes that a heat detector within the fire room operated.

In event a fire that initiated smoldering became flaming within 15 minutes of ignition, that fire was considered a flaming fire with the ignition time starting when the flames first appeared.

All fires were entered into the highest category for which they qualified.

TEST NO. 33

WAS THIS A FIRE DESIGNED TO MISLEAD?

Test No. 33 was an Interesting experiment. It was illustrative of the nature of the testing and the selection of the fire types.

The narrative describing the test begins:

"Test No. 33 was the final test of the living room series. This test was the flaming ignition of two chairs in the living room with a wastebasket full of paper between the chairs and a section of folded newspaper on the left (rayon) chair. The right chair (cotton/rayon) had no arms."

So, the researchers were providing a flaming ignition to not one, but *two* upholstered chairs.

To qualified fire specialists, such a description of afire initiation within a home would convey the idea that there had been, in test 33, the initiation of a very severe and rapidly dangerous fire.

Accordingly, a failure of a heat detector to promptly respond to a flaming fire (so described) would probably be interpreted as a *failure of* the detector to perform in a manner so as to protect human life.

None of the rate of rise heat detectors responded to this fire. Even the rate of rise heat detector *within the fire room* failed to respond.

Seemingly, a serious and potentially deadly failure by the heat detector occurred.

The smoke detectors did respond promptly. The first at 1.6 minutes. All smoke detectors had operated within 6.2 minutes.

So, here indeed a very dramatic disparity was shown (seemingly) In the performances of smoke detectors versus heat detectors.

At this level of research information, a level that most would not look beyond, the case was a closed one. Smoke detectors perform very well. Heat detectors failed.

Now, let us look beyond the obvious data and the conclusions of the researchers. Let us go back into pages where that scientific data is, as they say, in small print. Let us look where few who read the conclusions will look.

Let's begin with these facts:

The rate of rise detectors required but a modest fire temperature increase to perform. Only a 15°F increase in ceiling temperature within one minute was required to operate this detector. As dwelling fires go, this is a *trivial* temperature rise requirement.

Next step. Let's look at the tame temperature graph for the fare room and find out what happened.

When we look under Section J of this 337 page research report, along about page J150 (see page 30A) where we would expect to find the tame-temperature curve, we find that there as no tame temperature curve provided. Why not?

Having failed to find a tame temperature curve, let's see what is available.

Page J-151 (seepage 30B) shows a "maximum" temperature profile for the fare room. This data reveals that test fare No. 33 produced a maximum ceiling temperature of 125°F within the fare room. At what tame that maximum temperature occurred, however, as not clear.

The data also reveals that at the 5 foot level, the initial room temperature was 66°F, and that the final, or *maximum* temperature was 71°F, only a 5 degree rise. The test fare which lasted for 22.6 minutes raised

the temperature at 5 foot only by 5 degrees. A home heating system might be able to out perform that fare.

Now, let's make an assumption and a calculation. Assume that the rise an the ceiling temperature within the fare room, to its *maximum* of 125°F was a gradual rise, starting at perhaps 70°F (would be greater than the 66°F temperature at the 5 foot level).

Based on this assumption, over the 22 minute test period, the rate of rise of the ceiling temperature would have been *only 2.5 degrees per minute.*

This very modest rate of temperature rise would have been at only 16% of the rate *required* to operate the ROR detector set for a 15°F rise per minute.

Why then, dad the researchers not point these facts out to the reader of the report?

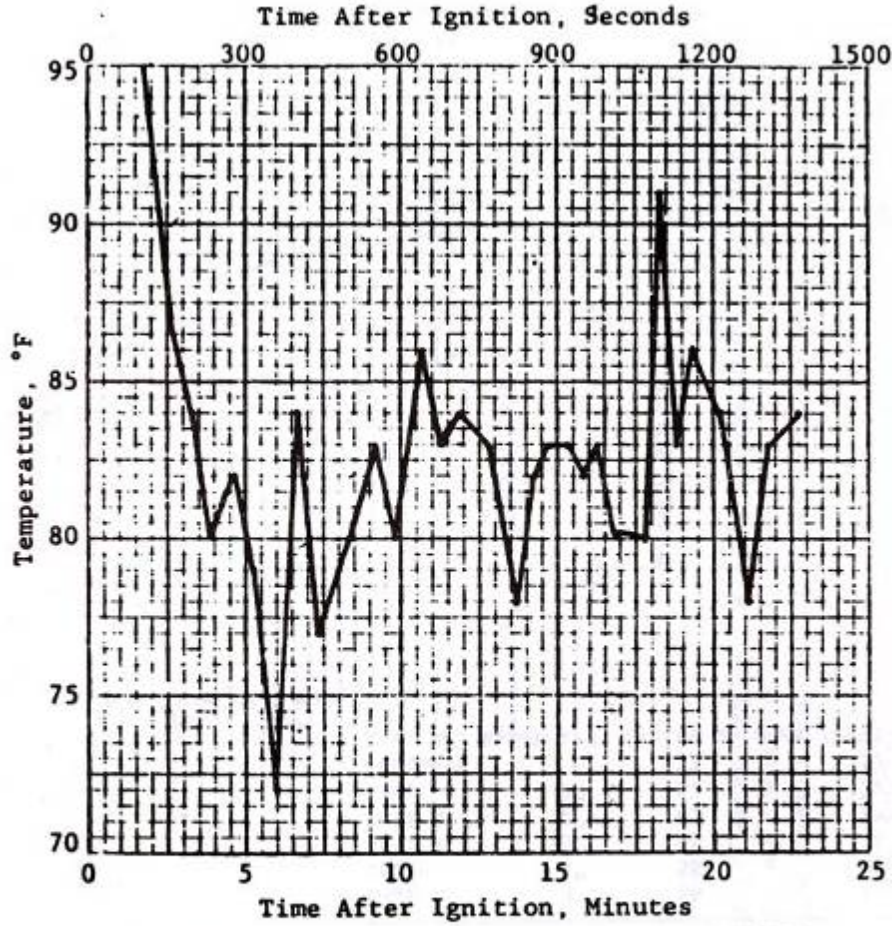
Why dad these researchers not reveal, right up there an the conclusions, the part that as normally read, that the reason the heat detector dad not operate as because the fare selected dad not produce any significant heat?

The conclusion of the researchers, relative to the performance of the heat detector during the tests, was directly opposite to that which should have been stated.

The researchers said:

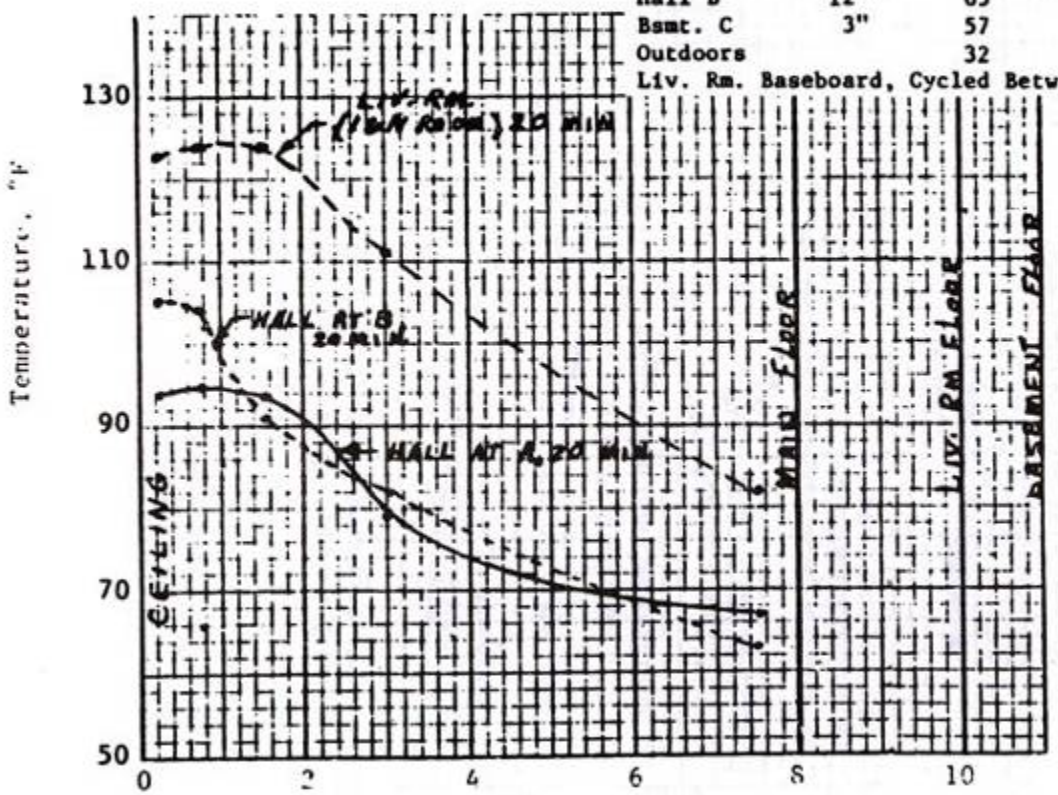
"The response of the heat detectors employed was considerably different from the response of the smoke detectors. Rate of rise thermal detectors with a 50 foot space rating were installed on each detector board."

"The results of the experiments indicate that these heat detectors, including the one an the room of origin, failed to respond to the majority of the fares."



TEMPERATURE 3 IN. ABOVE BASEBOARD CONVECTOR (LIVING ROOM), LS-33

Location	Distance From Wall	Temperature, 5 Ft High, °F Initial	Final (or max.)
Bedroom	3"	66	71
Study	3"	58	65
Hall A	12"	65	79
Hall B	12"	65	78
Bsmt. C	3"	57	56
Outdoors		32	30
Liv. Rm. Baseboard, Cycled Between 72-95			



Maximum Temperature Profiles, LS-33

Here was a technical truth hiding a lie of reality. Yes, the heat detectors failed to respond to the majority of the fires. But, *NO,* the heat detector did not "FAIL".

Rather, the researchers "FAILED" to conduct fire research so as to produce the types of flaming fires that would be normal to a home, the types that so frequently result In deaths.

Do the above statements show a willful intent, on the part of the researchers, to conceal important facts and data, and to convey false Impressions to the fire services and the public?

Knowing how knowledgeable the researchers were, and knowing how far from reality the conclusions the researchers reached were, in my judgment the test program *represented an intentional* plan to disseminate *false* information relative to fire detection technology.

THE POLITICS OF FIRE DETECTION
PRIOR TO THE DUNES TEST PROGRAM II

Following the release of the research report for Dunes Test Program I, which to place during 1974-75, those who manufactured and marketed heat detectors for the home protested the testing methods and the conclusions that emanated from Dunes I.

Going into Phase II of the test program, those who had challenged the earlier findings represented a very tiny portion of the total fire safety establishment.

Even within the fire detection industry, apparently there were relatively few who we opposing the researchers' conclusions and the related changes occurring within NFP. Standard No. 74.

The code NFPA-74 was being oriented toward "spot" smoke detectors replacing *complete* detection systems.

It should be kept in mind that from the time the NFPA code making business was fir established in 1896, until into the 1960's, the NFPA *had never produced a standard t protecting a dwelling with a fire detection system.* There had been a 70 year tradition that fire detection systems (and also fire sprinkler systems) were *not needed* in the home.

The fire alarm standards, and the fire detection and alarm industry, were according oriented almost exclusively toward *industrial and commercial* properties; not homes.

The creation of an alarm standard for protecting dwelling was not welcomed by a Many members of the fire alarm industry doubted that a market for home fire detection would evolve.

Perhaps those who were the leaders in the fire alarm field believed that one or two smoke detectors was a "saleable package" for a dwelling, whereas a more complete and more costly system was not.

Also, perhaps there were many who feared that the new standard would open the industry to an invasion by new businessmen, who, after establishing themselves first in ti home marketplace, would then grow to be competitors in the already established industry fire detection and alarm field.

Another factor also needs mentioning. Those who were promoting the smoke detector, and who obviously wanted their own philosophies and claims built into the NFP, 74 fire code, and into the mainstream of the fire protection movement, were far more active promoting their causes. This included full page advertising within the NFPA publication the Fire Journal, and in various other fire service oriented publications.

Summarizing, many of those who already were in business (within the commerce side of fire detection) either ignored or opposed the new potential market for detection systems in the home.

In contrast, the smoke detector manufacturers went after this market with a passion.

So, entering Dunes ii, the smoke detector industry was energetically promoting the smoke detector. The opposing forces were thin and weak.

What amounted to a condemnation of the heat detector by the researchers during Dunes I, in theory would either be "confirmed" or "rebutted" by the facts and findings of Dunes II.

THE PERFORMANCE OF THE HEAT DETECTOR
DUNES RESEARCH PROGRAM NO. II

The second program began Monday, September 15,1975. Thirty six tests were run during Dunes II.

During these tests, in contrast to Dunes *I, fixed temperature* heat detectors were (sometimes) installed within the fire room beginning with test no. 1.

Within the fire room the researchers installed one fixed temperature heat detector of the wind up type, and one freon operated fixed temperature detector. Both had fusible triggers set for 135°F.

Because of the extremely low heat release for most of the set fires, heat detectors located outside the fire room had little significance.

The great majority of the fires, as in Dunes I, were either of the smoldering type, which produced virtually no heat, or of a very low energy flaming type, which produced very little heat.

Table 4 defines the types of fire employed by the researchers, and the responses by the heat detectors.

There were 16 category 1 fires that were of a long duration smoldering type (smolder more than an hour). There were 4 category 2 fires that were smoldering, but of a shorter duration. All category 2 fires smoldered at least 15 minutes prior to flaming of self extinguishment.

The smoldering fires had little significance relative to a heat detector response since they did not produce significant amounts of heat. Also, it is logical to conclude that the smoke detectors would have (or should have) detected all smoldering fires before they converted to flaming.

If a smoldering fire converted to flaming within 15 minutes, that fire was considered to be a flaming fire, and the beginning of the flaming fire was considered to be at the time of conversion. This method of classification is reasonable because, during a smoldering period of 15 minutes, the production of toxic gases and smoke would normally be very modest, and not a major deterrent to escape.

Also, perhaps a failure of a smoke detector to detect the smoldering fire during the first 15 minutes is tolerable. Therefore, at the conversion time, the detection by a heat detector could be very important.

There were 9 fires of the category 3 type. These category 3 fires, although flaming, produced *very little heat..* A category 3 fire produced so little heat that the ceiling temperature in the fire room remained below 200°F. Therefore, most of these fires produced insufficient energy to operate the heat detector.

During three of the category 3 fires (tests nos. 64, 66 and 74) there were no heat detectors installed in the fire room; so, obviously no heat detectors operated.

Now let's look at the category 4 fires. These were fires that produced sufficient energy to drive the ceiling temperature above 200°F, towards the 500°F level.

The category 4 fires were at the low end of what could be considered the *very dangerous and fast spreading type* fire, that so often produces deaths within the home.

From category 4, through category 7, fires became exceedingly fast, and dangerous. However, no fire of a category higher than category 4 was used during the Dunes II program (or Dunes I for that matter).

Test No. 59 was a category 4 fire in the basement. Two chairs were placed side by side, approximately one foot apart. A wastebasket filled with trash was placed between them. One chair had some newspaper draped over one arm. A lit match was placed on top of the wastebasket.

This fire peaked at 265°F at the ceiling at 10.5 minutes, dropping back down to 250°F at 14.4 minutes, at which time the fire was terminated.

Compare this fire with the fire depicted in the NFPA film, "Fire Power" and it will be realized that this was a *very modest* growth fire in the home. The heat detectors provided perhaps a 5 to 10 minute escape time for this fire. The heat detectors went off at 7.2 minutes (wind-up) and 6.7 minutes (freon).

In addition to test No. 59, five other category 4 fires were lit. The conduct of the researchers relative to these other moderate energy fires was, to say the least, strange. For reasons that are not clear, heat detectors were *not* installed in the fire rooms during these 5 tests.

Summarizing, relative to the category 4 fires, during 5 of the 6 tests where fires were set that produced *enough energy* to have a *clear capability of operating a heat detector,* there was no heat detector available to operate.

This brings us to a serious concern relative to the Dunes II program.

Fundamentally, the researchers conducted two types of fire tests, which were:

A. Fires that were of a smoldering type, or otherwise produced so little energy, that sufficient heat to operate a heat detector did not develop.

B. Fires that had sufficient energy to operate a heat detector, but the heat detector was removed from the fire room.

How can these test methods be justified in relation to the following fundamental *conclusion* of the researchers?:

"These heat detectors ... failed to respond to the majority of the fires."

All but a few of the fires could not possibly have operated a heat detector because-either insufficient heat was produced, or the detector was not installed in the test room.

The truth is: the heat detectors performed exactly as they were designed to operate. When the heat produced drove the ceiling temperature above the operating temperature of the device, it sounded. When the ceiling temperature never reached the operating temperature, the device did not operate. Of course, when it was not installed it did not operate.

The quote in the paragraphs above was technically correct, but when examined within the overall message of the researchers, it was false. The overall message that came forth from the test program was that heat detectors *do not save human life in a home fire.*

The key researchers who helped prepare the report and the conclusions went on to promote that broader idea (heat detectors will not save life in a home) with the Federal Trade Commission.

TABLE #4
DUNES TESTS-PROGRAM II

CATEGORIES OF FIRE
AND
HEAT DETECTOR OPERATION

Fire Categories	Test Fires & Heat Detector Response
No1: Long Duration Smoldering Smolders for 1 hour or more.	41,42,43,46,47,48,51,52,54,56, 61,62,67x,72x,73x,75x Total-16
No2: Short Duration Smoldering Smolders for more than 15 minutes, less than 1 hour.	53,57,60,65x Total-4
No3: Low Energy Flaming Fire Fire fails to produce 200°F Temperature at ceiling of fire room within 15 minutes of flaming ignition or transition.	44,45,49,50,58,63,64x,66x,74x Total-9 Heat detector response during first 15 minutes-1 Fires where heat detector was not installed in fire room-3
No4: Slow Growth Flaming Fire Fire fails to produce 500°F Temperature at ceiling of fire room within 15 minutes of ignition.	59,68x,69x,70x,71x,76x Total-6 Heat detector response during first 15 minutes-1 Fires where heat detector was not installed in fire room-5
No5: Moderate Growth Flaming Fire Fire goes to flashover, and/or becomes major threat to life outside of fire room within 15 minutes of ignition.	No test fires of this type.
No6: Fast Growth Flaming Fire Fire goes to Flashover and/or becomes a major threat to life outside fire room within 5 minutes of ignition.	No test fires of this type. Note: This type fire is portrayed in National Fire Protection movie entitled "Fire Power".

Fire Categories	Test Fires & Heat Detector Response
No7: Flash Fire Fire goes to flashover and/or becomes a major threat to life outside of fire room within 2 minutes of ignition.	No test fires of this type.

Notes: 64x denotes that a heat detector was not installed within the fire room during this fire test.

63 denotes that a heat detector within the fire room operated.

In event a fire that initiated smoldering became flaming within 15 minutes of ignition, that fire was considered a flaming fire with the ignition time starting when the flames first appeared.

All fires were entered into the highest category for which they qualified.

Test fire No55 was aborted when clock failed.

WORDS CAREFULLY SELECTED TO MISLEAD

The Dunes fire research seems to have been predicated on the assumption that one type detector or the other, heat or smoke, must prevail as the superior detector, and the losing detector must be denied access to the marketplace.

This was fuzzy thinking. There are different fire types requiring different detectors.

Usually, the variations in the fire types also equates to *much* smoke but *little* heat at one end, and *quick* heat (and often *little* smoke initially) at the other end.

The smoke detector is the logical choice for slow fires.

The heat detector is the logical choice for fast and hot fires.

However, the researchers promoted the smoke detector for the entire range of fire. The testing did not embrace the entire range of fire.

The heat detector, under the parameters of the test program, was predestined to fail.

Some fires involved a flaming ignition of cotton upholstered furniture. Once the fire burrowed into the interior of the cotton pile, and the surface became charred, this fire behaved in a very similar manner to a smoldering fire. Yet by definition, it was a “flaming” fire.

Thus by creating fires that did not produce heat, and by removing the heat detectors when hot fires were conducted, the researchers “proved” that the heat detector “failed” during most tests.

Then, the researchers concluded as follows:

1. "These results indicate that fixed-temperature heat detectors with no thermal lag in every room would have little life saving potential *in the residential fire situations simulated here."*

2. "The results of the experiments indicate that these heat detectors, including the one in the room of origin, *failed to respond to the majority of the fires.*

3. *"Fixed temperature (135°F)* or rate of rise heat detectors in the room of fire origin provided little life saving potential. *These detectors failed to respond to a majority of the fires..."*

Note: The underlining in the above quotes has been added.

These were cleverly worded phrases intended to convey clearly the idea that the heat detector *failed.* But, the wording was designed so that the author could claim, if challenged, that that was not *exactly* what was said.

The above conclusions of the Dunes researchers seemingly put the National Bureau of Standards "stamp of approval" on policies that were already being entered into the NFPA74 standard.

Thus, the researchers helped to lock national thinking into the idea that where *life* is of concern, *only* the smoke detector must be used.

These conclusions and falsifications have profoundly affected fire safety in the United States during the intervening years.

PART FOUR

THE PERFORMANCE OF

THE SMOKE DETECTOR

THE SMOKE DETECTOR'S PERFORMANCE DURING THE DUNES TESTING

Following the completion of the 40 tests, which took place during the Dunes I program, the researchers gave a glowing evaluation of the smoke detector.

"In general, all smoke detectors responded well to all fires."

No doubt, the findings were well received by the great majority of the fire protection establishment. Seemingly, the scientists had confirmed that the prior initiated smoke detector promotional programs, were indeed justified. (Many fire service persons had already been earning extra money selling the detectors to the public.)

The smoke detector, it seemed, could indeed perform as a spot device, with only one or two satisfactorily protecting an entire home.

One or two smoke detectors could out perform an entire house full of heat detectors, the scientists informed us.

The officials who had believed these things all along, were proven correct. Or so it seemed.

But, what really were the smoke detectors tested against? What was the criteria for success?

There was not one fire set, during the entire 76 tests, that was of a type that could produce a "quick kill" in a home.

Without exception, extremely small fires were employed.

The researchers do not tell us how many B.T.U.'s of energy were released by the fires, or the B.T.U.'s per minute. But, as fires in homes go, the energy release was puny.

So, the smoke detector was tested against fires that allowed very ample time for escape.

The researchers had evaluated the smoke detector against those fire conditions that made it look good, and avoided those conditions that possibly might have made it look bad.

Let us say a smoldering fire allowed a one hour "escape window". Let us say that the majority of the nearby smoke detectors operated at 40 minutes.

To say that the smoke detector gave a 20 minute *safe time* to escape conveys a very favorable image.

On the other hand, let us assume the researchers said something along these lines:

> "The majority of nearby smoke detectors did not sound until 40 minutes into the tests, the more remote ones required on the average an excess of an hour to trip, and 10% failed to operate."
>
> "This performance was achieved by detectors factory set to operate to obscuration levels of 1 % and 2% whereas the laboratory testing for certification allows detectors that operate at 4% into the marketplace."
>
> "This performance of the smoke detector was in stark contrast to the advertised claims of the manufacturers, who claimed that their devices would operate even before the smoke could be seen."

Note that a more critical interpretation of the testing could have resulted in a harsh condemnation of the smoke detector manufacturers, who were falsely advertising the performance of their devices.

Thus, the performance of the smoke detector during the Dunes tests depended mainly on how the test interpreters wanted to see it.

If an ability to detect, within one hour, a fire that requires two hours to kill, is the criteria, then the smoke detector performed well.

If the smoke detector's ability to perform in accordance with the prior claims of the manufacturer was to be the criteria, then it failed.

If the smoke detector's ability to cope with the types of fires that can kill quickly in a dwelling, then the conclusion must be that it was not tested against such fires.

The researchers chose to evaluate the smoke detector in a way to present the best, and to conceal the worst. By making "escape time graphs", and reporting on the time that was available to escape under very slow fire conditions, a very rosy picture was presented to the public; but this was also a very dangerous presentation.

DO UPSTAIRS SMOKE DETECTORS PROVIDE ADEQUATE SAFETY RELATIVE TO A DOWNSTAIRS FIRE?

Test No. 5 is a pertinent one relative to this issue.

A smoldering cotton mattress was ignited by an electric charcoal igniter, in downstairs bedroom A. The bedroom door was open.

Accordingly, this fire type would also be typical of a smoldering sofa or upholstered chair in a downstairs den (no door to den).

Smoke detectors were installed in the upper bedroom corridor, and also downstairs near the stairway.

The smoldering fire converted to flaming at 51 minutes.

The upstairs detectors sounded at times ranging from 46 to 50 minutes, which means they did not perform until at or near the transition stage of the fire (at which time the fire begins to produce significant heat).

At 40 minutes into the test, conditions were deteriorating very rapidly on the first floor. At 30 minutes the carbon monoxide (CO) in the downstairs hall was 0.05 percent and at 45 minutes it was 0.1 percent. This is a dangerous concentration.

Visibility also was very poor at 45 minutes.

Carbon monoxide within the bedroom (test room) reached 0.2 percent at 44 minutes.

The conclusion is that a person within a downstairs bedroom may be seriously impaired, and the exit ways may become obstructed, prior to the operation of upstairs smoke detectors.

Stating it another way, upstairs detectors provide inadequate protection against a downstairs fire.

PART FIVE

RESEARCH ERRORS,

OMISSIONS

AND

LOST OPPORTUNITIES

THE ESCAPE POTENTIAL CURVES

The researchers developed data relative to detector operating times, the development of combustion gases (including carbon monoxide and carbon dioxide) the degree of light obscuration due to smoke, and temperature at the ceiling and at the five foot level.

From the data developed, the researchers prepared a series of "escape potential curves."

The researchers produced curves that indicated that the smoke detectors generally provided very adequate escape time, and the heat detectors did not.

However, the overall testing, and especially the fire type selection, were skewered to favor the smoke detectors. This was most unfortunate because the Dunes Tests represented an extremely unique opportunity to conduct vital research relative to fire survival within a home.

By failing to research fairly, properly, and with appropriate concern for future situations where human life would be at risk, the researchers allowed a great opportunity to improve safety in the home slip away.

For the most part, the "escape potential curves" actually have little relevance to real survival conditions in real homes.

The flaws built into the testing program include all of the following.

1. Smoke detectors that were set unusually sensitive (1% and 2%).

2. Only smoke detectors that were new were utilized. It would have been very beneficial to collect detectors from homes, aged 2 to 10 years, and to have tested them.

3. Virtually without exception the fires selected produced very little heat. The most dangerous fire type, the very fast spreading fire, was not tested.

4. The burning of one isolated cotton upholstered piece of furniture (apparently in an otherwise bare room) was not typical of most home fires.

5. Important differences between the photoelectric detector and the ionization detector were not adequately explored and analyzed.

6. The most common ignition source, the electric charcoal igniter, (which presumably represented a cigarette ignition of furnishings) produced a higher energy ignition than would be produced by a cigarette.

7. Because the smoldering fire, and also the very low energy flaming fire, usually required longer than average times to produce lethal environments, the "escape" times shown for the smoke detectors represent only *optimum* escape situations.

8. There is much to suggest that the great majority of fire deaths in homes result from extremely hot and fast developing fires. Yet, not one test of this variety was conducted.

9. In most of those instances where the flaming fire produced sufficient heat at the ceiling (200°F) to activate a heat detector, the heat detector was not installed, in the fire room.

Thus, the Dunes research program had very limited value for making judgments concerning detector performances and escape potentials.

The failures of the smoke detectors located in a hallway, outside the bedroom, to detect early the fire within the closed bedroom, prior to the creation of lethal conditions within the bedroom, were glossed over with but perfunctory comments. This failure to "red flag" a potentially deadly condition gave too much support to those who had an incentive to promote inadequate protection as being "adequate" to protect life.

The researchers also failed to properly emphasize that the smoke detectors very often required upwards of an hour to detector a smoldering fire. Certainly emphasis on this rather startling discovery was more than justified because there had been, prior to the testing, very extensive national advertising wherein the manufacturers had claimed their detectors would near "instantaneously" detect the smoldering fire. As the manufacturers put it, the so called "early warning detector" would warn of fire before the smoke would become visible.

The failure to point out that the national advertising was misleading, plus the very gratuitous favoring of the smoke detector in the conclusions of the report, must be seen as a supporting of those who were intentionally misleading the public relative to the performance of a safety device for protecting human life.

THE FAILURE TO ALERT FIRE OFFICIALS RELATIVE TO DETECTOR OPERATION IN THE TESTING LAB vs. DETECTOR OPERATION IN THE HOME

The smoke detectors used during the Dunes tests were set to trip when the light transmission levels were reduced by 1% or by 2% due to the smoke. The least sensitive setting allowed by the laboratory testing methods (for listing) was 4%; thus settings were two to four times more sensitive than minimum.

These differences, however, were relatively small in relation to the difference in how a smoke detector will perform in a laboratory "smoke box" test and a real environment.

In the laboratory smoke box, a built in air blower will drive the smoke into the detector, thus tripping it promptly when the required obscuration conditions develop. If the smoke detector is set for 4%, when the smoke level in the smoke box hits 4%, the detector will sound.

Fire officials, by an large, believe that a setting of say 4% on a smoke detector will mean that when smoke is at 4% in the home, the detector will sound. Of course, they have been taught to so believe.

Not true. In the home environment, when the fire is of a smoldering category, the smoke conditions are static, not dynamic. Hot air currents are not produced by a cool fire. Thus, there is no air movement to drive the smoke upward toward the ceiling, and outward in the direction of the smoke detector (which may be considerably distant from the fire site).

Theoretically, smoke may reach close to a 100% obscuration level (cannot see at all) at the level of a persons face when sleeping, prior to a detector at the ceiling sounding.

Now, let's examine some of the smoldering fire test results.

Test No. 11 involved a smoldering ignition of a heavily padded box spring in the basement. The box spring smoldered for 129 minutes (about 1-1/2 hours) before it flamed.

Smoke detectors were installed in the basement (top of stairs), the first floor hall, and the second floor hall. Smoke permeated the upper floors during the smoldering stage.

The five (especially sensitive) smoke detectors, at the ceiling in the first floor hall operated at times of 36 minutes to 115 minutes.

These detections correlated with a 95% light transmission in the hallway at the 5 foot level, when the first of the five detectors operated; and approximately a 30% light transmission when the last of the five smoke detectors operated.

If that smoke detector, which was the final one to operate, had been "protecting" a mother and child, the child would awaken to a condition where he (or she) could not see a door three feet away, and the mother would awaken to a condition where she could not see her child.

Of course, smoke that thick could also make it nearly impossible to breathe.

This test illustrates that the setting of the smoke detector under the laboratory approval procedures does not guarantee that a person will be able to see an object three feet distance when the smoke detector trips in the home. Indeed, under some conditions the smoke detector can be literally enveloped in smoke, and not operate.

In my judgment, the researchers failed to properly explain and emphasize this wide deviation that exists between the smoke detector's laboratory setting and the actual field conditions that may exist when the detector trips in the home.

During the intervening years, from the mid 1970's until the early 1990's, the number of homes protected with one or two smoke detectors multiplied. Few homes were so protected in the mid 1970's. Reportedly

80% of the homes were so protected by 1990. Yet, there has been very little reduction, if any, in fire deaths in homes in the U.S. during that period.

Why have the smoke detectors not resulted in a very dramatic reduction in fire deaths? Probably because false information, first disseminated by the manufacturers, and then disseminated by the researchers, produced a non-valid approach to installing fire detection equipment in homes.

THE FAILURE TO ADDRESS THE WIDE PERFORMANCE VARIATIONS IN SMOKE DETECTORS

Within the conclusions of the Dunes I report, Conclusion No. 7 on page 19 states, "It appears there is no difference in life saving potential between ionization and photoelectric detectors under expected residential fire conditions when taken as a whole".

This is another one of those areas where the researchers generalized broadly (mixing apples with the oranges), but in so doing failed to alert to serious situations.

Despite what the researchers concluded, there *are* real and important differences between the performance of the ion detector and the photoelectric detector.

The truth is: when the fire is of a smoldering type, the photoelectric detector tends to provide an earlier warning. When the fire is flaming, the ionization detector tends to operate more rapidly. These are important differences.

There also were very important deviations in the times of operation of the detectors of the same type that warranted greater notice and further study. These wide deviations occurred extensively.

When, for example, two photoelectric detectors are in the same location and one operates at 20 minutes and the other operates at 60 minutes, there is a world of difference between them in terms of survival.

Why did one trip in one third the time as the other? This was a critically important issue, and it should have been addressed.

Note that if *both* detectors are declared to be equal (pass minimum criteria) then the worst can become the standard that is provided to the citizen. Standardization will make the best no better than the worst, unless the reasons for the deviations are determined, and criteria is established to eliminate the worst.

The researchers led us to believe that all detectors employed during the Dunes tests were not only adequate, but superior (more sensitive) than minimum survival criteria required.

Now, let's further examine those deviations in performance.

For example, in Test 4, with the smoldering ignition of a mattress in the downstairs bedroom (bedroom door closed), ten smoke detectors in the downstairs hall operated. But, the operating times in minutes were 21 (P), 35 (P), 53 (P), 60 (1), 60 (I), 64 (P), 67 (1), 69 (1),90 (Dual Gate).

Test No. 10 involved a smoldering cotton mattress in the basement. The first detector to sound was a photoelectric at 32 minutes. But, another photoelectric at the same location did not operate until 65 minutes. Ionization detectors operated at 80 and 83 minutes.

The above sampling of results show that the detectors which were declared "equal" by the researchers were actually far from equal.

Here was another lost opportunity, to reveal important data to the public, and to use that information for the purpose of making the home safer from fire.

The citizen, who is the taxpayer, paid for the fire research, but then those who conducted the research concealed from the public information vital to survival in the home.

THE FAILURE TO ALERT THE FIRE SAFETY COMMUNITY TO THE NEED FOR "WITHIN THE BEDROOM" FIRE PROTECTION

It is known that most fire deaths occur during the sleeping hours.

It is also known that the fire that kills may often initiate within a bedroom.

Prior to the Dunes tests, much national advertising implied that ions from an incipient fire would spread throughout a home, rapidly tripping a centrally located ionization smoke detector. Further, it was commonly believed that the air handling system would distribute the products of combustion throughout the home, even though the door of the fire room was closed.

The researchers intentionally operated the air handling systems during all the tests, even when heating and/or cooling was not occurring.

Now, let us examine the data available from Test No. 4.

In Test No. 4, a charcoal igniter was placed on a cotton mattress in the downstairs bedroom. The door was closed.

Detector boards with ionization and photoelectric type smoke detectors were installed in the downstairs hallway near the closed bedroom. Detectors 1, 2, 3, 4, and 17 were on the ceiling. Detectors 5, 6, 7, 16, and 24 were on the wall, near the ceiling.

In addition, a detector board was on the ceiling of the upstairs hallway containing detectors 9, 10, 11, 12, 13, 14, 18, 19, and 25.

Review of the "observations" for this test reveals the following:

43 Minutes: The smoke level in the bedroom is getting dense.

60 Minutes: The char is now 18 to 20 inches in diameter with very heavy smoke generation. It is impossible to see across the fire room.

70 Minutes: The carbon monoxide level in the bedroom is greater than 0.2 percent. Levels in the bedroom are approximately 0.3 percent carbon monoxide, 1 percent carbon dioxide. First floor hall is at 40 percent transmission, bedroom is O percent transmission and second floor is at 95% transmission.

Note: Graph J.R.-4 shows that carbon monoxide actually was at approximately 0.4 percent (4000 p.p.m.) at 70 minutes at the 5 foot level in the bedroom, not 0.3 percent.

91 Minutes: Windows to fire room opened.

94.5 Minutes: Open flames on mattress.

Now, let's analyze what took place during this test.

At 60 minutes, within the bedroom, the carbon monoxide was at 0.3 percent at the 5 foot level. This environment was "lethal" with a 5 minute exposure, as per the data supplied within the Dunes report.

That means that at one hour into the test an occupant of that bedroom would long since have been dead.

How well did the smoke detectors outside that bedroom perform with, of course, the air handling system operating?

There were four photoelectric detectors in the downstairs hall and 5 ionization detectors, all set for alarming at either 1 % or 2% obscuration levels. Upstairs, there were four photoelectric and 4 ionization detectors.

One downstairs photoelectric detector went off at 21.2 minutes, and one photoelectric detector went off at 35 minutes. Thus, two out of the 8 smoke detectors operated in time to alert the household in time to probably save a sleeping person within the bedroom.

At 35 minutes, when the second photoelectric detector in the hallway had operated,
1

However, the occupant of the bedroom would have been dead, or at the very least brain damaged, by the time the other 6 smoke detectors operated. These downstairs detectors operated at times of: Photo--53.5 and 63.9 minutes; ion--59.9, 60.3, 66.5, and 95.1. the carbon monoxide was approximately 0.05 percent within the bedroom.

At 60 minutes, which was the first operation of an ionization detector, outside but near the bedroom, the obscuration in the down stairs hall was at 20%.

None of the smoke detectors in the upstairs hallway operated even though the test lasted 94.5 minutes and considerable smoke was present, but stratified at the 3 foot level, in the upstairs bedrooms.

The researchers, in the conclusions indicated that *all* smoke detectors had performed well. Yet, the occupant of the bedroom would have expired before 6 out of 8 of the downstairs detectors had operated, or *any of* the upstairs detectors had operated. How can this be?

It would seem the explanation lies in the apparent belief, by the researchers, that saving the person *within the fire room* was not an essential for a fire detection system.

THE FAILURE TO INSTALL SMOKE DETECTORS SO AS TO DETERMINE THE PROPER SITING

The basic stated purpose of the Dunes research was to find out how and where to install detectors.

Why then, were no smoke detectors installed *within* the fire room?

All told, 76 live fire tests were conducted in real homes. In all 76 tests, there was not one smoke detector installed within the fire room.

Further, it has been common knowledge for decades, that many of the components of smoke are heavier than air and will fall to the floor when cool. Smoke, that passes through an air handling system, is often cool when it exits the outlet.

The smoke from a smoldering fire often tends to not rise, but rather fall.

Assuming the basic purpose of a smoke detector is to detect a cold fire prior to it becoming a hot and dangerous fire, why weren't smoke detectors placed at the 5 foot level, and near floor level? This would have determined whether or not such locating of detectors would reduce the very long delays in detecting a cool smoldering fire.

AN OPERATING AIR HANDLING SYSTEM DOES NOT GUARANTEE EARLY SMOKE DETECTION

After spending many hours studying the Dunes research, one aspect becomes prominent, and that is the researchers' preoccupation with the opening and closing of doors, along with operating the air handling system.

This researching of the affect of the doors and air handling systems, including both summer and winter modes, was related to the concept of detection by remote detectors.

Since this "concept of remote detection" had already been built into the "folklore of fire science", and since the codes were already being shifted to reflect this concept, the testing of the ability of a smoke detector to detect a remote fire in the home, very soon after it started, was important.

Many fire specialists at the time believed that the ions would move freely through operating air distribution systems, to promptly operate smoke detectors on the other side of the closed door.

However, it must have become apparent to the Dunes researchers, very early in the testing, that the operating air handling systems did not guarantee a quick detection of the fire.

The researchers discussed this aspect of the testing under section I of the Dunes report,
"OBSERVATIONS OF EFFECTS OF THE H.V.A.C. SYSTEM IN THE PRIMARY TEST SITE".

The discussion of the airflow phenomenon and related matters took up seven pages of the report. Some very impressive mathematical formulae, and tables and diagrams took up another 10 pages.

I read carefully the researchers conclusions relative to the air handling systems' affect on the detectors and the smoke spread. In my judgement, their comments amounted to little more than the stating of the obvious, in an oblique manner, encased in scientific terminology.

I also have concluded that the researchers failed to report directly and honestly about the important findings that should have come forth from the studies. These are:

1. Remote smoke detectors do not reliably provide early warning of a fire.

2. Fire within a closed room may produce deadly conditions within that room prior to a smoke detector outside that room operating.

3. An operating air handling system will not guarantee early detection of a fire by a remote smoke detector.

Perhaps many lives that were lost in the years that followed might have been saved if these plain truths had been clearly and prominently spoken by the researchers.

RELIABILITY AND FALSE ALARMING PROBLEMS WERE IGNORED

Normally, in a scientific research report, the conclusions should not go beyond the parameters of the testing.

When one carefully reads the conclusions of the Dunes report, it is very easy to see that *advocacy* under lay it.

For all practical purposes, the messages that came forth were: the smoke detector performed well, the heat detector did not, and partial systems could provide adequate protection.

The researchers carried this advocacy forward, after the testing, into the workings of the fire code, and into the legal machinery of the marketing.

The principle researchers did much more than just research. They acted as strong advocates for a cause. The researchers used a research project (of very limited scope) as a tool to promote the smoke detector, and as a weapon to harm those who were marketing heat detectors.

At least one key researcher became an "expert witness" in legal actions which severely (and unjustly) restricted the marketing of heat detectors.

Yet, the Dunes research never investigated some factors that were exceedingly important when one considers the end result, which is whether the potential victim will live or die, when fire strikes.

Very important factors which were not adequately researched include: initial reliability, longevity, false alarming, and pertinence relative to the entire range of fire categories.

Even if we assumed that a *new* smoke detector was superior to a *new* heat detector for *all* types of fires (which we do not), it would still be essential to determine the *time frame* of the superiority.

If a superior detector will become an inferior detector, within one year, or 5 years, or 20 years, that is something important to consider. If there is a class or type of fire for which it is not superior, but rather inferior, that, too, needs investigating.

If one detector has a false alarming problem that may cause those who are annoyed to intentionally disarm it, then that must be an important consideration.

If, for some reason a detector often fails to operate as the fire grows large, the reasons should be ascertained.

Looking at the broad picture, it is clear that the Dunes research was far more narrow than its eventual application.

PART SIX

RESEARCH MOTIVES

AND THE RESULTS

DID THE RESEARCHERS CHANGE HORSES IN MIDSTREAM?

The cover sheet for the Dunes Tests report, Program No. I, is entitled:

> "Detector Sensitivity and Siting Requirements For Dwellings", PB-247-483, R. W. Bukowski, et al, IIT Research Institute, prepared for: National Bureau of Standards, 1975.

Under item 16 "ABSTRACT" this transmittal sheet states that,

> "A test program was undertaken to investigate the operation of residential smoke detectors under actual field conditions."

The main objectives of the research program are stated as:

> "To determine: 1) minimum sensitivity, 2) best location and 3) escape time provided by a group of typical detectors."

In reviewing these official observations and recommendations, I now make the following comment:

The cover sheet and the abstract state clearly that the purpose of the research was *to investigate smoke detectors.*

No mention is made of heat detectors.

Another point. During the Dunes I test program no fixed temperature heat detectors were installed.

Only two rate of rise heat detectors were installed during the first 13 tests and neither of them was installed within the fire room.

All of the above seems to confirm that the basic intent of the test program was to investigate only *smoke detectors,* not HEAT DETECTORS.

One wonders why, then, beginning with test No.14, the researchers began to install heat detectors within the fire room. And, why did the conclusions of the researchers contain gratuitous and harsh condemnations of the heat detector?

Can it be that going into the testing, the orientation was to *only* investigate smoke detectors, but that at some point during the testing (prior to test No. 14) a change in plans occurred.

But, if such a change in plans occurred, prior to test No. 14, why did the researchers continue with fires that mainly were of a type that would activate a smoke detector (much smoke); but *not a* heat detector (little or no heat generated)?

Assuming a shift in plans came about, resulting in a decision to test the heat detector as well as the smoke detector, why did the researchers not incorporate into the testing some of the hot, fast and very dangerous type fires for which the heat detector has the most value?

There is a plausible answer to these questions.

It is conceivable that the researchers entered into the test program holding the belief that the smoke detector would respond to the smokey fires very promptly, in accordance with the published advertisements and claims of the smoke detector manufacturers.

It could be that during the early testing the researchers were surprised and startled to find that the smoke detectors often required an excess of an hour to respond to the smoke generated by the smoldering fire.

But, at least one key researcher had taken steps (prior to the initiation of the research), as chairman of the NFPA-74 committee on Home Fire Warning Systems, to downgrade the need for heat detectors, and place great reliance on the smoke detectors, for protecting life in a home.

At least one of the keymen, perhaps *the* keyman, apparently had been so sure of the superiority of the smoke detector relative to the heat detector, that he had committed the pertinent fire code, (NFPA-74) to dramatic revisions favoring the smoke detector.

Having experienced, during the early tests, very slow responses by smoke detectors that were set very sensitive, it may have been that the researchers concluded that the justifications for the changes *already occurring* within the code were weak.

Certainly, at the very least, the extremely slow responses by the smoke detectors (during tests 1 through 13) would raise doubts about the wisdom of "putting all the eggs in the smoke detector basket" within the framework of the NFPA-74 code.

Perhaps it was only after such doubts began to surface that a decision was made to initiate a greater exploration of the value and the response times of, the heat detector.

But, if this is what occurred, can we assume that a strategy emerged to JUSTIFY the greater reliance upon the smoke detector, not so much because the smoke detector performed as an "EARLY WARNING DEVICE" (it didn't) but because the heat detector "FAILED TO PERFORM"?

It is a very human trait to sometimes puff up your own worth by disparaging competitors. Did the researchers justify their own prior actions relative to the smoke detector by testing the heat detector in ways *guaranteed* to make the heat detector "fail"?

There is much in the tracks of the research to so suggest.

The above is, of course, pure speculation. But, if such thinking did not occur,

> *WHAT OTHER EXPLANATION IS THERE FOR THE VERY STRANGE TESTING, AND THE VERY IMPROPER CONCLUSIONS, THAT CAME FORTH FROM THESE RESEARCHERS?*

And, so long as we are speculating, let us proceed:

Perhaps most strange of all is this. The men who signed their names to the report were all knowledgeable in fire protection matters. All had to have known that the performance of a fixed temperature heat detector and a fire sprinkler head were fundamentally the same, essentially, a melting of a eutectic metal .... a fusible trigger.

One significant difference is that at the time of the testing, and prior, it had been customary to build a substantial lag time into the sprinkler head, thus generally making the fire sprinkler head far slower to respond to a fire than most fixed temperature heat detectors that were on the market.

Also, these men undoubtedly knew that the well documented, more than 70 year long record of the fire sprinkler system, relative to safeguarding human life in buildings, including residential type buildings, had been extremely close to perfect. Almost with no exceptions, human life was never lost in a sprinklered building (human torch type fires excluded).

So, since a sprinkler head and a heat detector were essentially one and the same operating mechanism, and since the sprinkler had a very well proven and very long record of saving life, then to any scientific mind it would have been most obvious that a heat detector would indeed operate so as to save human life.

The conclusion must be that these men knew, fully and clearly, heat detectors were extremely valuable life saving devices.

Yet, these words literally erupt from the conclusions these men fashioned from the data.

"Fixed temperature (135°F) or rate of rise heat detectors in the room of fire origin provided little life saving potential".

"These results indicate that fixed-temperature heat detectors with no thermal lag in every room would have little life saving potential *in the residential fire situation simulated here".*

That there was something extremely strange occurring is beyond question.

Why was this research program used as a platform to literally destroy the heat detector as a component of a fire detection system for a home?

Those words, that condemned and destroyed the heat detector as a protector of human life within a home, could not have been lightly written, and they could not have been put to print without the knowledge that they were false.

Further, I cannot believe that terrible and false conclusion, that the heat detector would not save life, would be presented to a fire protection community by these researchers except there had been some reasonable assurance that, having made such charges, *support within the code making system would be forthcoming.*

These men must have had reason to believe their conclusion would be accepted and promoted by the code establishment, and most specifically by the NFPA-74 code group, and the smoke detector industry.

It would seem unlikely to me that those very few researchers, as of and by themselves, would dare to condemn the heat detector, as they did, except as part of and with the approval of a broader coalition of influential people within the fire community.

THE RESEARCH CONCLUSIONS ENCOURAGED FALSE SECURITY

Some extremely significant conclusions that were reached during the Dunes testing are stated on the cover sheet as follows:

"The tests indicate both photoelectric and ionization detectors at a sensitivity of approximately 1% per foot provide adequate escape time from all the test fires when installed to the following guide lines:

1. The detector should be installed at the head of each stairway.

2. Outside each separate sleeping area.

3. At least one detector on every level of a multi-story home."

By making the above statements, within the framework of a research report covering three years worth of research, the engineers were giving their approval to a protective system for a home so structured.

Further, the above statements by the researchers amounted to a "certification" that the performance claims of the smoke detector manufacturers, which were put out in the 1960's, were essentially correct.

Further, the research represented an "approval" of the changes already being made in NFPA-74.

What was the truth? The truth was that the protection, as defined, was not adequate, the claims of the smoke detector manufacturers had not been accurate, and the changes being made in NFPA were dangerous.

The truth was: the researchers never tested the more important fire categories.

The truth was: fire would kill someone in a bedroom with the door closed, before the hallway smoke detector operated.

The truth was: the products of combustion from a smoldering fire (smoke, ions) did *not* rise up a stairway to find the detector at the top of the stairway.

The truth was: one or two smoke detectors would *not* protect an entire home so as to provide any reasonable certainty of a warning in time to save life.

The truth was: smoke at the five foot level, could become extremely thick before a remote smoke detector operated.

The truth was: the ion type smoke detectors often required in excess of an hour to detect the smoldering fire, and that many times the detector did not sound until the fire entered the flaming stage.

The truth was: once the smoldering fire turned to flaming (after a prolonged period of producing smoke that did *not* trip a smoke detector) the dynamics of the hot fire caused the existing smoke to quickly blot out the exit paths.

The truth was: protection as defined, which must be considered to be *"SPOT PROTECTION",* or stating it another way, ***"INCOMPLETE PROTECTION",*** was ***never tested*** under the most adverse condition of the fast fire.

These truths never came out of the research.

That the spot protection never did represent adequate protection has been proven in the interim, with real fires in real homes.

In the years following the Dunes tests, the reduction in fire deaths, due to the smoke detector being installed in 80% or more of the American homes, was slight.

In short, the smoke detector did not impact on fire deaths in the U.S. as had been expected.

No doubt, the inability of the smoke detector, on a "spot" basis, to detect a fire early, is a major reason for the failure of the smoke detector program.

The May/June 1989 issue of the National Fire Protection Association's "Fire Journal" contains an article entitled, "What Kills In Fires, Smoke Inhalation or Burns". The authors are Beatrice Harwood and John R. Hall. John R. Hall, Ph.D., is NFPA Director of Fire Analysis and Research. Beatrice Harwood is a statistician with the U.S. Consumer Product Safety Commission. The article is based primarily on Ms. Harwood's 1988 report, Trends in Fire Deaths, 1970-1985.

Table 4 in this article lists the "Deaths Due to Fires and Flames, 1970-1985". The number of

structural fire deaths for these years are shown below:

DEATHS DUE TO FIRES IN STRUCTURES
1970-1985

Year	Deaths	Year	Deaths
1970	4,450	1978	4,926
1971	4,553	1979	4,926
1972	4,806	1980	4,801
1973	4,555	1981	4,710
1974	4,515	1982	4,371
1975	4,568	1983	4,136
1976	4,901	1984	4,185
1977	4,967	1985	4,159

Note: **In 1988 the number of deaths in structure fires climbed to 5,280.**

What is the significance of these fire deaths, as listed.

The surprise is that the years listed begin prior to a major influx of smoke detectors into homes, and it concludes after perhaps 80% of all homes are so equipped. Note that there was no significant reduction in fire deaths during these years.

True, over the 16 year period, 1970-1985, the population rose by about 15%.

But, a 15% reduction in deaths with 80% of the homes protected is a poor showing. And, by no means may this apparent reduction be attributed only to smoke detectors. Other factors to consider are:

1. Reduction in percent of population smoking.

2. Major improvements in furnishings (bedding, upholstered furniture) relative to cigarette ignition.

3. Gradual replacement of old homes with newer homes, including upgrading of electrical wiring.

4. Better fire prevention programs.

5. Increased use of fire sprinkler systems.

All of the above suggestions that the reduction in fire deaths due to the widespread use of smoke detectors is less than 10%.

One can only speculate as to what the results would have been in the event the Dunes researchers had properly tested all types of fires in the home, when they had a chance to do so, and had been completely objective and honest in their analyses.

My own professional view is that an honest research program would have proven that the NFPA-74 code, as first developed in the 1960's, was a reasonably valid code; and that if reasonable refinements had been developed, and if such proper protection had been promoted nationally, upwards of 40,000 fire deaths might well have been prevented during the intervening years.

May 23, 1991

Richard M. Patton
Registered Fire Protection Engineer,
President, Crusade Against Fire Deaths

LETTERS

OF

ENDORSEMENT

June 25, 1991

Crusade Against Fire
Deaths, Inc. P.O. Box 196
Citrus Heights, CA 95611-0196

Dear Dick:

I have finished reading with interest your research report concerning the Dunes Tests.

It seems that the information contained therein substantiates your opinion all along that there was falsification intended to promote smoke detectors and to eliminate any benefit from rate-of-rise-or fixed temperature heat detectors. Your conclusions are excellent as outlined in the step by step references to each test and published false results.

Your comments on page 55 remind me of the testing I did in Las Vegas schools having the required HAV systems installed according to the Uniform Mechanical Code. The systems did not shut down after I filled the entire schools with thick smoke.

On page 46 item 4 on that page is very true. In my years of testing for arson in set fires for training, I learned that a typical room must be completely furnished to provide a true example of fire start and behavior. Partially furnished rooms with false fire sets such as cotton batting, excelsior or flares will not provide real life results regardless of what the tests are trying to accomplish.

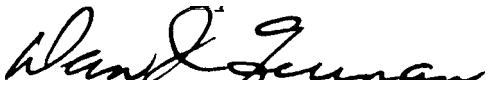
I also fully agree that if tests are to be made of smoke detectors, selection should be of used detectors from one to ten years old and not new extra sensitive set samples. This also is not true to life testing.

A twenty year old sprinkler head will operate the same as one newly installed head.

To sum up Dick, I believe that intentional fraud was perpetrated on the public by these dunes tests and I also believe that the fraud is criminal.

If only the right people can read and comprehend your report then I believe the Attorney General of the United States should bring charges against those responsible for this hoax.

Yours Truly,



Dan Quinan
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908 Lexington Ave.
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FIRE PROTECTION ENGINEERING
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August 6, 1991

To Richard Patton

From Joe Randall
Fire Protection Engineer

Subject: Your Dunes Test Critique

To me you have proven the following:

The tests failed to use the products on the market which are purchased by the consumer. The light transmission standards for the test equipment was far superior to those installed in homes.

The possible deterioration of the equipment was ignored.

The tests did not give a good cross section of typical residential fires.

CONCLUSION - THE FINDINGS OF THE REPORT ARE MISLEADING. OBJECTIVE TESTING USING SIDE BY SIDE FIXED TEMPERATURE: , SMOKE DETECTORS, RESIDENTIAL FIRE SPRINKLERS AND RATE OF RISE DEVISES OVER A WIDE RANGE OF FIRES SHOULD BE CONDUCTED.

The long history of success of Fire sprinklers which are fixed temperature devices was ignored.

The value of smoke detectors is greatly exaggerated by this study.

If I can help you in your program please let me know.

APPENDIX

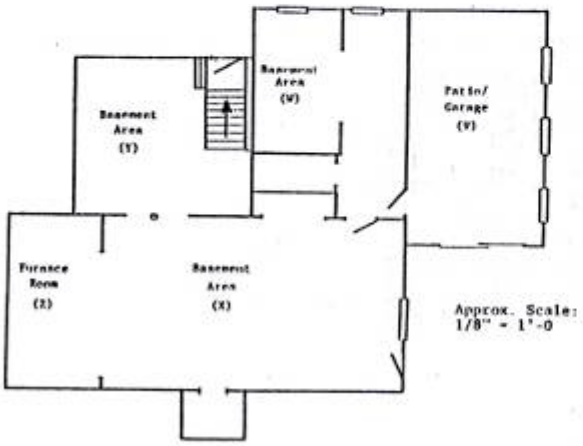


Figure 1. Basement floor plan for J. R. Whitehouse residence.

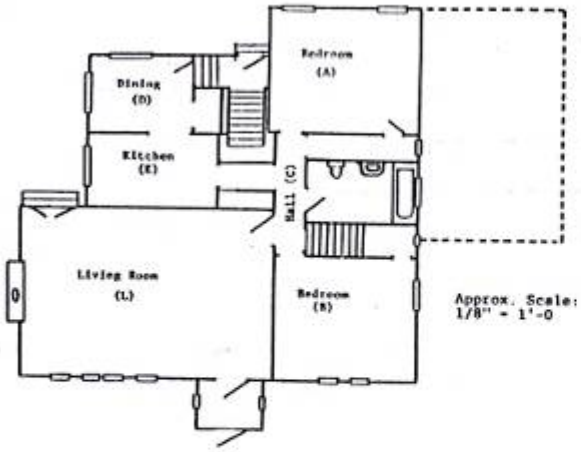


Figure 2. First-floor plan for J. R. Whitehouse residence.

Figure 3. Second-floor plan for J. R. Whitehouse residence.

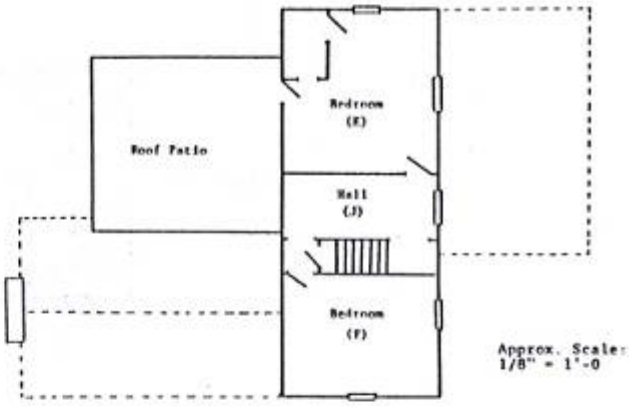
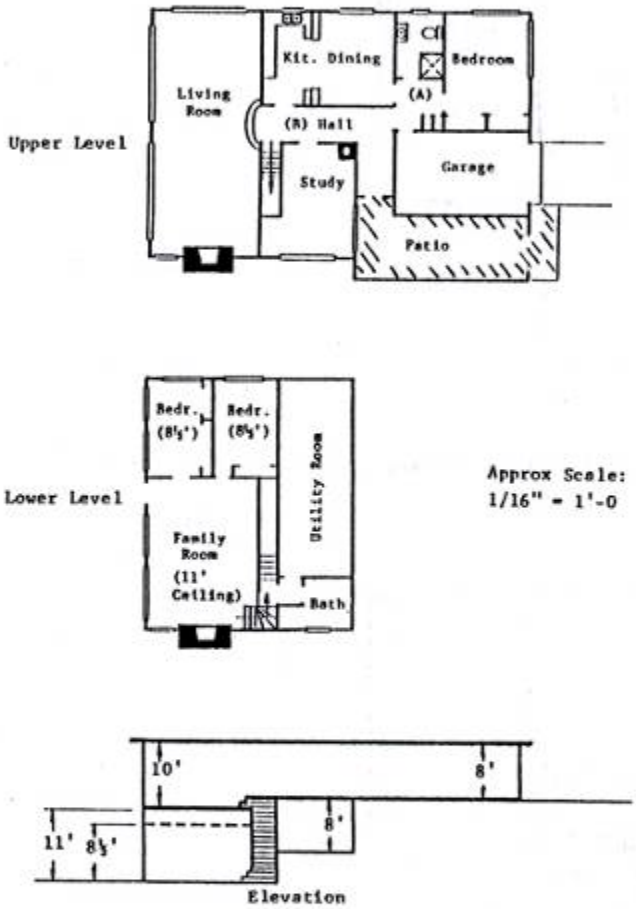


Figure 4. Floor plans for Lakeshore residence.



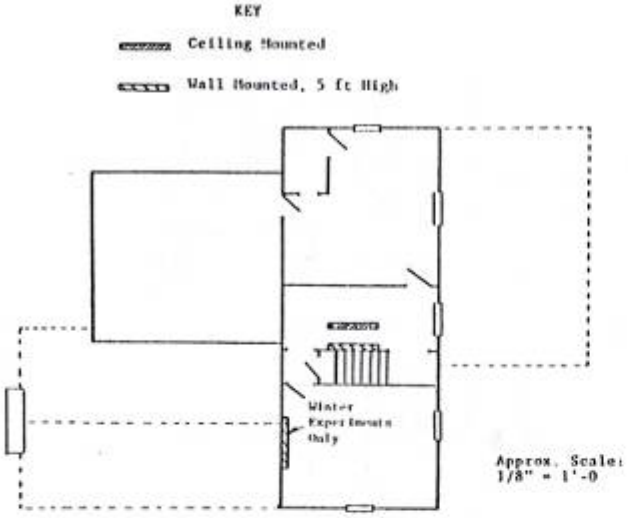


Figure 9. Fixed light beam locations (smoke) on second floor of J. R. Whitehouse residence.

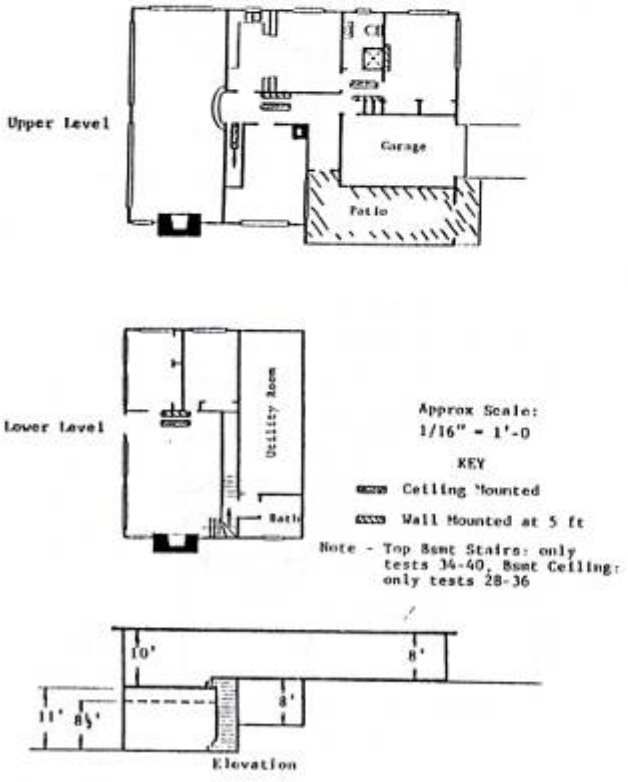


Figure 10. Locations of light beams for smoke measurements (except for ignition room) in Lakeshore residence.

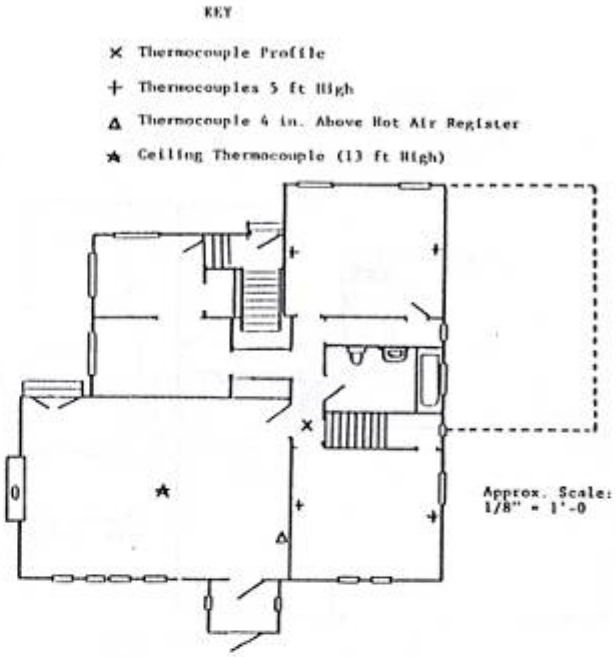


Figure 11. Fixed temperature measurements on first floor of J. R. Whitehouse residence.

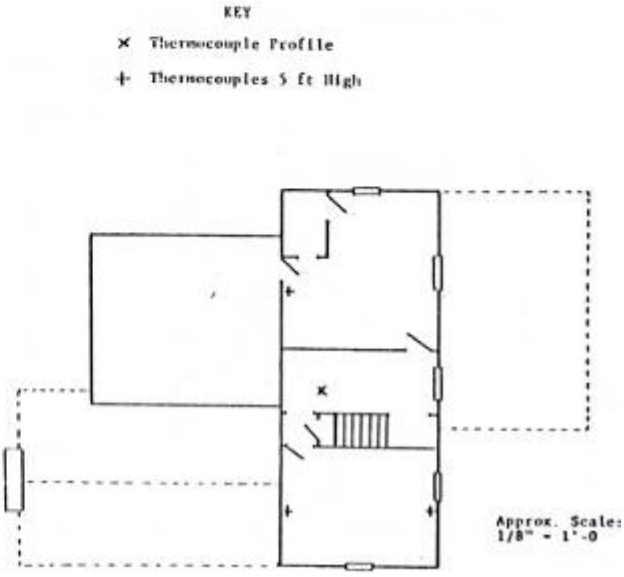


Figure 12. Fixed temperature measurements on second floor of J. R. Whitehouse residence.

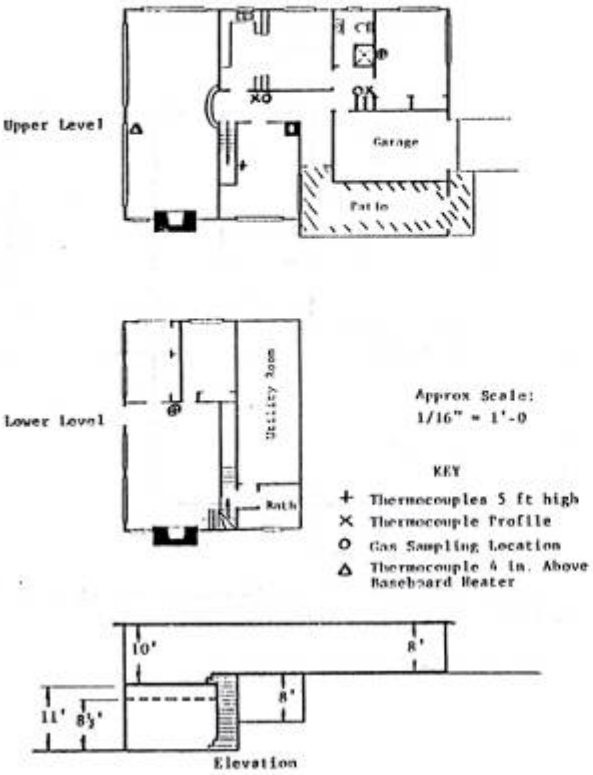


Figure 13. Fixed temperature measurements and gas-sampling locations in Lakeshore residence.

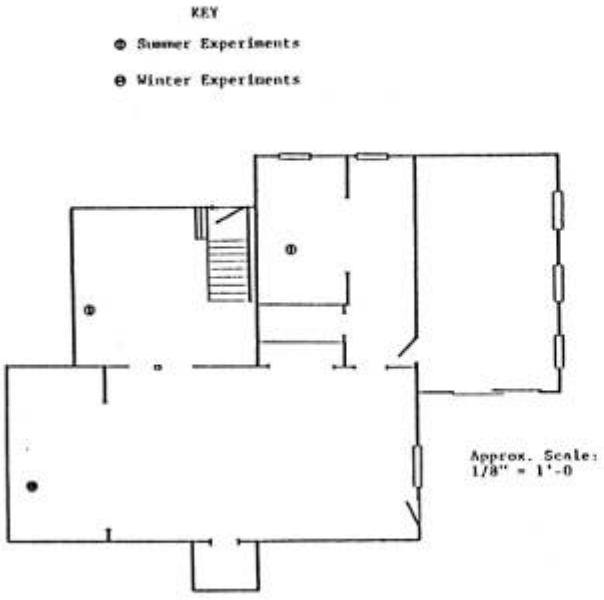


Figure 14. Gas-sampling locations on basement floor of J. R. Whitehouse residence.

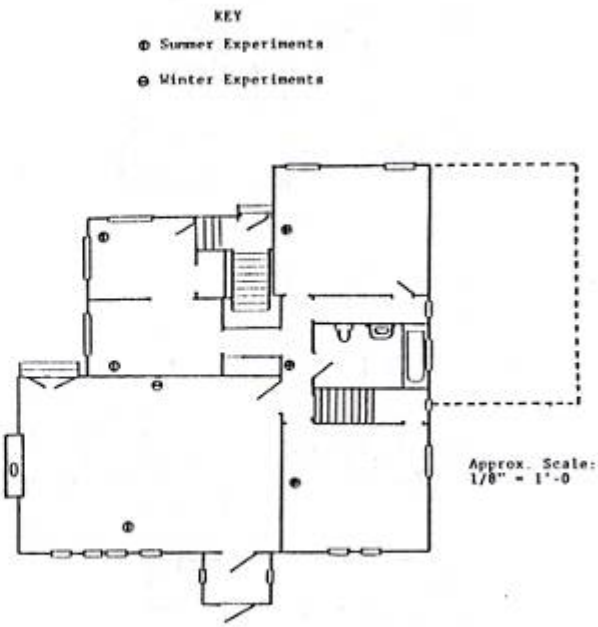


Figure 15. Gas-sampling locations on first floor of J. R. Whitehouse residence.

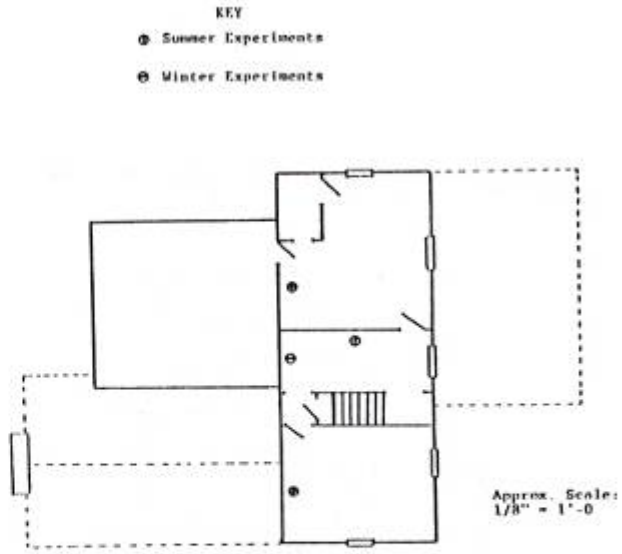


Figure 16. Gas-sampling locations on second floor of J. R. Whitehouse residence.

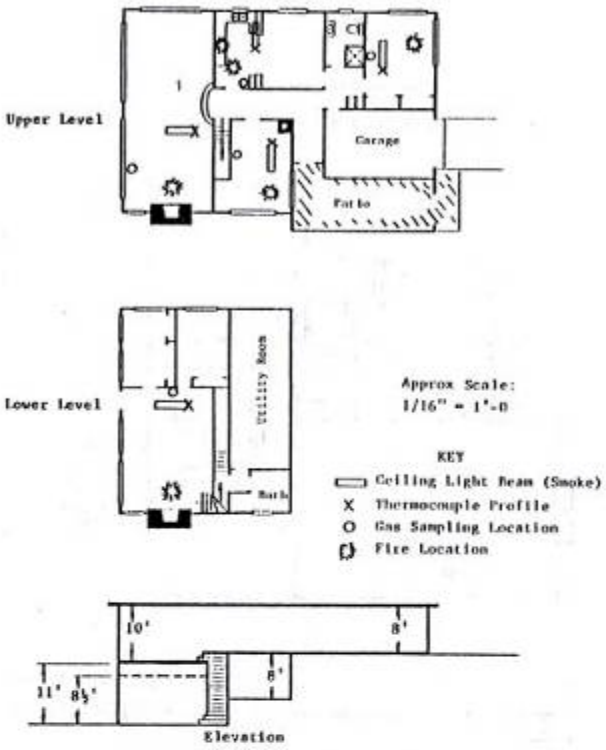
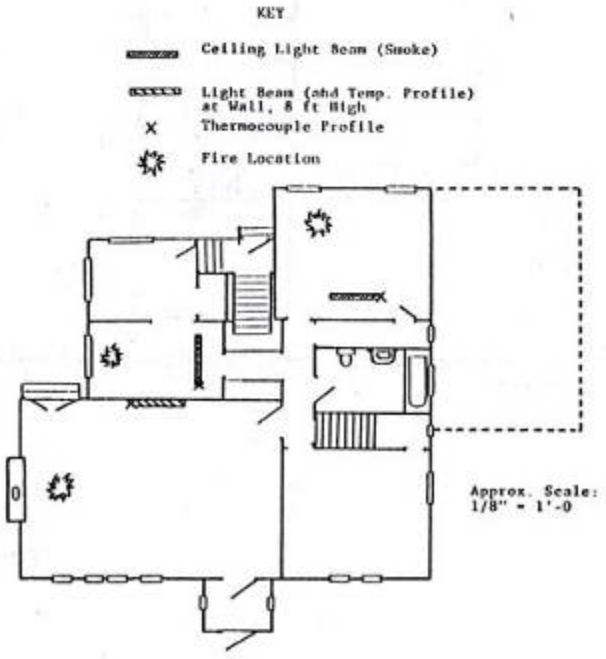


Figure 17. Fire locations and portable ignition room instrumentation in Lakeshore residence.

Figure 19. Fire locations and portable ignition room instrumentation on basement floor of J. R. Whitehouse residence.

Figure 18. Fire locations and portable ignition room instrumentation on first floor of J. R. Whitehouse residence.



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