

**FIRE SAFETY
REGULATION IN THE
UNITED STATES**

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REASONS GIVEN TO 'PROVE' SMOKE DETECTORS WORK.

- For the past 30 years studies, including the most recent NIST studies, have shown that they detect fires in time to provide adequate warning to occupants and that there is no qualitative difference in different types of technology, i.e. ionization vs. photoelectric.
- Statistics support this:
 - *Fire deaths have decreased since introduction of smoke detectors so they must work .*
 - *Statistics indicate that having a smoke detector decrease chance of deaths by 50%.*
- All smoke detectors are required to pass the UL smoke detector tests, which are robust and consist of a comprehensive test programs.

THE “TRUTH” REGARDING

‘PROOF’ THAT SMOKE DETECTORS WORK

- **Part One (Studies) - Studies over the past 25 years, including the most recent NIST studies, have shown that in some important scenarios that ionization detectors will often not work and that there is a qualitative difference between ions and photos.**
- **Part Two (Statistics) - There are a lot of reason for the decrease in fire deaths. In fact, statistics indicate that there is probably something wrong with the effectiveness of detectors, i.e. ionization detectors.**
- **Part Three (UL Approval) - All smoke detectors are required to pass the UL detector tests, but the test are not robust and comprehensive. They fail to adequately test for the kind of smoke that occurs in many fires.**

PART ONE

REVIEW OF SMOKE DETECTOR STUDIES

GENERALLY ACCEPTED OPINION REGARDING DETECTOR STUDIES

“When either ionization or photoelectric smoke detectors are located outside bedrooms and on each level of a house, they provide adequate warning to allow occupants to evacuate through their normal egress routes in most residential fire scenarios”. (NIST Review of Detector Studies, Fire Journal 1993.)

“In the 1990’s, reports surfaced that some privately funded testing had shown delayed response from smoke alarms using ion-type sensors to smoldering fires, While detailed reports were never published in the open literature, these persistent reports were the cause of some concern.” (From recent NIST Study.)

SCOPE OF NIST REVIEW

“An international literature search for publications dealing with the subject of fire detection was recently completed. This review identified 975 citations, 100 of them in foreign languages that were published in the last 15 years (76-91). As of June 1991, the cut-off date for inclusion in the bibliography, no studies, other than those cited here - and one in which only smoke detectors were tested - were published in open international literature that dealt with this topic. (I.e. heat and smoke detectors in residential settings.)” (NIST Review of Detector Studies, Fire Journal 1993.)

BREAKDOWN OF SMOKE DETECTOR STUDIES

- **Studies conducted prior to the mid-70's.**
 - Very old technology and older furniture. Not relevant.)
- **Studies conducted during the mid-late 70's.**
 - One cannot draw definitive conclusions from these studies unless the detector technology and furniture were similar to today's.
- **Studies conducted late 70's, early 80'.**
 - UL Smoldering smoke test caused increase sensitivity in detectors.
- **Studies conducted after mid 80's**
 - In 1984 and again in 1987 UL made changes to address nuisance alarms that had the affect of desensitizing detectors, particularly ionization detectors.

HISTORICAL DETECTOR STUDIES

(ITALICIZED STUDIES WERE NOT IN NIST SURVEY)

TESTING AGENCY	YEAR	COMMENTS
National Research Council of Canada	1962	This was a study (no testing) that just used judgement to est effectiveness of detectors.
Los Angeles Fire Dept.	1960	This used heat detectors and older photoelectric technology
Bloomington MN Fire Dept.	1969	Remote smoke detectors better than nearby heat detectors. Older technology..
<p>According to the NIST Study, published in Fire Journal, The smoke detectors used in the next test were <i>“significantly improved over those used in prior test and were <u>essentially equal to that of current devices.</u>”</i></p> <p>(I do not consider this to be accurate.)</p>		
Japan Housing Corp	1974	Smoke detectors better than heat detectors.
Factory Mutual Apartment Study*	1974	Ion good for flaming bad for smoldering Photo good for smoldering bad for flaming
Indiana Dunes	1976	Smoke Detectors better than heat detectors and one detector per level desireable
Massachusetts Analysis of Dunes	1976	A smoke detector per level will provide 3 minutes of escape time 89% of the time.

HISTORICAL DETECTOR STUDIES

(ITALICIZED STUDIES WERE NOT IN NIST SURVEY)

TESTING AGENCY	YEAR	COMMENTS
<i>Edmonton Fire Dept.</i>	<i>1976 (N/I)</i>	<i>Both ion and photo provide considerable life safety. In smoldering ion may go off too late.</i>
<i>Minneapolis Fire Dept. *³</i>	<i>1978</i>	<i>Both Ion and Photo gave good early warning if smoke could reach detector.</i>
<i>Australian Dept. of Housing and Const. *³</i>	<i>1979</i>	<i>All Smoke detectors adequate and smokes better than heats for flaming fires.</i>
<i>Modern furnitue, containing plastics used in all studies after this point. Modern furniture was used in some of the previous studies, i.e. FM.</i>		
<i>CAL CHIEFS LA Fire*³</i>	<i>1978</i>	<i>Smoke detectors more reliable than heat detectors. NIST analysis concluded both types of smoke detectors adequate. (Modern furn used, LAFD and IAFC Reps favor photo-electrics based on the results.)</i>
<i>Fire Research Station (Great Britain)</i>	<i>1978 (N/I)</i>	<i>Both ion and photo respond rapidly to flaming. Ion was not adequate in smoldering</i>
<i>Detection of Smoldering Fire – Melbourne (Fire Tech)</i>	<i>1986 (N/I)</i>	<i>Photoelectric detectors provided adequate escape time for most fires. Ionization generally were inadequate.</i>

N/I means prior to 1991 but, not included in NIST Study.

HISTORICAL DETECTOR STUDIES

(ITALICIZED STUDIES WERE NOT IN NIST SURVEY)

TESTING AGENCY	YEAR	COMMENTS
<i>Norwegian Fire Research Lab Study</i>	<i>1993</i>	<i>There are reasons to indicate ions are inadequate for smoldering fires. Ion only 15-20 secs better than photo in flaming fires. Advantage only beneficial under extraordinary circumstances.</i>
<i>Smoke Alarms In Typical Dwelling Fire Research (GB)</i>	<i>1997 (Pt 1)</i>	<i>Ion cannot be guaranteed to detect smoldering fire. Ion better at flaming and difference could be critical. (smolder > 30 m)</i>
<i>Practical Comparison of Alarms Fire Research (GB)</i>	<i>1997 (Pt 2)</i>	<i>Both Ion and Photo Adequate (In Pt 2 the “smoldering fire” appeared to smolder for a shorter period than in Pt 1</i>
<i>Simplex Study- 12th International Detection Conference</i>	<i>2001</i>	<i>Ion detector only slightly better for flaming. Photo provides clear advantage over ion if most likely danger is from smoldering fires</i>
<i>KEMANO FIRE STUDIES NRC-Canada</i>	<i>2002</i>	<i>Both Ion and Photo appeared to be adequate. (Fire appeared to smolder for less than 15 mins.</i>

SCOPE OF NIST REVIEW

- ***No studies, other than those cited here - and one in which only smoke detectors were tested - were published in open international literature (from 76-06/91) that dealt with this topic.***
- ***If article was published in 1993 why was 06/91 cut-off date? (Allowed Norwegian Study to be ignored.***
- ***Why ignore a study in which only smoke detectors tested? (Allowed Australian Study to be ignored.)***
- ***1979 Study by Fire Research Station ignored. (If I found this study how did NIST miss it?)***

NORWEGIAN FIRE TESTS (07/91)

- **"During smouldering fires it is only the optical detectors that provide satisfactory safety. With flaming fires the ionization detectors react before the optical ones. *If a fire were started by a cigarette, optical detectors are recommended.* If not the response with these two types of detectors are so close that it is only in extreme cases that this difference between optical and ionization detectors would be critical in saving lives."**
- **"The ionization detectors detected smoke from a smoldering fire much later than optical detectors. When the particular conditions during the fire development are taken into consideration there are reasons to indicate that this detection would not provide adequate safety during this type of fire. "In general the difference between the alarm times for the optical and the ionization detectors are reduced when detection is made from an adjacent room. This can be related to the fact that particles included in the smoke tend to coagulate."**

STUDY OF DETECTORS IN BEDROOMS & CORRIDORS (BRITISH GOVT. 1979)

- **Conclusion (From Title Page):**
 - "The work has shown that ionization chamber type detectors in the room of origin or in the corridor do not necessarily provide adequate warning that the escape route is impassable, or that the conditions in the room of origin are hazardous to life. This observation stems from the apparent lack of sensitivity of ionization chamber detectors to smoke from smoldering bedding."
- **Quotes from Discussion**
 - *Smouldering Fire:* "An interesting point to note is that, despite the fact that it did not operate in the very high concentration of smoke present immediately before the bed finally ignited, the ionization chamber detector in the main room (room of origin) operated positively and rapidly (within 15 secs) after the first appearance of flames."

Smoldering Dwelling Fires - Australia (Fire Technology 1986)

- **Photoelectric and ionization detectors sited in bedrooms with door partly ajar provide adequate detection of smoldering smoke only when it originates in the same room.**
- **Photoelectric detectors sited in the hallway are more effective for detecting smoldering smoke than ionization detectors, providing adequate escape time for most conditions of size and location of the smoke source**
- **Ionization detectors sited in the hallway generally provide in-adequate escape time unless smoke movement into the hallway is slowed down by narrow door openings, causing a slower loss of visibility, or unless they are sited close to the smoke source.**
- ***An acceptable arrangement for protection against smoldering fires under the conditions investigated appears to be photoelectric smoke detectors located at each end of the hallway.***

CLARIFICATIONS REGARDING NIST'S ANALYSIS OF DETECTOR STUDIES

- There were three studies, in the “public literature prior to 1991”, not discussed in the NIST/Fire Journal article. All three identified ion detectors as inadequate for smoldering fires.
- FM’s Study could be used to support photos over ions when one accounts for the “L-Factor” identified by Heskestad.
- Both Fire Service Organizations involved with the CAL Chiefs Study, LAFD and IAFC, felt that the results demonstrated photoelectric technology’s superiority.
- For the past 30 years, every study that used modern furniture and smoldered material for at least 30 minutes concluded that ionization technology was inadequate for smoldering.
- Although all studies recognized that ion were superior for flaming fires, no study felt that photoelectric were not adequate for flaming fires.

Note: My analysis was done by reading every periodical in the NFPA library over a period of about 3 years.

QUESTION:

ARE NIST CONCLUSIONS FROM RECENT TESTING, REGARDING RELATIVE BENEFITS OF ION VS. PHOTO, CONSISTENT WITH THESE OTHER STUDIES?

NOTE: Since the Smoldering Fires in the NIST Test smoldered for more than 30 minutes and used modern furniture, it should be compared to other tests that had these characteristics.

ANSWER?

“A report from the Commerce Department’s National Institute of Standards and Technology (NIST) today stated that both types of commercially available home smoke alarms (also called smoke “detectors”) consistently provide people enough time to escape most residential fires.” - NIST Press Release

THIS WOULD APPEAR TO CONTRADICT PREVIOUS SIMILAR TESTS (I.E. TEST THAT SMOLDERED MODERN FURN. >30 MINS) THAT FOUND ION INADEQUATE FOR SMOLDERING,

- DOES IT?

ASET - MANUFACTURED HOME

(PAGE 242, TABLE 27)

	PHOTO	ION
FLAMING		
Living Room	85	142
Bedroom	58	93
Bedroom(Door Closed	451	898
SMOLDERING		
Living Room	172	-43
Bedroom	1091	82
COOKING		
Kitchen	575	821

Smoldering fires in living room were the #1 fatal scenario.

ASET – 2 STORY HOME

(PAGE 243, TABLE 28)

	PHOTO	ION
FLAMING		
Living Room	108	152
Bedroom	---	374
Bedroom(Door Closed	3416	3438
SMOLDERING		
Living Room	3298	16 
Living Room (AC on)	2772	-54 
Bedroom	135	135
COOKING		
Kitchen	952	278

Smoldering fires in living room were the #1 fatal scenario.

NIST'S REASONS WHY CURRNET RESULTS DIFFER FROM 1975

- **Main difference in amount of escape time attributed to (Page 248):**
 - 1) Different and more conservative tenability criteria***
 - 2) Fire growth rates significantly faster***
- **In reality, since the obscuration criteria was always the limiting criteria, i.e. the first to be reached, the tenability criteria are essentially the same.**
- **In addition, although the flaming fire starts have an 80% decrease in time to untenability, The smoldering fire only have a 20% decrease and still do not reach untenability for over 50 mins on average**

MARGIN OF SAFETY (MOS) VS. AVAILABLE SAFE EGRESS TIME (ASET)

- ***MARGIN OF SAFETY = ASET - TIME REQUIRED FOR EVACUATION***
- ***ASET = Time to Untenability – Time to Detection***
- ***TIME REQU. FOR EVAC = React Time + Travel Time***
 - When looking at untenability computer model ASETB computes the level of untenability at location of victim. Atmosphere may be untenable near bedroom but, at that time, occupant could be exiting through living room.
 - Daytime evacuation times should be treated differently than nighttime evac since most victims are awake.

ANALYSIS OF NIST REPORT, RENO 2006

- **Ionization did NOT provide enough time for ANY victims for LR smoldering fire**
- **Ionization did NOT provide enough time for SOME victims for BR smoldering fire**
- **Photoelectric did NOT provide enough time for SOME victims for LR flaming fire**
- **Ionization and photoelectric both did NOT provide enough time for SOME victims for BR flaming fire**
-- *Between the two, photoelectric did worse*

BUT - Author neglects to point out “unstated assumption ...

“UNSTATED” ASSUMPTION

- **NFPA ASSUMES THAT EGRESS WILL TAKE 2 MINUTES IN ALL SCENARIOS AND THAT VICTIM DIES WHENEVER ANY POINT ALONG EGRESS PATH EXCEEDS TENABILITY WITHIN 2 MIN PERIOD. THIS IS FLAWED IN SEVERAL WAYS.**
 - ***FOR SMOLDERING INITIATED SCENARIOS VICTIM WILL BE ASLEEP, SO 2 MINS OK.***
 - ***FOR MOST FLAMING INITIATED SCENARIOS VICTIMS WILL BE AWAKE SO 30-45 SECS OK.***
 - ***FOR BEDROOM FIRES IT IS ONLY NECESSARY FOR VICTIM TO LEAVE BEDROOM AREA BUT FOR LIVING ROOM FIRES VICTIM NEEDS A SAFE ATMOSPHERE ALL THE WAY TO THE OUTSIDE***

RE-CONSIDERATION OF ANALYSIS OF NIST REPORT

- Ionization did NOT provide enough time for ANY victims for LR smoldering fire (-43, -54, 16) <120
 - Ionization did NOT provide enough time for SOME victims for BR smoldering fire (82, 135) < 120
 - Photoelectric did NOT provide enough time for victims for LR flaming fire (85, 108) > 45
 - Ionization and photoelectric both did NOT provide enough time for SOME victims for BR flaming fire (ION = 93, 374) (PHOTO = 58) >45
- Between the two, photoelectric did worse (But still adequate - my words.)*

WHAT IS A SMOLDERING FIRE? FROM RENO ANALYSIS)

- Fires with no extent of flame beyond the first item ignited account for at most 3% of fire deaths. This is an upper bound on deaths associated with fires that only smolder.
- Roughly 25-30% of home fire deaths involve fires estimated to have an initial smoldering phase. This estimate includes all cigarette fires and some/most electrical wiring fires.

THIS GIVES IMPRESSION THAT SMOLDERING FIRES ARE A SMALL PART OF THE PROBLEM.

IMPORTANCE OF SMOLDERING FIRES

- In a 1979 study of fatal fires, the NFPA found that, "two-thirds of the deaths in one and two fatality fires resulted from fires between the hours of 8pm and 8 am. Moreover, most of these deaths occurred in fire that gained large head starts - over 40 minutes for 38% of such deaths - before discovery.(Fire Journal)
- A British Study of fatal fires broke the fires into two types. Fires est. to have been discovered within 5 minutes of ignition (most likely to have been rapidly growing fires) and for fires where the time to discovery is estimated to have been 30 minutes or more (most likely to have involved a period of prolonged smoldering before severe flaming). There were 20 times more victims per fire for the smoldering scenarios. (NFPA HB)
- Delayed discovery, typically associated with fires that occur at night when everyone is asleep, also tends to be a characteristic of the smoldering fire caused by discarded smoking material. These smoldering fires are the leading causes of US fire fatalities and detectors are ideally designed to deal with them.
- "A Decade of Detectors", Fire Journal 09/85, John Hall.

OUR CHALLENGES - ACCORDING TO, RENO ANALYSIS

- To evaluate factors in smoke alarm performance seriously, systematically, scientifically, and comprehensively. ***(IS MY ANALYSIS NON-SCIENTIFIC, NON SYSTEMATIC?)***
- To avoid solutions that address one problem but make overall performance worse. ***(HOW WOULD SWITCHING TO PHOTOS MAKE PROBLEM WORSE?)***
- To move quickly when an unacceptable situation clearly exists and a better way to handle it also clearly exists. That's why TIA's exist.

IMPORTANCE OF CONSENSUS AND COST- RENO ANALYSIS

- Different groups balance affordability/practicality vs. performance/reliability in different ways. ***(WHAT DOES THIS MEAN? WHAT GROUPS IS HE TALKING ABOUT?)***
- Consensus has to embrace every point of view. Particularly if it's adopted as law. ***(HOW MANY CODE OFFICIALS ON NFPA COMMITTEE?)***
- An ideal, expensive system that nobody buys is worth just as much as a worthless, cheap system that everybody buys – Nothing. ***(WHAT EVIDENCE IS PRESENTED THAT CONSUMERS ARE NOT WILING TO PAY AN EXTRA \$5 PER DETECTOR? IF MANDATED THIS IS NOT EVEN AN ISSUE.)***

DO NFPA COMMITTEES ADEQUATELY REPRESENT SOCIETIES VALUES?

- *“ The typical industry-controlled code or standard is formulated by a committee elected or appointed by a technical society or similar group. Many of the committee members are drawn from the manufacturers to whom the code is to be applied. Others are drawn from engineering consulting firms and various Government organizations. However, since near unanimous agreement in the committee must generally be obtained to set requirements or to change them, the code represents a minimum level of requirements that is acceptable to industry. ... Described by code committees and by the language of many codes themselves as safety rules, they tend to inhibit those legally responsible for protecting the public from taking the necessary action to safeguard health and well being. Many states and municipalities have incorporated these codes into their laws, thus, in effect delegating to code committees their own responsibility for protecting the public.” - Admiral Hyman Rickover,*
- *Congressional Testimony,1970, quoted in Occupational Safety Management and Engineering.*

“MANUFACTURING UNCERTAINTY”

- **Opponents of safety regulations often try to “manufactur uncertainty” by questioning the validity of scientific evidence on which the regulations are based. Though most identified with the tobacco industry, this strategy has also been used by producers of other hazardous products. Its proponents use the label “junk science” (or non-scientific - my words) to ridicule research that threatens powerful interests. - *David Michaels, Manufacturing Uncertainty”, American Jouranl of Public Health 2005.***

IS MORE ANALYSIS NEEDED?

- In our current regulatory system debate over science has become a substitute for debate over policy. Opponents of regulation use the existence of uncertainty, (e.g. “what is a smoldering fire?” - my words) no matter its magnitude or importance, as a tool to counter imposition of public health protections that may cause them financial difficulty. *(Michaels)*
- All scientific knowledge is liable to be upset or modified by advancing knowledge. That does not confer upon us a freedom to ignore the knowledge we already have, or to postpone action that it appears to demand at a given time. *(Hill, Royal Society of Medicine, 1965.)*

PART TWO

REVIEW OF STATISTICS

SMOKE DETECTORS – FIRESAFETY’S GREATEST SUCCES STORY - NIST

- **Smoke detector usage rose from 10% in 1975 to 95% in 2000 while home fire deaths cut in ½.**

***“Thus the home smoke alarm is credited as the greatest success story in fire safety in the past part of the 20th century, because it alone represented a highly effective fire safety technology with leverage on most of the fire death problem that went from token usage to nearly universal usage in a remarkably short time.” –
NIST Executive Summary***

HOW MUCH OF REDUCTION IN FIRE DEATHS IS DUE TO DETECTORS?

- In the late 70's approximately 6,200 people dies per year in homes.
- According to the NFPA:
 - *If no one had detectors residential fatalities = 4,230.*
 - *If everyone had detectors resid fatalities = 2,430.*
 - *Actual ave for 1999-2001 = 3,140 fatalities per year.*
- According to the NFPA, fatalities would have decreased by approx 2,000 people per year

BURN CARE'S CONTRIBUTION TO FIRE DEATH REDUCTION

- **At the time of America Burning (1975) there were 12 full spectrum burn centers. By 1999 there were over 100 burn centers with 25 being full spectrum. On a yearly basis, deaths, once the victim has been placed into the burn care system, have decreased from around 4,000 to 1,000. (*America Burning Recommissioned – 1999*)**
- **This reduction may be partially due to the fact that smoke detectors and FF's SCBA allow victims to be rescued earlier. It has been my personal experience that FFs SCBA has made a significant contribution to victims survival rate.**

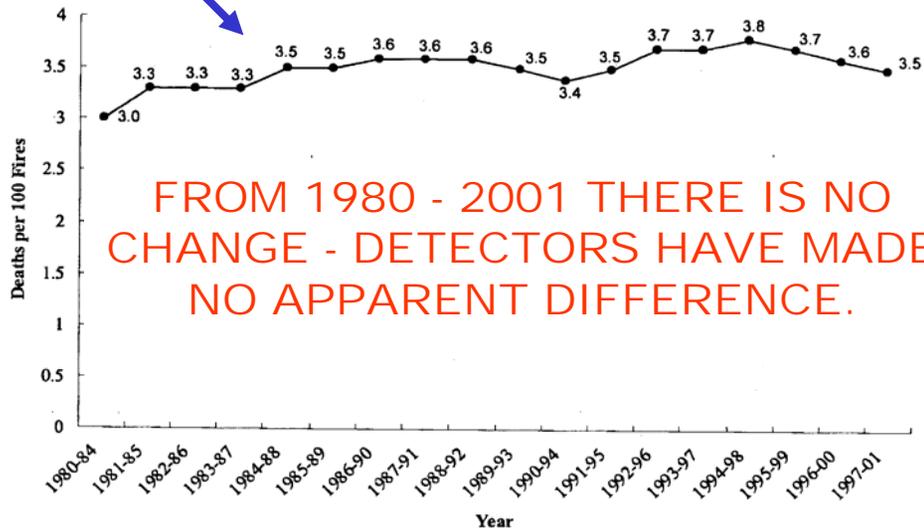
REDUCED SMOKING'S CONTRIBUTION TO FIRE DEATH REDUCTION

- **Stopping smoking can significantly reduce the devastation, injury and cost by fire. 2/3 of all U.S. reductions in fire fatalities related to smoking from 1984 – 1995 were attributed to reductions in cigarette consumption. (Dr. B. Leistikow, University of California at Davis – Cancer Research Dept.)**
- **The most important part of the smoking-material fire problem-the number of structure fires-has declined by two-thirds, or 66 percent, since 1980, while the number of civilian deaths has dropped by 49 percent from the high in 1981 and 44 percent since tracking began in 1980. However, deaths per 100 smoking-material fires were 66 percent higher in 1995 than they were in 1980. (John Hal/, PhD – “Cigarettes Kill”, www.interfire.org - reprinted from NFPA Fire Journal, Jan/Feb 1998)**

SMOKING DEATHS PER 100 FIRES - 5 YEAR ROLLING AVERAGES

This trend should have signaled a problem by the mid 80's.

Figure 4. Trend in Civilian Deaths per 100 U.S. Smoking-Material Home Fires (Five-Year Rolling Averages)



Source: NFIRS and NFPA survey

OTHER IMPORTANT CONTRIBUTIONS TO FIRE DEATH REDUCTION

- ***Mattress and Bedding Fire Fatalities have declined from 937 (1980) to 398 (1998). Down 57%,***
- ***Upholstered Furniture Fire Fatalities have declined from 1,386 (1980) to 550 (1998). Down 60%.***
- ***Increased use of sprinklers(1% homes, 7% apts.)***
- ***Adoption of Model Building Codes***
- ***Adoption of SCBA and other equipment by FD's.***
 - ***Although I do not have any statistics, I can speak from personal experience, that many people are alive today because FFs rescue them who could not, before SCBA.***

TRENDS IN FIRE DEATHS VS. INCREASE IN DETECTOR USAGE

	51-71 (20 YEARS)	65-75 (10 YEARS)	77-87 (10 YEARS)	92-02 (10 YEARS)
INCREASE IN HOMES WITH DETECTORS OVER	0%-<4%	<4%-10%	22%-82%	90%-96%
% DECREASE IN FIRE DEATHS PER MILLION PEOPLE	-26.0% NFPA ESTIMATES HB – 14TH ED..	-27% (Residential) National Safety Council	-29% (All) NFPA	-25% (All) NFPA

FIRE DEATHS WERE DECREASING BEFORE WIDESPREAD USE OF DETECTORS AND CONTINUED TO DECLINE AFTER “MARKET SATURATION”.

NFPA's EST. BENEFIT OF RES. SMOKE DETECTORS

**“ IF A HOME FIRE OCCURS,
SMOKE ALARMS REDUCE
THE RISK OF DEATH BY
40-50%. ”**

DO DETECTORS PROVIDE 40-50% LESS RISK?

COMPARISONS OF ESTIMATES (NFPA METHOD)

		SMOKE DETECTOR PRESENT	SMOKE DETECTOR ABSENT	REDUCTION IN RISK
RISK (NUMBER DEATHS/ 100 FIRES) NFPA ASSUMPT'S <i>BUILT IN</i>	NFPA AVE (99-01) NFIRS V4.0 & V 5.0 (ADJ)	0.65	1.13	43%
	NFPA (2001) NFIRS V4.0 & V 5.0 (ADJ)	0.86	1.13	24%

RISK (NUMBER DEATHS/ 100 FIRES) <i>MORE SPECIFIC DATA</i>	USFA – 2001 (NFIRS V 5.0)	0.772	1.044	26%
	NFPA AVE (99-01) NFIRS V 5.0	1.12	1.21	7.0%
	U.K. (94-97)	0.785	0.767	-2.3%
	U.K.(FROM NFPA) (99-01)	0.63	0.68	-7.0%

% OF FATAL FIRES WERE SMOKE DETECTOR OPERATES

	% OF FATAL FIRES WITH WORKING DETECTORS	% OF HOMES WITH DETECTORS	% OF FIRES WITH WORKING DETECTORS
1988	9%	81%	38%
1990	19%	86%	42%
1994	19%	93%	49%
1996	21%	93%	52%
1998	29%	94%	55%
2001	39%	95%	55%

FROM 1994 – 2001

% OF FATAL FIRES WITH WORKING SMOKE DETECTORS INCREASED 100%

% OF HOMES WITH SMOKE DETECTORS INCREASED 2%

% OF FIRE WITH WORKING SMOKE DETECTORS INCREASED 12%

QUOTES FROM “FIRE IN THE UNITED STATES , 85-94”

- *“Smoke detectors are much less likely to be present when there are fatalities. Detectors do indeed make a difference. Yet in 19% of the reported residential fire deaths in 1994, a detector did operate; in 1988, it was 9%. In some cases the detector may have gone off too late to help the victim, or the victim may have been too incapacitated to react. But the % of deaths with detectors, especially the upward trend, is somewhat disturbing since there is a widespread belief that an operating detector will save lives. Further study is needed to show what other factors were involved with these deaths.”*

QUOTES FROM “FIRE IN THE UNITED STATES , 95-01”

- *“In 39% of fire deaths, an alarm did operate – 10% points higher than in 1998. This is somewhat disturbing since there is a widespread belief that an operating alarm will save lives. In some cases, the alarm may have gone off too late to help the victim, the victim may have been too inebriated or too feeble to react, or the fire may have been too close to the victim. “*

Note: After suggesting further study for several editions, the USFA stopped suggesting that further study is warranted, even though they suggested it when the % of operating detectors in fatal fires was far smaller.

CONCLUSION ON STATISTICS

It appears that a careful review of the available statistics indicates that smoke detectors are not nearly as effective as many people assume. In fact the statistics seem to indicate that there is a “problem” with the smoke detectors that have been used for the past 20 years. I am not saying that they do not work at all. I am saying that they do not appear to work as efficiently as they should. Or as efficiently as they are claimed to be by many experts as well as manufacturers.

When talking about a “problem” with detectors, one is actually talking about a problem with “ionization” detectors, 89% of all detectors. (CPSC-1995)

FATALITIES VS. DETECTOR INFO

(UNKNOWN APPORTIONE IN PARENTHESIS)

	DETECTOR PRESENT OPERATED	DETECTOR PRESENT DID NOT OPERATE	DETECTOR NOT PRESENT	UNKNOWN
USFA 2001 (NFIRS v5)	26.4 (40)	13.7 (20)	26.4 (40)	33.8
MASS 2002 (NFIRS v5)	39.0 (45)	15.0 (17)	33.0 (38)	13.0

- *In both studies approximately 40% of fatalities occur when detector operates. This equals approximately 1400 people per year.*
- *In both studies approximately 20% occur when detector is present but inoperable. This equals approximately 700 people per year.*
- *My analysis of Massachusetts fatalities shows that when detector operate about 1/2 of victims were able bodied and fire was a slow growth fire. Victims should have been able to get out.*

POTENTIAL BENEFITS OF SWITCHING TO PHOTOELECTRIC DETECTORS

- Photolelectric detectors might reduce by 1/2 the # of people dying in smoldering fires when the detector works. (This would be a 20% reduction.)
- Photolelectric detectors might reduce the number of disabled detectors due to nuisance alarms. (Assume problem reduced by 1/4 - 5% reduction)
- It seems reasonable to assume that switching from ionization to photoelectric technology could save 800 lives (.25 * 3,200) per year!

This number could be higher, if # of fatalities that occur when no smoke detector present is over-estimated. (Many Chief's assume that if occupants died then the smoke detector wasn't there - good PR opportunity.

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PART THREE

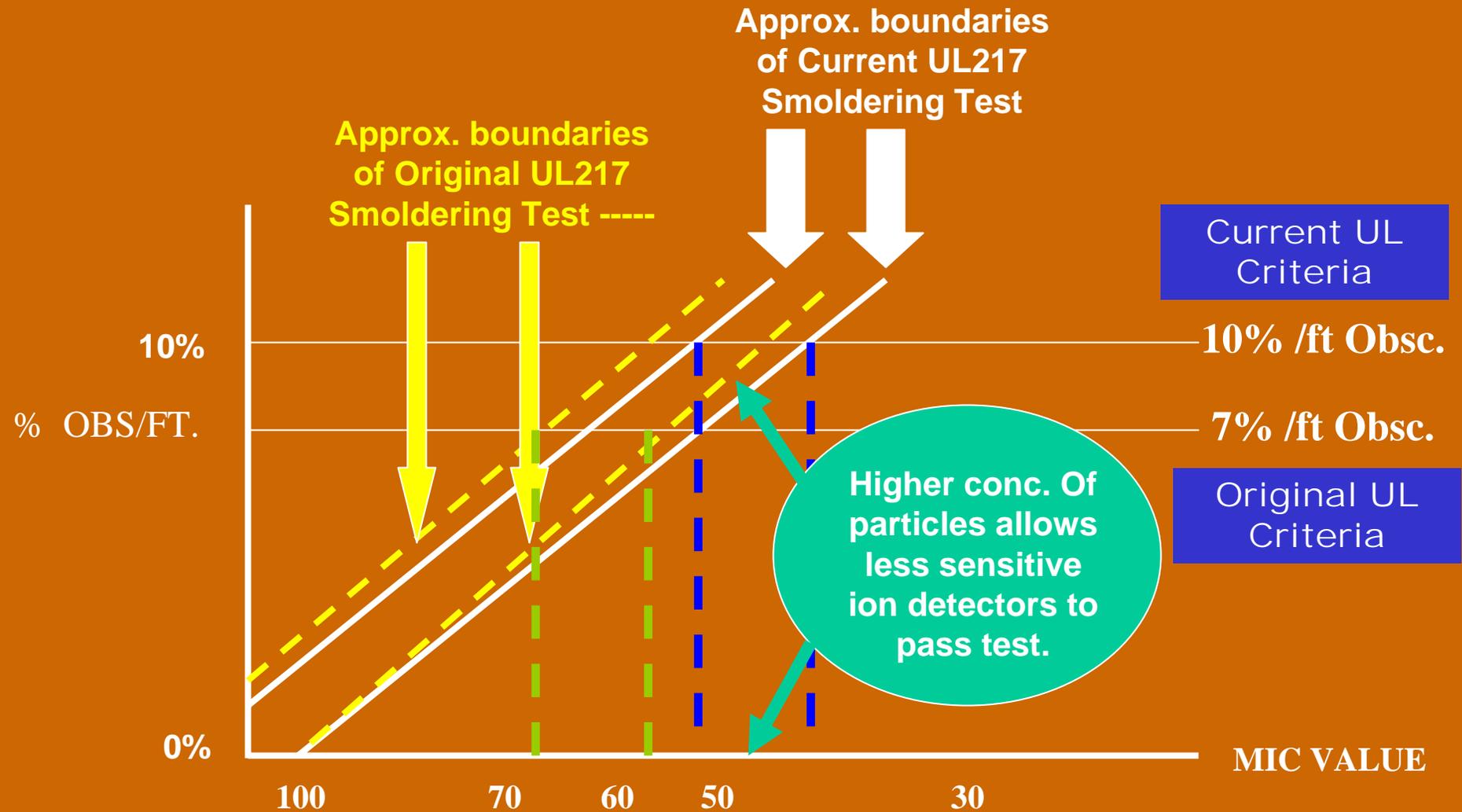
REVIEW OF UL APPROVAL

QUICK HISTORY OF UL217

YEAR	EVENT
<1976	2 Standards: UL167 for Ion and UL168 for Photo
1976	UL217 created using 4 flaming fires from UL167. Prod Sens: 0.2-4.0 gray smoke, 0.5 – 10% for black smoke
1979	Smoldering test added – 7% criteria. (Typical ion detector increased in sensitivity in order to pass this new test.)
Early 80's	Massive nuisance alarm problems cause UL to investigate possible desensitization of detectors.
01/84	Minimum sensitivity for gray smoke increased from 0.2% to 0.5%. (Forces increase in ave. sensitivity.)
05/84	Smoldering Profile “shifted” as well as slower build-up. Insect screen. No response <0.5% in Smoldering Test. Max. sens. for black smoke increased from 10% to 13%
87-88	Passing Criteria of Smoldering Test increased from 7% to 10%. (Allowed increase in production sensitivities.)

QUICK HISTORY OF UL217

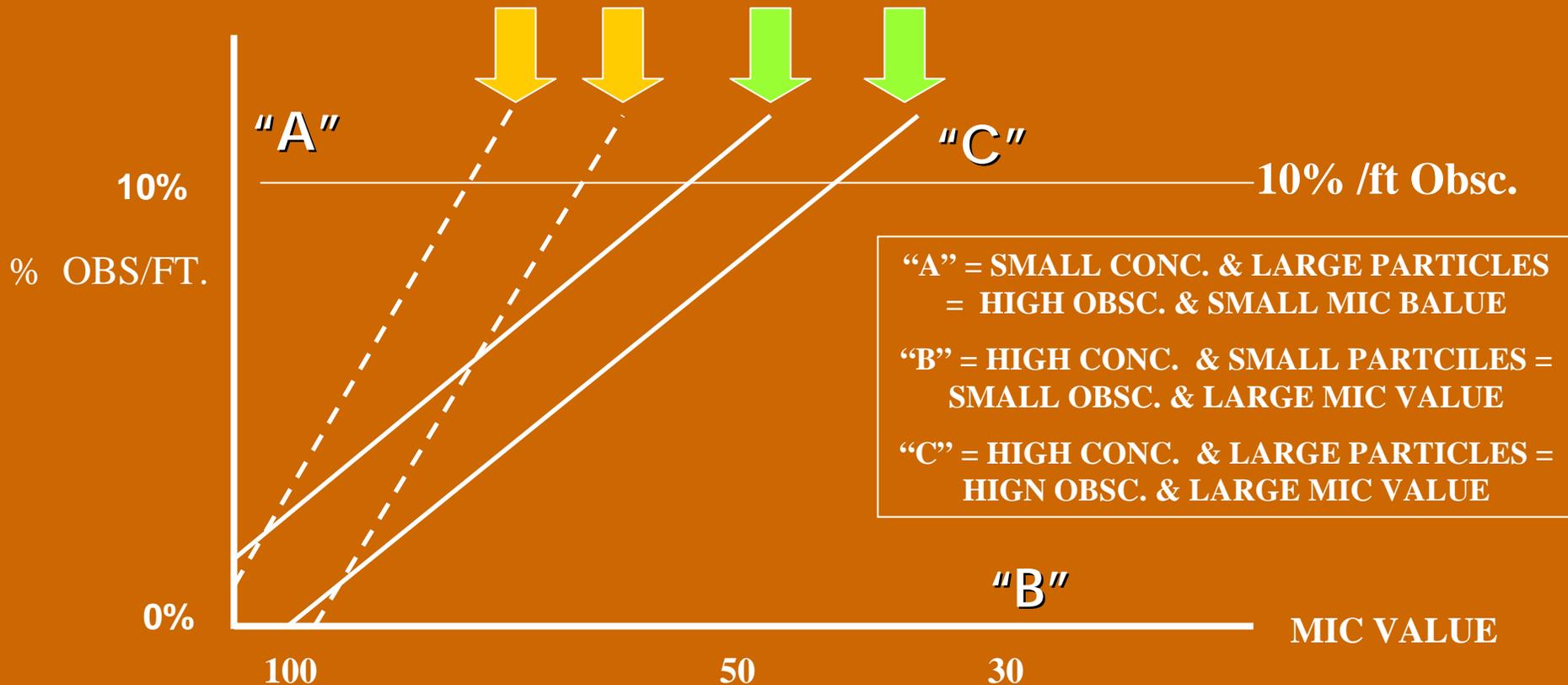
BOUNDARIES "SHIFTED TO RIGHT AND PASSING CRITERIA CHANGES FROM 7% TO 10%



“SMOKE PROFILE” OF UL 217 SMOLDERING TEST

Author’s hypothesized
boundaries of new
UL217 “Plastic”
Smoldering Test

Approx. boundaries
of current UL217
Smoldering Test



EN54 AND UL217 SMOLDERING COMPARISON

Draft 7
August
Page 7

**TF-2, EN54
SMOLDERING
TEST (FAST)**

**TF-7, UL 217
SMOLDERING
TEST (SLOW)**

**≈17% OBS/FT
EN54 PASSING
CRITERIA**

**10% OBS/FT
UL PASSING
CRITERIA**

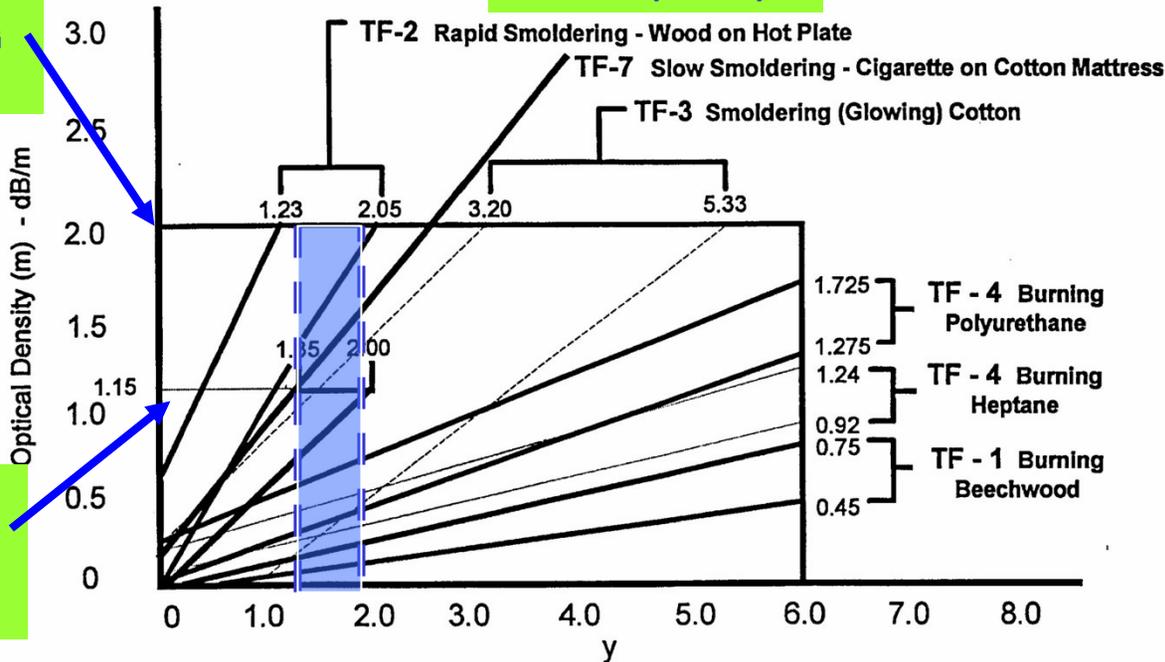
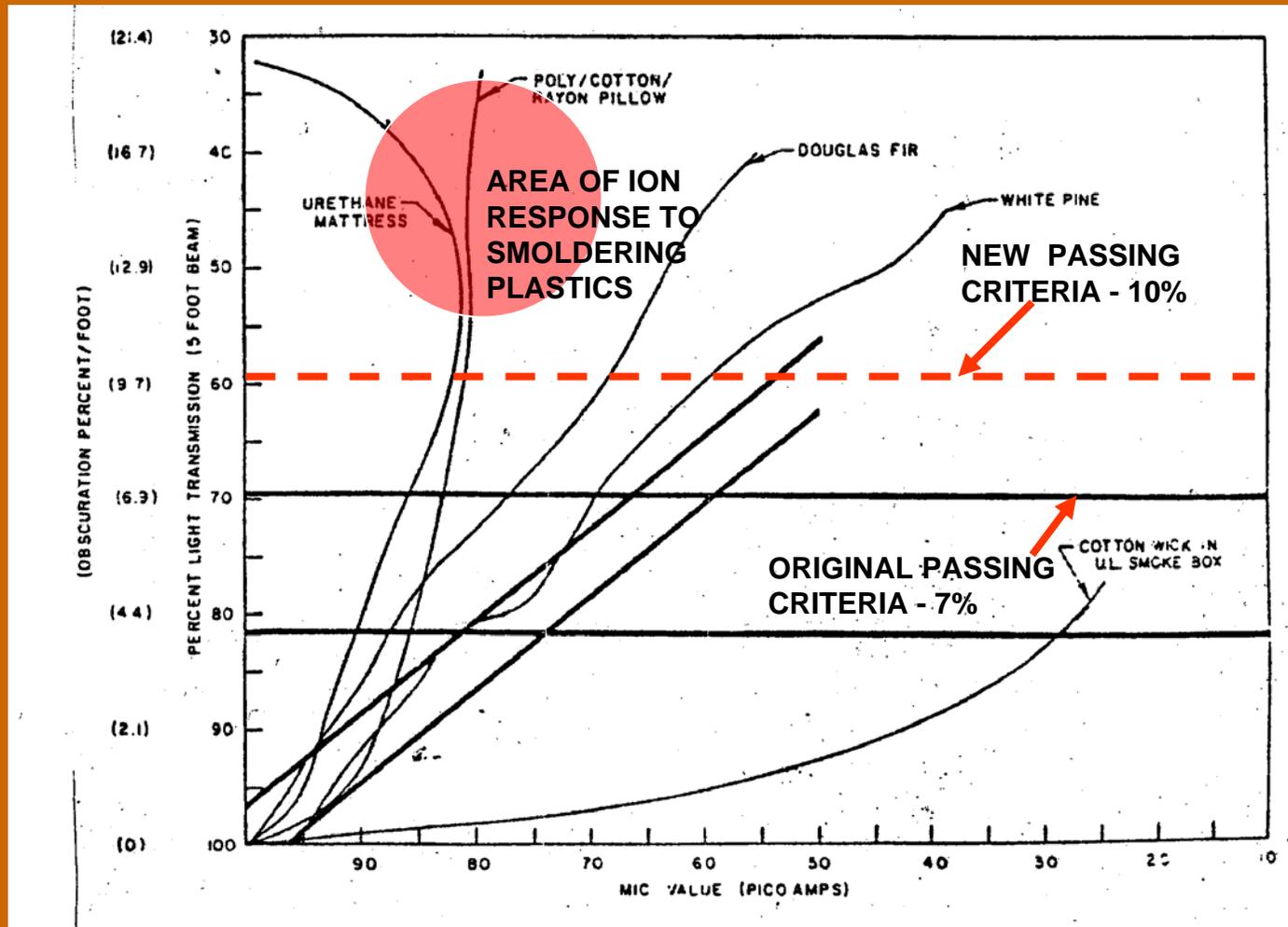


Figure 1
Composite of ISO Test Fires Profile Curves
m Versus y

**NOTE: TF-2 REACHES 10% OBS/FT
IN APPROX. 400-650 SECS**

**NOTE: TF-7 REACHES 10%OBS/FT
IN APPROX. 2,700-4,500 SECS**

SMOKE PROFILE (MIC VS. OBS.) OF SMOLDERING MATERIAL - SCHUCARD



SMOKE BOX SENSITIVITY VS. RESPONSE TO FUELS (Schucard)

IONIZATION DETECTOR				
SMOKE BOX	WHITE PINE	DOUGLAS FIRE	URETHANE MATTRESS	POLYESTER PILLOW
0.85	6.2	7.7	20.0	NO RESPONSE
1.1*	7.4*	NO RECORD	21.6	26.8
1.3*	8.9*	11.2	20.0	21.8
1.78	10.4	15.6	NO RESPONSE	26.8
3.7	9.6	18.0	NO RESPONSE	28.4

*** Ionization detectors at these sensitivities would have flukned original UL test at 7% but passed at 10%.**

SMOKE BOX SENSITIVITY VS. RESPONSE TO FUELS (Schucard)

PHOTOELECTRIC DETECTOR				
SMOKE BOX	WHITE PINE	DOUGLAS FIRE	URETHANE MATTRESS	POLYESTER PILLOW
1.23	1.4	2.2	6.5	6.8
1.5	1.3	1.6	3.6	2.8
1.68	1.2	0.85	0.5	1.0

As would be expected, the photoelectric detectors are responding to white pine at approximately the same % obscuration per foot as their smoke box sensitivity rating. When UL changed the passing criteria, it was to allow for less sensitive ionization detectors not photoelectric detectors.

SUCCESS PREDICTION FROM HARPE AND CHRISTIAN

ORIG. UL217 PASSING CRITERIA - 7%

2ND UL217 PASSING CRITERIA - 10%

SMOLDERING FIRE
SUCCESS RATE

VS.

%OBS/FT

AT TIME OF DET.
ACTIVATION

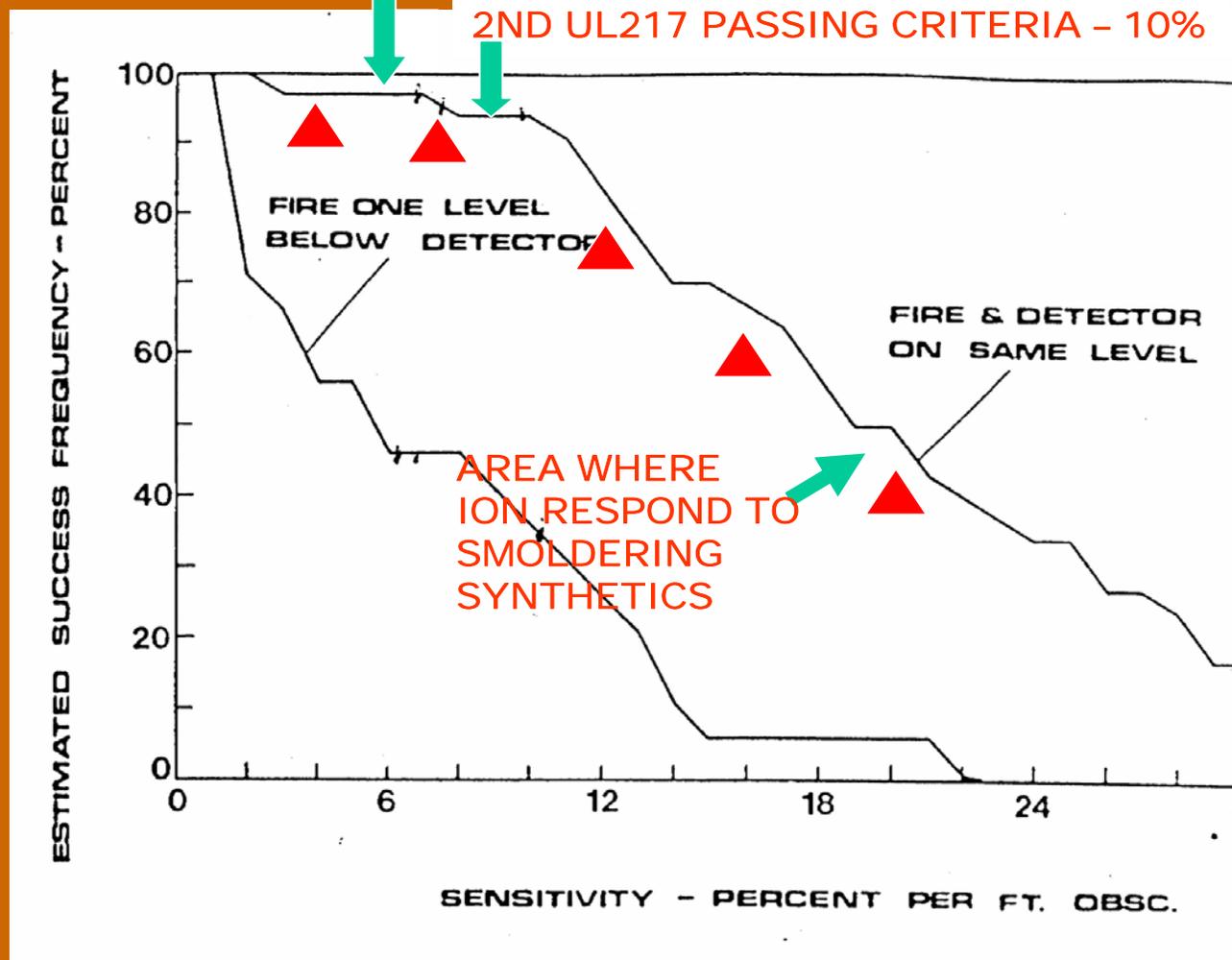
4% OBS/FT - 98%

8% OBS/FT - 97%

12% OBS/FT - 80%

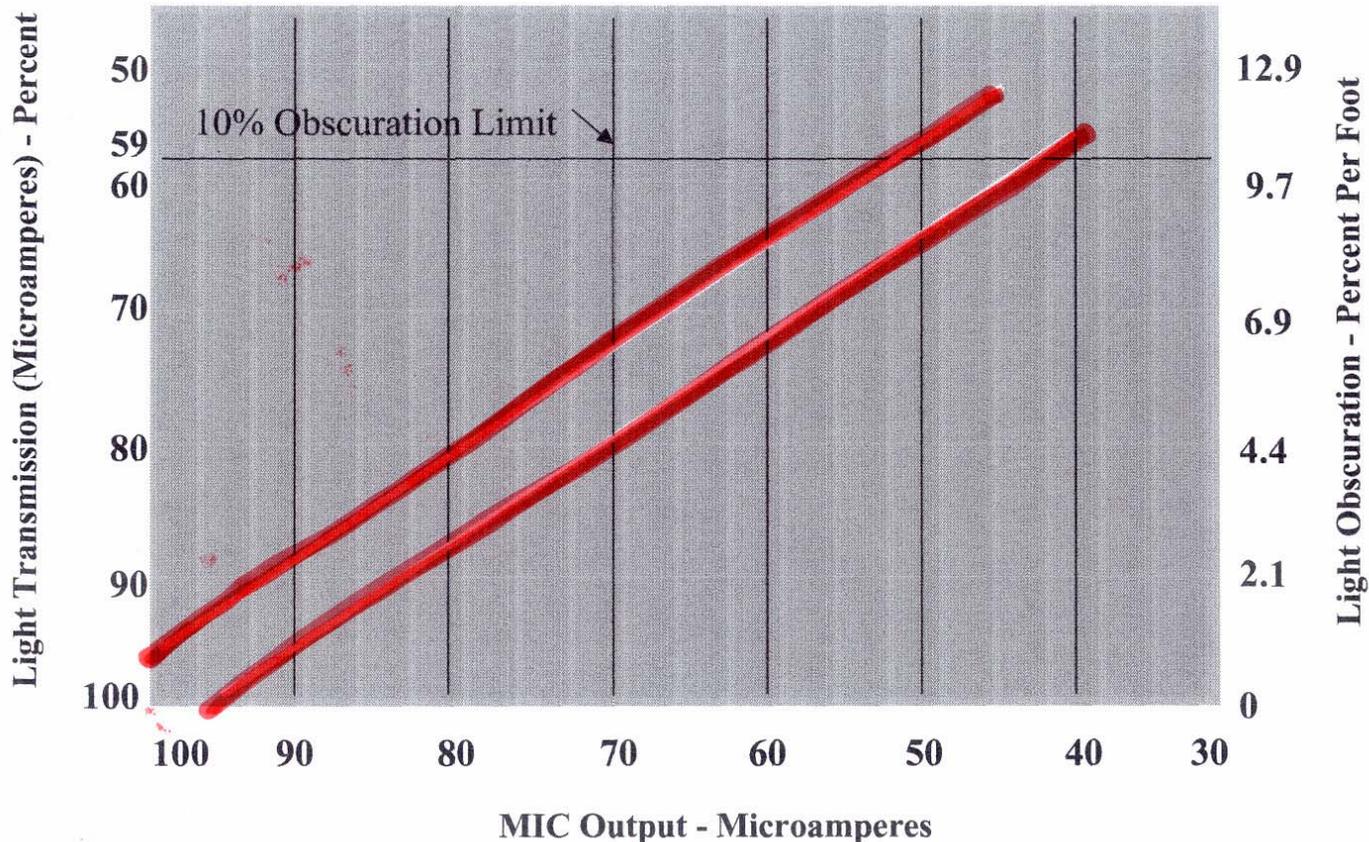
16% OBS/FT - 65%

20% OBS/FT - 45%

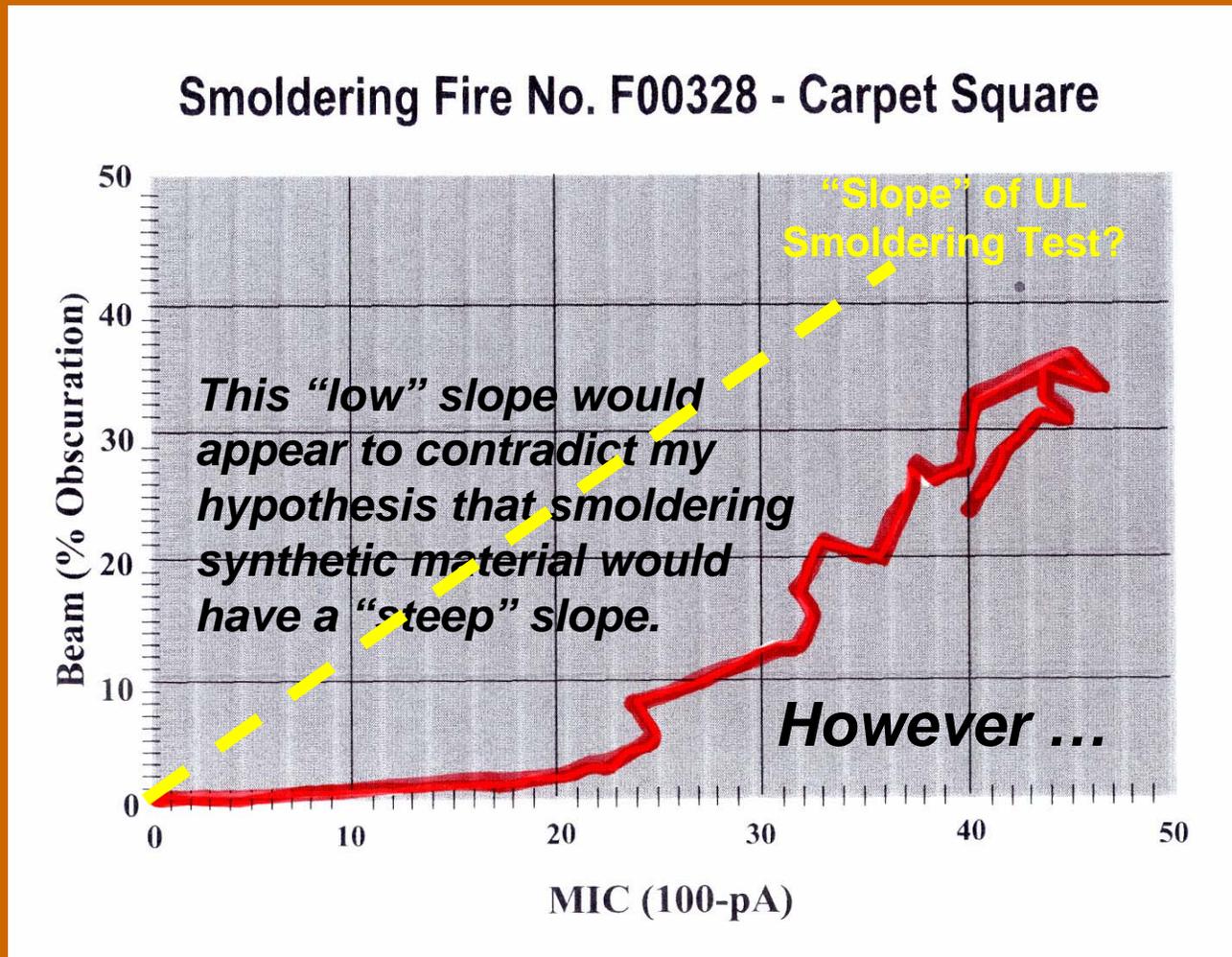


FROM UL FIRE COUNCIL 2004 (Paul Patty's Presentation)

Smoldering Smoke Profile

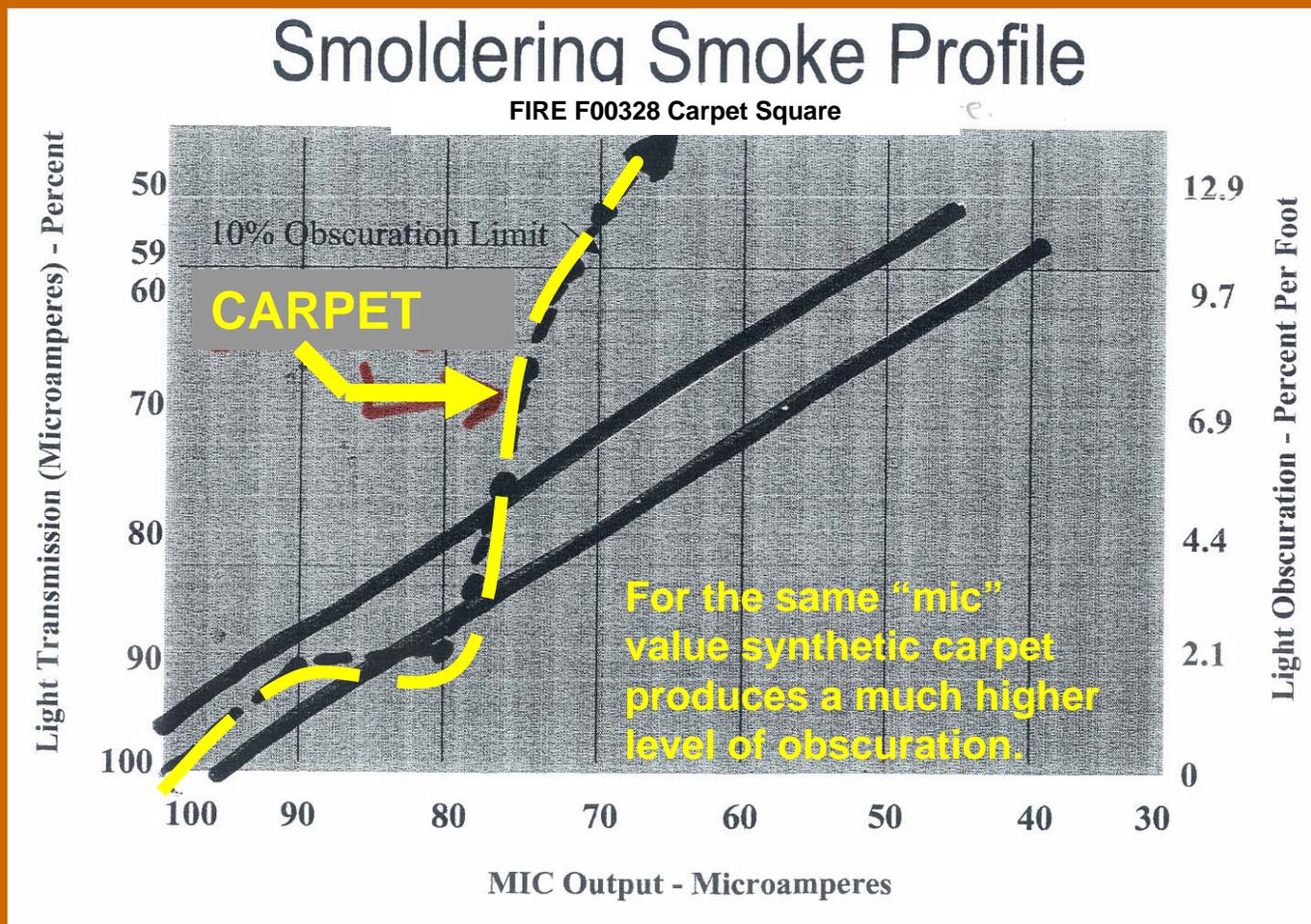


FROM UL FIRE COUNCIL 2004 (Paul Patty's Presentation)



Note: MIC Scale "reversed" and Obscuration Scale "compressed".

CARPET PROFILE - REDRAWN (Using Same Scale as UL217)



QUES: DOES UL HAVE DATA ON OTHER SYNTHETIC MATERIAL?

WHAT % OBS/FT DID ION AND PHOTO RESPOND IN THIS TEST?

CONCLUSION ON UL217

- **Ionization detectors that pass the UL 217 smoldering test may not, in fact probably will not, be able to detect the smoke produced by smoldering fires involving plastic material before untenable levels are exceeded.**
- **The inability of the current smoldering test to accurately “mimic” modern furniture was recognized as early as the late 70’s.**
- **A similar problem may exist in Europe. Even though the smoke profile has a steeper slope. There does not seem to be any logic supporting a 17% Obs/ft passing criteria. (Perhaps this criteria was needed to allow ionization detectors to pass.)**

PART FOUR

CONCLUSION AND RECCOMENDATIONS

ARE WE MAKING THE LOGICAL ERROR OF “CIRCULAR REASONING”

- A** Original approval tests were justified because “everyone knows SD work”. (Therefore the test boundaries were set to the limit that let common detectors pass.)



- B** Manufacturers now say the proof that their detectors are effective is that they pass the UL Tests.

- C** We know smoke detectors are effective because deaths have decreased since their introduction.



- D** We know that most of the reduction is due to smoke detectors because they are effective.

CODE REQUIREMENTS SHOULD RECOGNIZE CONSUMER REALITIES

- **We cannot rely on the free market since we do not have an educated consumer.**
 - ***Most studies, as well as NFPA 72, recognize the inappropriateness of ionization detectors near kitchens, yet manufacturers are still advertising ion detectors as useful in “every room”, even “kitchens”. How is a consumer supposed to critique this type of message? How many read the appendices of NFPA 72?***
 - ***Due to information, incorrect in my opinion, that states both types of detectors are equally effective, why would a consumer choose a photoelectric detector over an ionization detector. How many consumers, or even fire chiefs, will read anything more than the NIST Press Release.***
 - ***Except for large retailers, such as Home Depot or Lowes, many stores do not even carry photos due to low consumer demand. Consumers are not even aware they exists.***

IS THIS “NEW” INFORMATION?

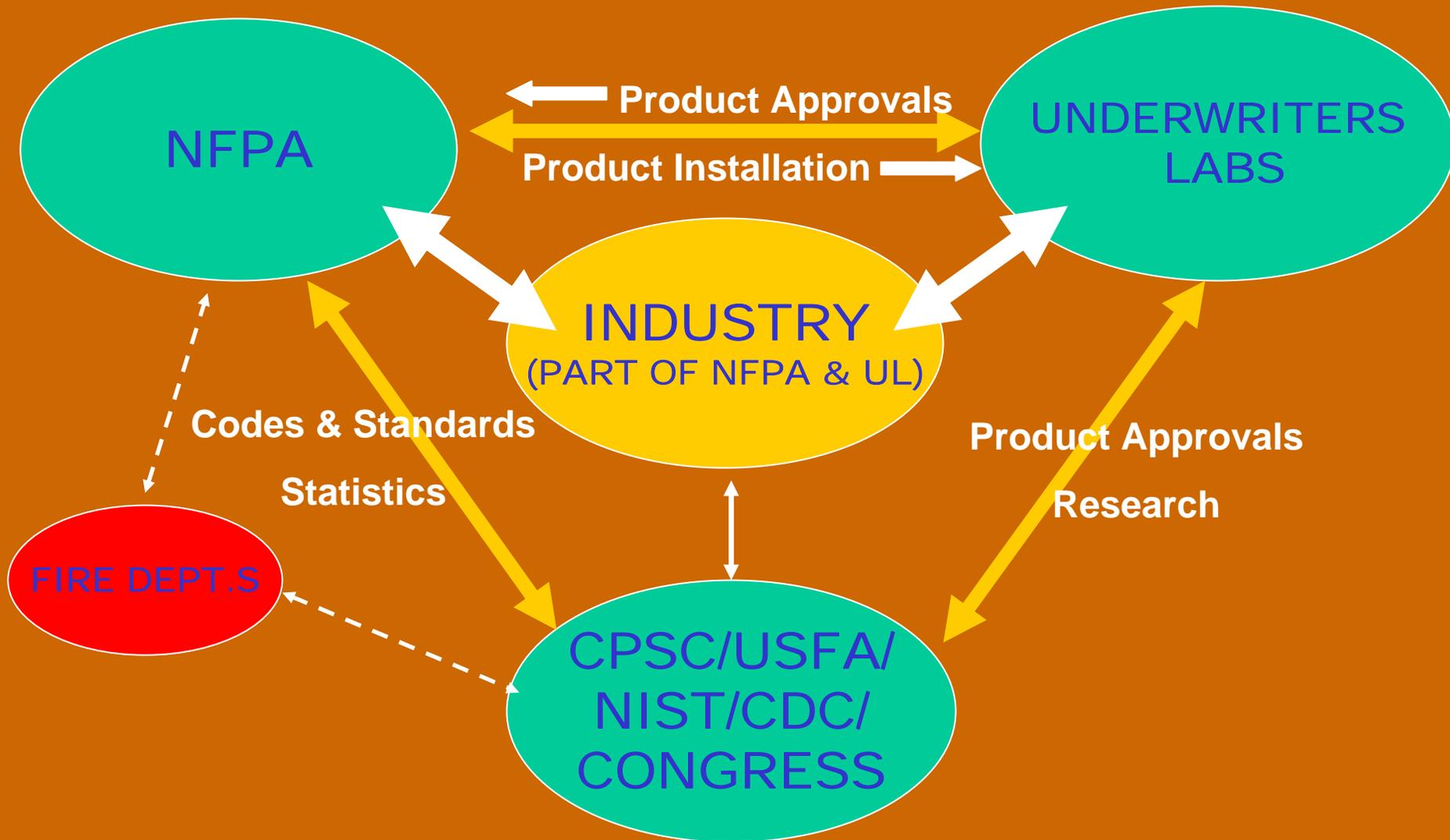
In my opinion, the evidence that there is a serious and important flaw in the effectiveness of ionization detectors to detect some of the most common types of fatal fires has been around for over 20 years.

If this is true -

why wasn't it recognized sooner?

US FIRE REGULATORY "SYSTEM"

QUESTION: "WHO'S RESPONSIBLE?"



QUEST: WHO'S RESPONSIBLE?

ANS: EVERYONE AND YET NO ONE

- Why was there almost 30 years between comprehensive residential detector studies in the US. At a time when detector technology and materials were changing?
- USFA states repeatedly in "FIRE in the US", "*Further study is needed to show why % of working detectors in fatal fires is increasing.*" Who was supposed to do it the study?
- CPSC is not allowed to regulate in areas where a "private, voluntary" regulations are effective. UL217 hardly seems effective, yet when asked by CPSC to consider updating UL217, UL responds to request from CPSC, "*They would consider it if someone proposed a new test.*" Who is UL referring to: the manufacturers, NFPA, CPSC?
- *Who is ultimately responsible for the interpretation of fire statistics, USFA, CDC, NFPA?* *Who is responsible if the statistics are mis-interpreted?*

PROBLEMS WITH CURRENT “SYSTEM”

- **There are a variety of govt, educ, and priv orgs with a mandate to protect the public from harm. However, diffusion of responsibility often results in neglect of the harms caused by tech failures.**
- **Information can be diffused and fragmented among various organizations. Limiting any one group’s ability to see the “whole picture.”**
- **Commitment to a “course of action”, may encourage highlighting info consistent with that “course of action” and ignoring info that is inconsistent with that “course of action”. (In this case, getting smoke detectors into as many homes as possible as quickly as possible.)**

(Minding the Machines, Evan & Manion, 2002)

“NATIONAL” SOLUTIONS

- **Any codes or standards group that wants to have its codes/standards adopted by government organizations must subsidize the attendance of consumer groups and public officials to insure proer balance when making “value judgements.”**
- **The USFA must be more pro-active in analyzing fire data as opposed to collecting it so that private groups can analyze it.**
- **Any technical document that is going to be submitted to a committee responsible for developing a code/standard must be made available on the internet so that it can be adequately scrutinized, instead of “available at our library”.**

“LOCAL” SOLUTIONS

- **Whenever a technical report is submitted to any local or state board, committee, or code official, the submitter must offer an independent peer review at their expense.**
- **Model codes provide consistency regarding materials and design specifications, I.e. “technical issues”. But local states and communities within states should retain the right to vary from model code in areas where “value judgements” are incorporated into code. (For example sprinklers in single family homes in towns with Volunteer Fire Depts.**
- **Local Fire Chiefs have to become more active and ask questions instead of accepting information as the “gospel truth.”**

***MORE FOOD FOR
THOUGHT***

***“They wonder why I am a
cynic.”***

***SE EXPRESSWAY
TANKER TRUCK FIRE 03/99
10,000 GALLONS OF GASOLINE***



BIG DIG TUNNEL COULD COPE WITH BLAST?

- **Quotes by CAT Project Spokesperson (Boston Globe March 23, 1999) -**
 - **“West Virginia tested explosions of much greater magnitude than this one ... including one in a gasoline tanker that would have generated 100MW of heat with temperatures up to 2,400 degrees.”**
 - **“The Tunnels did not collapse, and Big Dig officials say their tunnels will be even better able to withstand a blast.”**

OPINION OF BFD REGARDING CLAIMS OF CAT PROJECT

- **Memorial Tunnel (West Virginia) Tests looked at the following fire sizes 10MW, 20MW (representative of a bus or truck), 50 MW, and 100MW (Representative of 480ft² of flammable fuel)**
- **The 100MW fire appears to be meant to simulate a spill from 100 gallons of tanker fuel not tanker cargo.**
- **Expressway Fire is estimated to have been 500 ft by 20 ft (10,000 ft²) - Flame height = 50 -100ft**
- **Contrary to claims of Big Dig Officials - The fire on the Expressway was far larger than any tested during the Memorial Tunnel Tests.**

BFD OPINION OF CONSEQUENCES OF XWAY SPILL IN TUNNEL

- **A spill/fire of this magnitude involving flammable liquid cargo would overwhelm any installed fire mitigation systems, ventilation, sprinklers etc.**
- **It is unlikely that any occupants of vehicles located in the tunnel for hundreds of feet in front and in back would be able to safely evacuate.**
- **It is unlikely that any firefighters would be able to approach close enough to extinguish.**
- **Depending on duration of fire, the survivability of tunnel would be an issue to consider.**

***LNG TRANSIT
IN
BOSTON HARBOR***

*FOR
COMMITTEE ON HOMELAND SECURITY
AND
FEDERAL AFFAIRS*

*BOSTON FIRE DEPARTMENT
Commissioner Paul A. Christian*

by

Deputy Chief Joseph M. Fleming

HOW BIG WILL THE INITIAL FIRE BE IN TERMS OF RADIANT HEAT?

- THE LLOYD’S REPORT

- “The Lloyd’s Report, commissioned by Tractabel LNG North America LLC, the company that runs the Everett LNG terminal, instead concluded that, at worst, an attack on a tanker would “create a slow moving relatively confined fire.”” - *Boston Globe 10/13/01.*
- *This Report is important because, “The Lloyd’s Report was used by the Coast Guard in approving a safety plan for the Everett site.” - Providence Journal, 01/04/04.*

- THE QUEST REPORT

- *“J. Robinson, of FERC, said Quest would continue to use the Quest Report, That study with a relatively mild assessment of the dangers posed by federal officials to suggest that an accident involving one of the tankers would only impact a small area.” - Mobile Register, 11/25/03.*

EST. OF HEAT FLUX - 1M² HOLE

	7,000 BTU per hr-ft ²	4,800 BTU per hr-ft ²	4,000 BTU per hr-ft ²	1,500 BTU per hr-ft ²	750 BTU per hr-ft ²
FAY 1m ² Hole	1,280 ft.	Approx. 1,750 ft.	1,598 ft.	2,417 ft.	
QUEST 1m ² Hole	835 ft.	Approx. 900 ft.	1020 ft.	1,420 ft.	
LLOYD'S 1m ² Hole 20m pool		175 ft.			400 ft.
LLOYD'S 1m ² Hole 50m pool		300 ft.			900 ft.

Note: *Fay estimates are approximately 50% higher than Quest's.
Fay's estimates are 3 or more times greater than Lloyd's.*

A 1m² hole fire should last approximately 30 minutes.

WHY ARE ESTIMATES SO DIFFERENT?

- Originally Quest stated
 - “The calculations (of the 10/10 Report) would address a national security concern with the Boston LNG Terminal following the 9/11/03 attacks.” – *Mobile Register 10/19/03*.
- Later, in 11/03, Quest stated in a letter to DOE.
 - *That Quest modeled a ship collision in the outer harbor as the “most credible worst case event”.*
 - This assumption allowed Quest to take into account “wave action”, which caused pool size to be smaller.
 - Quest also wrote, “*It is important to note that the model developed by Quest is flexible in the sense that other locations with different site-specific conditions may yield significantly different results”.*
- However, in a 07/02 e-mail D. Juckett of the DOE wrote, “To put together the original scenario DOE coordinated: State Officials, DOT, USCG, industry , and others. Questions:
 - *Why weren’t local officials involved?*
 - *Did this group agree to “outer harbor accident” scenario?*

WHAT DO THE NFPA “ACCEPTABLE” LEVELS MEAN?

- **3000 Btu/hr/ft² - The NFPA Committee members consider a this level of radiation acceptable for buildings containing educational and healthcare occupancies.**
 - ***This level of heat flux will cause 2nd degree burns in 15 seconds.***
 - ***This level of heat flux will cause extreme pain in 5 seconds.***
 - ***Fatal to 50% of the affected population in 60 seconds.***
 - **According to a Quest Report.**
- **Why is it “acceptable” to potentially expose school children to these types of heat flux?**

CAN FIRE BE EXTINGUISHED?

- *“Frank Katulak, Senior Vice President of Operations for Distrigas says even if a fire did occur, Fay’s scenario overestimates its likely impact. By throwing water on an LNG fire within seconds, the tugboat escort could reduce a fire effects, Katulak says. He agrees that water could not extinguish the fire.” – Providence Journal 01/04/04*
- However other sources disagree.
 - *“Contact between water and pooled LNG should be avoided to prevent increased vaporization, unless vapor can be controlled.” - NFPA Handbook.*
 - *“Water is ineffective in fighting LNG fire because it provides a heat source for vaporization”. (Which makes the fire and heat worse – my words) - Liquefied Natural Gas in California: History, Risks, and Siting*

WHO HAS JURISDICTION?

- BFD Assumed that the agency that authorize the hazard analysis, e.g. the Quest Study, was the agency that had jurisdiction.
- The “State”?
 - *USCG informed BFD it was the State. (05/02)*
 - *The Exec Office of Public Safety denied involvement. (06/02)*
 - *Juckett, from the DOE identified, M. Bolden, Under Sect. of Public Safety as making request for a study to DOE. (07/03)*
- The DOE?
 - *Junkett stated in an e-mail that DOE, “was able to task Quest using existing government funds”.(07/03)*
 - *DOE Press Officer, Drew Malcolmb later stated, “DOE was not involved with the study in any way”.(– Mobile Register 10/19/03)*
- FERC (Federal Energy Regulatory Commission)?
 - *J, Robinson of FERC stated, “FERC does not set exclusion zones around tankers.” But he also stated, “FERC had used and would continue to use the Quest Study”. (Mobile Register, 11/25/03.)*

CONFUSING JURISDICTION LEADS TO POOR DECISION-MAKING.

- *“The regulatory scheme for oil and gas is complex and divided among many agencies. ... Therefore, determining who has jurisdiction and what rules apply to a given location is sometimes difficult. The complexity of the regulatory scheme ... can complicate efforts to institute changes in the regulations to accommodate new policies. ... “Finally, it should be noted that the fragmentation of regulatory authority in this area may create obstacles to implementation of any new initiatives. ... Federal regulation of the industry is split among DOE, FERC, DOT, EPA, and the Coast Guard. Moreover, many safety requirements are enforced at the state level.” - “Oil and Natural Gas Infrastructure”*
- *“Not deciding is not a new phenomenon. Every bureaucrat worth his salt, from the pharaoh’s court in ancient Egypt to the blame-layers in the final days of the Bush administration, learns how to protect his position by passing the buck. ... Not taking responsibility is now institutionalized in layers of forms and meetings (and commissioning “studies” - my words). - “Death of Common Sense”*

WHY THERE IS A NEED FOR AN “INDEPENDENT REVIEW”

- ***Surveys of almost 1,500 members of...professional societies (next 3 words are illegible) (e.g. environmental economics, epidemiology, exposure assessment, industrial hygiene, toxicology) found that 3 in 10 respondents had observed a biased research design, 2 in 10 had observed plagiarism, and 1 in 10 observed data fabrication or falsification. Respondents with many years in risk analysis, business consultants, and industrial hygienists reported the greatest prevalence of misconduct. These respondents perceived poor science, economic implications of the research, and lack of training in ethics as causes of misconduct. (Greenberg and Goldberg, 1994: 223) - Minding the Machines***

WHY THERE IS A NEED FOR “PUBLIC PARTICIPATION”

- *“Controversies have politicized the issue of risk. Risk assessment is no longer seen as simply an exercise in the technical measurement of risk. Questions of risk can no longer be defined simply in technical terms; they must also be defined in political and social terms, because the real question is not how safe it is, but how safe is safe enough for individuals and society? Moreover, since technical risk assessors are no more qualified than the general public to assess value judgements ... The view that the public perception of risk is distorted by subjective biases and that only experts can define the “real” risks is overly simplistic. Experts are also subject to biases in interpreting quantitative data, especially when objective uncertainties are present. Many so-called objective assessments ultimately depend on the subjective interpretations and normative judgements of engineers and applied scientists.”*

- Minding the Machines

WHY THERE IS A NEED TO CLEARLY IDENTIFY “JURISDICTION”

- ***“Soon after the Civil Service Act in 1883, at the beginning of America’s Modern bureaucracy, Woodrow Wilson, a noted political scientist before he became president, emphasized the need to vest public servants with “large powers and...discretion” as the indispensable “condition of responsibility.” Otherwise, he warned, nothing will get done: “The less his power the more safely obscure and unnoticed does he feel his position to be, the more readily does he relapse into remissness.” ... Viewed under history’s light, it is clear what happened. We have deluded ourselves into thinking that the right decisions will be ensured if we build enough procedural protection. We have accomplished exactly the opposite: Decisions, if they happen at all, happen by default. Public decisions are not responsible because no one takes responsibility.” - The Death of Common Sense***