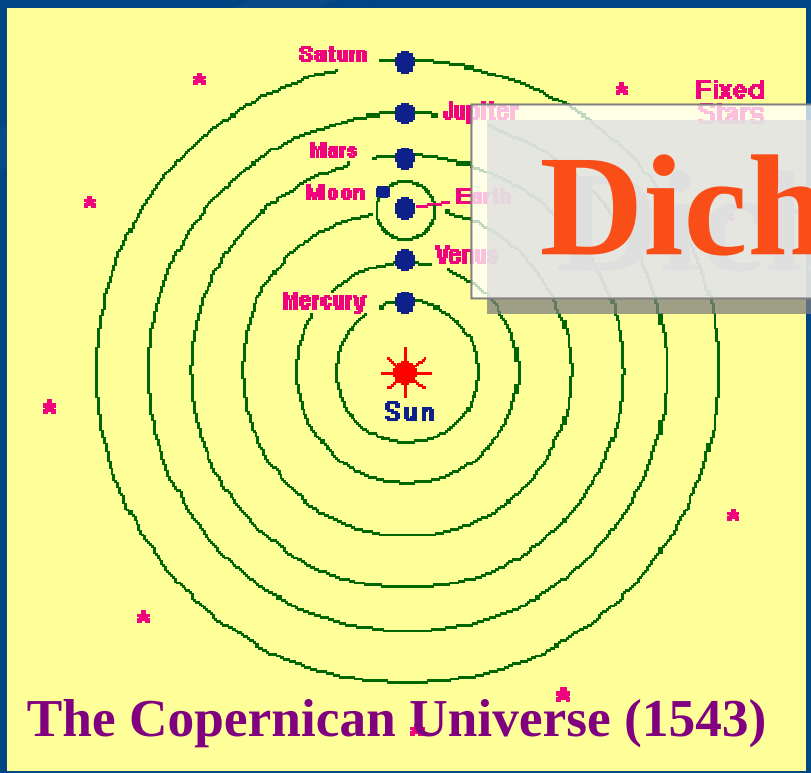
Why is Fire Red?

FM Global's Quest for Burning Answers

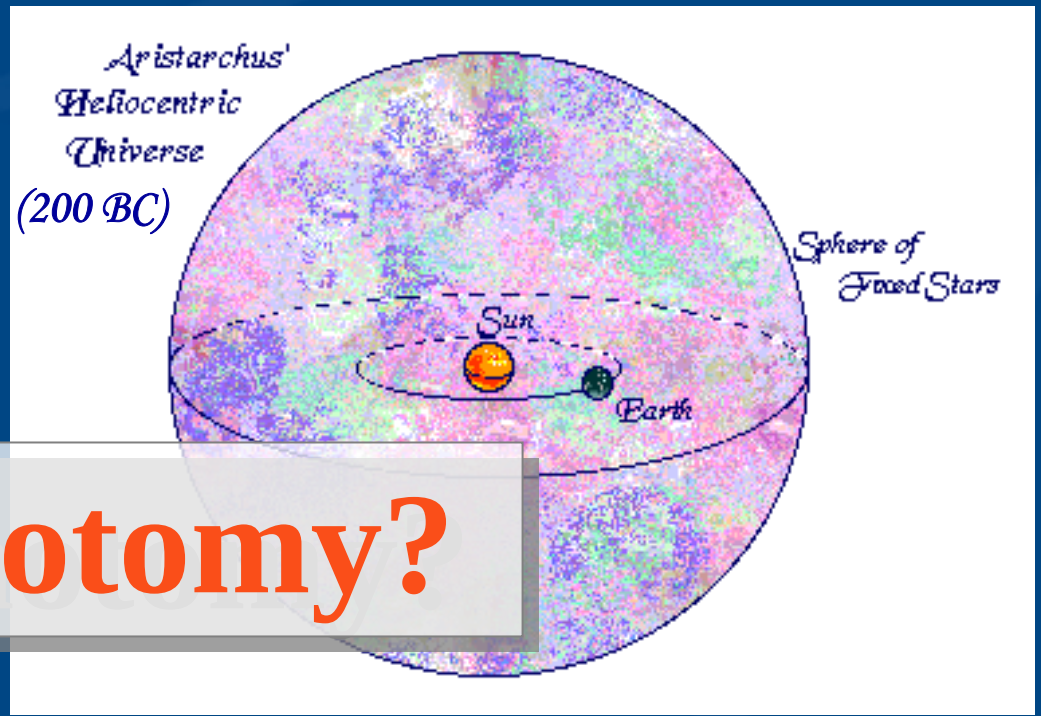
Jeffrey S. Newman
Director Protection Research

inFIRE Conference 2005

Misinformation is at the heart of all scientific inquiry



The Copernican Universe (1543)



Dichotomy?

Plausible and implausible explanations need to be ruled out in order to understand what is really going on.

- *Scientists answer questions from other scientists with mathematical models, graphs, tables and drawings, accompanied by very precisely worded verbal arguments. Their answers must be so precise that they are often difficult to follow and take a long time to state.*

- *Teachers, on the other hand, answer questions from students using the simplest models of science that work to answer each particular question. Students should keep in mind that such an answer always carries an asterisk* with it.*

  **It's more complicated than that.*

- *Ask me a question, I will give you an answer based on the simplest scientific model I can use. If you then refine your question I may have to switch my answer to use a more complicated model.*

- *Choosing the correct model to use in answering a science question is one of the most difficult things to do.*

- *For example, if you ask me about the orbit of the moon I'll answer you by using Newton's laws, however if you ask me about two neutron stars orbiting each other I'll have to switch to Einstein's general relativistic model. There is no need to use general relativity in a high school class when discussing the orbit of the moon.*

...it's the journey...

"If we knew what we were doing, we would not call it 'Research'".

- Albert Einstein

Outline

- ***Introduction***
- ***History***
- ***Calibration Examples***
- ***Benchmark Testing***
- ***Concluding Remarks***

Milk Street - 1886

Customer Location - 1890

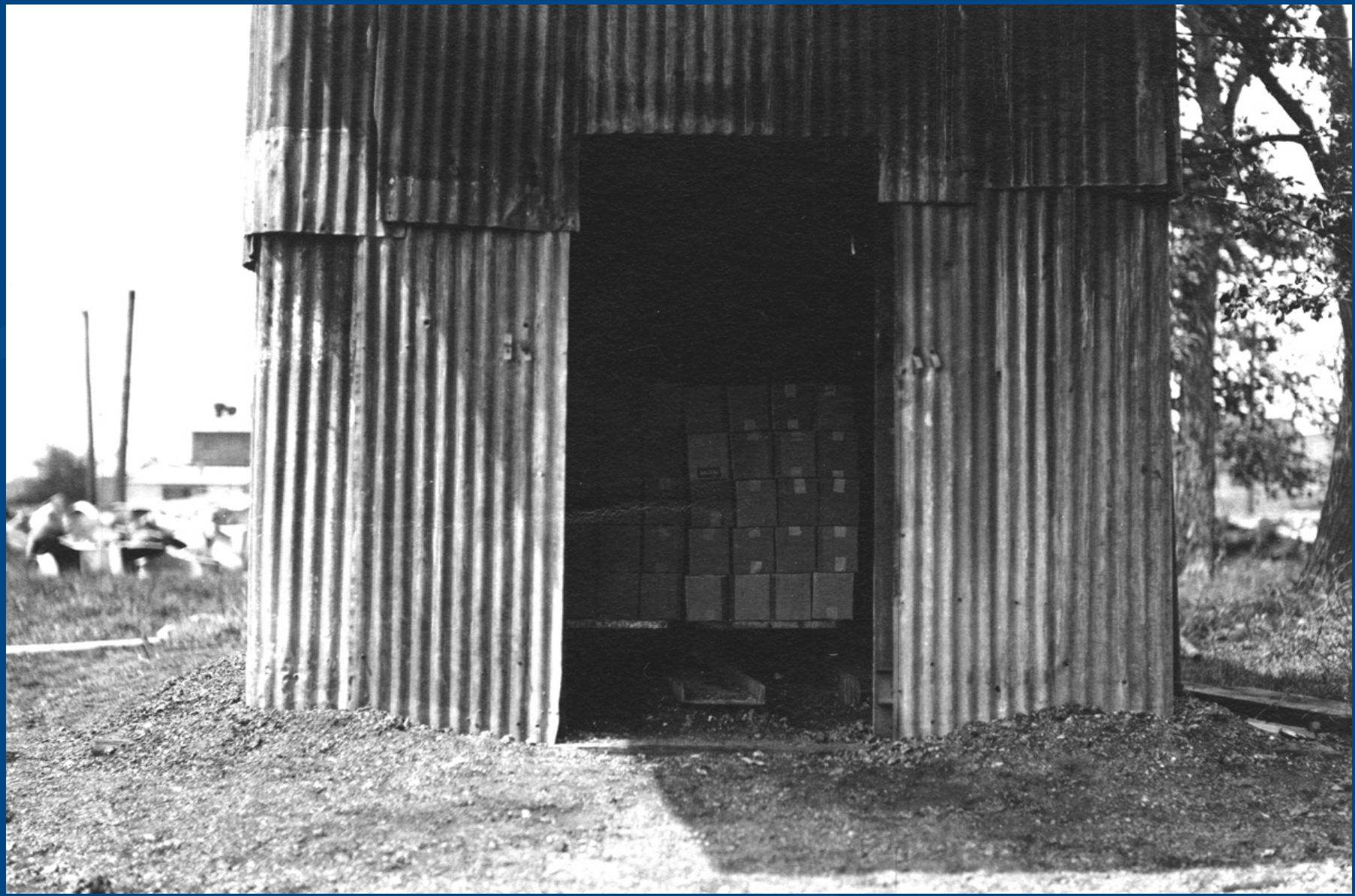
The Apple Orchard

High Street - 1922

High Street - Chemical Lab

High Street - Hydraulics Lab

Back at the Farm……..



Everett Testing Station - 1922

Everett Site

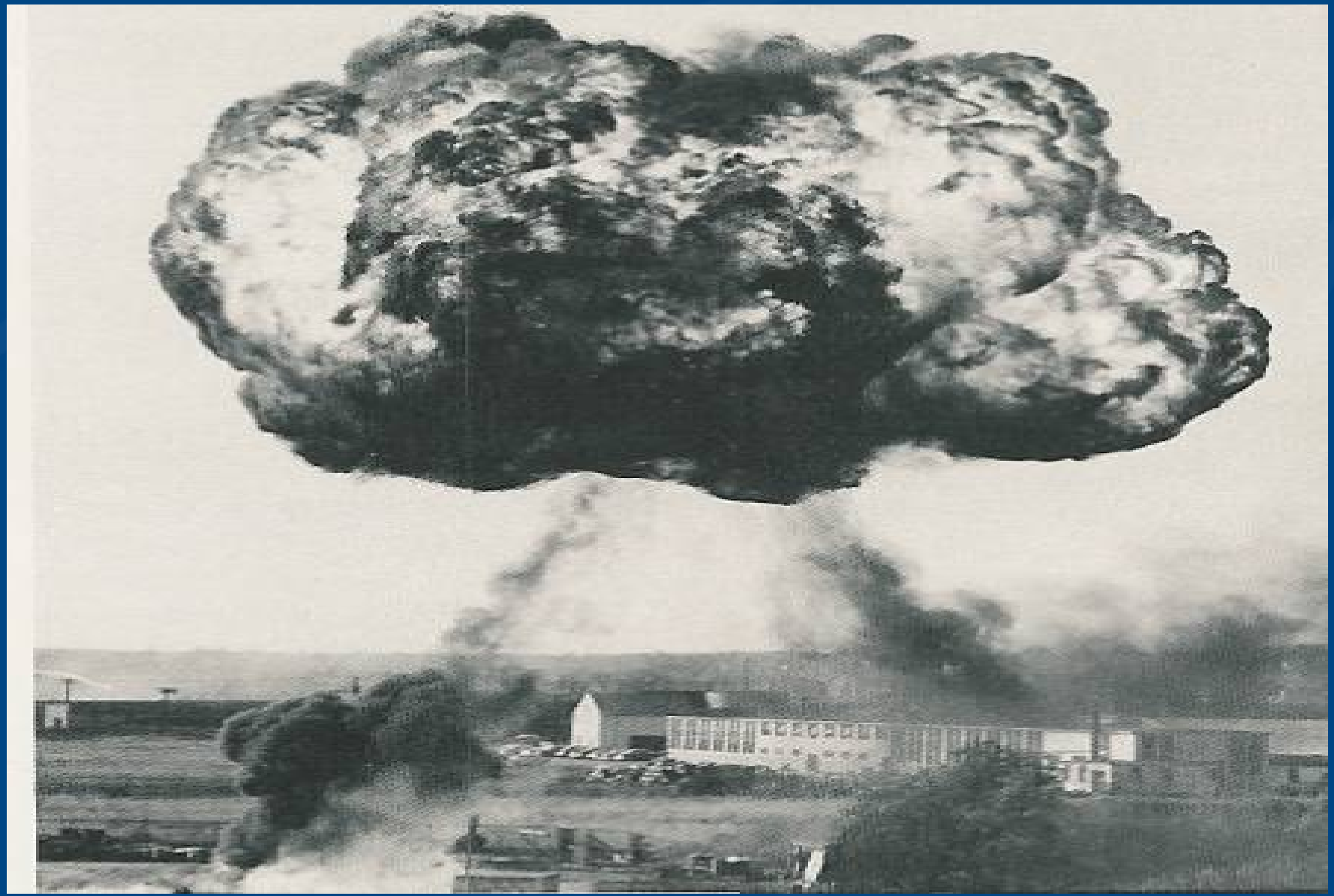
First Attempt at Flood Research

Norwood - 1947

Norwood - 1949

Norwood - 1964

Norwood - 1964



Definition – “State-of-the-Art”

- ***the highest degree of development of an art or technique at a particular time***

West Glocester

The FM Global Test Center

How is Large-Scale Fire Testing Defined?

- ***Size of Testing Sample?***
- ***Size of Facility?***
- ***Size of Resulting Fire?***
- ***Range of Applicability of Results?***

Design Considerations

- ***Functionality***
  - smoke exhaust management (between spaces)
  - smoke exhaust, air inflow (within spaces)
  - test water system
  - data acquisition
  - air emission control, water treatment

Design Considerations

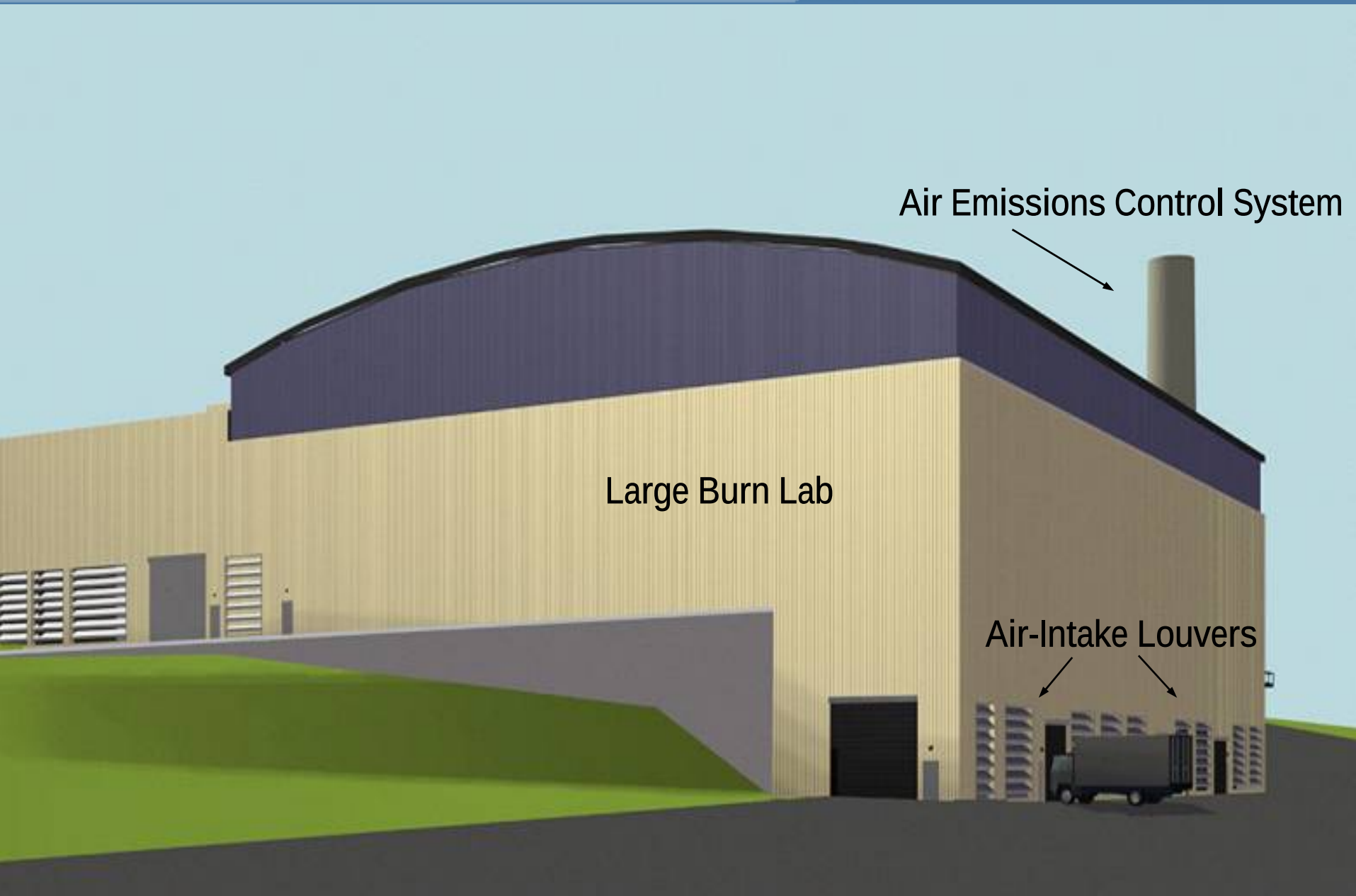
- ***Technology***
  - 20 MW calorimeter
  - Full range of fire calorimeters
    (20 MW, 5 MW, 1 MW, 0.2 MW, 0.05 MW)
  - Calorimetry for sprinklered fire tests
  - Displacement ventilation
  - New instrumentation

Pre-2001 Test Center Campus

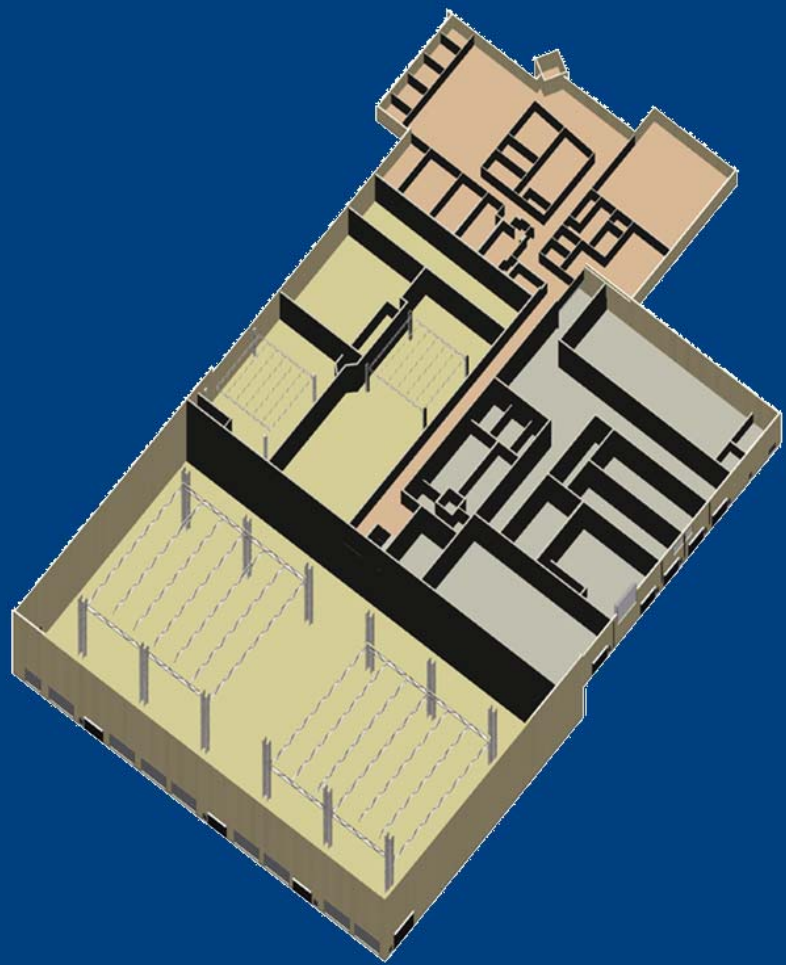
New FM Global Research Campus

The FM Global Research Campus

Fire Technology Laboratories



Fire Technology Laboratories



Large Burn Lab - 20 MW Calorimeter

Attic Ductwork - 20 MW Calorimeter

Air Emission Control System [240,000 scfm]

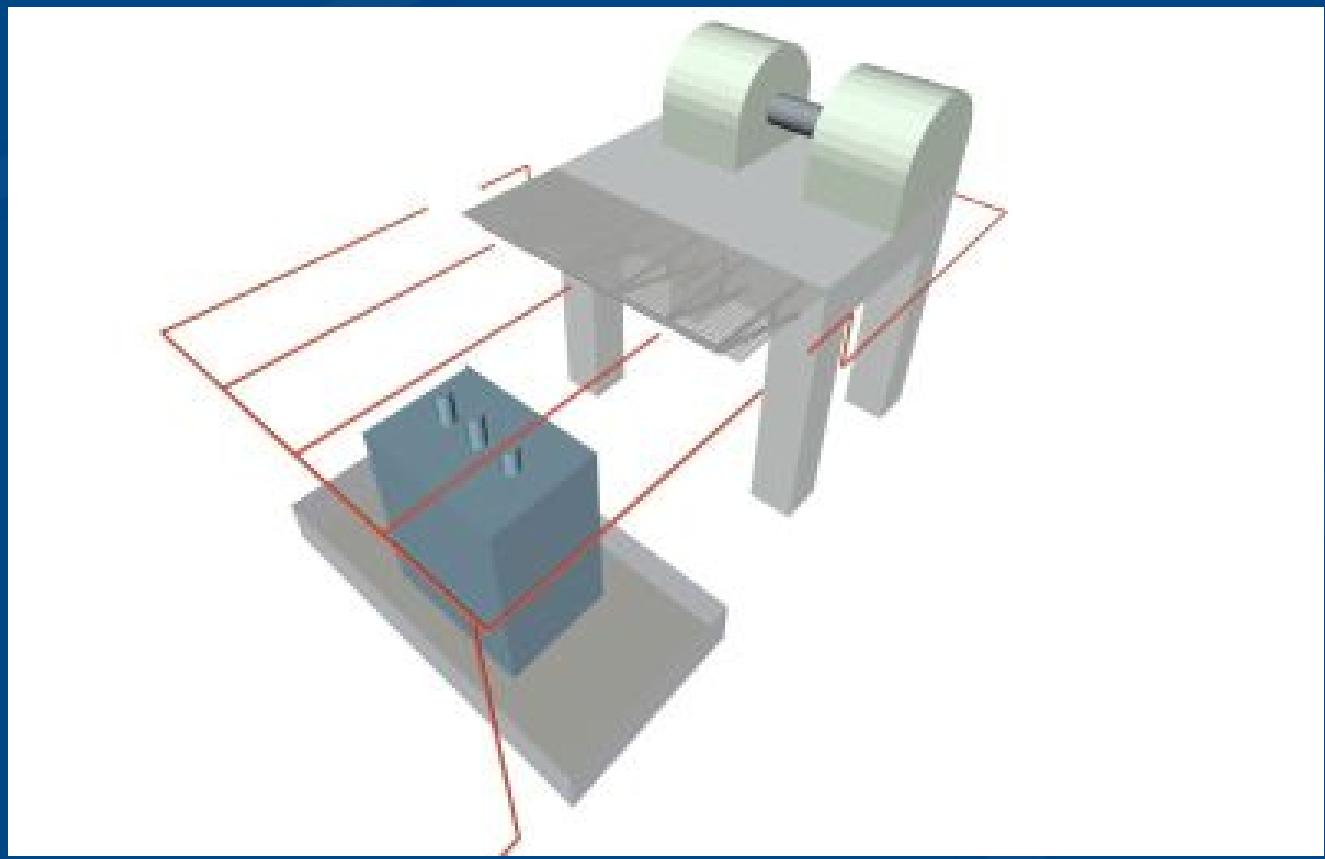
Large Burn Lab - Calibration (Pool Fire)

Large Burn Lab - Sprinklered Fire Tests

Rack Storage Fire Tests

- ***9-ft high, 30-ft ceiling***
- ***Standard plastic commodity***
- ***K-17 (7 psig, 0.45 gpm/ft^2)***

Turbine Fire Protection



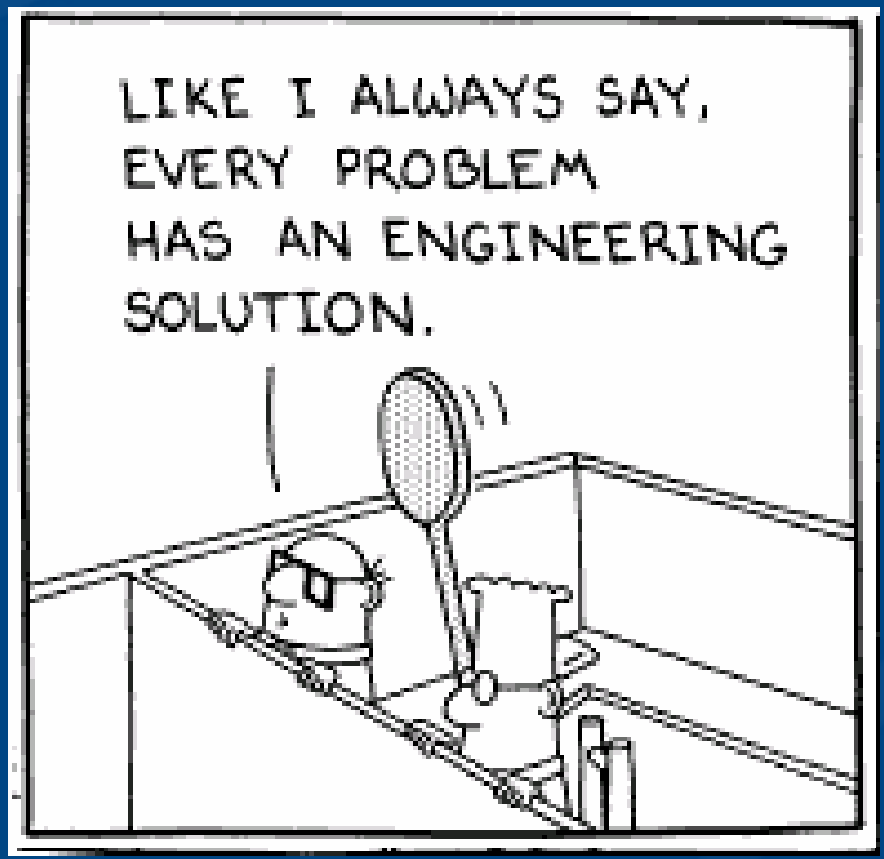
Turbine Fire Protection

Turbine Fire Protection

Roll Paper Testing

Roll Paper Testing

Plastic Pallet Testing


LIKE I ALWAYS SAY,
EVERY PROBLEM
HAS AN ENGINEERING
SOLUTION.

Natural Hazards Lab

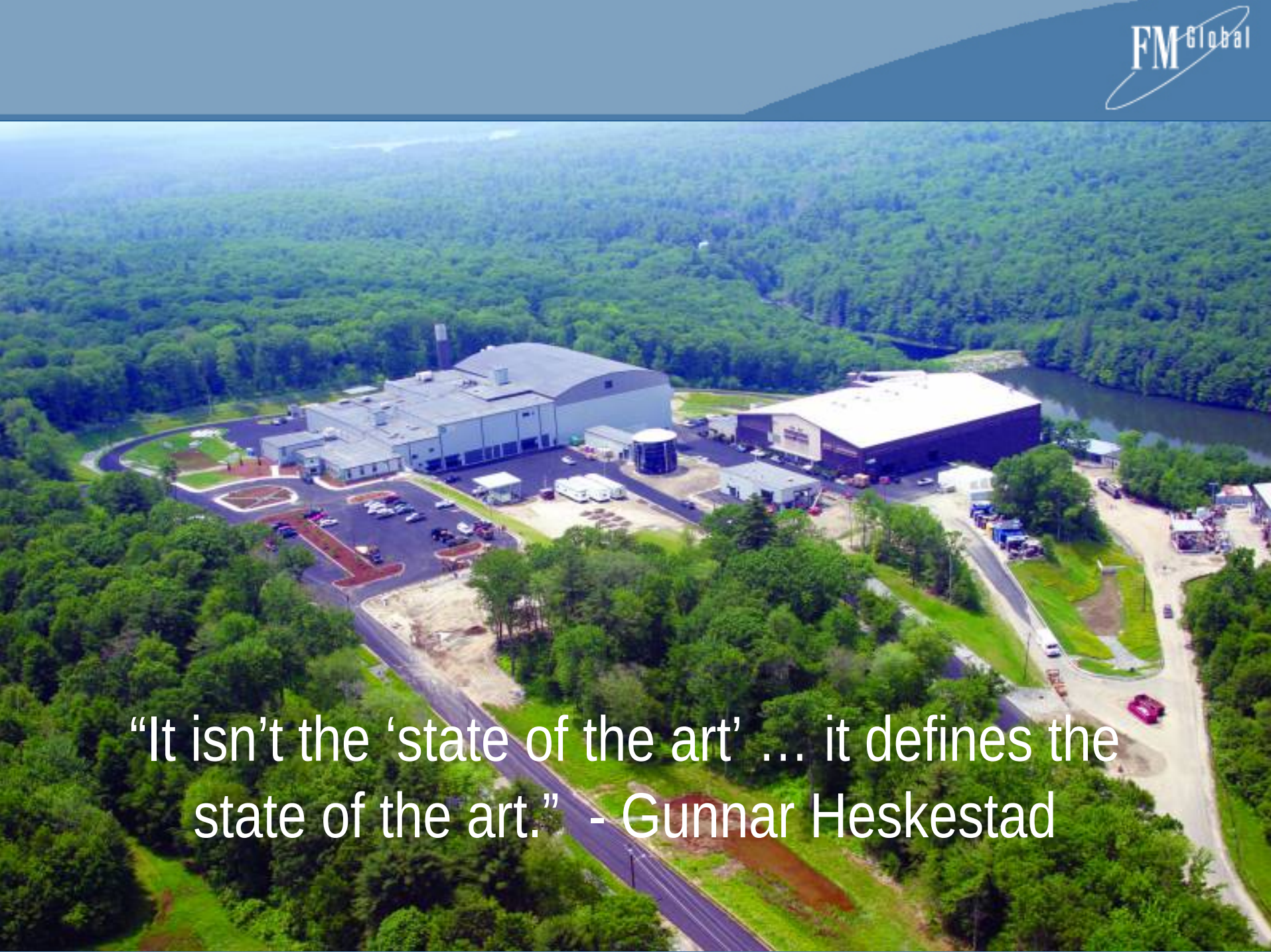
Natural Hazards Lab

Hydraulics Lab

Dust Explosion Demonstration Area

How is Large-Scale Fire Testing Defined?

- ***Size of Testing Sample?***
- ***Size of Facility?***
- ***Size of Resulting Fire?***
- ***Range of Applicability of Results?***


“It isn’t the ‘state of the art’ … it defines the state of the art.” - Gunnar Heskestad

By the Way ……. Why is Fire Red?

- ***Light is often said to have a color temperature. What this means is that the color of the light is the color of light radiated by a so-called black body (an idealized radiating object) which is at that temperature.***
- ***For example, the outer core of the candle flame is light blue -- 1400 °C. That is the hottest part of the flame. The color inside the flame becomes yellow, orange and finally red. The further you reach to the center of the flame, the lower the temperature will be. The red portion is around 800 °C.***

A Survey to Support "Evidence-Based Practice" in Special Libraries Serving Fire Service Personnel and Researchers in Public Safety and Homeland Security Areas

Lian Ruan
Director/Head Librarian
Illinois Fire Service Institute
University of Illinois at Urbana-Champaign
lruan@fsi.uiuc.edu
Linda C. Smith
Professor and Associate Dean
Graduate School of Library and Information Science
lcsmith@uiuc.edu

The Project Overview

- Funded by the 2003 SLA Steven I. Goldspiel Memorial Research Grant and Campus Research Board Award, University of Illinois at Urbana-Champaign

The Project Overview

- Surveyed the Practices of Six Selected Libraries that Represent Significant Contributors of Information Services to Fire Professionals (Including Fire Service Personnel as First Responders and Researchers) in the United States

- Focused on Evidence-Based Research

- Expanded Our Knowledge about the Value and Impact of Information Services Provided by Special Libraries and the Special Librarians Who Manage Them for Firefighters and Researchers in the Fire Service

- Built the Knowledge Base of Special Librarianship, Particularly Demonstrating the Library's Critical Roles in Public Safety and Homeland Security

Statement of the Problem

- How Do Special Libraries Serving Fire Professionals Fit into This Component?
- Are They Used?
- Valued?
- Are They Efficiently Organized to Give Maximum Access to Their Resource Collections?
- What Impact Have Special Libraries Made on Information Use by Fire Professionals in Their Decision-Making?

Participating Fire Libraries

Fire Library-*Training*	**Fire Library-*Research***
1) New York State Department of State's Office of Fire Prevention and Control, Academy of Fire Science	1) National Fire Protection Association (NFPA)
2) Illinois Fire Service Institute, University of Illinois at Urbana-Champaign	2) Fire Protection Publications/Oklahoma State University
3) Fire/EMS/ Safety Center-Minnesota State Colleges and Universities	3) Oklahoma City National Memorial Institute for the Prevention of Terrorism

Participating Fire Libraries

- Differed Somewhat by Site, but Remarkably Consistent in Many Areas
- Three of Them: State Fire Academy Libraries (the Only Three in the Nation), Supporting Statewide Training in Many Areas, Including Hazardous Materials, Arson and Fire Investigation, Firefighting Operations,Technical Rescue, Incident Command, Fire Instructor and Officer Development, Emergency Medical Technician, Unified Command, Environmental Health and Safety Training and Education Leadership, and State Sponsored National Fire Academy (NFA) Courses
- The Remaining Three Libraries: Unique Collections on Research

Participating Fire Libraries

- Houses the Archives and Resources on Fire Research, Prevention, and Suppression and the Promotion of Life and Building Safety
- Supports Production and Distribution of Fire and Emergency Services Training Materials
- Supports Research to Discover Equipment, Training and Procedures for Emergency Responders to Prevent Terrorism and Respond to it
- Four House Archives Collections
- Two Libraries: Located on a University Campus; Other Two: National or International in Scope
- The Study only Reflects Service to the Users in the United States and Not to International Users


Archives Search - Microsoft Internet Explorer
File Edit View Favorites Tools Help
Back Search Favorites History
Address http://128.174.100.91/dbtw-wpd/newWeb/archives-re.htm
Go Links
LOCAL 1260
Make Request
Request
New Search
Help
Done
Internet

Characteristics of Participating Libraries

	Number of Titles					FTE staff		Facilities	
Organization	Monographs	Serials	Non-print [1]	E-resources	Archives	Librarians	Support staff	Square feet	Budget
A	5,100	95	3,070	No Answer	No Answer	1	0	3,000	10,517
B	4,165	385	3,115	307	218	2	4	1,193	55,763
C	4,065	153	648	8,077 [2]	202	1	1	1,500	20,000
D	10,923	230	334	No Answer	Historical archives	1	2	2,412	141,500
E	9,000	150	3,000	No Answer	Manuscripts & photographs	1	1	5,000	36,000
F	2,724	22	93	494	No Answer	1	4	285	No Answer

Note: 1. Non-print materials include videotapes, CD-ROMs, DVDs, slides, and transparencies. 2. Netlibrary ebooks.

Statistics of Participating Libraries for 2003

Organization	Reference	Circulation	Interloans Requested	Interloans Supplied	Library services
A	2,262	2,867	5	47	No Answer
B	1,530	1,468	81	421	Current awareness, OPAC training, listserv, reference, electronic document delivery
C	500	726	81	113	Online Fire Admin courses
D	1,500	Data not available	2	2	Document fulfillment, research
E	152	1,520	Data not available	Data not available	No Answer
F	45	120	12	12	No Answer

Methodology

Questionnaire Development

- Designed the Questionnaire to Measure the Impact of Information Provided by the Special Library on Fire Emergency Responses Related to Homeland Security and Public Safety
- Focused Specifically on the Impact of Information on Decision-making Behavior Rather than Specific Time or Monetary Savings
- Collected a Combination of Quantitative and Qualitative Data
- Used the Chicago, Rochester and SLA Study Instruments as the Basis for Designing Questionnaires to Measure the Impact of Library-Supplied Information on Practical Decision-Making and Applied Research

Conducted the Study

- 16 Months (September 2003 to December 2004)
- Phase I – Preparation and Set Up lasted about three months (September 2003-December 2003)
- Phase II – Data Collection: the longest and most challenging (January-August 2004)
- Phase III – Data Analysis and Research Report (September to December 2004)

Study Sample and Usable Returns

Organization	User Population	Total Response	Format	
			Hardcopy	Online
A	2000	59	39	20
B	2300	143	63	80
C	250	47	36	11
D	1440	53	43	10
E	152	28	26	2
F*	10	8	5	3
Unspecified (Through Web Responses)		5	-	5
Summary Total		**343**	**212**	**131**

Note: *The Library F only has a few walk-in patrons. There are about 40,000 hits on the library website each month. Even though the survey questionnaire was linked to the website, no response was received from this channel.

Today's Firefighters

- Crucial Roles Local Firefighters/EMTs to Save and Rescue Citizens' Lives.
- A Wide Range of Duties in Fire Fighting, Emergency Medical Care, Hazardous Materials (e.g. Toxic Incidents), Terrorism (e.g. Bio-Terrorism) and Other Emergency Responses
- Illinois Firefighters Acquire and Maintain an EMT License
- 60% Emergency Calls – Medical Related

ILLINOIS FIRE SERVICE REALITIES

1,293
Fire Departments

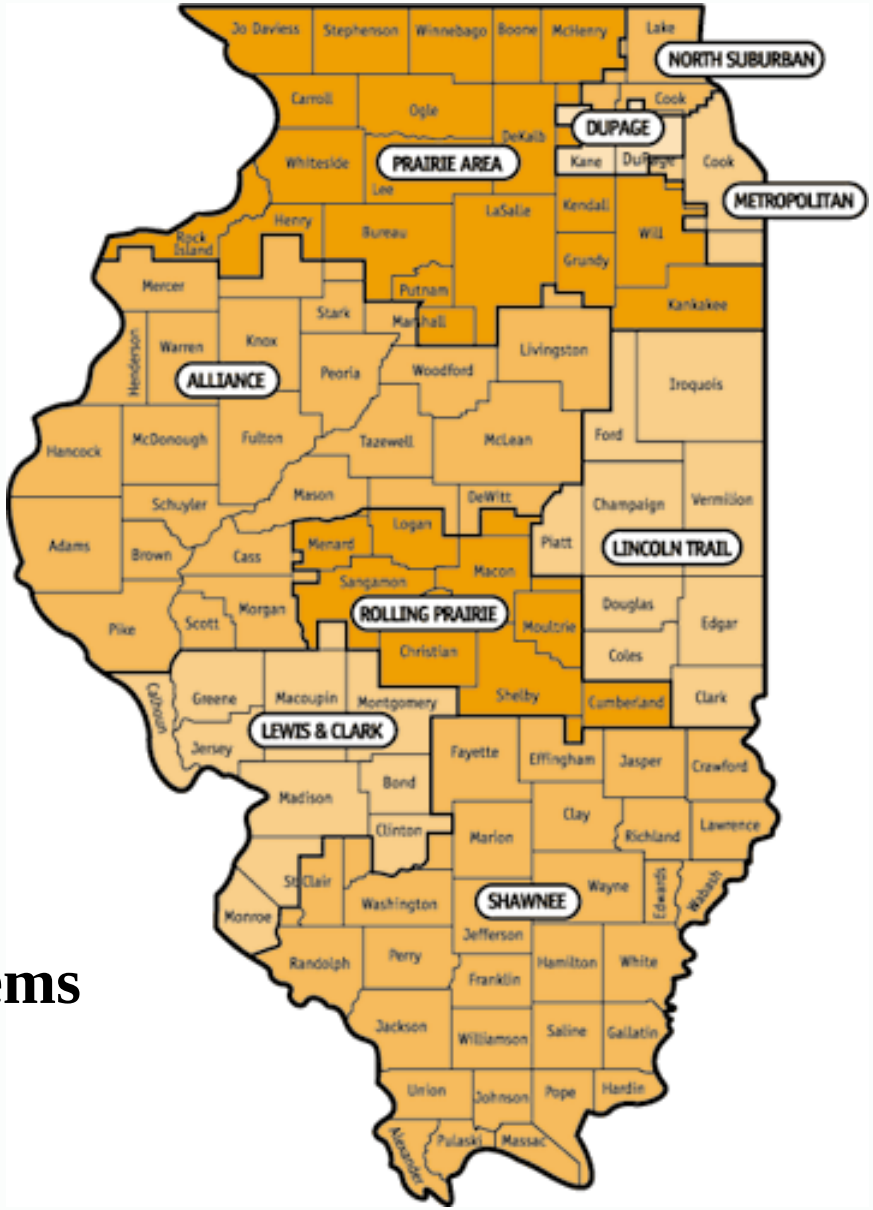
42,675 Firefighters
(Paramedics)
- 8,600 Officers
- 13,300 Paid

70%
of all Departments are **VOLUNTEER / PAID ON CALL**

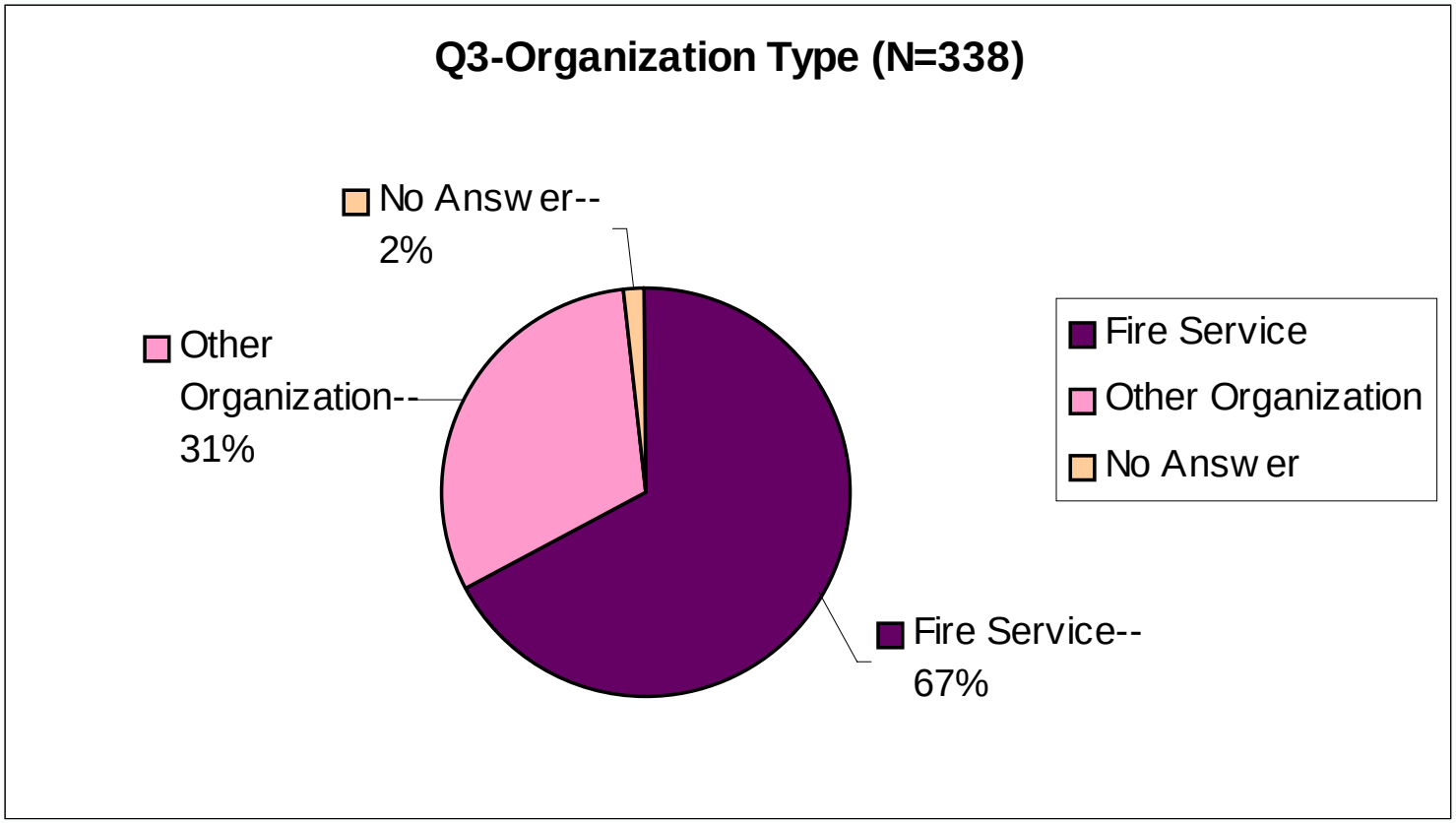
20%
Turnover Rate


CENTRALIA FIRE DEPARTMENT

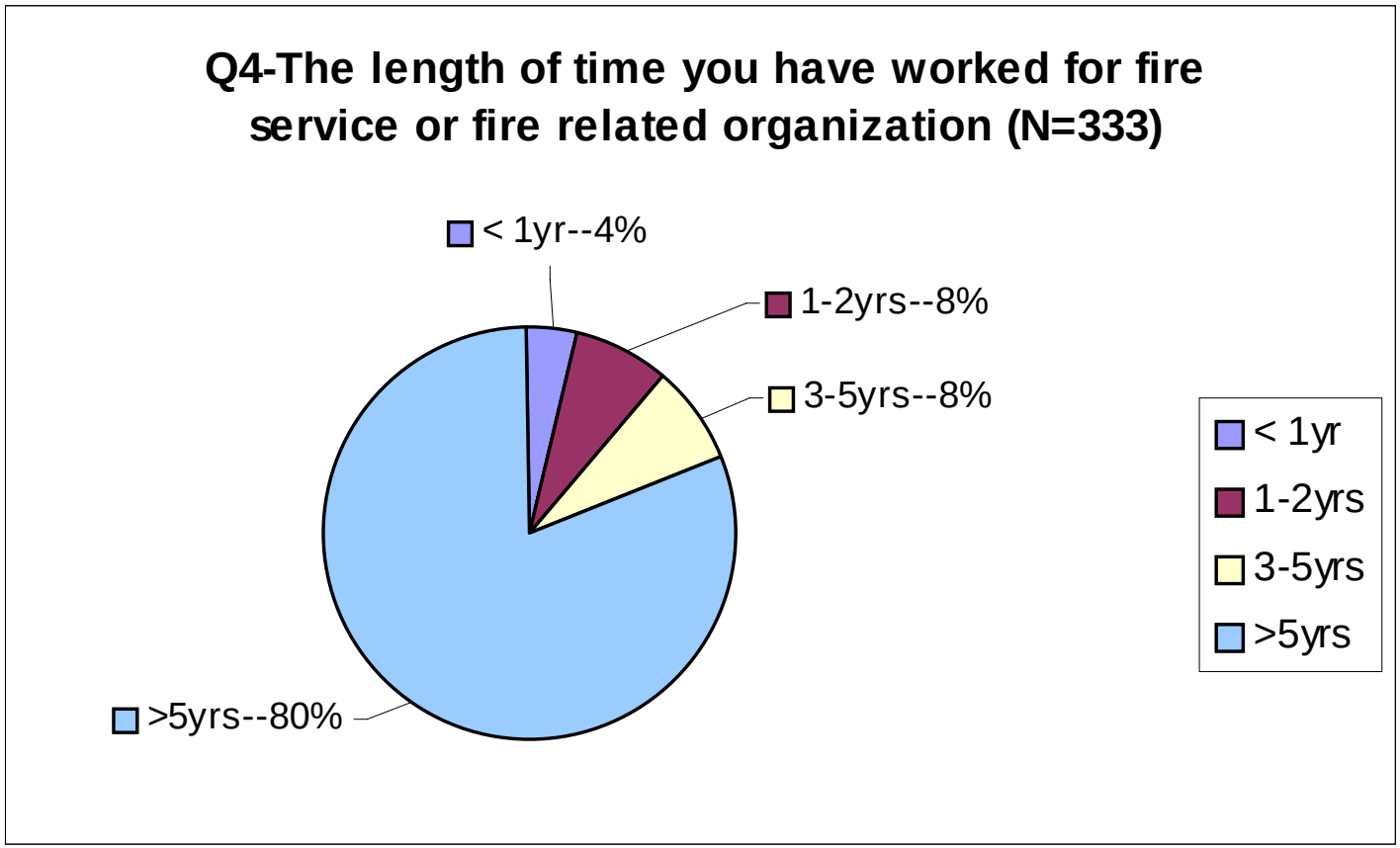
Library Systems in Illinois



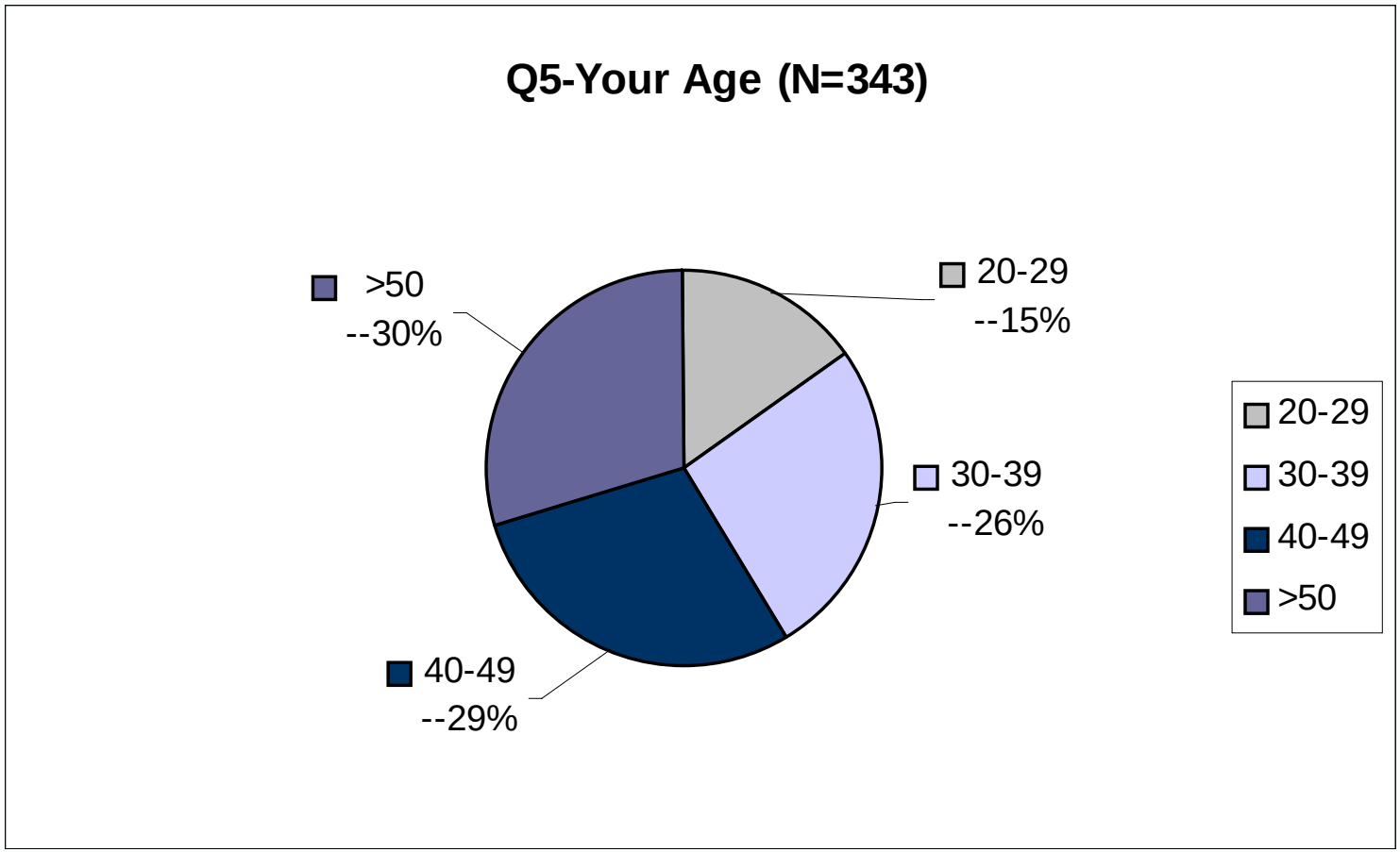
Characteristics of Survey Respondents
Organization Type



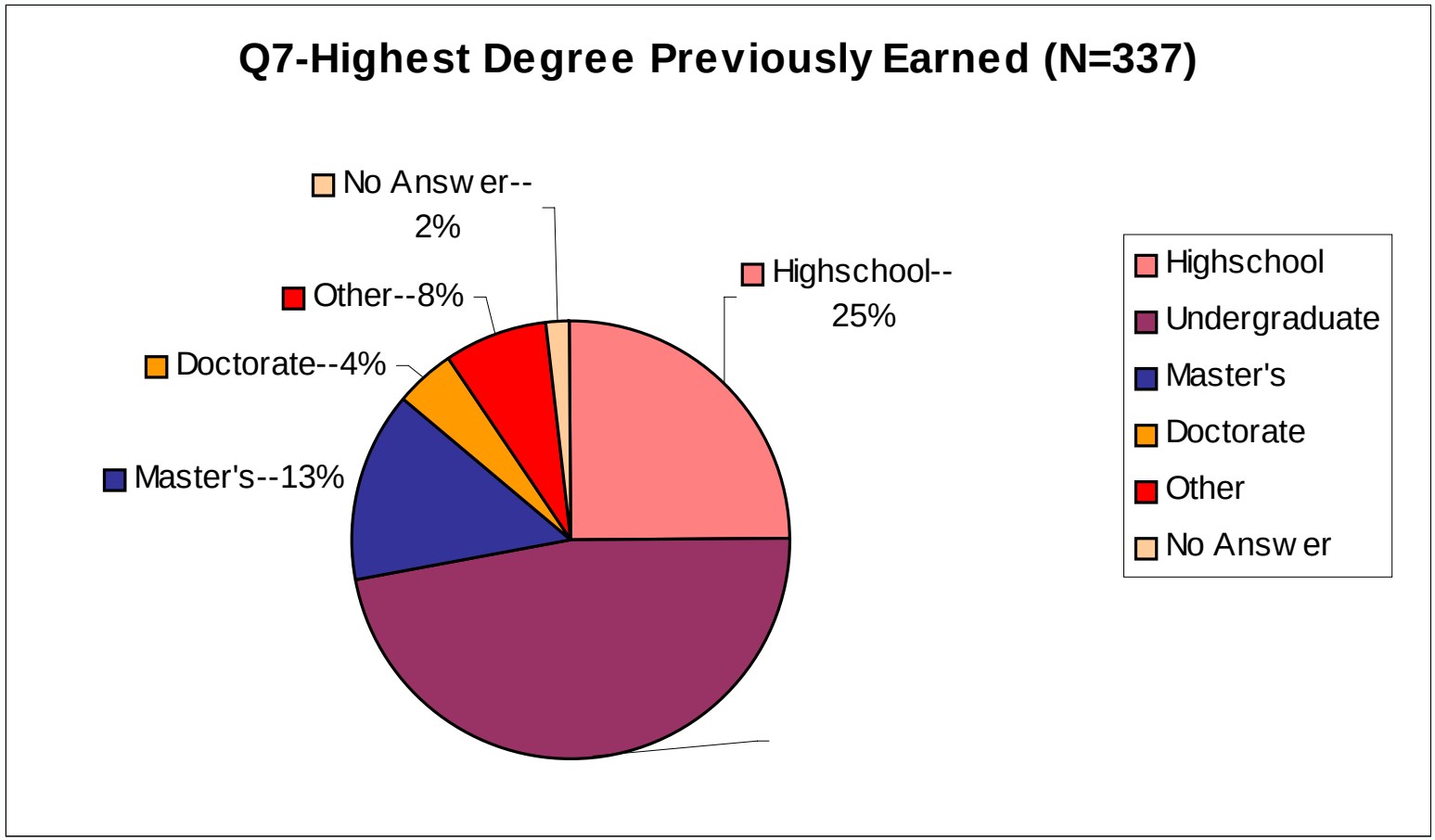
Characteristics of Survey Respondents
Work Years



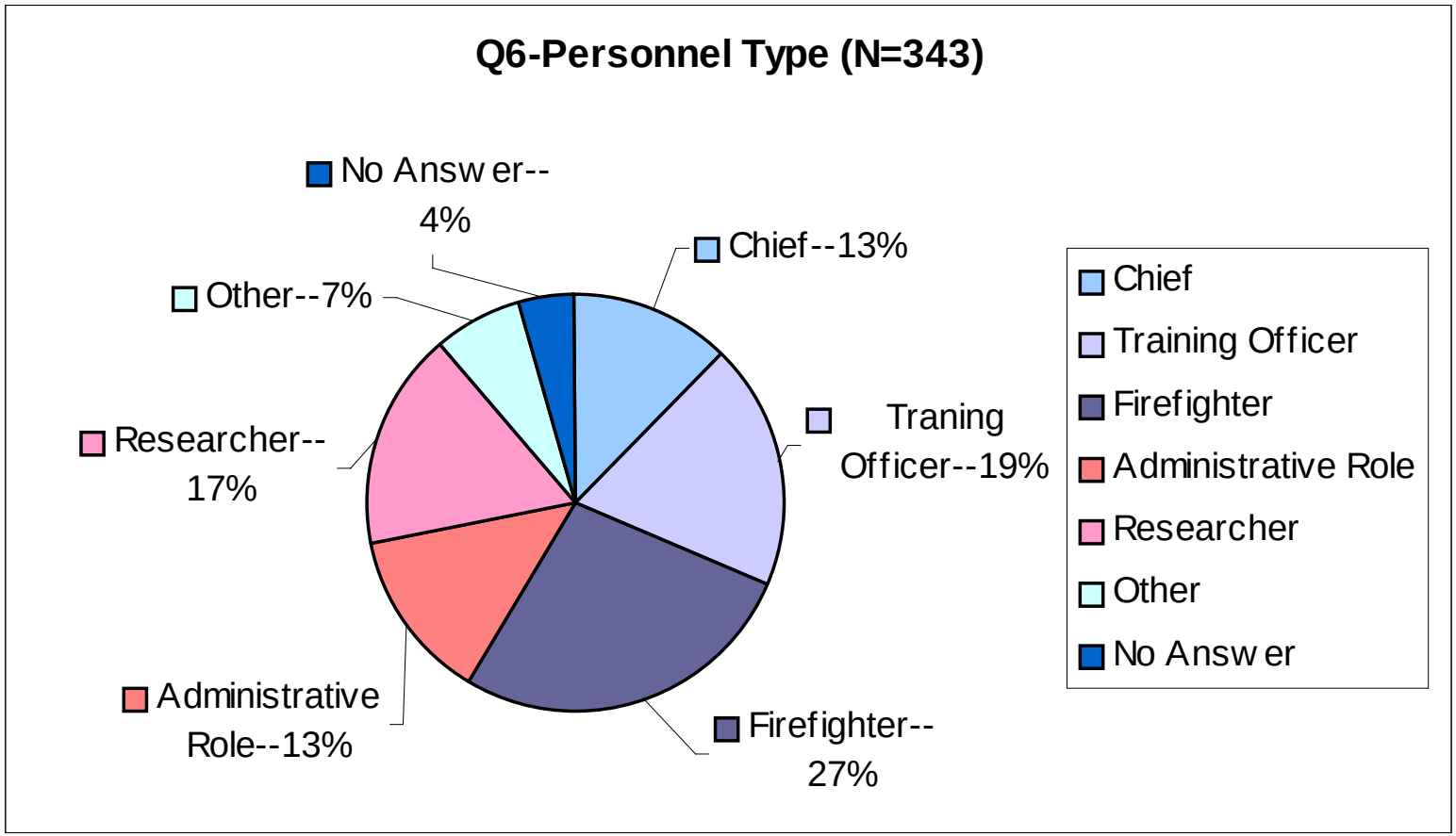
Characteristics of Survey Respondents
Age Groups



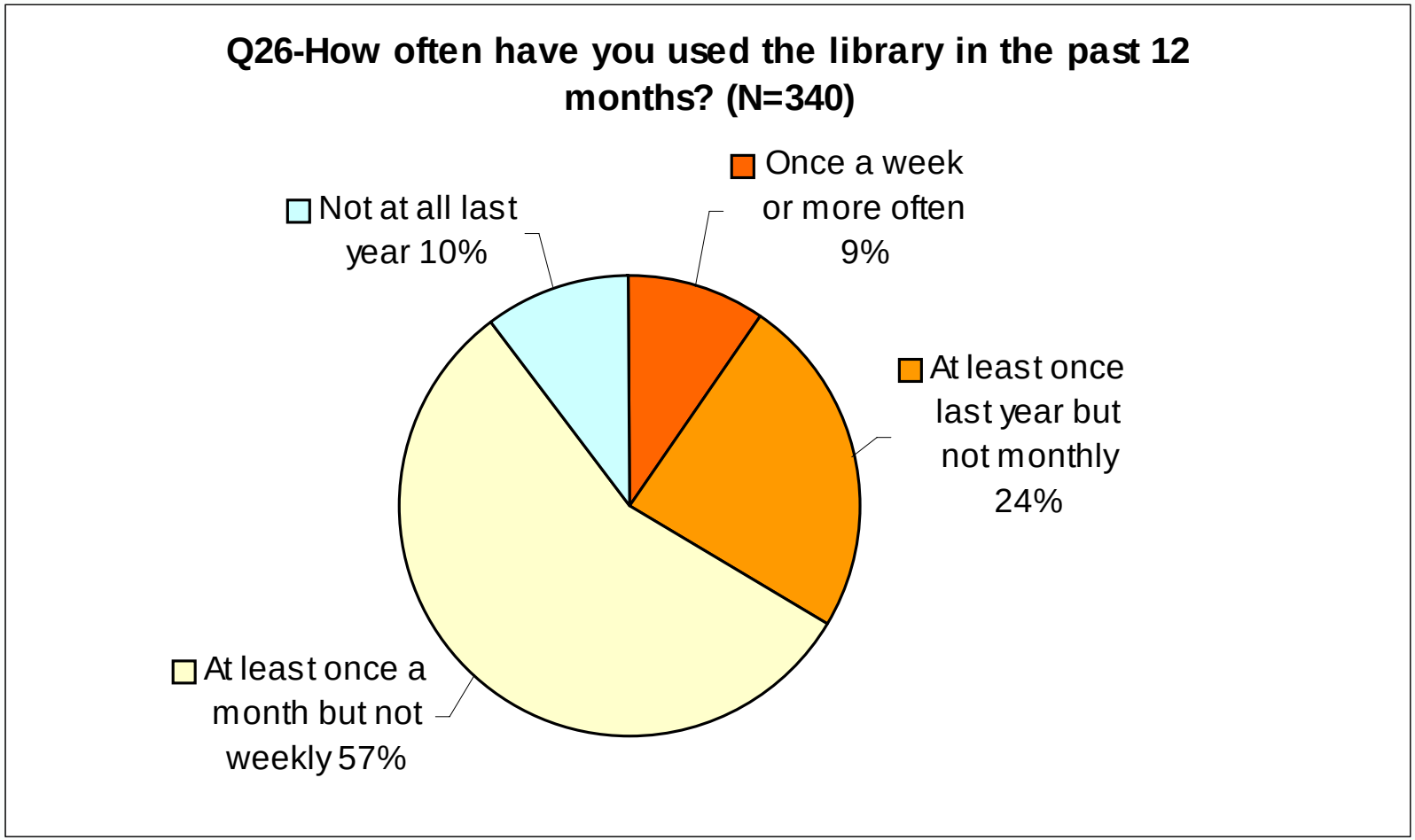
Characteristics of Survey Respondents
Degrees Obtained



Characteristics of Survey Respondents
Personnel Type



Characteristics of Survey Respondents
Usage of the Library



Identified Information Need: **Selected Questions Survey**

Respondents Asked in the Current and Previous 12 Months

1) **Research** information for classes I was **teaching**.
2) **Training information** to present to a college class on the chemistry and physics of fire.
3) I had a list of books needed for a[n] upcoming Lt. **Test.**
4) A **literature review** for a project designed to **mitigate behaviors** associated with fatal smoking fires.
5) Information on the **heat stress** study.
6) Requested use of **emergency response to terrorism** instructor mate
7) Materials on **copyright laws** and standard forms used.
8) What programs are out there on **confined space training**?
9) Information regarding **volunteer fire department retention and recru**
10) How does the **fire/EMS distinction in career fire departments** affe
11) Material for **search & rescue for interior fire operations.**
12) Sources on the pros and cons of **Quint apparatus.**
13) Physical fitness for firefighters. Different examples and exercises spe
14) Information linking **CAD** (Computer Aided Dispatch and Firehouse) s
15) Materials on the subject of **structural fire fighting**?
16) Historical data on **fires in places of assembly.**
17) Information on **protecting firefighters working on the road at a tra**
18) Looking for **firefighter fatalities information.**
19) Research material on the **ethics in a fire department.**
20) Information dealing with **citizen fire academies.**
21) I asked for information on obtaining **grants** for my department.
22) Reports on **high-piled storage fire testing**.
23) Which organizations are working with **health and safety problems i**
24) Test reports and publications on **suppression systems**.
25) Requested training videos on **pop-up roll bars and RIT [Rapid Inter**
26) Video case studies and material related to **FAST/RIT [Fire Attack Su**
27) Information on **fire station construction.**
28) **Biomechanics of firefighting** (the effect of wearing SCBA [Self-Con
29) Information on policies and procedures related to performing **fire sta**
30) Information on the current threat of **domestic right-wings extremist**
31) Reference materials on **fire department budget development**.

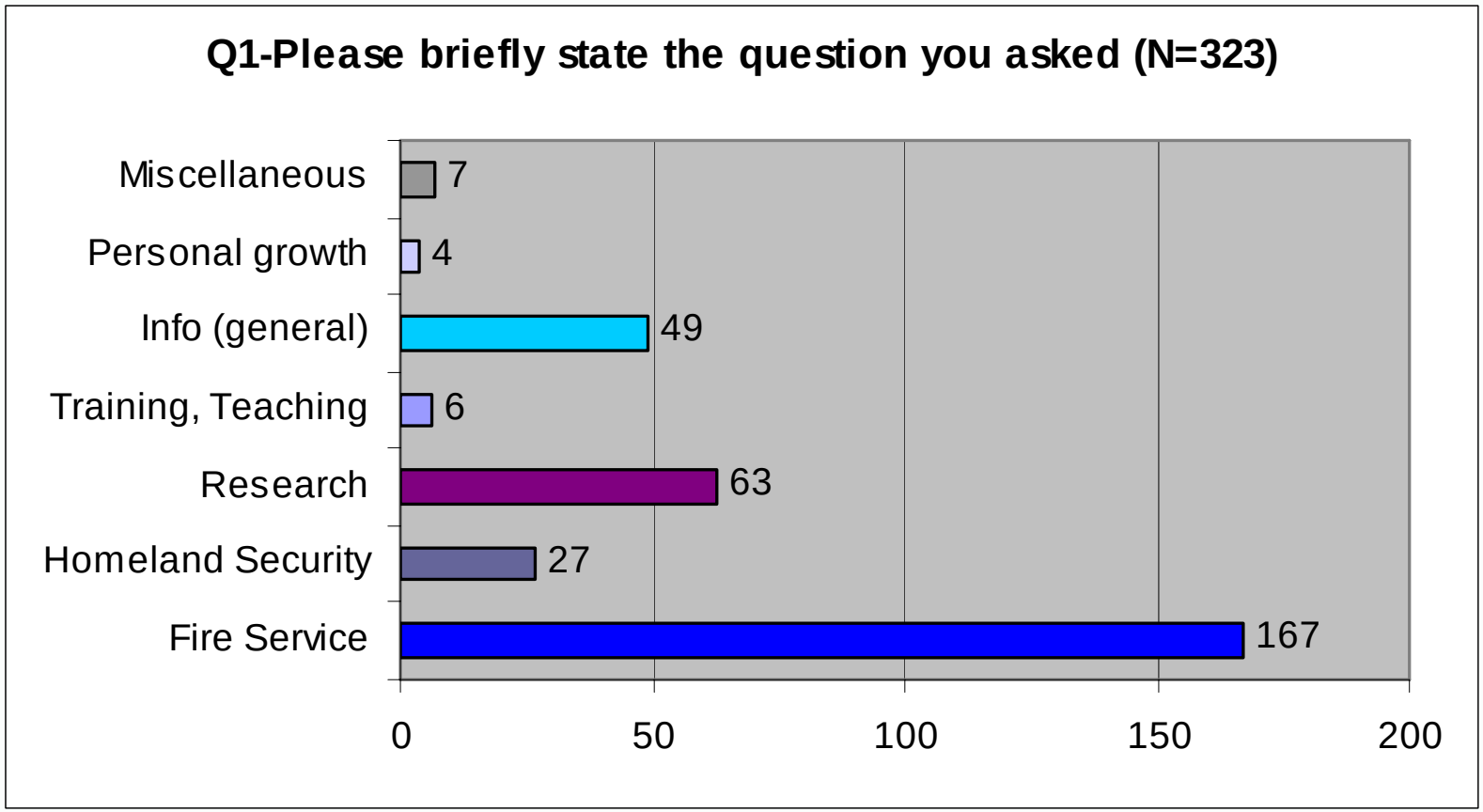
1) **Research** information for classes I was **teaching**.
2) **Training information** to present to a college class on the chemistry and physics of fire.
3) I had a list of books needed for a [n] upcoming Lt. **Test.**
4) A **literature review** for a project designed to **mitigate behaviors** associated with fatal smoking fires.
5) Information on the **heat stress** study.
6) Requested use of **emergency response to terrorism** instructor materials.

Identified Information Need:

Sample Questions on Subject Areas

Subject Areas	Sample Questions
Personal Growth	1. Books to be used with the promotional process. 2. Books/video tapes for a promotional exam.
Info (General)	1. Information on copyright laws and standard forms used. 2. Assistance with overhead transparencies.
Training, Teaching	1. Reference books to students to use for classes. 2. Videos for a class. Research information for classes I was teaching.
Research	1. I need to research the history of the NFPA Standards Council. 2. What are various service levels for pedestrian movement as presented in J. Fruins research?
Homeland Security	1. Requested use of emergency response to terrorism instructor materials. 2. Information on how EMS [Emergency Medical Services] providers should respond to terrorism.
Fire Service	1. Information on arson. 2. Videotapes showing live fires.

Identified Information Need: **Subject Areas Asked by the Respondents**

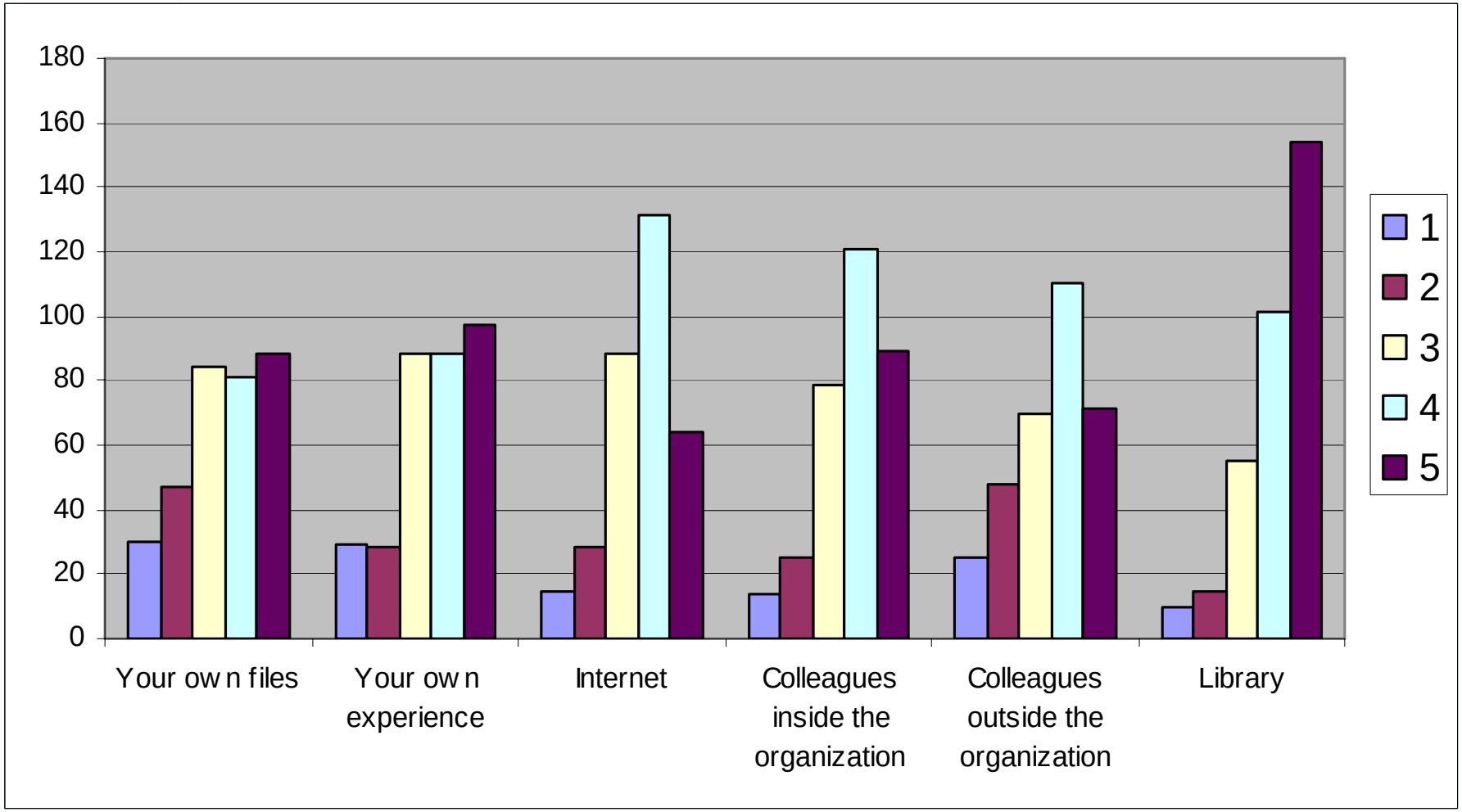


Importance of Different Information Sources

(A scale of 1 to 5 where 1=not very important at all; 2=of some importance; 3=of considerable importance; 4=of great; 5=of greatest importance)

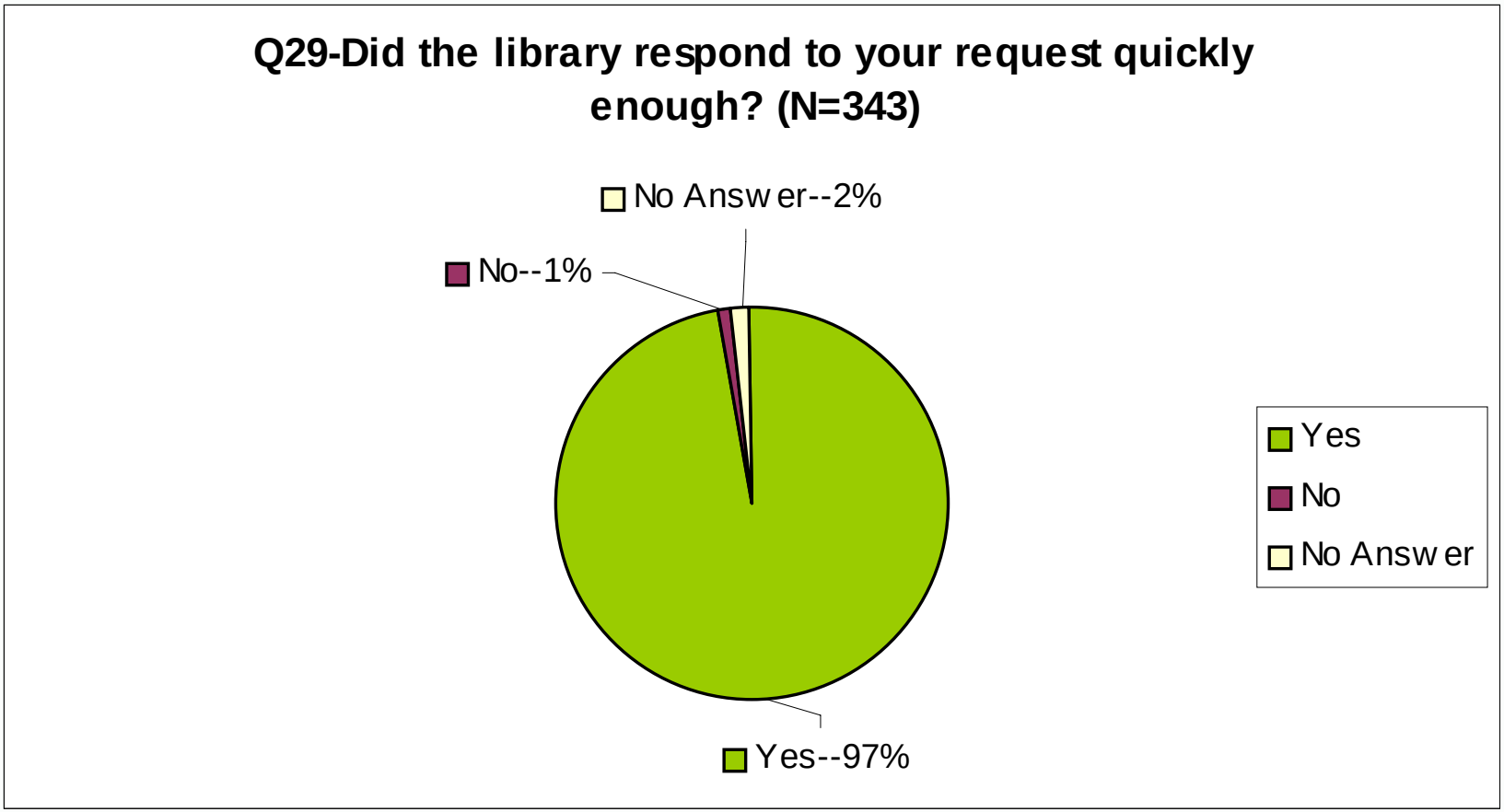
Sources	1	2	3	4	5	Number	Mean	Standard Deviation	Median
Your own files	30	47	84	81	88	330	3.45	1.27	4
Your own experience	29	28	88	88	97	330	3.59	1.24	4
Internet	15	28	88	131	64	326	3.62	1.04	4
Colleagues Inside the organization	14	25	79	121	89	328	3.75	1.07	4
Colleagues Outside the organization	25	48	70	110	71	324	3.48	1.20	4
Library	10	15	55	101	154	335	4.12	1.03	4

Importance of Different Information Sources

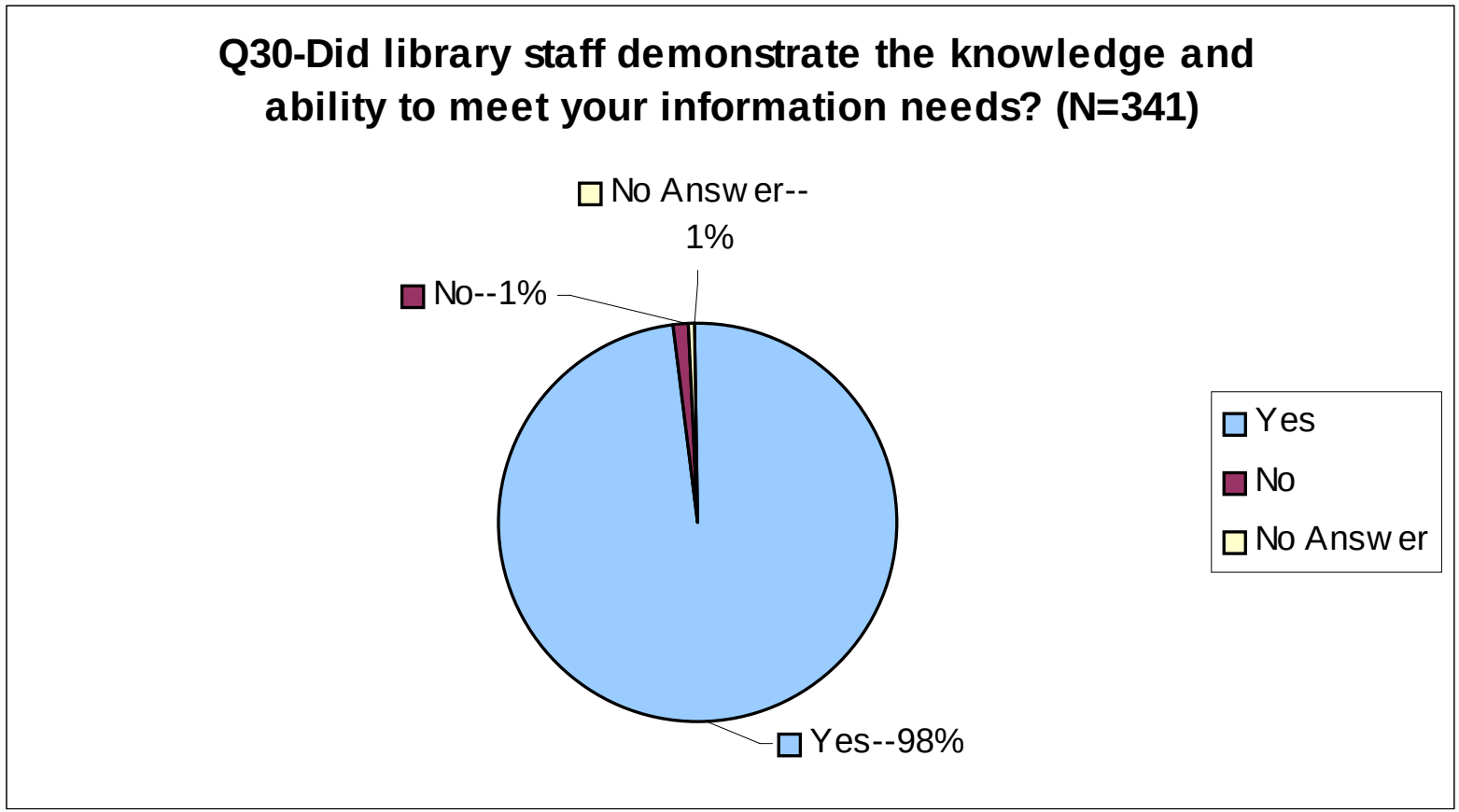


How Did Libraries Respond to Respondents' Needs?

Library's Quick Response

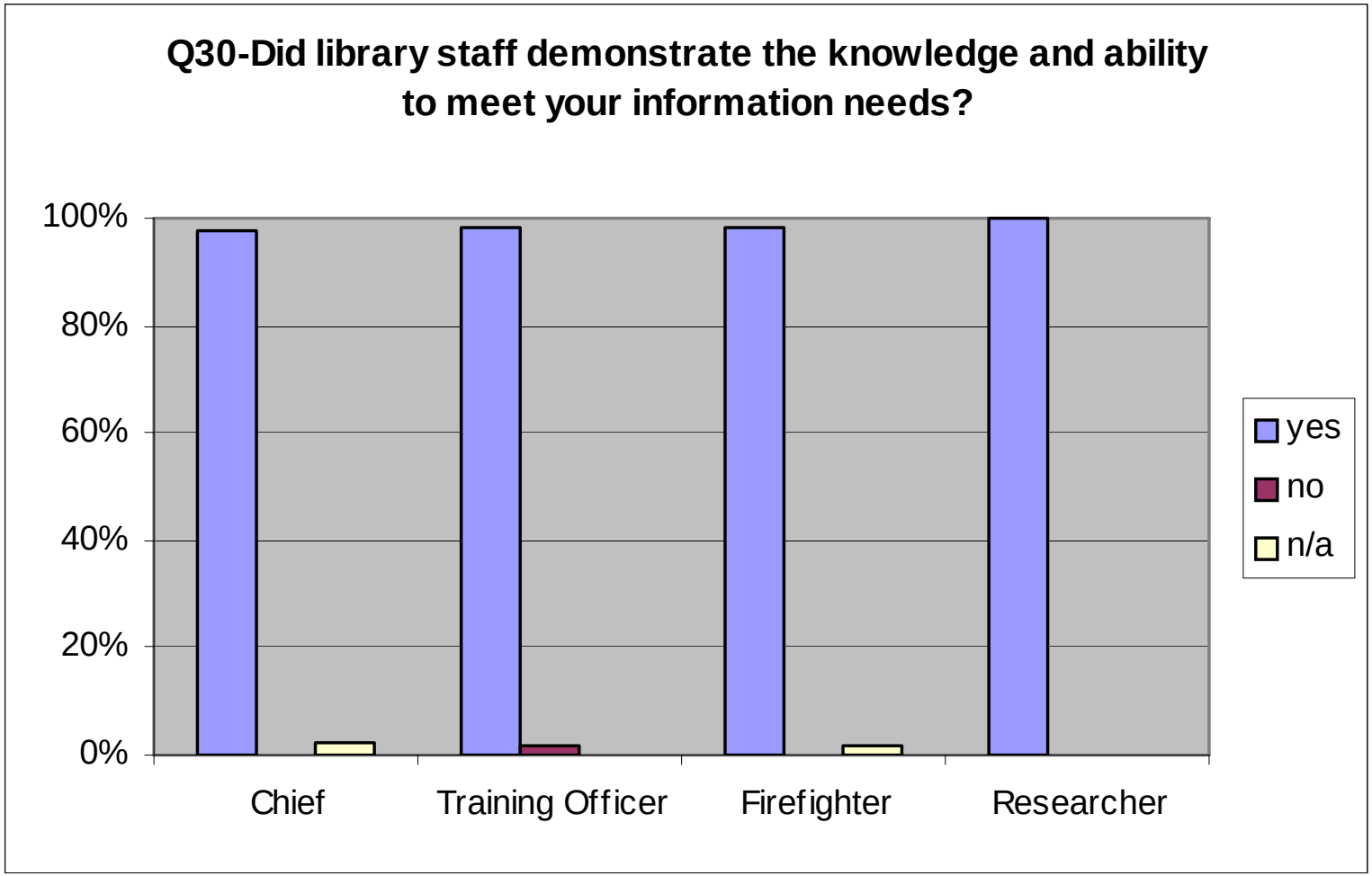


How Did Libraries Respond to Respondents' Needs? Library Staff's Knowledge and Ability



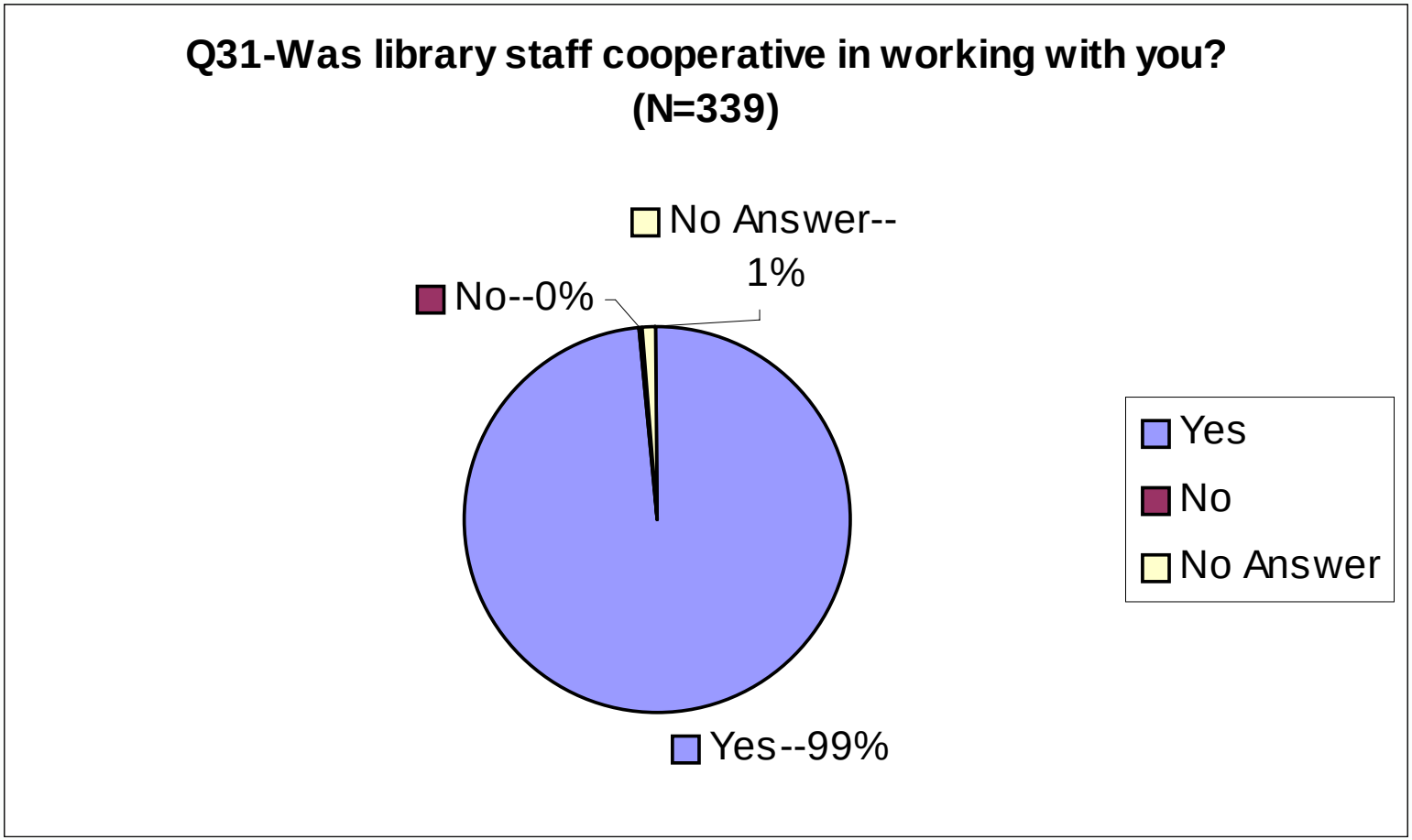
How Did Libraries Respond to Respondents' Needs?

Different Groups and Library Staff's Knowledge and Ability

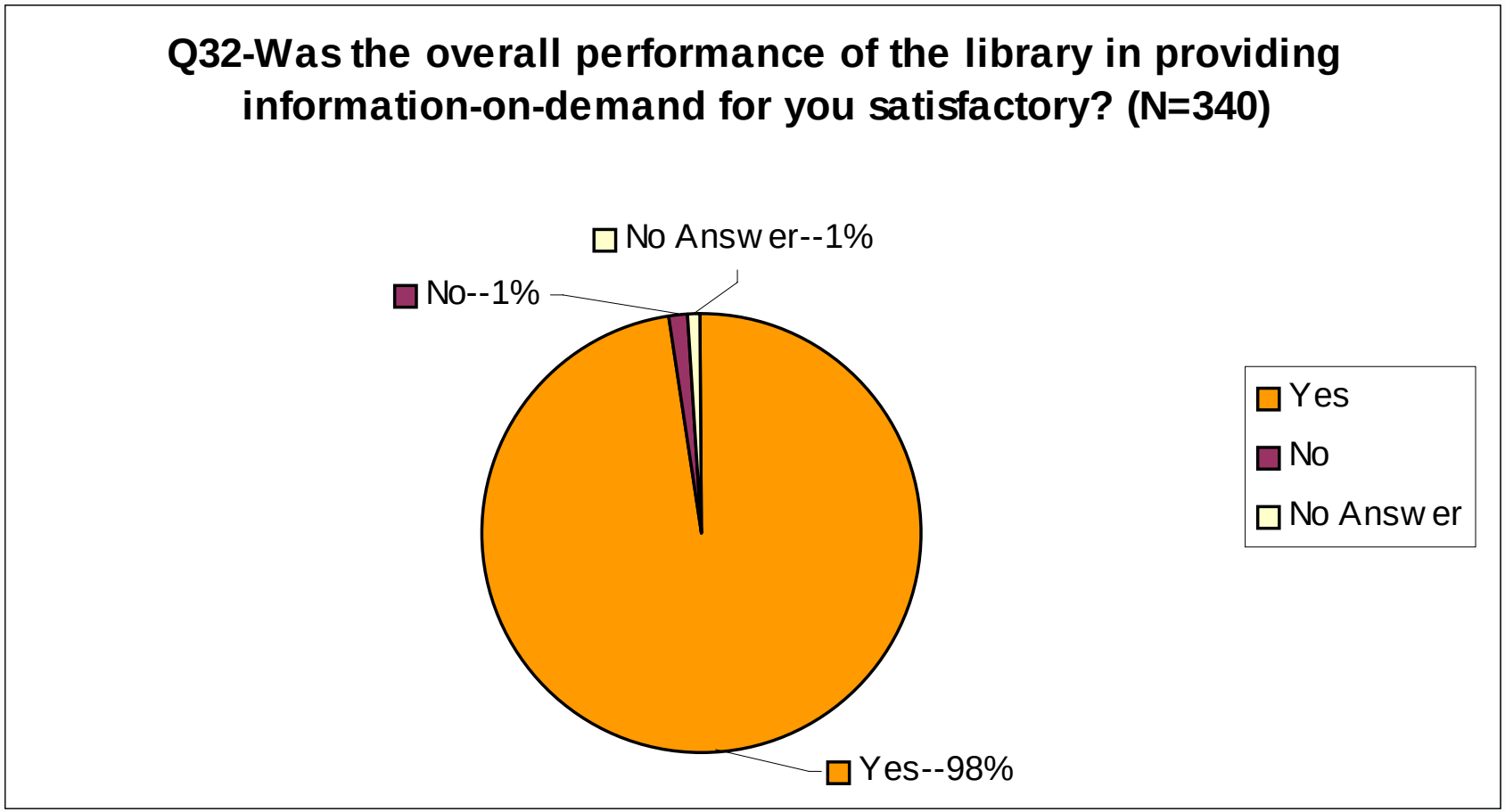


How Did Libraries Respond to Respondents' Needs?

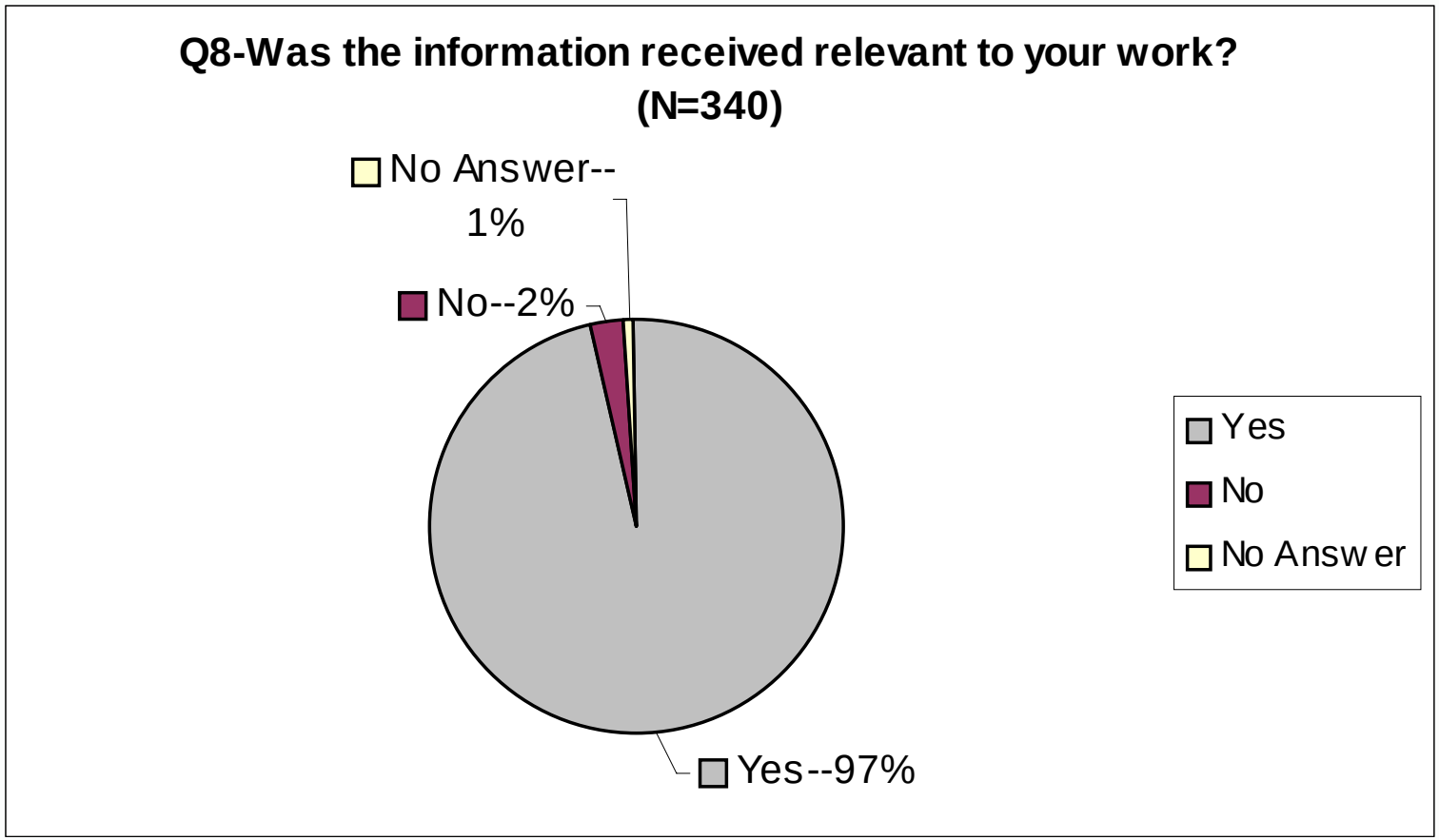
Cooperative Library Staff



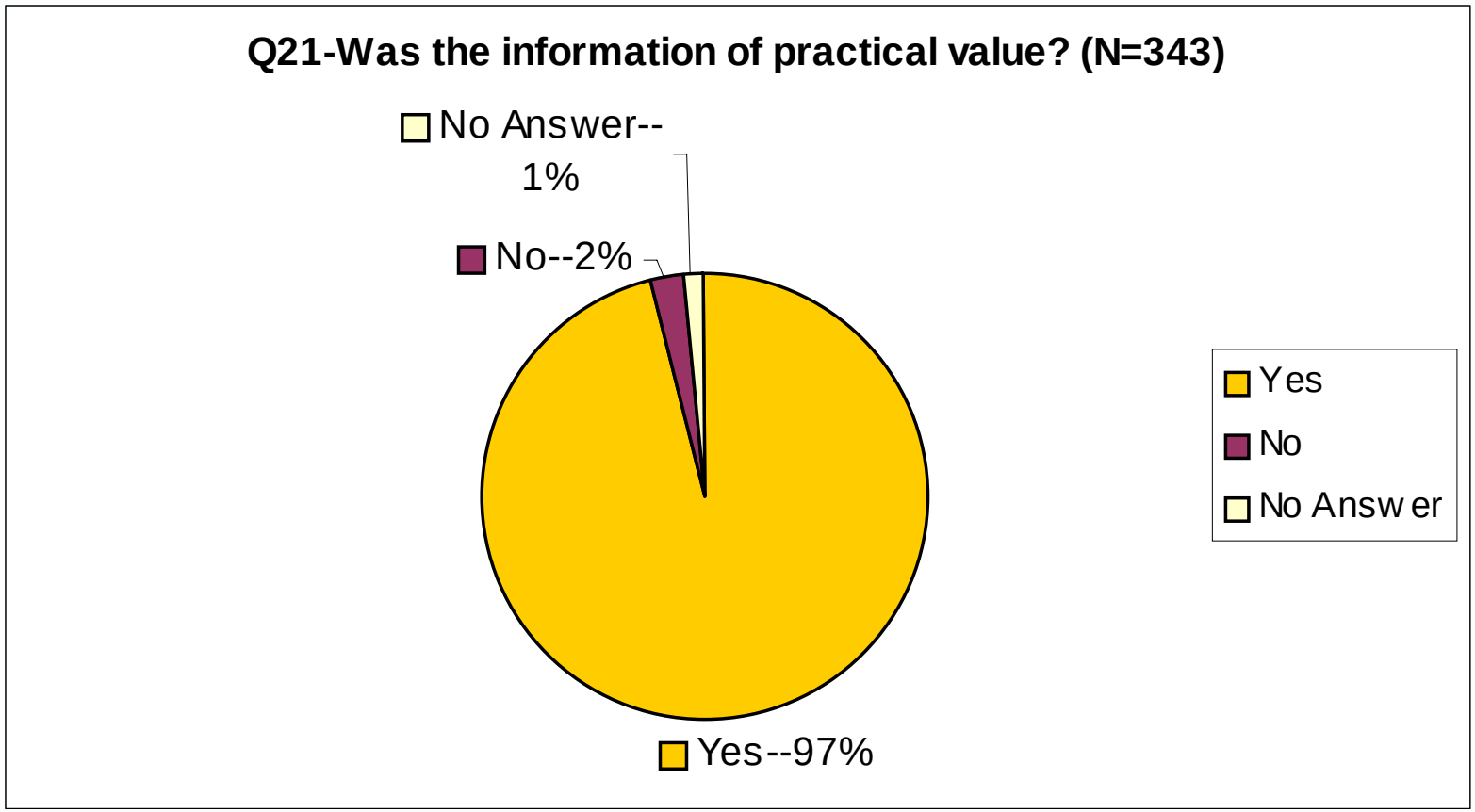
Library's Overall Performance



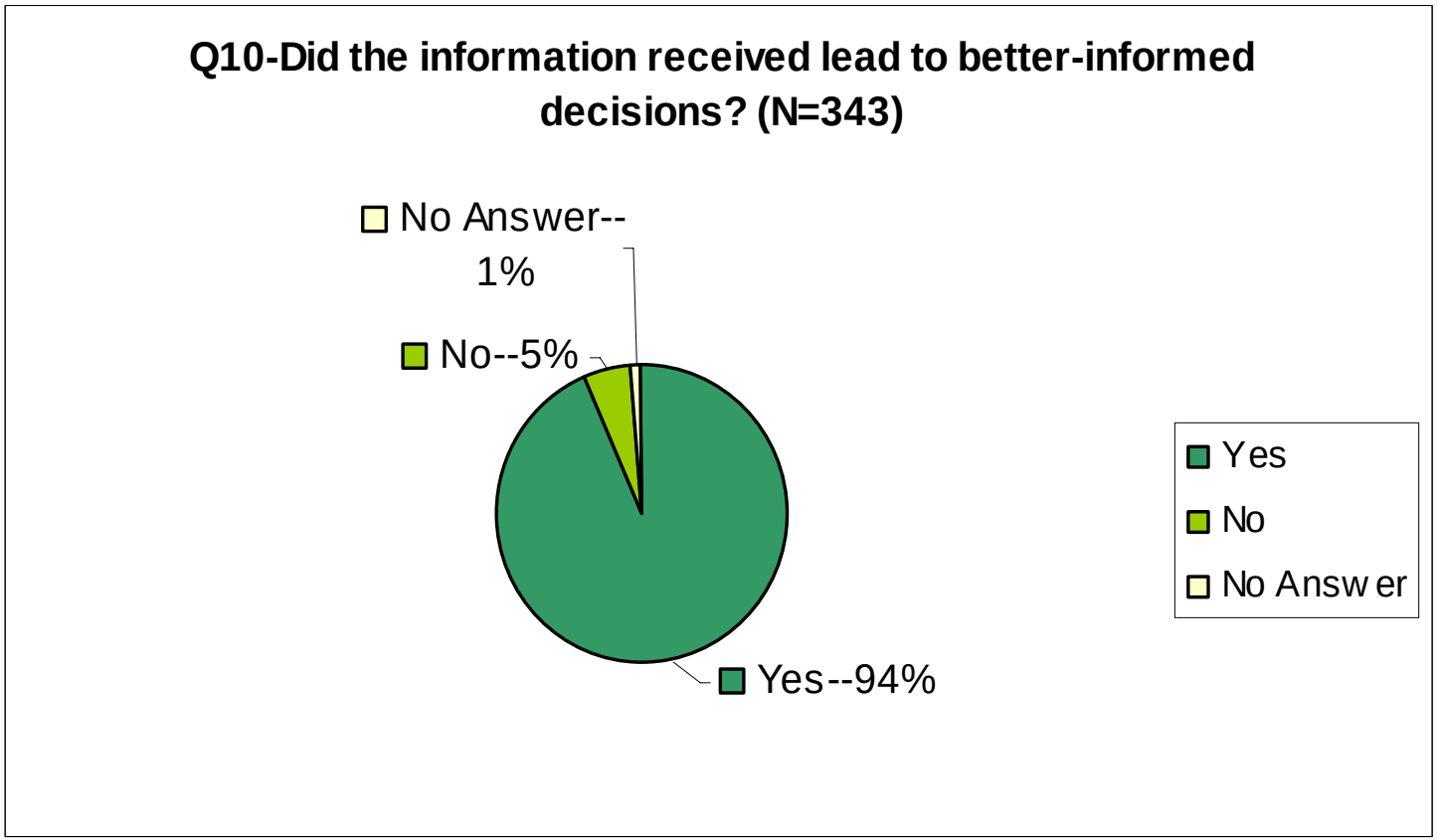
Value and Impact of Information Services: Relevant Information



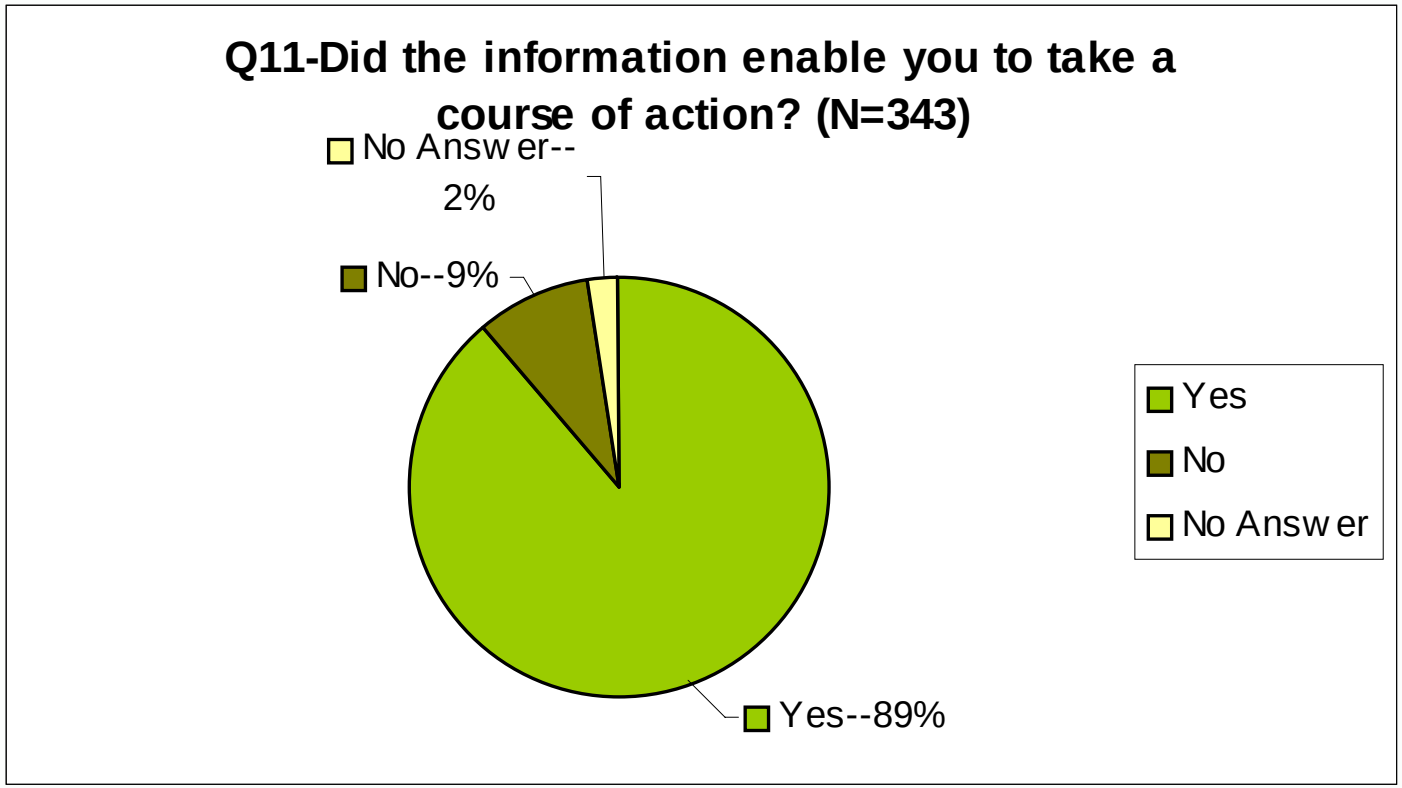
Value and Impact of Information Services: Practical Value



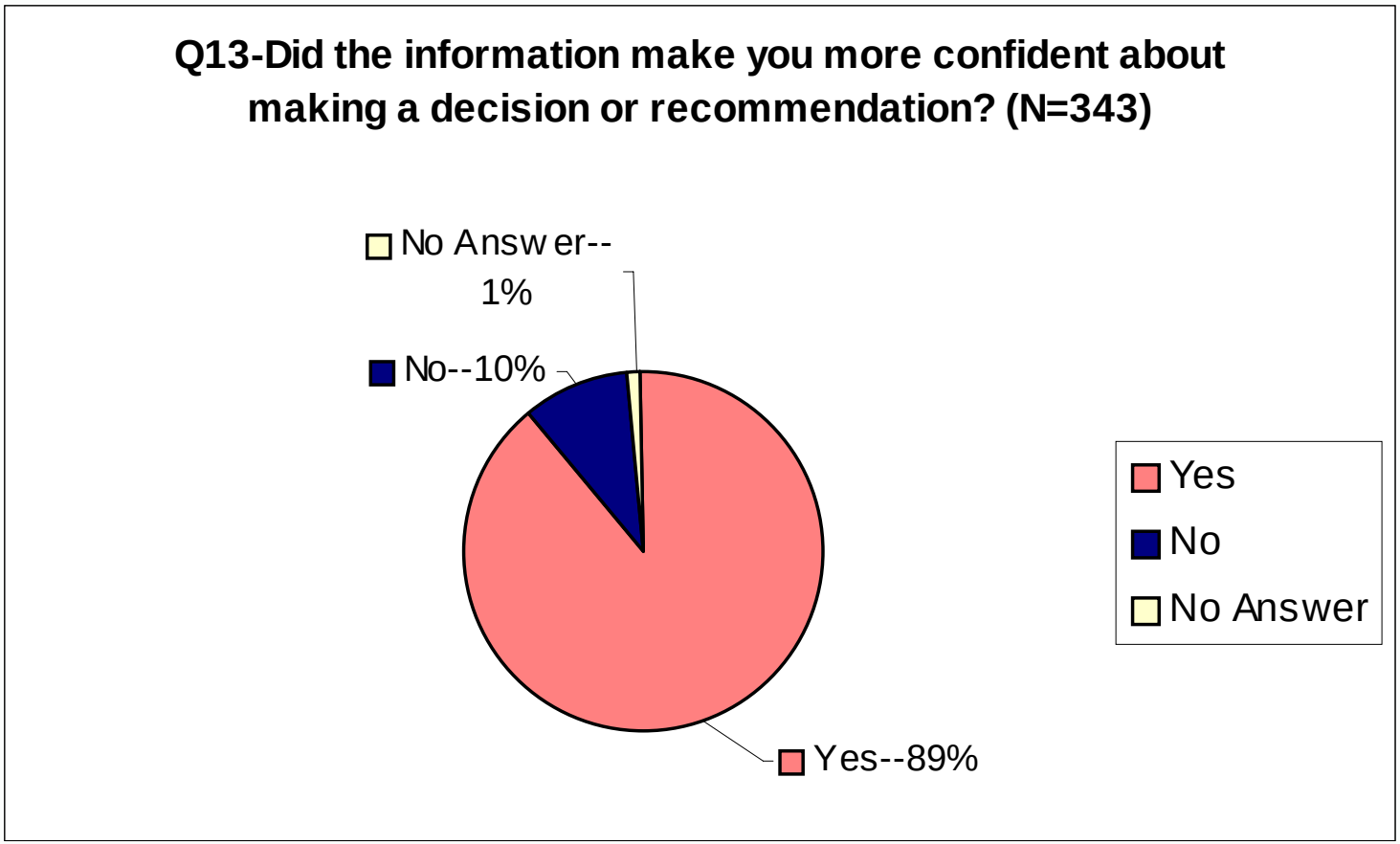
Value and Impact of Information Services: Better-Informed Decisions



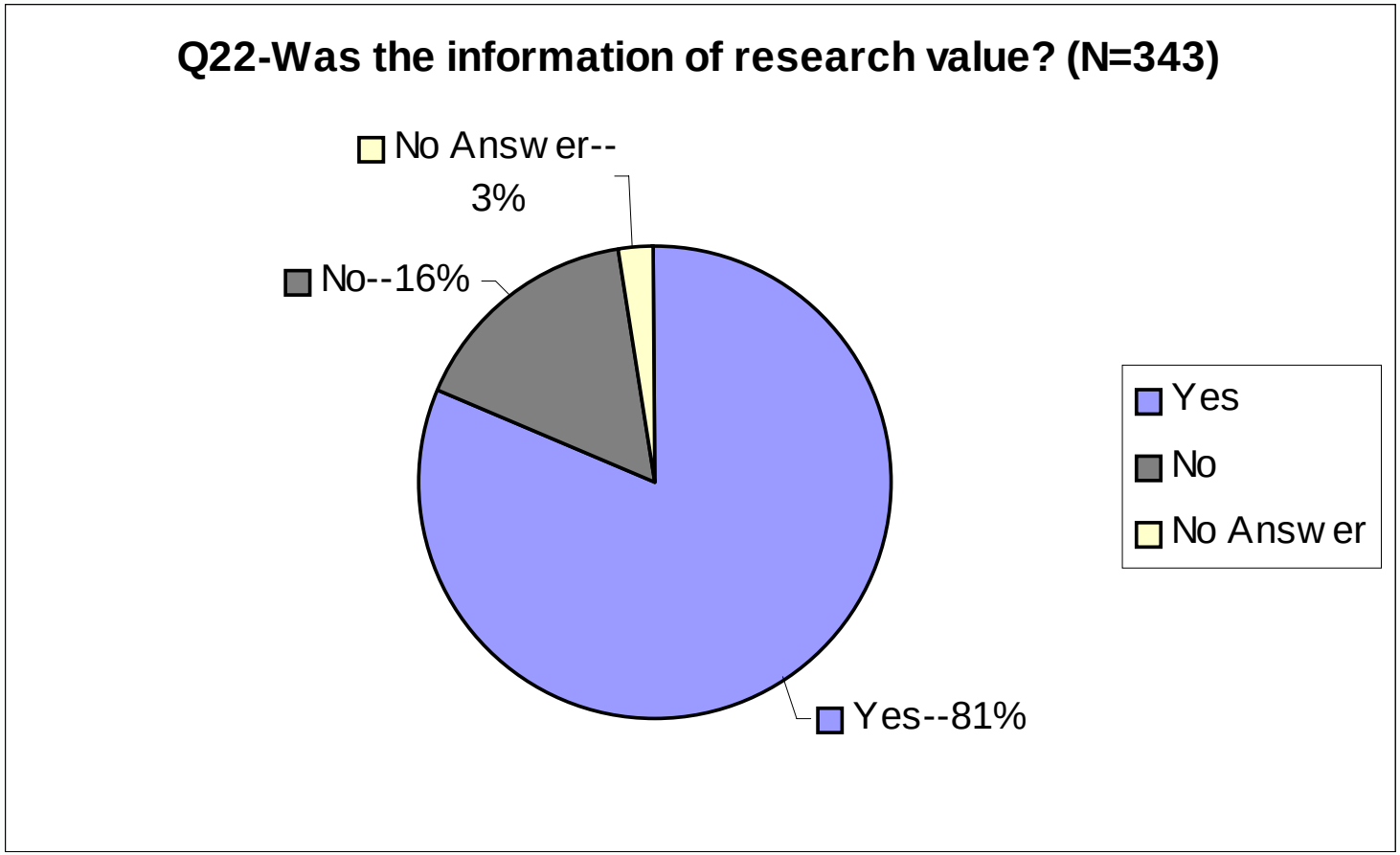
Value and Impact of Information Services: A Course of Action Taken



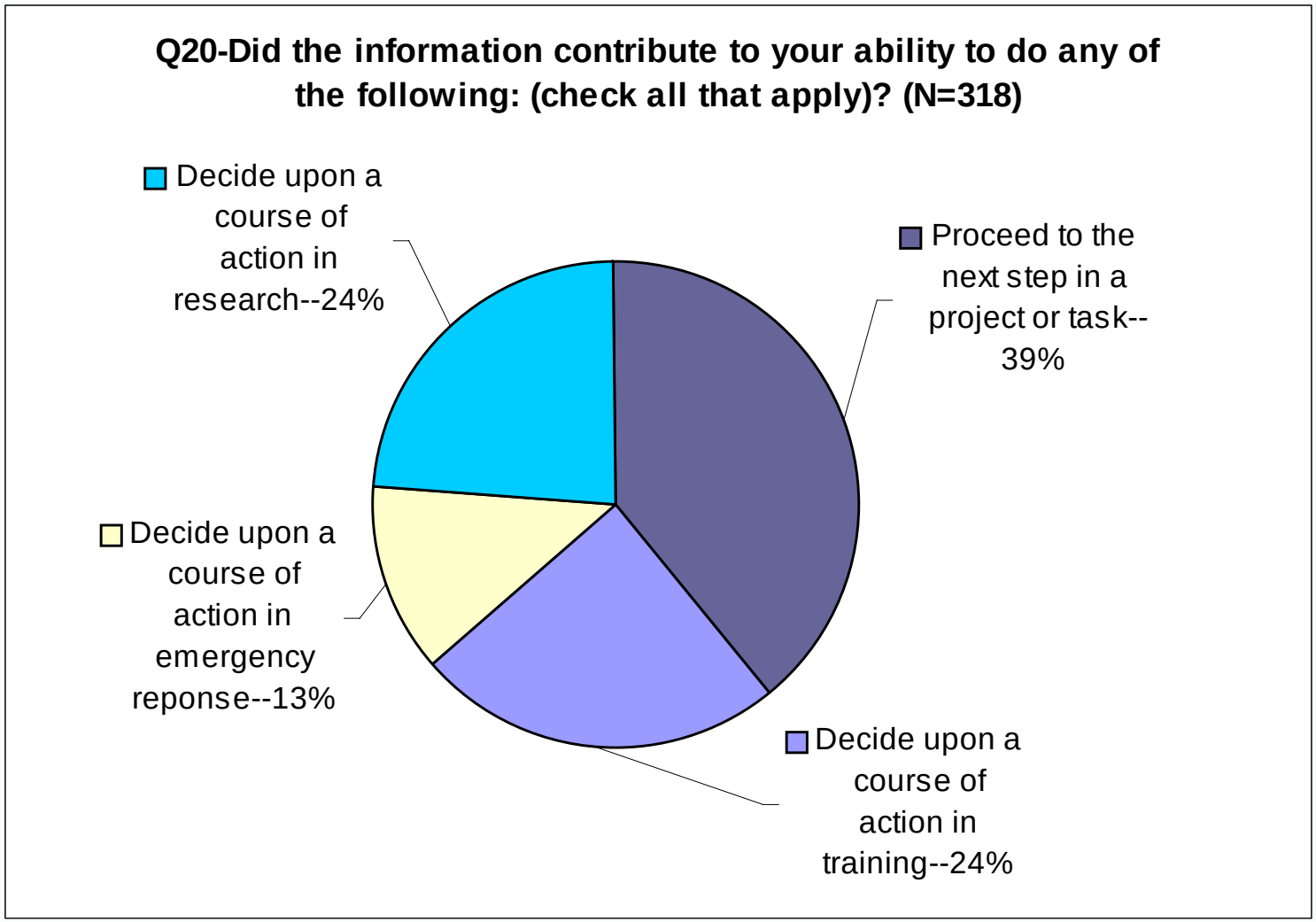
Value and Impact of Information Services: More Confidence Gained



Value and Impact of Information Services: Research Value



Value and Impact of Information Services: Specific Types of Decision-Making Situations



Limitations of the Study

- The Methodology: Emphasized Outcomes Related to Meeting Specific Information Needs
- Findings and Interpretation: Library Users with Specific Requests in Particular Situations
- No Feedback from Non-Library and Virtual Users

Limitations of the Study

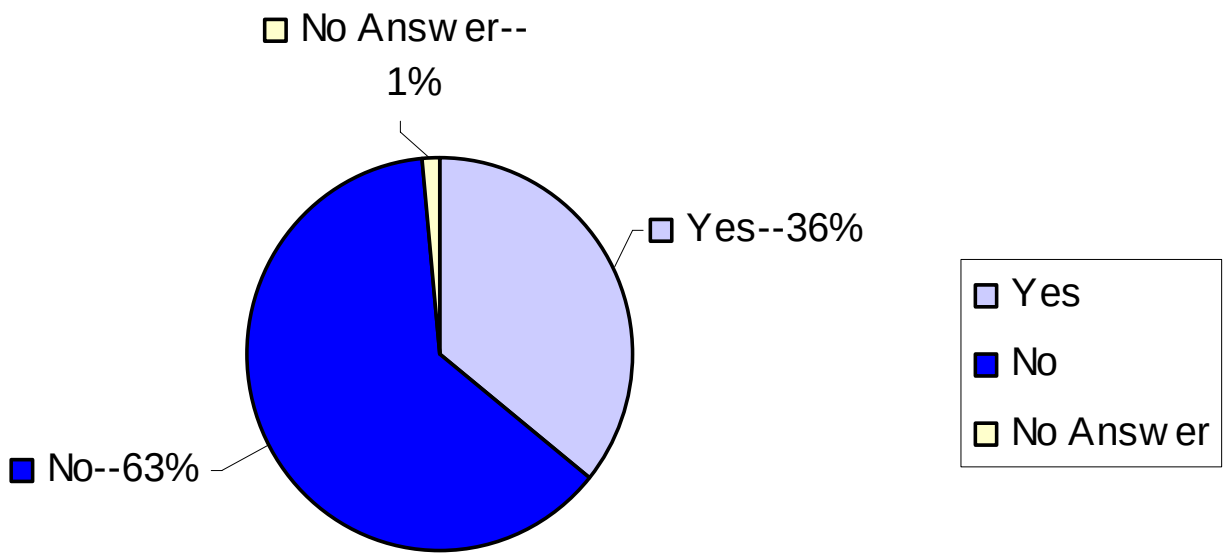
- Not Include Contributions from Other Fire-Related Libraries in Public and Private Sectors in the U.S.

- Challenge: Reach Sufficient Respondents in Solo Libraries Due to Limited Staff and Confidentiality Concerns

- The Long Time Frame May Introduce the Possibility of Incomplete and Inaccurate Recollections by Respondents.

Unaware of Library Services

Q28-Did the information about your library sent to you as part of this survey project make you aware of library service you did not previously know about? (N=338)



Lessons Learned

- The Challenge of Reaching Sufficient Respondents in Solo Libraries due to Limited Staff and Confidentiality Concerns
- The Challenge of Remote Distance and Invisible Users
- Low Level of Technology Infrastructure
- Busy Schedule

Ashley Fire Protection Distr. 9/21/00

The Role of Information Services in Emergency Preparedness

- Enhance Efficiency in Fire Fighting and Emergency Response
- Increase Safety, Both for Fire Emergency Service Professional and the Victims They are Assisting
- Enhance Planning and Training to Protect Both Fire Emergency Service Professional and the Communities They Serve

Significance of the Study

- Focuses on Measuring the Impact of Information Provided by Special Libraries on Users in the Public Sector rather than the Private Sector
- Systematic Evaluations of Library Services and Programs to Address Public Safety and Homeland Security Information
- A Beginning by Providing both Quantitative and Qualitative Data Analysis
- Based on the Results of the Study, Develop Services that Target Particular Types of Impacts, as well as Improving the Level of Impact in Various Areas

Future Research

- Non-Users: Including Those Eligible to Access Services but Who Do not Know How, and Others who would not Have Access at all Because There is no Library Providing Such Specialized Services

- Virtual Users: Accessing Services via a Library's Web Site, and Others Involved in Public Safety, such as Emergency Medical Responders

- Other Studies: Examine and Identify Skills, Attributes and Subject Knowledge for Librarians and Information Professionals Working in Fire Emergency Services and Homeland Security

The Full Report

- http://www.sla.org/content/learn/scholarship/goldspiel/goldspiel2003.cfm (only available for SLA members)

Other Conference Presentations

- 2005 Medical Library Association Meeting Symposium, entitled “The Role of Information services in Emergency Preparedness Planning,” San Antonio, Texas, May 15,

- 2005 SLA Annual Conference, Toronto, Canada, June 6

FABERC : Building the Foundation for the Digital Library in Fire and Building Education Collections

Lora Brueck

Gordon Library

Worcester Polytechnic Institute

What is FABERC?

- Fire and Building Educational Resource Collection
- Collaboration of WPI fire faculty, Gordon Library, Web Development Office and Academic Technology Center
- Aggregator and resource gateway for the fire science and building communities
- Repository for collections of pedagogically sound content

Beginnings

- **Spring 2003 grant to NSF for digital library in the fire sciences to be part of the National Sciences Digital Library (NSDL)**
- **Grant partially funded to create prototype digital library**

The Team

WPI Fire Protection Engineering Dept.

- **Project management**
- **Content and content expertise**
- **Professional contacts**
- **Instructional design and assessment**

Gordon Library

- **Project management**
- **Digital library expertise**
- **Content**
- **Collection development**

The Team (cont'd)

Academic Technology Center

- **Project management**
- **Systems engineering and support**
- **Media production and technology expertise**
- **Instructional design and assessment**

Web Development Office

- **Graphic design**
- **Web design and development**
- **Online survey experience**

Project Tasks

- Create a governance structure
- Create a database structure
- Catalog existing resources
- Develop, test and publish portal
- Assess project outcomes
- Disseminate results

Governance Structure

- Selected from fire community, WPI, DLESE
- Defined policies to address needs
- Established collection policies
- Based on DLESE model

Progress to date

- **Logo designed**

- **Website established (www.FABERC.org)**
- **Survey undertaken**

Database

- FABERC database created in test database using WPI's existing software—Endeavor's ENCompass
- Metadata structure developed to describe digital objects—Firedoc, LC subject headings and locally created keywords
- Repositories created for collections—fire sprinklers (movie files) and electronic text documents (WPI ETDs and documents from Emmons Collection)
- Object records created manually

Next steps

- Bulkload metadata from NIST BFRL collection
- Analyze survey results
- Determine better structure for database and searching
- Integrate search mechanism into FABERC homepage
- Create mechanism for other libraries and institutions to add to database
- Work on OAI harvesting for inclusion in NSDL
- Apply for further funding
- Develop more partners

Resources

- **FABERC http://www.faberc.org**
- **To search FABERC database: http://encompass.wpi.edu:20008 http://www.faberc.org/search.html**
- **NSDL: http://nsdl.org**

Questions? Comments!

lbrueck@wpi.edu

PHOTOELECTRIC VS. IONIZATION A REVIEW OF THE LITERATURE *"REVISITED"*

Original paper was presented at 1997 Symposium. This presentation will incorporate findings from recent NIST smoke detector testing.

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, <u>While detailed reports were never published in the open literature,</u> these persistent reports were the cause of some concern." (From recent NIST Study.)

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..
According to the NIST Study, published in Fire Journal, The smoke detectors used in the next test were *"significantly improved over those used in prior test and were essentially equal to that of current devices."* (I do not consider this to be accurate.)		
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
Edmonton Fire Dept.	*1976 (N/I)*	***Both ion and photo provide considerable life safety. In smoldering ion may go off too late.***
Minneapolis Fire Dept.*-3	**1978**	**Both Ion and Photo gave good early warning if smoke could reach detector.**
Australian Dept. of Housing and Const.*-3	**1979**	**All Smoke detectors adequate and smokes better than heats for flaming fires.**
Modern furnitue, containing plastics used in all studies after this point. Modern furniture was used in some of the previous studies, i.e. FM.		
CAL CHIEFS LA Fire*-3	1978	**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.)***
Fire Research ion (Great Britain)	*1978 (N/I)*	***Both ion and photo respond rapidly to flaming. Ion was not adequate in smoldering***
Smoldering Fire – Aust. (Fire Tech)	*1986 (N/I)*	***Photoelectric detectors provided adequate escape time for most fires. Ionization generally were inadequate.***

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
Norwegian Fire Research Lab Study	*1993*	*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.*
Smoke Alarms In Typical Dwelling Fire Research (GB)	*1997 (Pt 1)*	*Ion cannot be guaranteed to detect smoldering fire. Ion better at flaming and difference could be critical. (smolder > 30 m)*
Practical Comparison of Alarms Fire Research (GB)	*1997 (Pt 2)*	*Both Ion and Photo Adequate (In Pt 2 the "smoldering fire" appeared to smolder for a shorter period than in Pt 1*
Simplex Study- 12th International Detection Conference	*2001*	*Ion detector only slightly better for flaming. Photo provides clear advantage over ion if most likely danger is from smoldering fires*
KEMANO FIRE STUDIES NRC-Canada	*2002*	*Both Ion and Photo appeared to be adequate. (Fire appeared to smolder for less than 15 mins.*

SUMMARY OF HISTORICAL STUDIES

- **All the studies that utilized synthetic material and smoldering scenarios that lasted more than 30 minutes concluded that ionization detectors were not providing adequate warning. (7 studies over 3 decades in 4 different countries.)**
- **No study that utilized the photoelectric detectors with “open designs” similar to current photoelectric detectors showed photoelectric detectors providing inadequate warning.**

NIST VS. HISTORY?

***"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

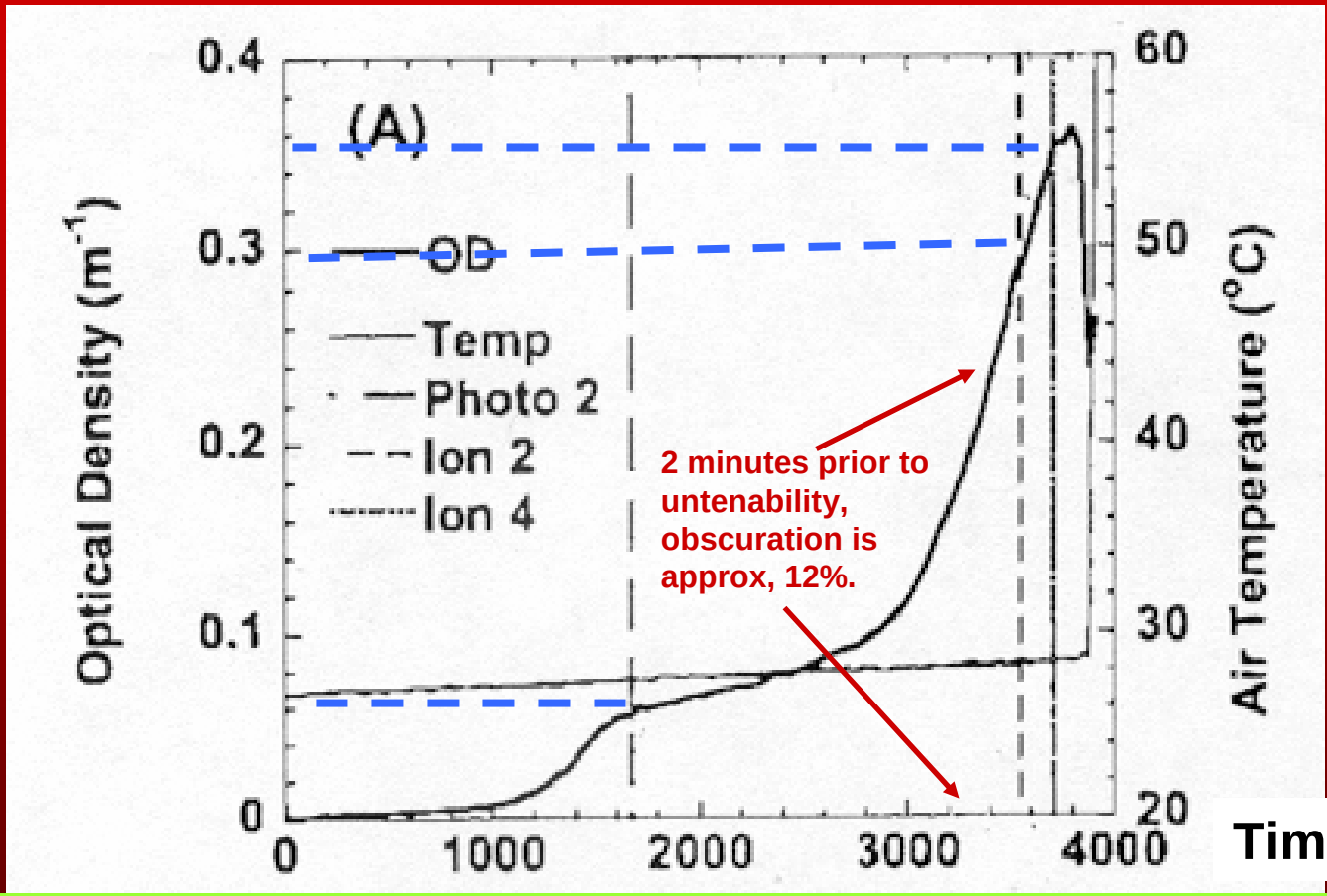
Smoldering fires in living room were the #1 fatal scenario.

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 - SMOLDERING LIVING ROOM FIRE - TEST 34



Photo(3-4% O/ft), Ion 2 - (17-19% O/ft), Ion 3 - (20-22% O/ft)

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**

"REAL" DIFFERENCE IN RESULTS FROM 1975 RESULTS

	1975		CURRENT	
	FLAMING	SMOLDER	FLAMING	SMOLDER
ION	ADEQUATE	ADEQUATE	ADEQUATE	*NOT ADEQUATE*
PHOTO	ADEQUATE	ADEQUATE	ADEQUATE	ADEQUATE

The important result that differs from the 1975 tests is that the ionization detector is not responding adequately to smoldering fires. The best explanation is: ionization detectors may have been de-sensitized over time (definitely since the early 80's) and are relatively poor at detecting the kind of smoke given off by today's furnishings. This possible explanation was never investigated or even discussed by NIST.

PART TWO

REVIEW OF STATISTICS

“Not everything that counts can be counted and not everything that can be counted, counts.” - Albert Einstein

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 ;last 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 without any smoke detectors! (2/3 of total.)**

Data from NFPA Smoke Detector Study 11/04.

TRENDS IN FIRE DEATHS COMPARED TO INCREASE IN DETECTOR USAGE

	65-75	77-87	92-02
Increase in homes with detectors over 10 years	<4% - 10%	22% - 82%	90% - 96%
% decrease in fire deaths per million people, over 10 years	-27% (Residential) National Safety Council	-29% (All) NFPA	-25% (All) NFPA

Fire deaths wee decreasing <u>before</u> widespread use of detectors and continued to decline <u>after</u> "market saturation".

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 Recomissioned – 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.**

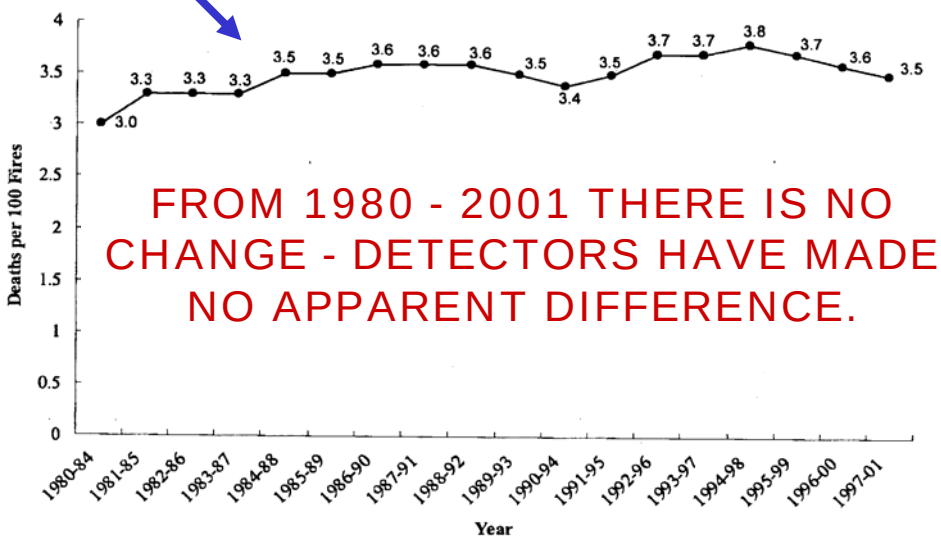
REDUCED SMOKING'S CONTRIBUTION TO FIRE DEATH REDUCTION

- **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 Hall, 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)



FROM 1980 - 2001 THERE IS NO CHANGE - DETECTORS HAVE MADE NO APPARENT DIFFERENCE.

Source: NFIRS and NFPA survey

NFPA's EST. BENEFIT OF RES. SMOKE DETECTORS

- **" If a home fire occurs, smoke alarms reduce the risk of death by 40-50%. From 99-01 the reduction in risk for apts. & condos was only 7%**
- **From 1999 an increasing amount of data has been collected in NFIRS Version 5.0.**
- **In 2001 using this new data the NFPA estimated reduction was only 21%.**
  - ***Were the previous estimates, which incorporated assumptions to compensate for incomplete data, overly optimistic?***
  - ***How much of this new, and smaller, reduction is due to characteristic that go along with owning a smoke detector: higher income, newer construction, better evac plans etc?***

% 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 , 95-01"

- ***"In 39% of fire deaths, an alarm did operate – 10% points higher than in 1998 and <u>30% points higher than in 1988</u>. 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. "***

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)

PART THREE

REVIEW OF UL APPROVAL

ORIGIN OF SMOLDERING FIRE TESTS

- **EN54 - Swiss originators, felt that the fires represented pyrolyzed and self-sustained cellulosic smoldering.**
- **Canadian - Developed by ionization manufacturer, no technical justification.**
- **UL217 - Originally Douglas Fir proposed. Problems with repeatability, particularly with challenge to ionization detector, led to abandonment. White Pine selected to mimic cotton mattresses. (This also allowed ion to pass.)**

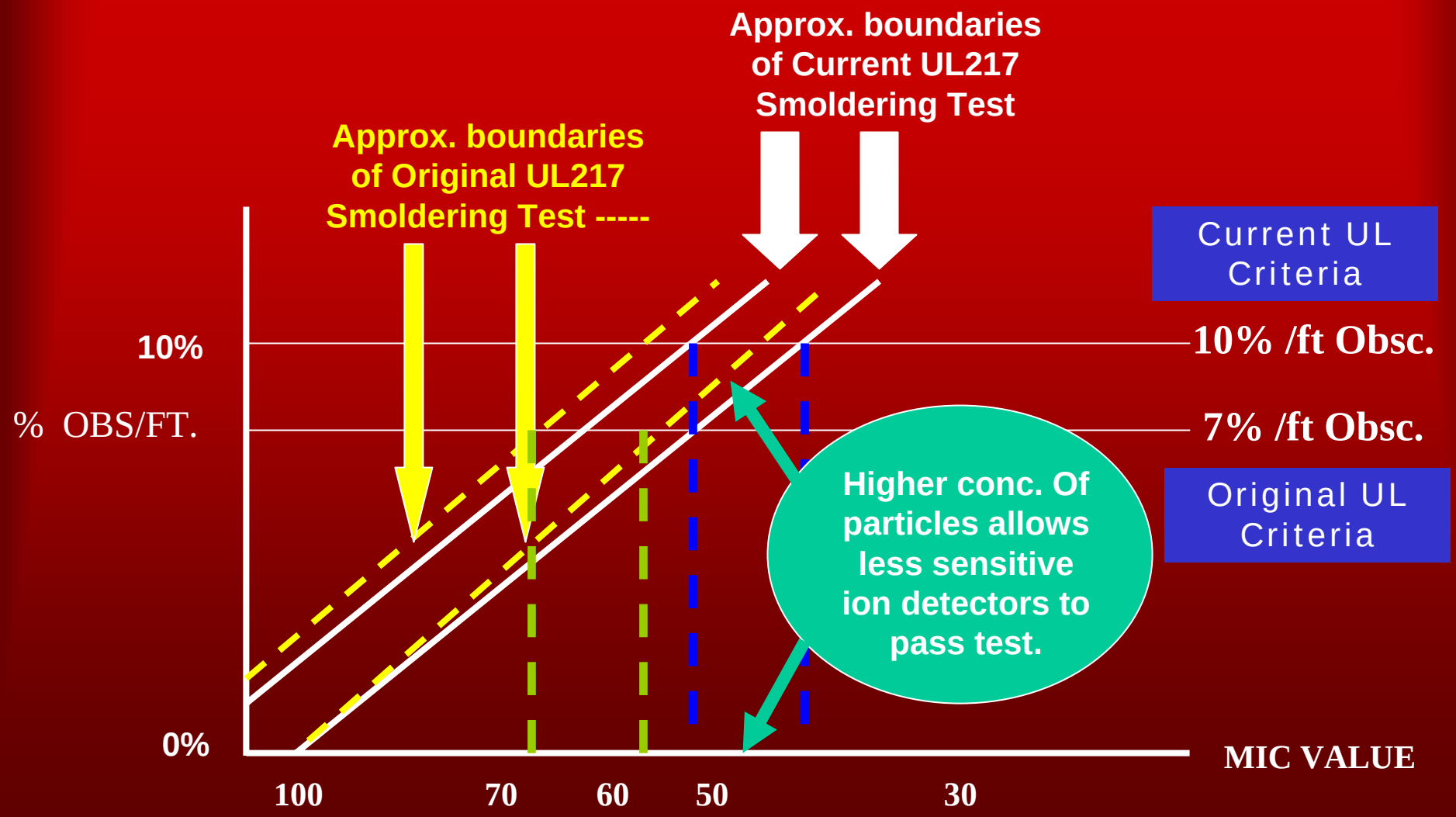
Source: USFA - *Analysis of Fire Detector test Methods/Performance*, 1980.

QUICK HISTORY OF UL217

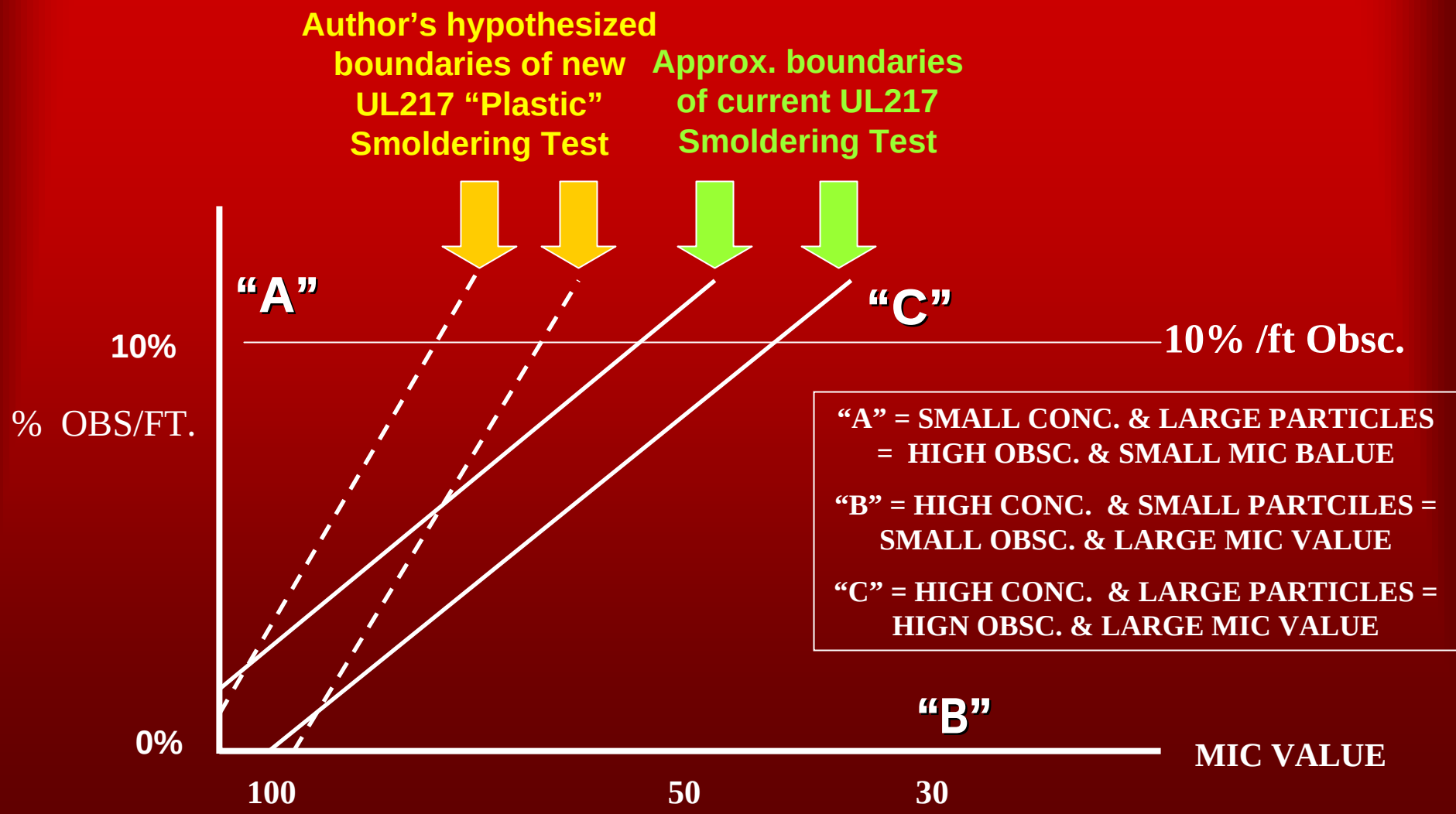
YEAR	EVENT
<1976	2 Standards: UL167 for Ion and UL168 for Photo
1976	UL217 created using 4 flaming fires from UL167. Prod Sens: 0.2-4.0 gray smoke, 0.5 – 10% for black smoke
1979	Smoldering test added – 7% criteria. (Typical ion detector increased in sensitivity in order to pass this new test.)
Early 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



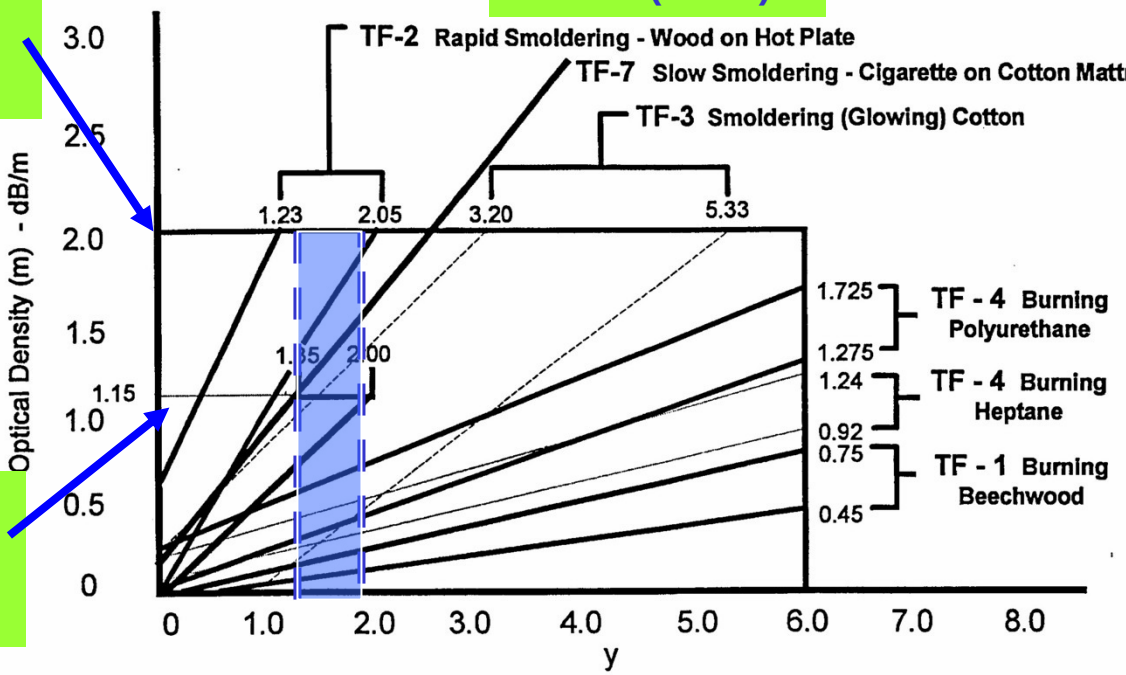
EN54 AND UL217 SMOLDERING COMPARISON

TF-2, EN54 SMOLDERING TEST (FAST)

≅17% OBS/FT

EN54 PASSING CRITERIA

TF-7, UL 217 SMOLDERING TEST (SLOW)



10% OBS/FT

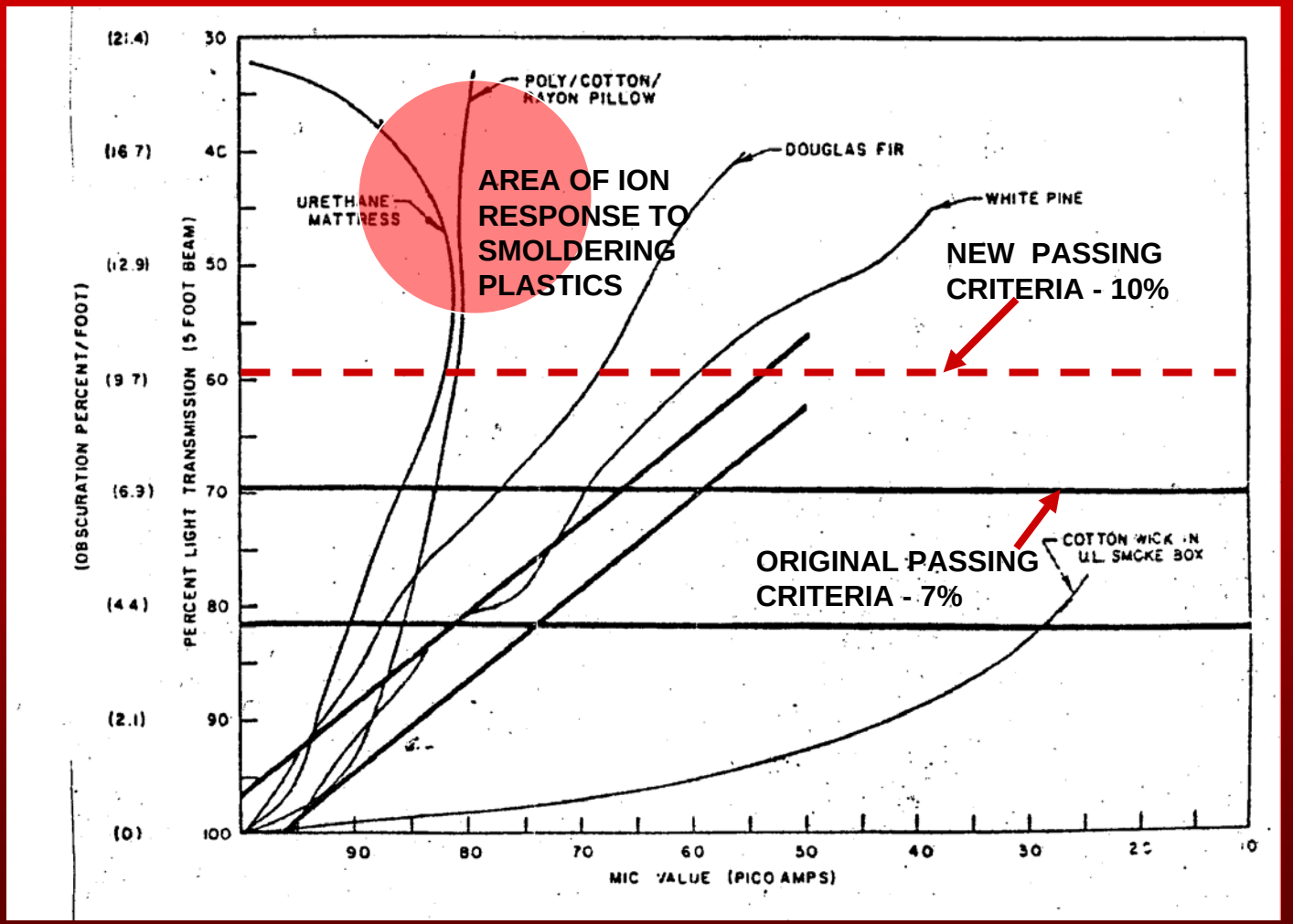
UL PASSING CRITERIA

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 flunked original UL test at 7% but passed at 10%.**

SUCCESS PREDICTION FROM HARPE AND CHRISTIAN

SMOLDERING FIRE SUCCESS RATE

VS.

%OBS/FT

AT TIME OF DET. ACTIVATION

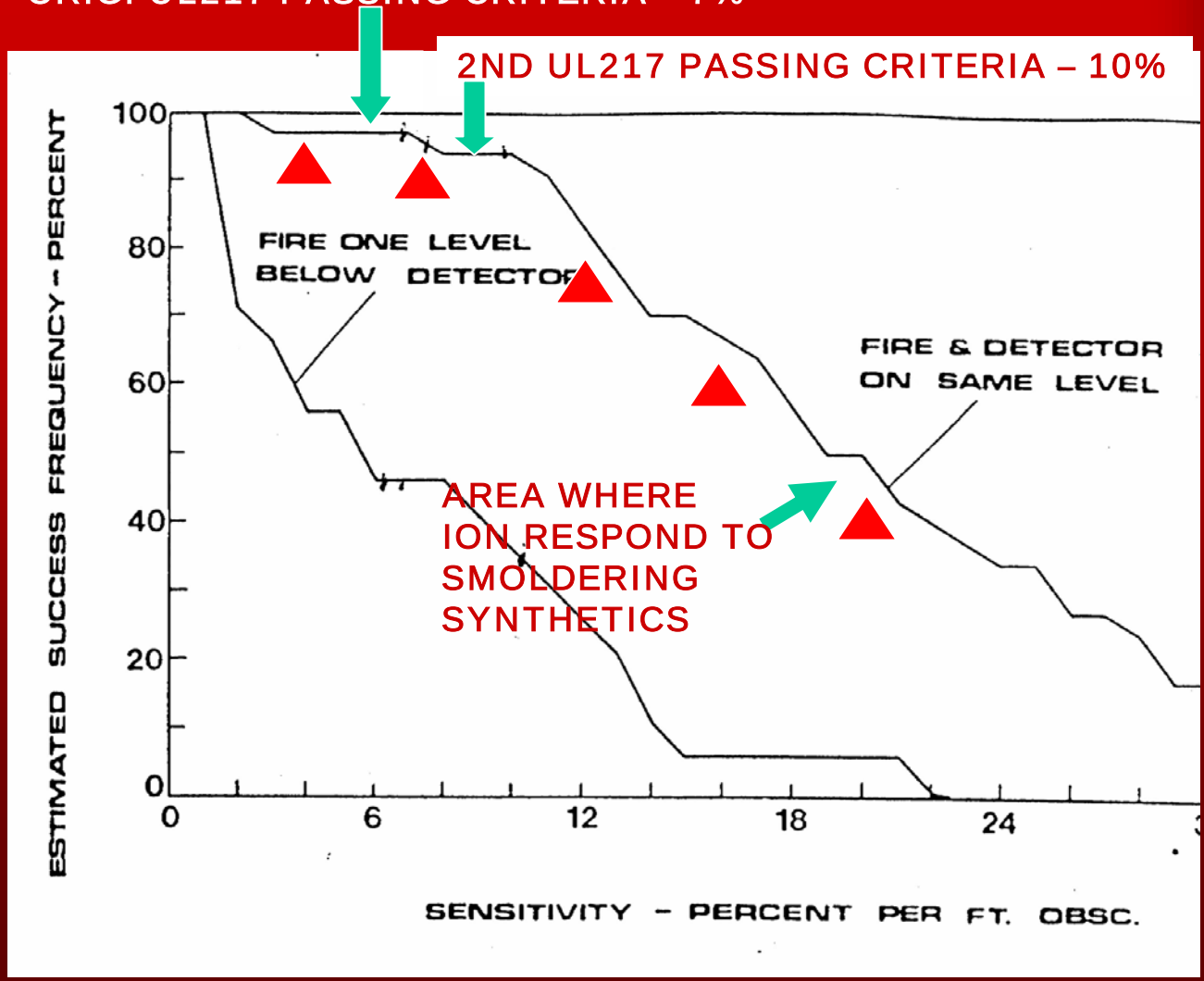
4% OBS/FT – 98%

8% OBS/FT – 97%

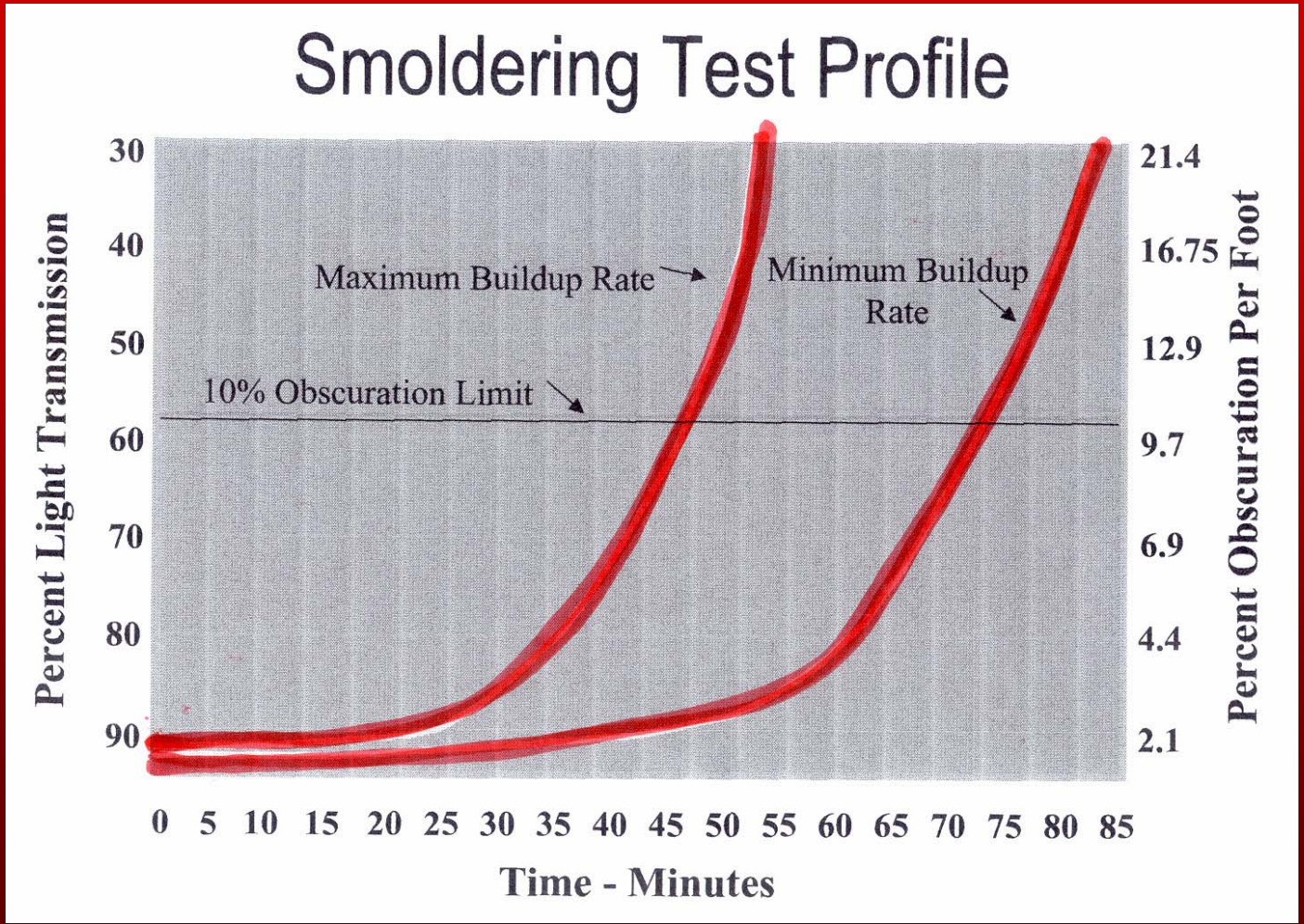
12% OBS/FT – 80%

16% OBS/FT – 65%

20% OBS/FT – 45%



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



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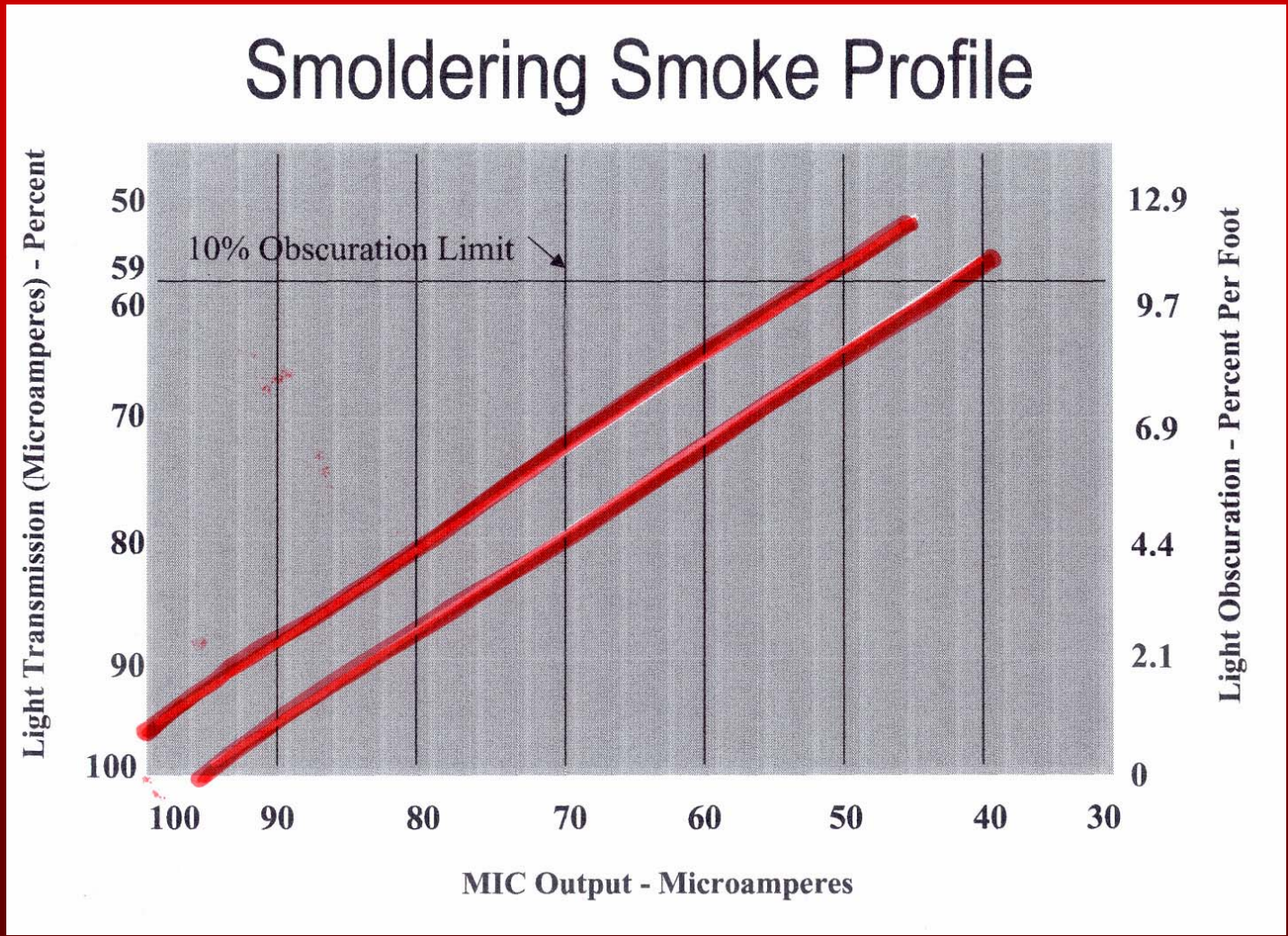

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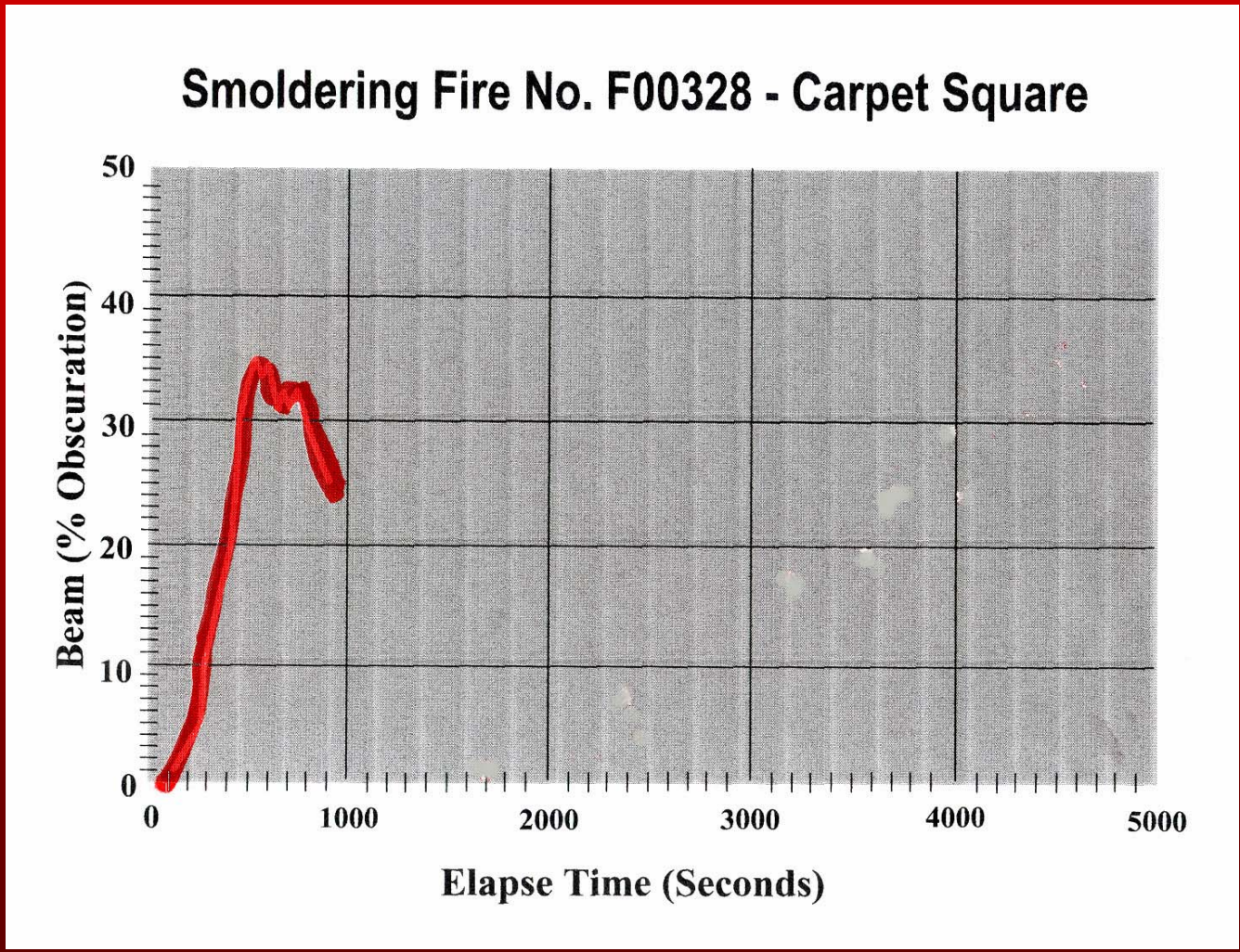
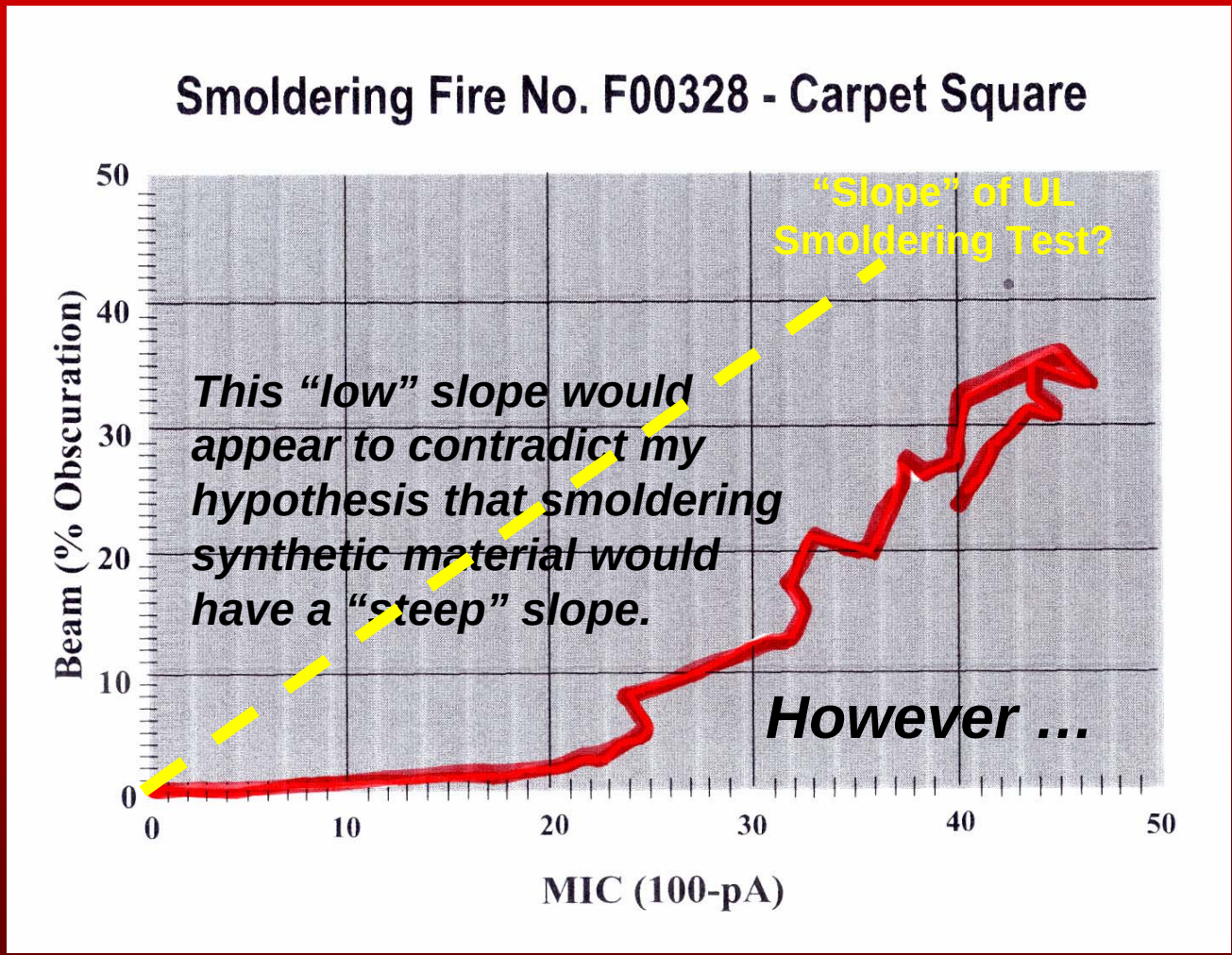
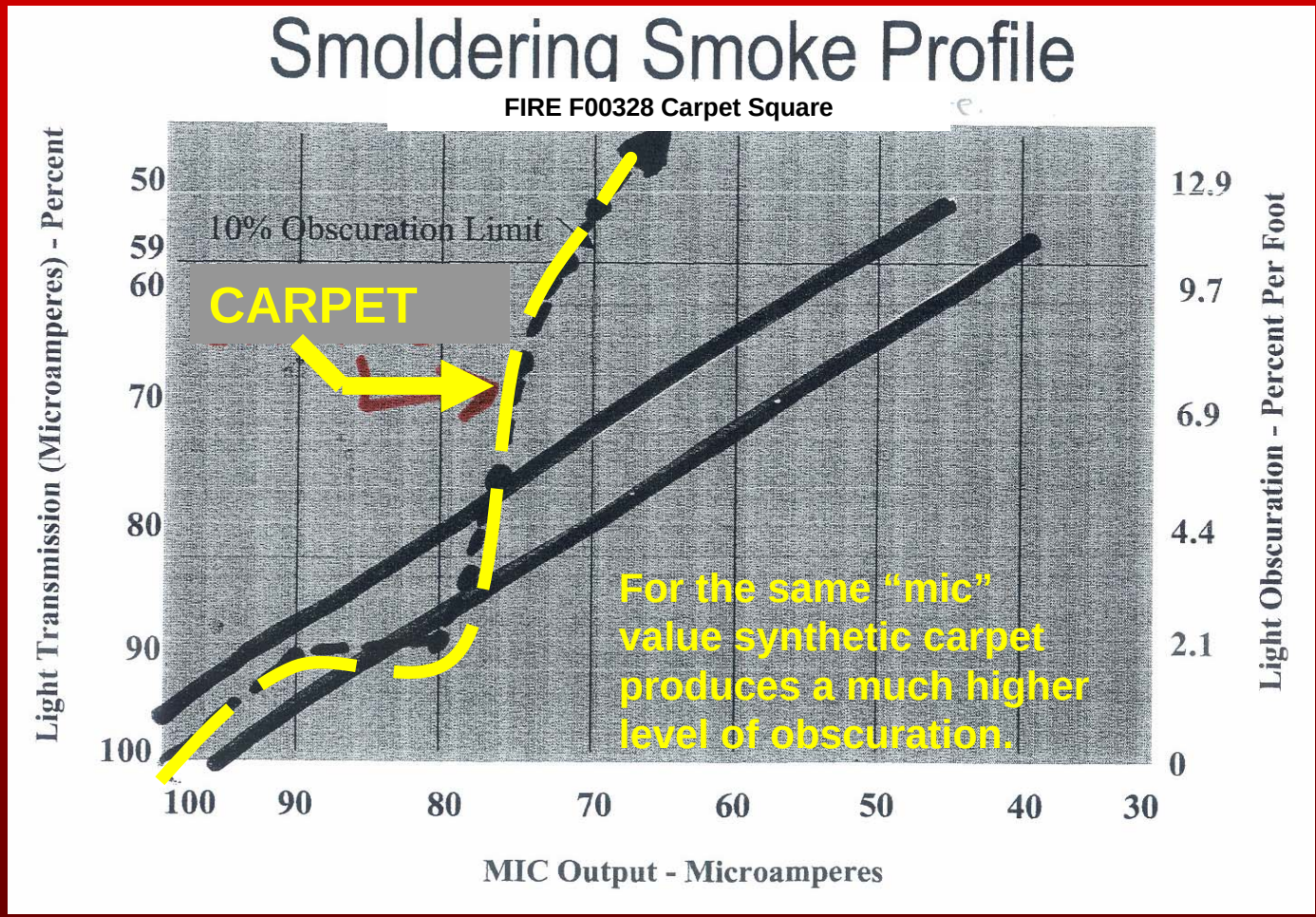


FROM UL FIRE COUNCIL 2004 (Paul Patty's Presentation)



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?

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.)**

A supports B  **B supports A**

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.**

C supports D  **D supports C**

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

TESTING RECOMMENDATIONS

- **Add a "2nd Generation" smoldering test, as implied by Harpe and Christian, the designers of the original UL217 Smoldering Test. The smoke profile, (mic vs. obscuration) of this test should "mimic" the kind of smoke given off by today's furnishings, i.e. plastic-based furniture. (The boundaries of this profile will probably be steeper than the current boundaries.)**
- **The growth rate should approximate the growth rate of the smoldering fires in the recent NIST tests. They should reach 10% obs/ft in approximately 45-60 minutes**

DETECTOR INSTALLATION RECCOMENDATIONS (NEW)

- **MASS BLDG CODE**
  - *At least one detector per level (outside bedroom area).*
  - *More than one required if level > 1,200 ft^2 in area*
  - *1 detector per bedroom.*
  - *Battery back-up.*
  - *Interconnected.*
  - *Photoelectric if within 20 ft of kitchen or bathroom.*

- **MY PROPOSAL**
  - *At least one detector per level (outside bedroom area).*
  - *1 detector per bedroom.*
  - *If any room exceeds 300 ft^2 then a detector is required in that room,*
  - *Enough detectors so that any door to a room, that does not have a detector, is within 15 ft. of a detector.*
  - *Battery back-up.*
  - *Interconnected.*
  - *<u>All detectors should contain a photoelectric operating mechanism.</u>*

CODES & UL TESTS SHOULD RECOGNIZE CONSUMER REALITIES (EXISTING)

- **We cannot rely on the free market since we do not have an educated consumer. (Since they do not recognize benefits they often decide purely on cost.)**
  - ***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.***

SOME MISC. COMMENTS

- **Why do we allow ionization detectors to be installed in sprinkled residential occupancies? *(The only hazard left is a smoldering fire.)***
- **IF UL217 (Residential) and UL268 (Commercial) Standards use the same fire tests, why does UL72 have spacing limitations for commercial detectors, approx. 22 ft max to combustible, but not residential?**
  - ***Indiana Dunes Researchers recommended 2 detectors in long hallways. In 1980 USFA Researchers recommended 30 ft spacing of detectors in corridors - max. 15 ft to combustible.***
- **UL Canada uses a 7% obs./ft. passing criteria. Does this mean Canadian detectors are more sensitive? Do they have more nuisance alarms?**

SHOULD PEOPLE SLEEP WITH BEDROOM DOORS CLOSED?

- **NIST takes the position that their testing re-inforces the recommendation for people to sleep with their bedrooms doors closed.**
  - ***However, this only becomes a factor if smoke detectors do not sound in time. In addition, if the exitway is blocked, and they cannot escape out a window or be rescued then eventually they will die.***
  - ***A recent CPSC Study indicates that closing the bedroom door increase the probability that the detector will not be heard.***

Therefore, NIST is giving advice that benefits people without working detectors, or ionization detectors in smoldering fires, and NIST is giving advice that endangers people with working detectors.

SUGGESTIONS FOR FC MEMBERS

- **Take sample "off-the-shelf" detectors from Europe, Canada, and America. Run all of them through each test to see if results differ.**
- **Encourage fires to be investigated for *"cause of deaths and injuries"* as well as *"cause and origin".***
  - ***Try to determine if it was smoldering or flaming.***
  - ***Check COhB of victims. High level often supports smoldering scenario. High levels could explain inappropriate behavior.***
  - ***Collect detector determine type and whether or not it had power. Try to estimate if audibility was an issue.***
  - ***If detector disabled, determine if it was too close to nuisance source.***
  - ***Take into account distance of fire from detector.***
  - ***NOTIFY UL OF ANY PROBLEMS DISCOVERED.***

FINAL THOUGHTS

If I am right, by switching from ion to photo technology, (or by developing a smoldering test that represents synthetic material) smoke detectors can finally realize their full potential and fire deaths can be reduced by hundreds of lives per year.

I would appreciate any information that supports, or more importantly contradicts, my opinions to be sent to me as soon as possible.

Thank you.

jayf.bfd@ci.boston.ma.us - 617-343-2812

DORMITORY DEMONSTRATION FIRE TESTS

inFIRE Conference
FM Global
Norwood, MA
June 15, 2005

FM GLOBAL

- *200 COLLEGES AND UNIVERSITIES WORLDWIDE*

OBJECTIVE

- *REALISTICALLY ILLUSTRATE LIFE SAFETY HAZARDS ASSOCIATED WITH STUDENT DORMITORY FIRES*

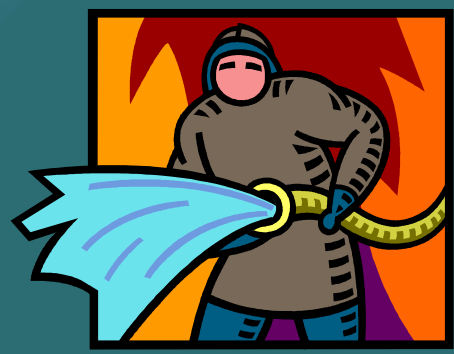
- *SHOW BENEFIT OF SPRINKLER PROTECTION FOR DORMITORY SPACES*

FIRE IN STUDENT DORMITORIES

- ***APPROXIMATELY 2900 FOUR-YEAR CAMPUSES IN U.S.***

- ***60 PERCENT HAVE FIRE SPRINKLER PROTECTION***

- ***OCCUR MOST OFTEN SEPTEMBER TO MAY****



FIRE INJURIES

- *MOST OCCUR DURING FIRE CONTROL (56 PERCENT) OR ESCAPING (16 PERCENT)*
- *SLIGHTLY MORE INJURIES WHILE SLEEPING (24% VS. 19%)*
- *LESS WHILE ESCAPING (16% VS. 25%)*

[USFA DATA]

FATALITIES

- *7.7 PER 1000 FIRES VS. LESS THAN 1*
- *18 FATALITIES 1979 – 1998 [UNIVERSITY OF MARYLAND STUDY]*
- *JANUARY 2000 – THREE FATALITIES AND 60 INJURIES [SETON HALL, NJ]*

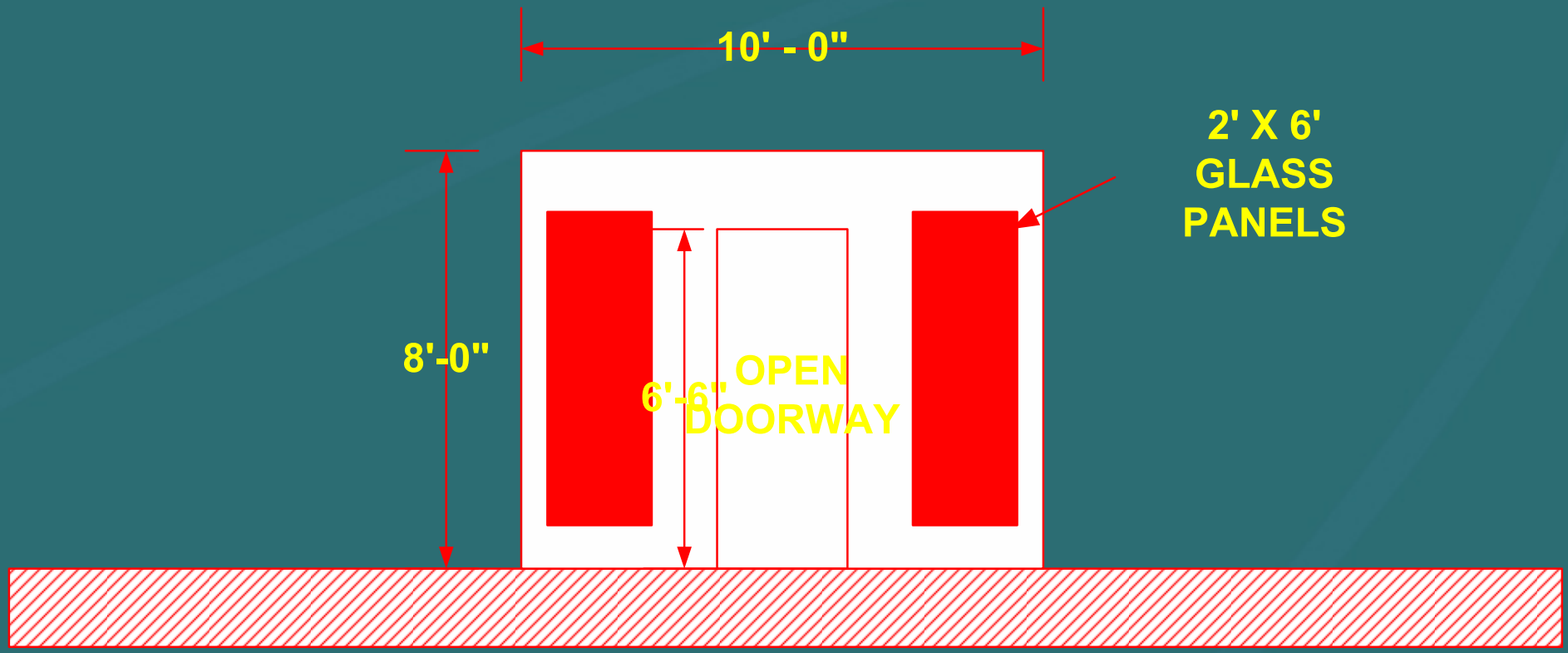
LOSS COST

- *NEGATIVE PUBLICITY = POTENTIAL RECRUITING PROBLEMS*
- *PROPERTY DAMAGE - $24.7M ANNUALLY (1980 – 2001)*
- *HOUSING SHORTAGE DURING ACADEMIC YEAR*

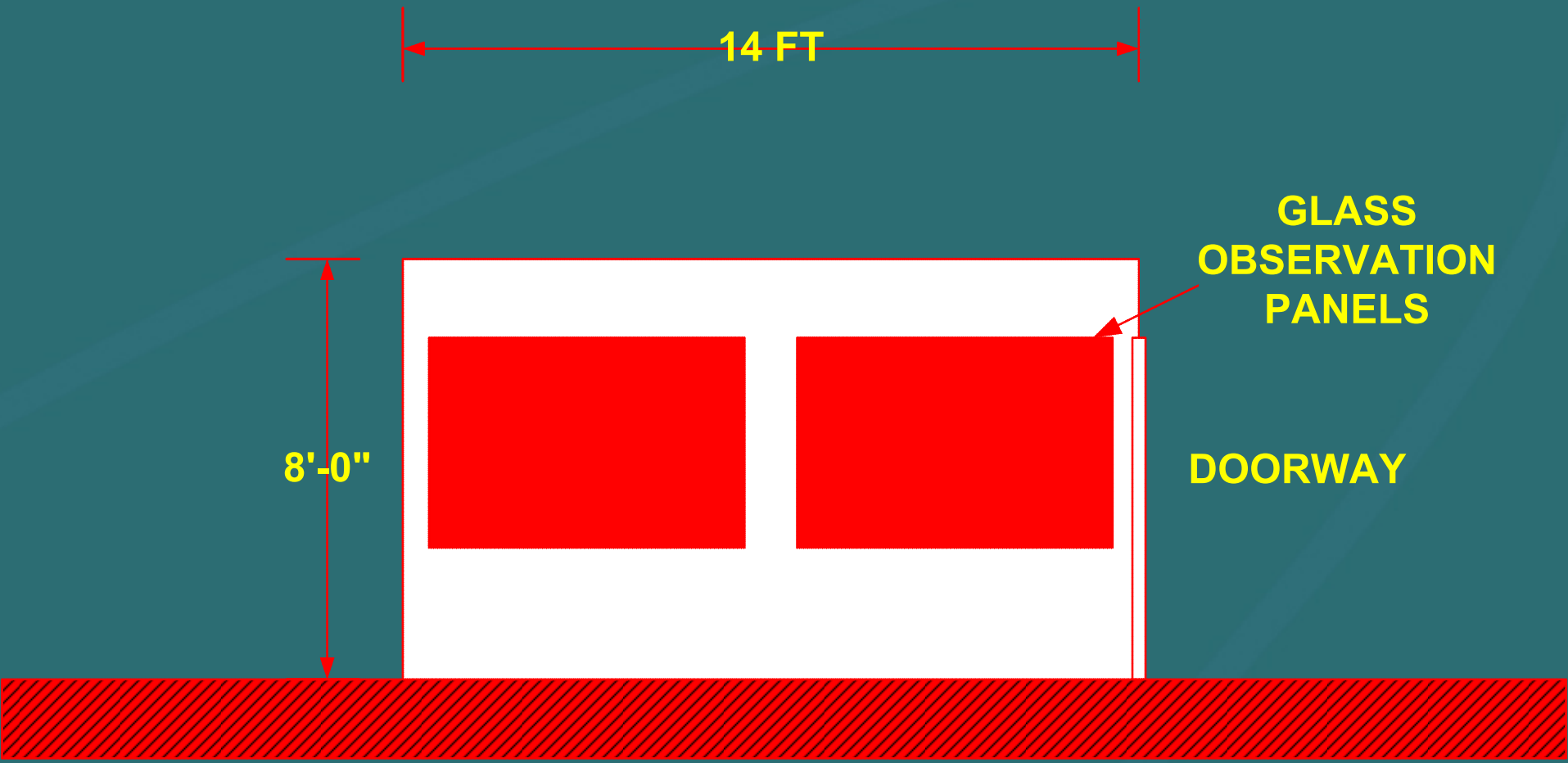
TEST PROCEDURE

- ***REPRESENTATIVE DORM ROOMS***
  - FURNITURE
  - CLOTHING/PERSONAL ITEMS

- ***SPRINKLERED VERSUS UNSPRINKLERED COMPARTMENTS***

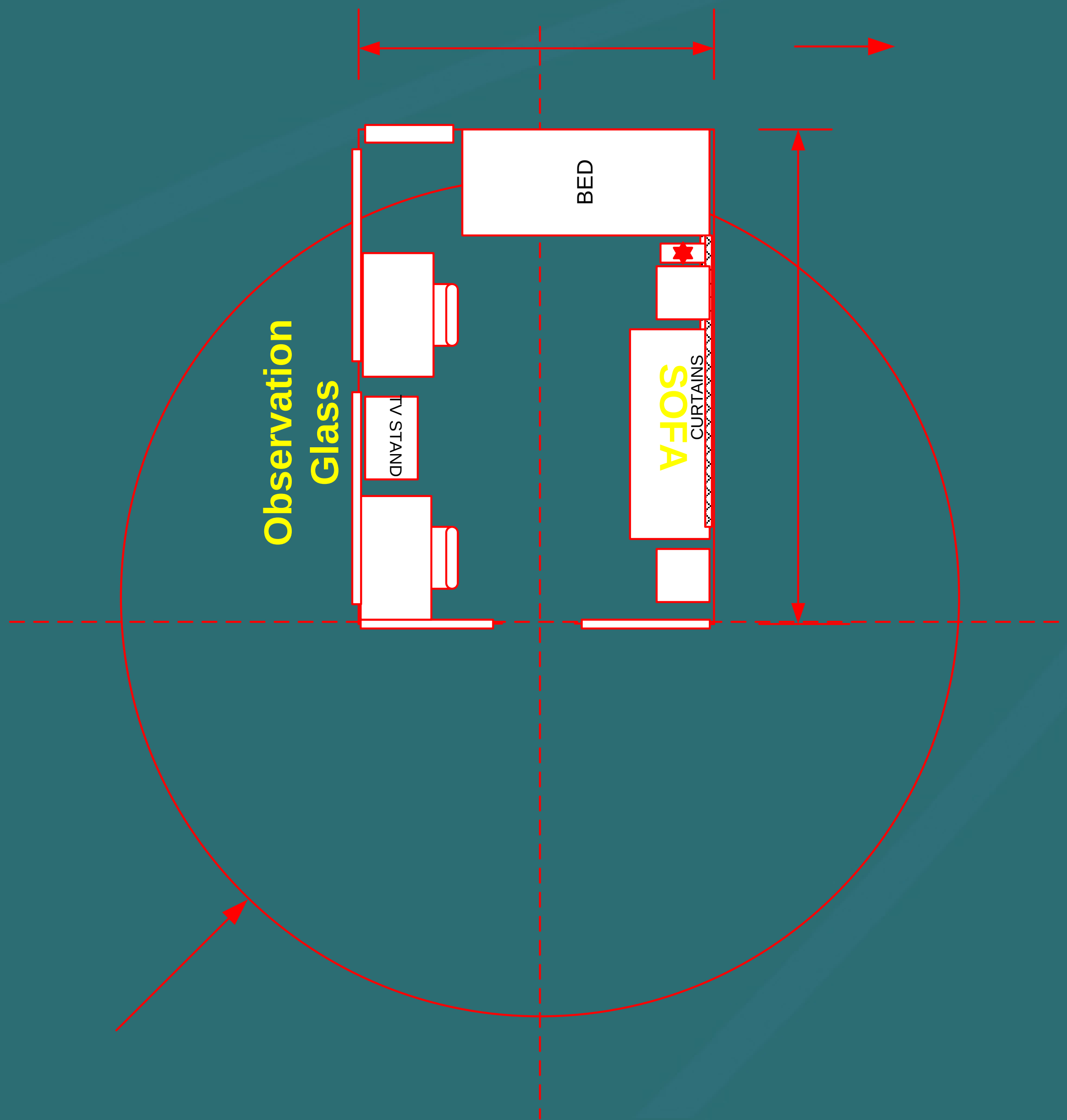


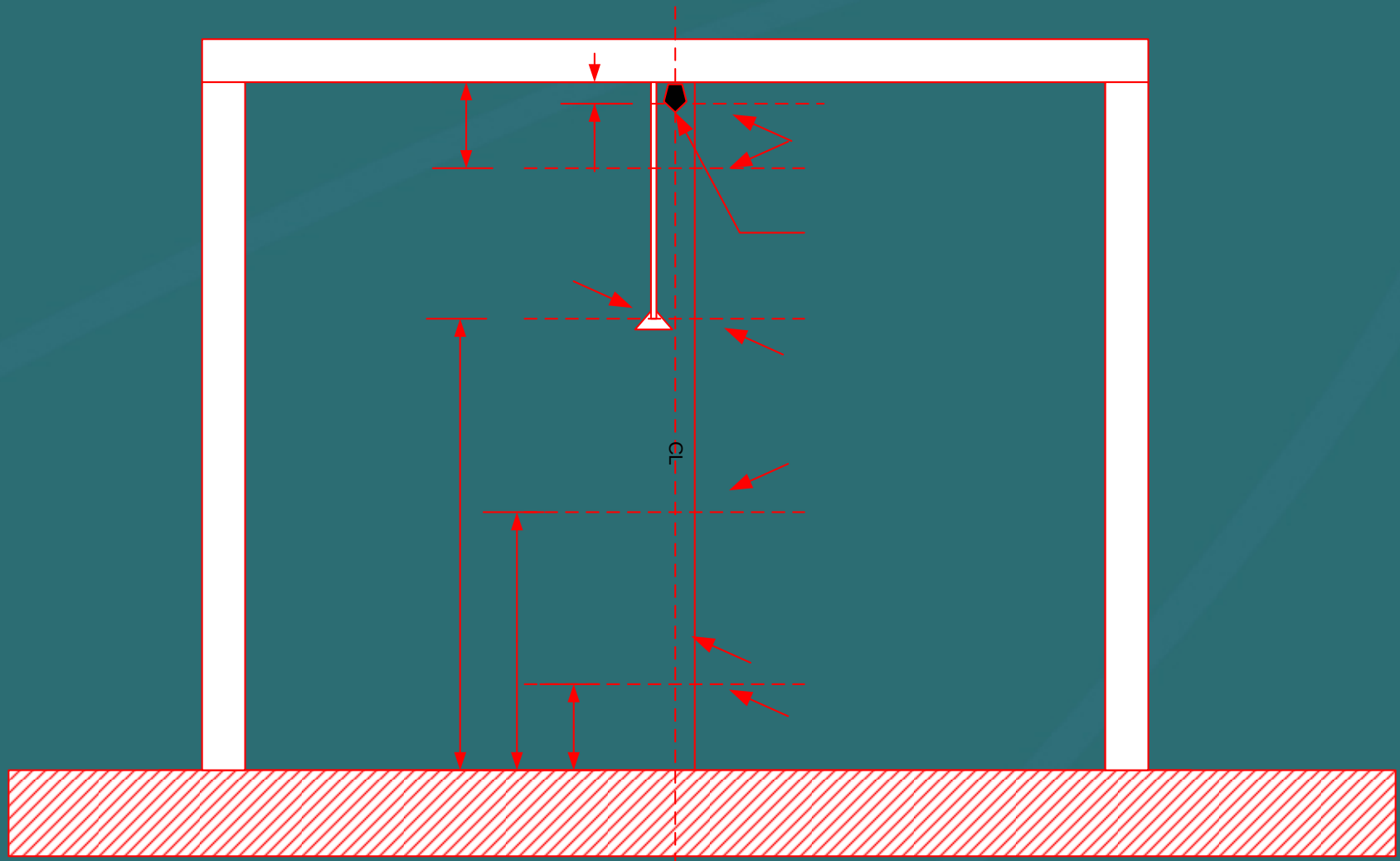
DORMITORY DEMONSTRATION FIRE TESTS
ELEVATION VIEW FRONT (DOOR)



DORMITORY DEMONSTRATION FIRE TESTS - ELEVATION VIEW
OBSERVATION PORT SIDE


CAUTION
CAUTION
CAUTION
CAUTION


BED
Observation Glass
TV STAND
SOFA
CURTAINS



INSTRUMENTATION STATION AT CENTER OF ROOM

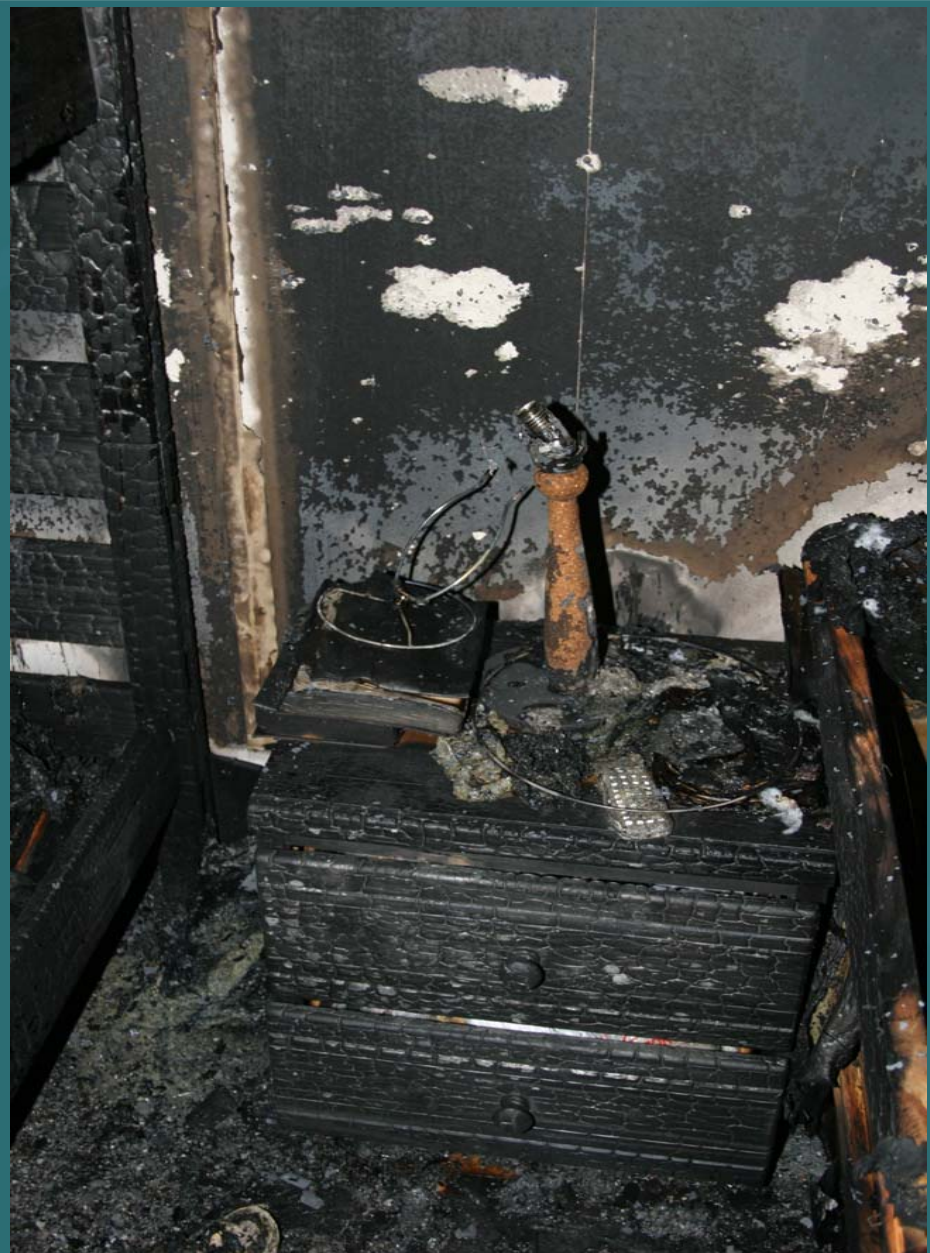

ECONOMICS

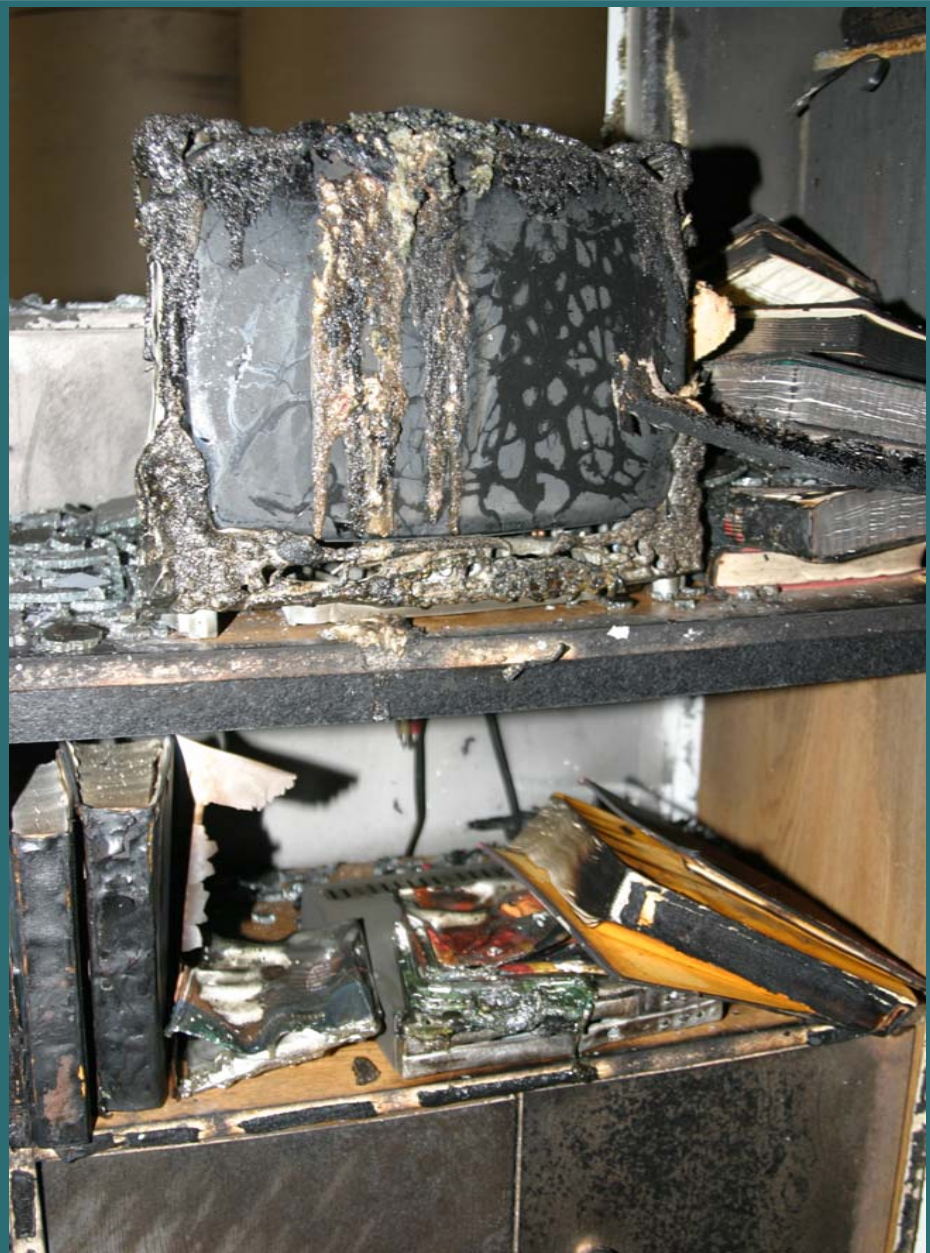

Date
Test No.
Ser. No.

Unprotected

Protected
(Sprinklered)

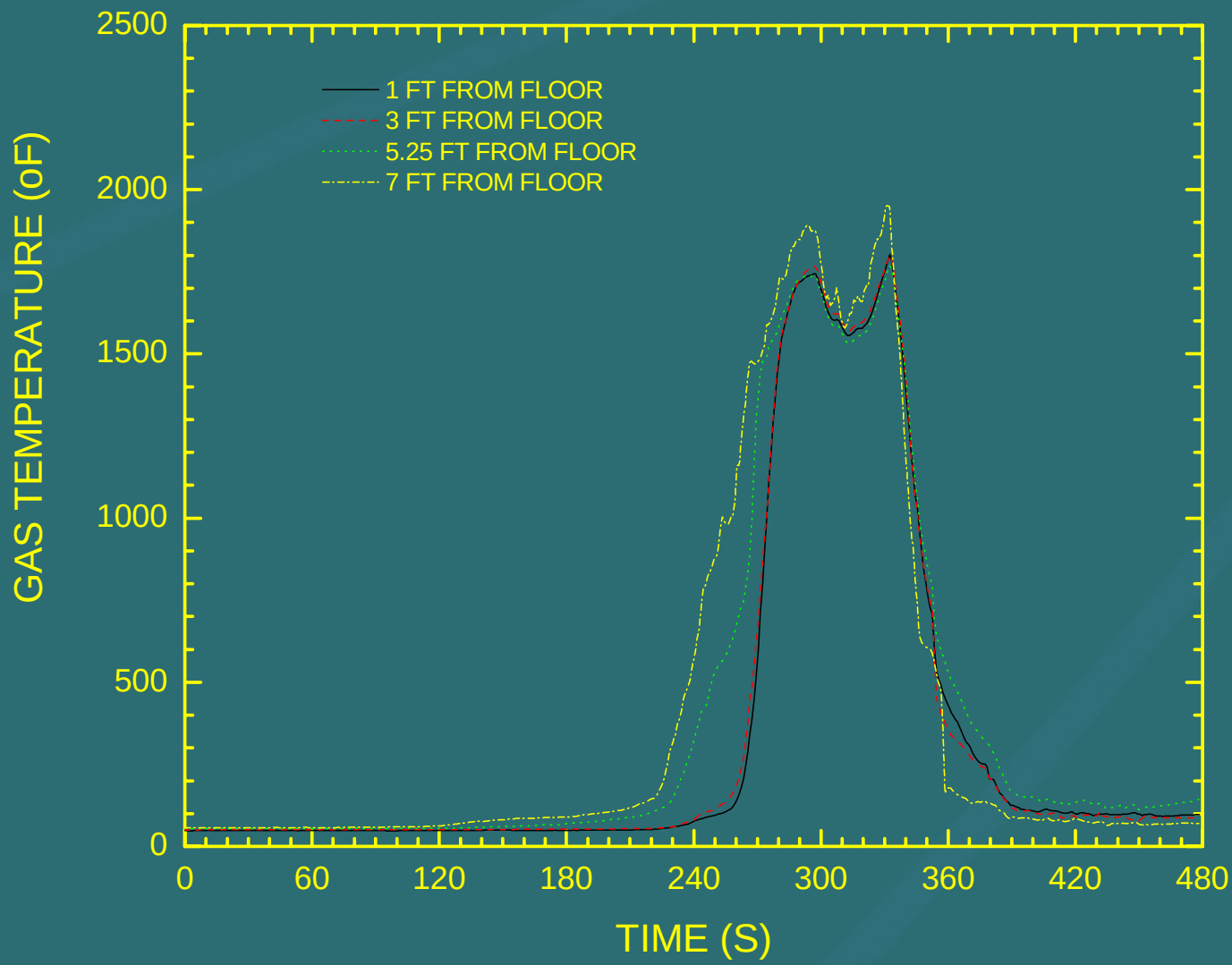

Date
Test No.
Ser. No.

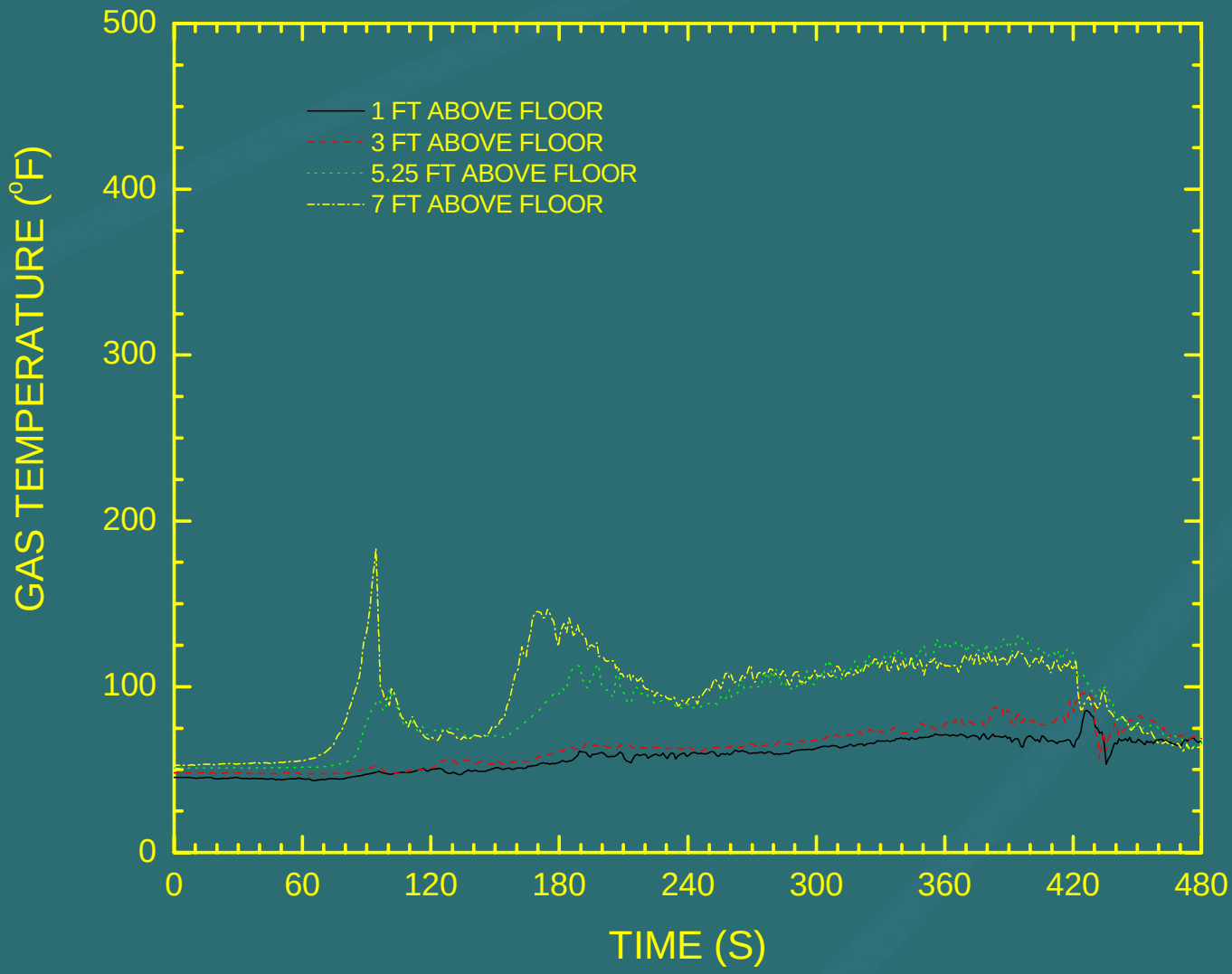





IN THE NAME OF THE FA
DANIELLE STEEL WANDERLUST
TG 4-56


ECONOMICS


1 FT FROM FLOOR
3 FT FROM FLOOR
5.25 FT FROM FLOOR
7 FT FROM FLOOR
GAS TEMPERATURE (oF)
TIME (S)
0
500
1000
1500
2000
2500
0
60
120
180
240
300
360
420
480


GAS TEMPERATURE (°F)
500
400
300
200
100
0
1 FT ABOVE FLOOR
3 FT ABOVE FLOOR
5.25 FT ABOVE FLOOR
7 FT ABOVE FLOOR
0
60
120
180
240
300
360
420
480
TIME (S)

SUMMARY
COMPARTMENT CONDITIONS

	TEST 1	TEST 2
CONDITION	**UNPROTECTED**	**PROTECTED**
MAXIMUM EYE-LEVEL AIR TEMPERATURE	***1769 ºF***	***131 ºF***
MAXIMUM 3-FT ELEVATION	***1801 ºF***	***97 ºF***
MAXIMUM HEAT RELEASE	***4600 kW***	***938 kW***

RESULTS

- ***SPRINKLERS PROVIDE IMPROVED LIFE SAFETY***
  - ROOM CONDITIONS
  - TIME TO EGRESS

- ***SPRINKLERS REDUCE PROPERTY DAMAGE***

THE
FIRE PROTECTION
RESEARCH FOUNDATION

The Fire Protection Research Foundation

..... an introduction

THE FIRE PROTECTION RESEARCH FOUNDATION

What is It?

- Since 1982,The Foundation has conducted consortium projects for code writers, fire safety professionals, corporate and public managers, and the international regulatory community
- Unique structure for public/private collaboration on research
- Independent nonprofit whose mission is to provide practical, usable data on fire and building safety

THE FIRE PROTECTION RESEARCH FOUNDATION

How does it operate?

- Benchmarking – state of the art symposia
- Agenda Setting – research planning in emerging areas
- Research Programs – research projects to meet the needs of NFPA Committees and others
- Projects range from small literature search type studies to major fire testing programs

THE FIRE PROTECTION RESEARCH FOUNDATION

Research Programs and Partners

- The Foundation has carried out a broad range of collaborative research programs on such subjects as fire protection system performance, fire risk assessment methods, flammable liquids protection, fire fighter protective clothing, and many others
- Research partners have included private corporations, federal and state government agencies, research and testing laboratories, NFPA and other not-for-profit organizations, regulatory authorities, and others

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RESEARCH FOUNDATION

Resource to Technical Committees

- Short term technical questions
- Integrating new technology
- Request for a new standard.
- Long term regulatory challenges

THE FIRE PROTECTION RESEARCH FOUNDATION

Research Process

- Research Projects Initiation:
  - Need for research identified by technical committee, organizations/associations, manufacturers, end user groups, other affected interests
- Core Planning Meeting:
  - Outline goals, scope, tasks, schedule
  - Develop preliminary work plan
  - Determine likely funding sources and secure sponsors

THE FIRE PROTECTION RESEARCH FOUNDATION

Research Process (cont'd.)

- Technical Advisory Committee:
  - Principal sponsors, code enforcers, code writers, technical experts, NFPA committee liaison
  - Determines technical objectives of the project and general approach
- Research Testing/Analysis Performed:
  - Technical Director appointed as appropriate
  - Oversight and collaboration provided by TAC members
  - TAC members receive early access to program results
- Research Reports Published:
  - Progress and final reports published and available to all

THE FIRE PROTECTION RESEARCH FOUNDATION

Foundation Activities Related to Fire Protection Systems

- New Fire Detection and Alarm Research Council
- Bridging the gap symposia on suppression and detection
- Research programs

THE FIRE PROTECTION RESEARCH FOUNDATION

Fire Detection and Alarm Research Council

- **Mission -** To advance the implementation of detection and alarm system technology through research and communication programs, closely tied to the needs of NFPA Technical Committees.

- **Activities -** research planning, symposia planning, participation in TACs for research projects

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Developing Research Projects – Detection

- Human behavior studies – high frequency alarms
- Roadway tunnel fire detection systems
- Detector performance in deep profiled ceilings
- Visual signaling effectiveness in high ceiling spaces
- Smoke and heat signatures – today's residential furnishings – impact on detector test profiles

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Developing Projects - Fire Suppression Systems

- Database of fire test reports
- Hazardous materials storage protection – oxidizers, combustible liquids, retail solid shelf storage
- Resource to NFPA 2001 for studies on enclosure loads

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Emerging Issues

New materials and systems are entering the built environment every day. With them come unique challenges for the codes and standards that regulate safety.

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Emerging Issues

- How do we integrate the increased focus on security into today's approaches to fire safety design?
- How can we ensure the safety of our highway infrastructure (for example refueling stations, fuel cells storage, and emergency response) as we introduce alternative vehicle fuels?
- How do we design our buildings to provide fire safety measures appropriate to the aging U.S. population?

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Detection System Performance in Roadway Tunnels

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RESEARCH FOUNDATION

Project Goals

- Investigate the performance attributes of current fire detection technologies for roadway tunnel protection;
- Develop performance criteria for fire and smoke detection systems in roadway tunnel applications;
- Help optimize the technical specifications and installation requirements for this application.

Project Plan

- Develop appropriate design fire scenarios and test protocols for evaluating performance of road tunnel detectors;
- Conduct full-scale tunnel fire tests to document the performance of currently available fire detection technologies under challenging tunnel fire scenarios;
- Analyze technical data and conduct computational modeling to help understand and optimize the technical specifications and installation requirements for application of fire detection technologies in road tunnels;

Project Plan, cont'd

- Evaluate environmental effects in real tunnel environments on system performance;
- Benchmark full scale fire research scenarios against data from demonstration fire tests;
- Provide technical data to standards and code writers for the development of guidelines for application of fire detection technologies in road tunnels.

THE FIRE PROTECTION RESEARCH FOUNDATION

Potential Sponsors

- Federal Highway Administration
- New Jersey, Virginia, Washington State and Quebec Province DOTs,
- Port Authority of NY/NJ
- National Research Council of Canada
- Detection System Manufacturers

THE FIRE PROTECTION RESEARCH FOUNDATION

Safety Issues in the Hydrogen Economy

- **Background**
  As the development of hydrogen technology reaches the commercial stage, the safety community is exploring the issues surrounding the physical infrastructure which is and will be constructed to support the widespread use of this technology. The NFPA publishes several codes and standards that directly or as surrogates address the use, handling, and storage of hydrogen.

Research Planning

- On January 25, 2004, the Foundation convened a research agenda planning workshop designed to define a research agenda and roadmap for hydrogen safety. Members of key NPFA Technical Committees, the fire service, research community, government agencies, and those commercially involved in hydrogen technology were in attendance.

Research Priorities

- **Assembling** the safety requirements currently under development for hydrogen in a variety of storage and occupancy situations into a user friendly document.
- **Stationary Fuel Cell Siting** - appropriate spatial separation of hydrogen fuel used for stationary fuel cell systems in equipment enclosures.
- **Vehicle Refueling Stations** – appropriate siting distances, fire separations, and other protection features for stations for vehicle refueling with hydrogen and other fuels.

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Research Priorities

- **Metal Hydride Storage Safety** – appropriate safety precautions for metal hydrides in a variety of storage configurations and occupancies
- **Safety of Enclosed Parking Structures** – determination of appropriate LFL criteria; assessment of leak rates, and appropriate mitigation/venting strategies
- **Fire Service and AHJ Education** – to include a regulatory guide, compendium of case studies of installations, and guidance on acceptable risk assessment tools and techniques.

THE FIRE PROTECTION RESEARCH FOUNDATION

Current Foundation Initiatives

- **Stationary Fuel Cell Siting** – appropriate spatial separation requirements for hydrogen storage for fuel cells in non combustible cabinets – application for remote (eg cell phone towers) locations
- **Vehicle Refueling Stations** – fire safety requirements

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FIRE PROTECTION
RESEARCH FOUNDATION

Why work with the Foundation?

- Unique structure for collaboration with diverse parties
- Cost sharing
- Independent, well recognized resource
- In touch with needs of the NFPA Committee structure/implementation routes
- Wide network for communication of results

THE
FIRE PROTECTION
RESEARCH FOUNDATION

The Fire Protection Research Foundation

..... questions?

Fire Statistics in the US

Marty Ahrens
National Fire Protection Association
Quincy, MA 02169-7471
June 16, 2005

Data Sources

- National Fire Incident Reporting System (NFIRS)
- NFPA Annual Survey
- National estimates based on NFIRS and NFPA Annual Survey
- Fire Service Inventory
- Fire Incident Data Organization (FIDO)
- Others
  - Death certificates from National Center for Health Statistics
  - FBI's Uniform Crime Reporting

Our Statistics

- Measure what is reported to fire departments
- Details are based on what is reported to NFIRS
- Cannot measure risk unless combined with other databases

NFIRS

- U.S. Fire Administration compiles the National Fire Incident Reporting System
- Participating states use standard coding system
- Local NFIRS data is submitted through or released by states
  - About one-third to one-half of reported fires make it into NFIRS
- Largest and most detailed fire incident database in the world
- Not designed as a statistical sample

Data Classification System

- 1976 edition of NFPA 901, *Uniform Coding for Fire Protection,* used for 1980-1998 data
- Updated with Version 5.0
  - First used in 1999
  - Major overhaul of coding structure

NFIRS Fields

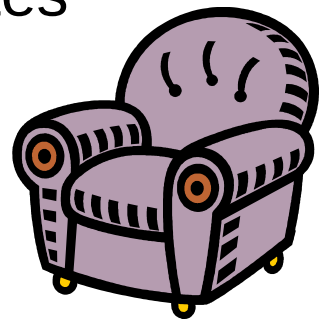
- Dispatch and summary data
  - Date, time, address, incident type, apparatus, personnel, losses
- Property details
  - Occupancy or property use and status
  - Number of stories
  - Construction type (dropped from 5.0)
  - Mobile property type
  - Complex
- Fire protection
  - Detection and automatic extinguishing systems
  - Presence and operation

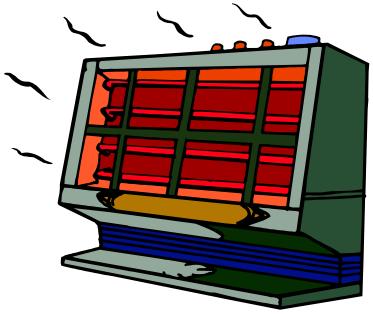
Fire Descriptors and Causes

- Area and level of origin
- Heat source
- Item first ignited
- Equipment involved in ignition
- Factor contributing to ignition
- Extent of flame damage
- Victim characteristics on casualty reports

Combine Data Elements

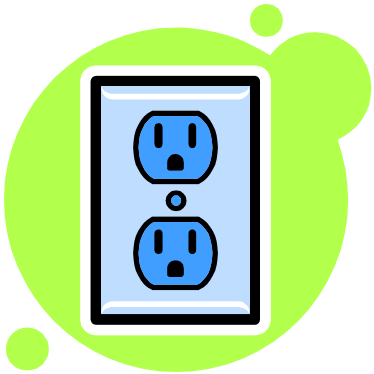
- Upholstered furniture fires started by cigarettes
- Electric or gas heater home fires
- Children playing with lighters vs. matches
- Arson (intentional fires) in schools
- Candle fires by month and area of origin or item first ignited





Defining the Questions

- Electrical fires may be defined by
- By electrical distribution equipment in equipment involved in ignition
  - Does not include electrical problems in cooking or heating equipment or other appliances
  - NFPA generally uses this approach
- By heat source
  - Includes appliances of all types
- Simple questions don't always have simple answers



Find More on NFIRS at

- http://www.usfa.fema.gov/nfirs/
  - Documentation and forms
  - Coding manuals
- May be helpful for some to look at code choices

NFPA Survey

- Sample includes all departments protecting populations over 100,000 and one-third of smaller departments, stratified by size
- Content
  - Fires, loss and casualties by incident type
  - Intentional structure and vehicle fires
  - Non-fire incidents, with special attention paid to false alarms
  - Firefighter injuries
- "Fire Loss in the United States During 2003" is free on http://www.nfpa.org/Research/

More on NFPA Survey

- Sample of fire departments allows for “big picture” national estimates
- Includes follow-up of vehicle fire deaths in smaller departments
- Cannot make state projections
- Limited regional projections possible
- Results in summer or early fall of following year

How a Fire Gets Counted

Fire dept. called

Handled privately

Not included in statistics

Report completed

Report not completed

Not included in statistics

Sent to state

Not sent to state

Not included in NFIRS -- May be captured by NFPA survey

Sent to USFA- In NFIRS

Not sent to USFA Not in NFIRS

National Estimates

- NFIRS provides the details, but not the whole universe of reported fires
- NFPA survey is sample-based, so projections can be made about total
  - Lacks detail
- Combine the two to develop scaling ratios
  - Different ratios used for residential, non-residential, outside, vehicles, casualties and dollar loss
- Method developed by analysts from the USFA, NFPA and CPSC
- Statistics may be skewed by inclusion or exclusion of unusual incident
- Used in majority of NFPA's reports

Fire Incident Database Org

- Anecdotal database at NFPA
- Clipping service, Internet, other sources identify significant fires
  - Incident information is obtained from fire departments, insurance companies, etc.
- Source for Firewatch column and annual reports on catastrophic fatal fires, large loss fires and firefighter fatalities
- Not a valid source for most statistical analyses
- Sources are kept confidential

Fire Service Inventory

- Survey of fire department resources and staffing
- Three-year cycle
- Data source for Mike Karter's *US Fire Department Profile*
  - Describes what is, not what should be

Death Certificate Data

- Uses external cause of injury codes from International Classification of Diseases (ICD) codes
- Best historical data
  - National Safety Council data on unintentional fire or burn deaths goes back to 1913
  - Consistent coding system used nationally
  - Some disconnects with new versions
- More reliable at capturing subsequent fatalities
- Used in John Hall's report *US Fire Deaths by State*
- Fire deaths have been captured under category "Non-transport, unintentional injuries"
- Different analyses may use different codes

FBI's Uniform Crime Reporting (UCR)

- Police department data
  - Crimes
  - Solves
  - Arrests
  - Arrestees
  - Convictions
- Used in John Hall's *Intentional Fires and Arson*

Summary

- Different data sources were designed to meet different goals
- NFIRS details are available at local, state and national level
- NFPA survey provides national data only
- National estimates of specific fire problems are calculated by combining NFIRS and NFPA survey
- Death certificate data allows comparisons with non-fire data
- FBI's UCR data provides information about arson arrests

One-Stop Data Shop
The Source for Fire Statistics

Nancy Schwartz
National Fire Protection Association
Quincy, MA 02169-7471
June 16, 2005

Customers and Questions

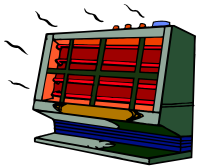
- Fire service, consultants, media, students, NFPA committee members, moms and dads
- Statistical
- Anecdotal
- Referrals

Products and Services

- Reports
- Custom Work
- One-Stop Data Shop on the Web

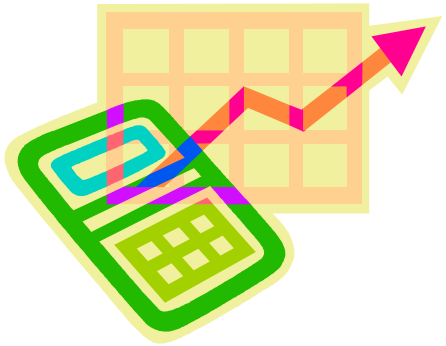
One-Stop Data Shop Reports

- Fire Loss During 2003
- Characteristics of Home Fire Victims
- Overview Report
- Smoking
- Heating
- Cooking
- Intentional Fires and Arson
- Children Playing
- U.S. Fire Death Patterns by State
- Candles
- Fire Protection: Smoke Alarms and Sprinklers



Custom Work

- Custom analyses
  - Produce national estimates of specific fire problems



- Incident searches
  - Search for articles in NFPA publications on specific topics

One-Stop Data Shop on the Web

- Reports available
  - Member benefit
  - Some free to all visitors
  - Executive summaries available to all visitors
- Fire fact a week
- Fact sheets
- Fire statistics

Contact Information

Phone: 617-984-7450

E-mail: osds@nfpa.org

Web: www.nfpa.org/osds

Thank you and have a safe trip home.