The following information is the statistical section of the One-Stop Data Shop's Special Information Data Package on LP-Gas Fires. If you are interested in fire incidents involving LP-Gas, please contact Nancy Schwartz at 617-984-7450 or e-mail osds@nfpa.org.

FIRES IN WHICH LP-GAS WAS THE MATERIAL FIRST IGNITED
STATISTICAL ANALYSIS

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Fires in Which LP-Gas Was the Material First Ignited

LP-Gas was the material first ignited in 11,290 incidents per year.
Liquefied petroleum gas (LP-Gas) is used to fuel a variety of equipment in residential and non-residential occupancies. From 1994 through 1998, LP-Gas was the type of material first ignited in an annual average of 11,290 fires and explosions. These fires caused an average of 39 civilian deaths per year, 498 civilian injuries per year, and an annual average of $61,800,000 in direct property damage. Only one in five of these fires occurred in or on structures. However, structure fires accounted for more than four out of every five of the civilian deaths, more than half of the civilian injuries and four-fifths of the direct property damage. Almost three-quarters of the incidents were outside or other fires or explosions with no after-fire. The frequency of fires and associated losses by incident type is shown below.

Fires in Which LP-Gas Was the Material First Ignited, by Incident Type
1994-1998 Annual Averages

Incident Type	Fires		Civilian Deaths		Civilian Injuries		Direct Property Damage (in Millions)	
Structure fires	2,450	(21.7%)	33	(86.2%)	283	(56.8%)	$50.8	(82.1%)
Vehicle fires	610	(5.4%)	3	(8.0%)	79	(15.9%)	$7.1	(11.4%)
Other fires	8,230	(72.9%)	2	(5.8%)	136	(27.3%)	$4.0	(6.5%)
Total	11,290	(100.0%)	39	(100.0%)	498	(100.0%)	$61.8	(100.0%)

These are fires reported to U.S. municipal fire departments and so exclude fires reported only to Federal or state agencies or industrial fire brigades. Fires are rounded to the nearest ten. Sums may not equal totals due to rounding errors. A proportional share of fires in which the type of material first ignited was unknown or blank has been included in these totals. Structure fires include any fire in or on a structure. Other fires include outside fires, explosions with no after fire and unclassified fires. Damage has not been adjusted for inflation.

Source: National estimates based on NFIRS and NFPA survey

LP-Gas fires have increased as gas grills became popular.
Table 1 shows the frequency of fires in which LP-Gas was the type of material first ignited by year from 1980 through 1998. Overall, these fires increased 32%, from 8,200 in 1980 to 10,780 in 1998. However, this increase was due entirely to the increase in outside and other LP-Gas fires. These fires almost tripled from 3,120 in 1980 to 8,180 in 1998. Much of this increase is likely due to the growth in gas grill usage. In 1998, gas-fueled grills were involved in 4,400 outdoor home fires, almost three times the 1,700 incidents in 1980.*

* John R. Hall, Jr., *U.S. Home Cooking Patterns and Trends,* page 63, Quincy, MA: NFPA Fire Analysis and Research Division, June 2001.

LP-Gas structure fires fell 46% from 3,870 in 1980 to 2,090 in 1998 while LP-Gas vehicle fires dropped 57% from 1,210 to 520 during that same time period. From 1997 to 1998, LP-Gas structure fires fell 2%, vehicle fires fell 20%, and outside and other fires and explosions involving LP-Gas fell 12%. LP-Gas fires overall declined 11% from 12,050 in 1997 to 10,780 in 1998. (See Figure 1.)

Three-quarters of LP-Gas structure fires occurred in residential properties.
Three out of every four LP-Gas structure fires occurred in residential occupancies. Two-thirds occurred in one- and two-family dwellings. Table 2 shows the frequency of these fires by occupancy group. Italics indicate that 0.5% or more of these fires occurred in that specific occupancy group. The occupancy classes are sorted according to their codes in NFIRS, rather than by frequency of fires.

Additional information is available.
For more information about home fires in which LP-Gas was the type of material first ignited, please refer to the section on LP-Gas in *The U.S. Home Product Report: Forms and Types of Material First Ignited in Fires,* by Kimberly D. Rohr. This report may be ordered from the One-Stop Data Shop in NFPA's Fire Analysis and Research Division.

NFPA 58, *Standard for the Storage and Handling of Liquefied Petroleum Gases,* and NFPA 59, *Standard for the Storage and Handling of Liquefied Petroleum Gases at Utility Gas Plants,* describe the recommended practices for safe use of LP-Gas. Theodore C. Lemoff's chapter "Storage of Gases" in the *Fire Protection Handbook,* 18th edition, provides a general overview of safety issues involved with various types of gas storage.

Table 1.
Fires in Which LP-Gas was the Material First Ignited By Year
Unknown Type of Material First Ignited Allocated Proportionally

Year	Structure Fires		Vehicle Fires		Other Fires		Total Fires	
1980	3,870	(47.2%)	1,210	(14.7%)	3,120	(38.0%)	8,200	(100.0%)
1981	3,860	(45.6%)	1,130	(13.4%)	3,480	(41.1%)	8,470	(100.0%)
1982	3,990	(45.3%)	1,170	(13.3%)	3,660	(41.5%)	8,810	(100.0%)
1983	3,530	(42.6%)	1,150	(13.9%)	3,600	(43.5%)	8,280	(100.0%)
1984	3,340	(43.0%)	1,200	(15.4%)	3,240	(41.6%)	7,780	(100.0%)
1985	3,390	(42.0%)	1,040	(12.8%)	3,640	(45.1%)	8,060	(100.0%)
1986	3,080	(35.1%)	920	(10.4%)	4,790	(54.5%)	8,780	(100.0%)
1987	3,010	(29.9%)	1,040	(10.3%)	6,010	(59.7%)	10,060	(100.0%)
1988	3,330	(30.6%)	1,050	(9.6%)	6,510	(59.8%)	10,890	(100.0%)
1989	3,040	(26.9%)	940	(8.3%)	7,320	(64.7%)	11,310	(100.0%)
1990	2,880	(25.4%)	960	(8.4%)	7,490	(66.1%)	11,320	(100.0%)
1991	2,960	(24.5%)	780	(6.5%)	8,330	(69.0%)	12,070	(100.0%)
1992	2,830	(25.4%)	750	(6.7%)	7,560	(67.9%)	11,140	(100.0%)
1993	2,910	(25.1%)	800	(7.0%)	7,860	(67.9%)	11,570	(100.0%)
1994	2,790	(24.3%)	630	(5.5%)	8,090	(70.3%)	11,520	(100.0%)
1995	2,570	(22.1%)	600	(5.2%)	8,430	(72.7%)	11,600	(100.0%)
1996	2,670	(24.8%)	630	(5.8%)	7,460	(69.3%)	10,760	(100.0%)
1997	2,120	(17.6%)	650	(5.4%)	9,280	(77.0%)	12,050	(100.0%)
1998	2,090	(19.4%)	520	(4.8%)	8,180	(75.8%)	10,780	(100.0%)
Average 1980-1998	3,070	(31.5%)	920	(9.4%)	5,750	(59.1%)	9,730	(100.0%)
Average 1994-1998	2,450	(21.7%)	610	(5.4%)	8,230	(72.9%)	11,290	(100.0%)

These are fires reported to U.S. municipal fire departments and so exclude fires reported only to Federal or state agencies or industrial fire brigades. Fires are rounded to the nearest ten. Sums may not equal totals due to rounding errors. Structure fires include any fire in or on a structure. Other fires include outside fires, explosions with no after fire and unclassified fires.

Source: National estimates based on NFIRS and NFPA survey.

Fires in Which LP-Gas Was First Ignited, by Year and Incident Type
1980-1998

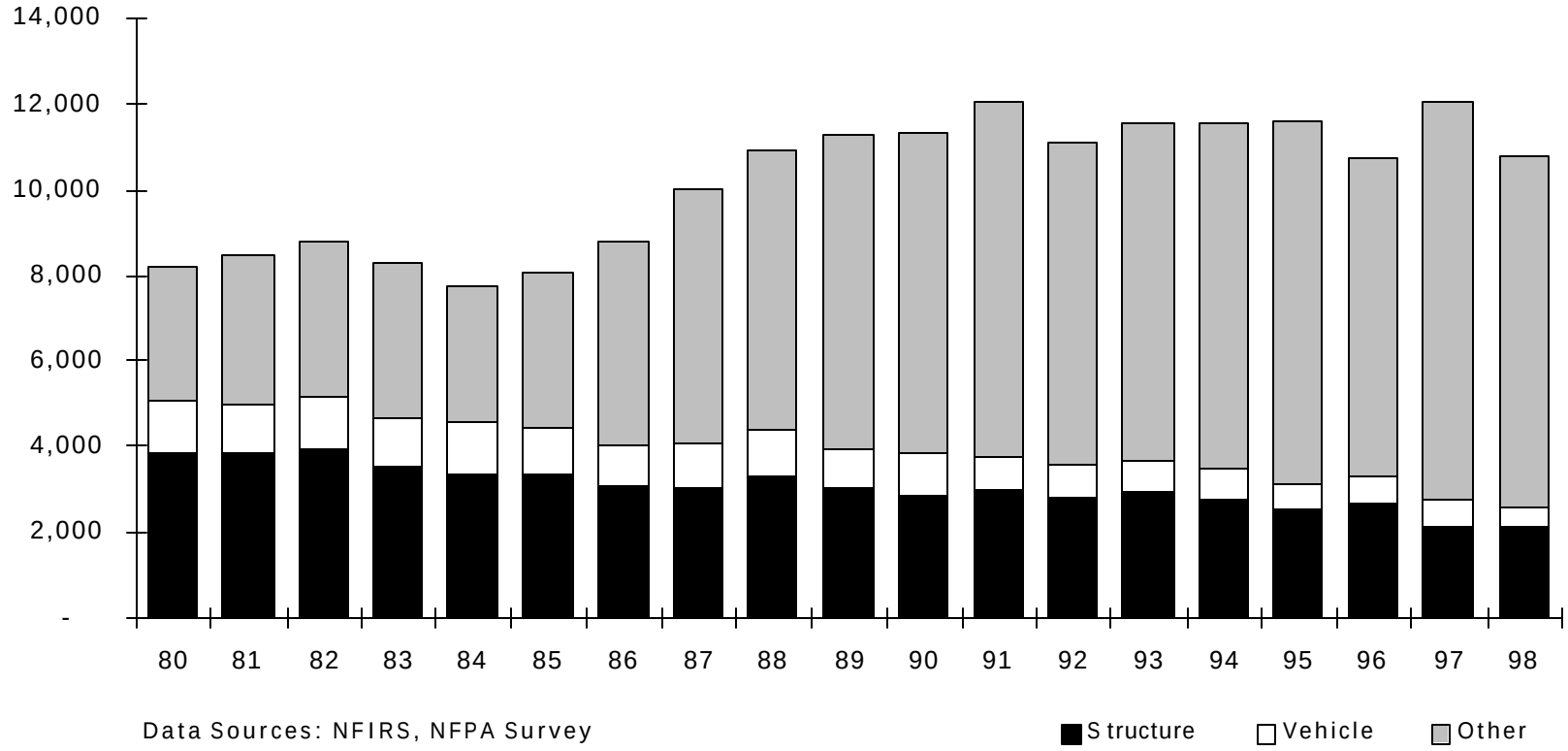

Table 2. Structure Fires in Which LP-Gas Was the Type of Material First Ignited, by Occupancy, 1994-1998 Annual Averages

Occupancy	Fires		Civilian Deaths		Civilian Injuries		Direct Property Damage (in Thousands)	
Public Assembly	***115***	***(4.7%)***	***2***	***(4.6%)***	***10***	***(3.4%)***	***$1,978***	***(3.9%)***
Fixed use amusement or recreation properties	4	(0.2%)	0	(0.0%)	0	(0.1%)	$141	(0.3%)
Variable use amusement or recreation properties	3	(0.1%)	0	(0.0%)	0	(0.0%)	$73	(0.1%)
Religious properties or funeral homes	*12*	*(0.5%)*	*1*	*(2.9%)*	*2*	*(0.9%)*	*$227*	*(0.4%)*
Clubs	3	(0.1%)	0	(0.0%)	1	(0.3%)	$24	(0.0%)
Libraries, museums or court rooms	1	(0.0%)	0	(0.0%)	0	(0.0%)	$0	(0.0%)
Eating or drinking places	*91*	*(3.7%)*	*1*	*(1.7%)*	*6*	*(2.1%)*	*$1,512*	*(3.0%)*
Unclassified or unknown-type public assembly properties	1	(0.0%)	0	(0.0%)	0	(0.0%)	$0	(0.0%)
Educational Properties	***16***	***(0.7%)***	***0***	***(0.0%)***	***1***	***(0.4%)***	***$309***	***(0.6%)***
Non-residential schools	*11*	*(0.5%)*	*0*	*(0.0%)*	*1*	*(0.4%)*	*$88*	*(0.2%)*
Residential schools	2	(0.1%)	0	(0.0%)	0	(0.0%)	$5	(0.0%)
Trade or business schools	1	(0.0%)	0	(0.0%)	0	(0.0%)	$216	(0.4%)
Colleges or universities	1	(0.0%)	0	(0.0%)	0	(0.0%)	$0	(0.0%)
Unclassified or unknown-type educational properties	1	(0.0%)	0	(0.0%)	0	(0.0%)	$0	(0.0%)
Institutional Properties	***13***	***(0.5%)***	***0***	***(0.0%)***	***2***	***(0.8%)***	***$100***	***(0.2%)***
Care of the aged	4	(0.2%)	0	(0.0%)	0	(0.0%)	$2	(0.0%)
Care of the young	1	(0.0%)	0	(0.0%)	1	(0.3%)	$96	(0.2%)
Care of the sick or injured	2	(0.1%)	0	(0.0%)	1	(0.4%)	$1	(0.0%)
Prisons or jails	3	(0.1%)	0	(0.0%)	0	(0.1%)	$0	(0.0%)
Care of the physically inconvenienced	1	(0.0%)	0	(0.0%)	0	(0.0%)	$0	(0.0%)
Care of the mentally handicapped	2	(0.1%)	0	(0.0%)	0	(0.0%)	$1	(0.0%)
Residential Properties	***1,891***	***(77.2%)***	***29***	***(88.2%)***	***231***	***(81.8%)***	***$31,839***	***(62.7%)***
One- or two-family dwellings	*1,661*	*(67.9%)*	*27*	*(81.2%)*	*200*	*(70.8%)*	*$27,487*	*(54.2%)*
Apartments	*188*	*(7.7%)*	*2*	*(6.9%)*	*24*	*(8.6%)*	*$3,152*	*(6.2%)*
Rooming, boarding or lodging houses	5	(0.2%)	0	(0.0%)	1	(0.5%)	$107	(0.2%)
Hotels or motels	11	(0.4%)	0	(0.0%)	1	(0.5%)	$643	(1.3%)
Dormitories	4	(0.2%)	0	(0.0%)	1	(0.3%)	$67	(0.1%)
Home hotels	2	(0.1%)	0	(0.0%)	0	(0.2%)	$4	(0.0%)
Unclassified or unknown-type residential property	*20*	*(0.8%)*	*0*	*(0.0%)*	*2*	*(0.9%)*	*$379*	*(0.8%)*
Store or Office Properties	***95***	***(3.9%)***	***0***	***(0.0%)***	***6***	***(2.0%)***	***$3,277***	***(6.5%)***
Food or beverage sales	*24*	*(1.0%)*	*0*	*(0.0%)*	*1*	*(0.4%)*	*$46*	*(0.1%)*
Textile or wearing apparel sales	2	(0.1%)	0	(0.0%)	0	(0.0%)	$0	(0.0%)
Household goods sales or repairs	4	(0.2%)	0	(0.0%)	0	(0.1%)	$412	(0.8%)
Specialty shops	4	(0.2%)	0	(0.0%)	0	(0.1%)	$18	(0.0%)
Recreation, hobby or home repair supply sales, or personal services	6	(0.2%)	0	(0.0%)	0	(0.1%)	$423	(0.8%)
Professional supplies or services	11	(0.4%)	0	(0.0%)	1	(0.3%)	$154	(0.3%)
Motor vehicle or boat sales or services	*23*	*(0.9%)*	*0*	*(0.0%)*	*1*	*(0.5%)*	*$1,289*	*(2.5%)*
General item stores	8	(0.3%)	0	(0.0%)	1	(0.3%)	$556	(1.1%)
Offices	*14*	*(0.6%)*	*0*	*(0.0%)*	*0*	*(0.1%)*	*$380*	*(0.7%)*
Unclassified or unknown-type store or office property	1	(0.0%)	0	(0.0%)	0	(0.0%)	$0	(0.0%)

Occupancy groups with 0.5% or more of the LP-Gas fires are italicized.

Table 2. Structure Fires in Which LP-Gas Was the Type of Material First Ignited, by Occupancy, 1994-1998 Annual Averages (Continued)

Occupancy	Fires		Civilian Deaths		Civilian Injuries		Direct Property Damage (in Thousands)	
Basic Industry, Utility or Defense Properties	***37***	***(1.5%)***	***0***	***(0.0%)***	***3***	***(0.9%)***	***$1,837***	***(3.6%)***
Nucleonics or energy production	2	(0.1%)	0	(0.0%)	0	(0.0%)	$102	(0.2%)
Laboratories	1	(0.0%)	0	(0.0%)	0	(0.0%)	$0	(0.0%)
Communications, defense or document facilities	2	(0.1%)	0	(0.0%)	0	(0.0%)	$195	(0.4%)
Utility or energy distribution systems	6	(0.2%)	0	(0.0%)	1	(0.3%)	$309	(0.6%)
Agriculture	*22*	*(0.9%)*	*0*	*(0.0%)*	*2*	*(0.7%)*	*$1,100*	*(2.2%)*
Forests, hunting or fishing	1	(0.0%)	0	(0.0%)	0	(0.0%)	$26	(0.1%)
Mining or quarrying of raw materials	3	(0.1%)	0	(0.0%)	0	(0.0%)	$90	(0.2%)
Unclassified or unknown-type basic industry, utility or defense properties	1	(0.0%)	0	(0.0%)	0	(0.0%)	$14	(0.0%)
Manufacturing Properties	***43***	***(1.8%)***	***0***	***(0.0%)***	***9***	***(3.2%)***	***$4,543***	***(9.0%)***
Food manufacturing	4	(0.2%)	0	(0.0%)	1	(0.5%)	$3,989	(7.9%)
Beverages, tobacco or essential oil manufacturing	1	(0.0%)	0	(0.0%)	1	(0.5%)	$0	(0.0%)
Textile manufacturing	1	(0.0%)	0	(0.0%)	0	(0.0%)	$0	(0.0%)
Footwear, wearing apparel, leather or rubber manufacturing	2	(0.1%)	0	(0.0%)	0	(0.0%)	$18	(0.0%)
Wood, furniture, paper or printing	5	(0.2%)	0	(0.0%)	1	(0.3%)	$137	(0.3%)
Chemical, plastic or petroleum manufacturing	6	(0.3%)	0	(0.0%)	3	(0.9%)	$3	(0.0%)
Metal or metal product manufacturing	*15*	*(0.6%)*	*0*	*(0.0%)*	*2*	*(0.8%)*	*$281*	*(0.6%)*
Vehicle assembly or vehicle manufacture	3	(0.1%)	0	(0.0%)	0	(0.0%)	$5	(0.0%)
Other manufacturing	2	(0.1%)	0	(0.0%)	0	(0.1%)	$0	(0.0%)
Unclassified or unknown-type manufacturing properties	4	(0.2%)	0	(0.0%)	0	(0.1%)	$110	(0.2%)
Storage Properties	***143***	***(5.8%)***	***1***	***(4.3%)***	***12***	***(4.3%)***	***$5,123***	***(10.1%)***
Agricultural storage	*32*	*(1.3%)*	*0*	*(0.0%)*	*5*	*(1.8%)*	*$1,457*	*(2.9%)*
Processed food or tobacco storage	3	(0.1%)	0	(0.0%)	1	(0.3%)	$13	(0.0%)
Petroleum product or alcoholic beverage storage	8	(0.3%)	1	(2.9%)	3	(1.1%)	$456	(0.9%)
Wood or paper product storage	6	(0.3%)	0	(0.0%)	0	(0.1%)	$1,062	(2.1%)
Chemical or plastic storage	1	(0.0%)	0	(0.0%)	0	(0.0%)	$1	(0.0%)
Metal or metal product storage	7	(0.3%)	0	(0.0%)	0	(0.1%)	$793	(1.6%)
Vehicle storage or garage	*63*	*(2.6%)*	*0*	*(1.3%)*	*2*	*(0.7%)*	*$1,002*	*(2.0%)*
General item storage	8	(0.3%)	0	(0.0%)	0	(0.2%)	$200	(0.4%)
Unclassified or unknown-type storage property	*16*	*(0.7%)*	*0*	*(0.0%)*	*0*	*(0.1%)*	*$140*	*(0.3%)*
Special Properties	***61***	***(2.5%)***	***0***	***(0.0%)***	***8***	***(2.7%)***	***$950***	***(1.9%)***
Construction or unoccupied properties	*18*	*(0.7%)*	*0*	*(0.0%)*	*1*	*(0.4%)*	*$78*	*(0.2%)*
Special structures	*14*	*(0.6%)*	*0*	*(0.0%)*	*2*	*(0.6%)*	*$36*	*(0.1%)*
Outdoor properties	*14*	*(0.6%)*	*0*	*(0.0%)*	*3*	*(1.2%)*	*$81*	*(0.2%)*
Water areas	1	(0.0%)	0	(0.0%)	0	(0.0%)	$0	(0.0%)

Occupancy groups with 0.5% or more of the LP-Gas fires are italicized.

Table 2.
Structure Fires in Which LP-Gas Was the Type of Material First Ignited, by Occupancy
1994-1998 Annual Averages

Occupancy	Fires		Civilian Deaths		Civilian Injuries		Direct Property Damage (in Thousands)	
Road or parking properties	5	(0.2%)	0	(0.0%)	0	(0.2%)	$33	(0.1%)
Equipment operating areas	4	(0.2%)	0	(0.0%)	0	(0.1%)	$621	(1.2%)
Unclassified or unknown-type special property	4	(0.2%)	0	(0.0%)	1	(0.3%)	$101	(0.2%)
Unclassified or Unknown Type Properties	***34***	***(1.4%)***	***1***	***(2.9%)***	***1***	***(0.4%)***	***$800***	***(1.5%)***
Total	**2,449**	**(100.0%)**	**33**	**(100.0%)**	**283**	**(100.0%)**	**$50,755**	**(100.0%)**

Occupancy groups with 0.5% or more of the LP-Gas fires are italicized.

These are fires reported to U.S. municipal fire departments and so exclude fires reported only to Federal or state agencies or industrial fire brigades. Fires, deaths and injuries are rounded to the nearest one, and direct property damage is rounded to the nearest hundred dollars. Sums may not equal totals due to rounding errors. A proportional share of fires in which the type of material first ignited was unknown or blank has been included in these totals. Structure fires include any fire in or on a structure. The annual averages are provided for each broad occupancy group with the averages for the specific occupancy group listed underneath. Property damage figures have not been adjusted for inflation.

Source: National estimates based on NFIRS and NFPA survey.

Appendix A: How National Estimates Statistics Are Calculated

Estimates are made using the National Fire Incident Reporting System (NFIRS) of the Federal Emergency Management Agency's (FEMA's) United States Fire Administration (USFA), supplemented by the annual stratified random-sample survey of fire experience conducted by the National Fire Protection Association (NFPA), which is used for calibration.

Data Bases Used

NFIRS provides annual computerized data bases of fire incidents, with data classified according to a standard format based on the NFPA 901 Standard. Roughly three-fourths of all states have NFIRS coordinators, who receive fire incident data from participating fire departments and combine the data into a state data base. These data are then transmitted to FEMA/USFA. Participation by the states, and by local fire departments within participating states, is voluntary. NFIRS captures roughly one-third to one-half of all U.S. fires each year. More than one-third of all U.S. fire departments are listed as participants in NFIRS, although not all of these departments provide data every year.

The strength of NFIRS is that it provides the most detailed incident information of any national data base not limited to large fires. NFIRS is the only data base capable of addressing national patterns for fires of all sizes by specific property use and specific fire cause. (The NFPA survey separates fewer than 20 of the hundreds of property use categories defined by NFPA 901 and solicits no cause-related information except for incendiary and suspicious fires.) NFIRS also captures information on the avenues and extent of flame spread and smoke spread and on the performance of detectors and sprinklers.

The NFPA survey is based on a stratified random sample of roughly 3,000 U.S. fire departments (or just over one of every ten fire departments in the country). The survey includes the following information: (1) the total number of fire incidents, civilian deaths, and civilian injuries, and the total estimated property damage (in dollars), for each of the major property use classes defined by the NFPA 901 Standard; (2) the number of on-duty firefighter injuries, by type of duty and nature of illness; and (3) information on the type of community protected (e.g., county versus township versus city) and the size of the population protected, which is used in the statistical formula for projecting national totals from sample results.

The NFPA survey begins with the NFPA Fire Service Inventory, a computerized file of about 30,000 U.S. fire departments, which is the most complete and thoroughly validated such listing in existence. The survey is stratified by size of population protected to reduce the uncertainty of the final estimate. Small rural communities protect fewer people per department and are less likely to respond to the survey, so a large number must be surveyed to obtain an adequate sample of those departments. (NFPA also makes follow-up calls to a sample of the smaller fire departments that do not respond, to confirm that those that did respond are truly representative of fire departments their size.) On the other hand, large city departments are so few in number and protect such a large proportion of the total U.S. population that it makes sense to survey all of them. Most respond, resulting in excellent precision for their part of the final estimate.

Projecting NFIRS to National Estimates

To project NFIRS results to national estimates, one needs at least an estimate of the NFIRS fires as a fraction of the total so that the fraction can be inverted and used as a multiplier or scaling ratio to generate national estimates from NFIRS data. But NFIRS is a sample from a universe whose size cannot be inferred from NFIRS alone. Also, participation rates in NFIRS are not necessarily uniform across regions and sizes of community, both of which are factors correlated with frequency

and severity of fires. This means NFIRS may be susceptible to systematic biases. No one at present can quantify the size of these deviations from the ideal, representative sample, so no one can say with confidence that they are or are not serious problems. But there is enough reason for concern so that a second data base - the NFPA survey - is needed to project NFIRS to national estimates and to project different parts of NFIRS separately. This multiple calibration approach makes use of the annual NFPA survey where its statistical design advantages are strongest.

There are separate projection formulas for four major property classes (residential structures, non-residential structures, vehicles, and other) and for each measure of fire severity (fire incidents, civilian deaths, and civilian injuries, and direct property damage).

For example, the scaling ratio for 1998 civilian deaths in residential structures is equal to the total number of 1998 civilian deaths in residential structure fires reported to fire departments, according to the NFPA survey (3,250), divided by the total number of 1998 civilian deaths in residential structure fires reported to NFIRS (1,224). Therefore, the scaling ratio is 3,250/1,224 = 2.66.

The scaling ratios for civilian deaths and injuries and direct property damage are often significantly different from those for fire incidents. Except for fire service injuries, average severity per fire is generally higher for NFIRS than for the NFPA survey. Use of different scaling ratios for each measure of severity is equivalent to assuming that these differences are due either to NFIRS under-reporting of small fires, resulting in a higher-than-actual loss-per-fire ratio, or possible biases in the NFIRS sample representation by region or size of community, resulting in severity-per-fire ratios characteristic only of the oversampled regions or community sizes.

Note that this approach also means that the NFPA survey results for detailed property-use classes (e.g., fires in storage structures) may not match the national estimates of the same value.

Calculating National Estimates of Particular Types of Fires

Most analyses of interest involve the calculation of the estimated number of fires not only within a particular occupancy but also of a particular type. The types that are mostly frequently of interest are those defined by some ignition-cause characteristic. The six cause-related characteristics most commonly used to describe fires are: form of the heat that caused the ignition, equipment involved in ignition, form or type of material first ignited, the ignition factor that brought heat source and ignited material together, and area of origin. Other characteristics of interest are victim characteristics, such as ages of persons killed or injured in fire.

For any characteristic of interest in NFIRS, some reported fires have that characteristic unknown or not reported. If the unknowns are not taken into account, then the propensity to report or not report a characteristic may influence the results far more than the actual patterns on that characteristic. For example, suppose the number of fires remained the same for several consecutive years, but the percentage of fires with cause unreported steadily declined over those years. If the unknown-cause fires were ignored, it would appear as if fires due to every specific cause increased over time while total fires remained unchanged. This, of course, does not make sense.

Consequently, most national estimates analyses allocate unknowns. This is done by using scaling ratios defined by NFPA survey estimates of totals divided by only those NFIRS fires for which the dimension in question was known and reported. This approach is equivalent to assuming that the fires with unreported characteristics, if known, would show the same proportions as the fires with known characteristics. For example, it assumes that the fires with unknown ignition factor contain the same relative shares of child-playing fires, incendiary-cause fires, short circuit fires, and so forth, as are found in the fires where ignition factor was reported.

Rounding Errors

The possibility of rounding errors exists in all our calculations. One of the notes on each table indicates the extent of rounding for that table, e.g., deaths rounded to the nearest one, fires rounded to the nearest hundred, property damage rounded to the nearest hundred thousand dollars. In rounding to the nearest one, functional values of 0.5 or more are rounded up and functional values less than 0.5 are rounded down. For example, 2.5 would round to 3, and 3.4 would round to 3. In rounding to the nearest one, a stated estimate of 1 could be any number from 0.5 to 1.49, a roughly threefold range.

The impact of rounding is greatest when the stated number is small relative to the degree of rounding. As noted, rounding to the nearest one means that stated values of 1 may vary by a factor of three. Similarly, the cumulative impact of rounding error - the potential gap between the estimated total and the sum of the estimated values as rounded - is greatest when there are a large number of values and the total is small relative to the extent of rounding.

Suppose a table presented 5-year averages of estimated deaths by item first ignited, all rounded to the nearest one. Suppose there were a total of 30 deaths in the 5 years, so the total average would be 30/5 = 6.

In case 1, suppose 10 of the possible items first ignited each accounted for 3 deaths in 5 years. Then there would be 10 entries of 3/5 = 0.6, rounded to 1, and the sum would be 10, compared to the true total of 6.

In case 2, suppose 15 of the possible items first ignited each accounted for 2 deaths in 5 years. Then there would be 15 entries of 215 = 0.4, rounded to 0, and the sum would be 0, compared to the true total of 6.

Here is another example: Suppose there were an estimate of 7 deaths total in 1992 through 1996. The 5-year average would be 1.4, which would round to 1, the number we would show as the total. Each death would represent a 5-year average of 0.2.

If those 7 deaths split as 4 deaths in one category (e.g., smoking) and 3 deaths in a second category (e.g., heating), then we would show 4 x 0.2 = 0.8 deaths per year for smoking and 3 x 0.2 = 0.6 deaths per year for heating. Both would round to 1, there would be two entries of 1, and the sum would be 2, higher than the actual rounded total.

If those 7 deaths split as 1 death in each of 7 categories (quite possible since there are 12 major cause categories), then we would show 0.2 in each category, always rounding to 0, and the sum would be 0, lower than the actual rounded total. The more categories there are, the farther apart the sum and total can -- and often do -- get.

Note that percentages are calculated from unrounded values, and so it is quite possible to have a percentage entry of up to 100%, even if the rounded number entry is zero.