

## Unwanted Fire Alarms

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Unwanted fire alarms, however they are defined, are a problem for the fire service, businesses, and the public. They disrupt activities for no good reason and can generate a sense of complacency. In a 2004 article on increasing the prevalence of working smoke alarms in disadvantaged inner city in the *Journal of Epidemiology and Community Health* by H Roberts, et al., the authors quoted an eight-year-old: “When the smoke alarm goes off, I have to turn up the television.” Unwanted alarms that trigger an automatic fire department response put a tremendous strain on fire department resources.

In his report, *Fire Loss in the United States during 2010*, NFPA’s Michael J. Karter, Jr. estimated that U.S. fire departments responded to an estimated total of 482,000 structure fires in 2010. In contrast, they also responded to 2,178,000 false alarms. These calls include false calls reported by the public as well as automatic alarms and are not limited to false calls relating to structure fires. False alarm responses included:

- 992,000, (45% of false alarms) calls due to unintentional activations,
- 708,500 (32%) due to system malfunctions,
- 163,000 (8%) malicious or mischievous false alarms and;
- 323,500 (15%) other false alarms, including bomb scares and unclassified false alarms.

Fire departments went to 16 false alarms for every 10 fires, and 45 false alarms for every 10 structure fires.

Responses due to unintentional activations have generally been increasing since 1990. System malfunctions were generally increasing from 1990 to 1999 and have been trending generally downward since then. Malicious or mischievous false alarms have been falling over the past 20 years.

The U.S. Fire Administration’s National Fire Incident Reporting System (NFIRS) now collects data on all types of fire department responses. Due to the size of the file, 2003 was the last year that the national file included non-fire responses such as false alarms. NFPA’s Ben Evarts used the 2003 NFIRS data and NFPA survey results to provide more detailed estimates about the type of unwanted alarm and the occupancies in which they occurred. Note that NFIRS does not distinguish single-station smoke alarms from smoke detectors that are part of a system. The term “smoke detectors” in NFIRS is used to capture incidents with both technologies.

In 2003, false alarms due to malfunctions and false alarms due to unintentional activations together accounted for three-quarters of all false alarm responses. Unintentional smoke detector activations caused one in five (19%) alarms from these two categories.

When malfunctions and unintentional activations were grouped by the equipment involved, smoke detection activations accounted for almost one-third (31%) of these unwanted false alarms. Fire alarms system activations led to almost the same percentage (30%). Carbon monoxide detection, heat detection, sprinklers, and other extinguishing equipment were involved in a much smaller share of the unwanted alarms.

While residential properties accounted for the largest share of false alarms of any single occupancy group, non-residential properties accounted for more than half of false alarm responses in all categories shown except unintentional smoke detector activations. Fifty-five percent of unintentional smoke detector activations occurred in residential properties, including

- one-quarter (27%) in one- or two-family homes,
- 18% in apartments or other multi-family dwellings, and
- 10% in other residential properties.

The requirements for smoke detection in residential dwelling units are very different from those in commercial properties. The purpose of fire-warning equipment for residential occupancies is to “provide a reliable means to notify the occupants ...”, according to Section 29.2 of the 2010 edition of NFPA 72, *National Fire Alarm and Signaling Code*. Fire department notification by household fire alarm systems is not a priority of the code. Common areas of multi-family housing, hotels, dormitories and similar residential properties would be protected by commercial fire alarm systems.

The ratio of smoke alarm activations to actual fires is even higher in surveys of the public than it is in fire department responses. In a 2010 Harris poll done for the NFPA, 96% of surveyed households said they had at least one smoke alarm. In roughly half (52%) of all homes with at least one smoke alarm, a smoke alarm was installed in the kitchen, despite the fact that smoke alarms should generally not be installed in kitchens because of the potential for nuisance alarms. Forty-three percent of those with smoke alarms said that at least one had sounded in the past year. Among those with activations, cooking was cited as a factor by roughly three out of four households. Eight percent with activations said the alarm chirped to indicate a low battery.

When respondents in the same survey had to select only one answer, none mentioned a real fire as a cause of the activation. When those with activations were asked a series of yes or no questions,

- 5% agreed that that the activation alerted them to a real fire,
- 15% said the alarm sounded in response to a fire they already knew about,
- *Twenty-two percent said it warned them of something that could have become a fire.*
- 43% said it sounded after they knew food was burning.
- Almost two-thirds (63%) agreed that the activations were due to normal conditions associated with cooking, smoking, steam or other normal household conditions.
- Twelve percent said it went off for no apparent reason.

One of the challenges in addressing the problem is determining what, exactly, is an unwanted alarm. Different studies and regulations use different definitions. The same activation may be useful to some and unwanted to others.

There is a continuum of fire alarm activations and response across five scenarios. The first, malfunctioning alarms with no hazards and no obvious trigger, are probably the most annoying to all parties. The second, unwanted or unintentional activations in response to predictable environmental stimuli such as cooking fumes, shower steam, and construction activities, are also disruptive. However, the pattern is understood.

The third scenario, a warning of pre-fire conditions, is often overlooked in discussions of fire detection. Smoke detectors or other fire alarms can alert occupants to a situation that is on the verge of becoming a fire but is very easily remedied. These warnings are useful. It would be inappropriate to call them false or nuisance alarms, but they would generally not be considered fires either. Malfunctioning alarms and nuisance activations are clearly undesirable. A warning of pre-fire conditions is very useful, but a fire department response is generally not needed.

In the fourth scenario, the alarm sounds when a fire is very small. Often, these fires self-extinguish. Burnt popcorn in a microwave is an example of this scenario. In other situations with early discovery, the occupant is often able to extinguish the fire prior to fire department arrival. However, there is a risk of fire spread if the occupants cannot quickly put the fire out. When detection operates in response to a serious fire, immediate action is required. An automatic alarm that summons the fire department more quickly is very helpful.

The earlier someone on site knows about a potential fire, the better. NFPA 101®, *Life Safety Code*®, addresses the reach of fire alarms in private areas of residential occupancies. Smoke alarms in these spaces shall sound only within individual dwelling units, rooms or suites. Unless permitted by the authority having jurisdiction, these smoke alarms shall not actuate the building fire alarm system and shall not be automatically transmitted to the fire department. In some cases, however, a smoke detector in a common hallway may activate after an occupant opens their door to air out smoke from burnt food. This may result in a full building evacuation and fire department response.

NFPA 72 currently allows supervising stations to verify alarm signals from household fire alarm systems before notifying the fire service if such verification will not delay reporting by more than 90 seconds and the authority having jurisdiction agrees. Proposals have been made to expand this verification practice to non-residential occupancies. Such verification can reduce the costs and risks associated with unnecessary response. When the automatic alarm is signaling a real fire, a delayed response can allow the fire to grow unchecked for a longer period of time.

Peter J Finley's 2001 paper for the USFA's Executive Fire Officer Program (EFOP), *Residential Fire Alarm Systems: the Verification and Response Dilemma*, surveyed departments protecting populations of 47,000 to 67,000 and residents of his community, Vineland, New Jersey, who had experienced fire department responses to false alarms in their homes. Among the departments that responded to his survey, on average

- One in five (19%) fire-related responses was made because of automatic fire alarm activations;
- 9% of automatic fire alarm activations were residential fire alarm system activations.
- System malfunctions caused almost one-third (31%) of the residential fire activations.
- Only 3% of residential fire activations were actual fires.

Three-quarters (78%) of the departments did not permit verification of residential fire alarms prior to responding. However, almost nine out of ten (88%) would modify the response if dispatch is informed that the alarm may be false.

To address false alarms, one-quarter of the departments issue citations or violation notices and almost one-third (31%) use fines or penalties when necessary. Eighty percent of the departments who issue fines allow at least three false alarms in a year before issuing the fines. Most of the fire departments did not consider unintentional activations to be false alarms for enforcement purposes.

Dubivsky's and Bukowski's 1989 study of Veterans Administration hospitals found 15.8 unwanted activations for every real alarm, or one unwanted activation for every six devices per year. Among the causes cited for false alarms in these facilities were: smoking (in groups); dust; humidity; high air velocity; defective; transient (electrical); lack of maintenance; insects; steam; construction work; housekeeping that used aerosols, solvents, or similar items.; cooking and baking; fumes (inside or outside); water; malicious; or a combination of factors that together increased the systems' sensitivity.

In his March 2007 *NFPA Journal* article, "Nuisance Alarms," Glen Kitteringham described the approach used by the Brookfield Properties management group in addressing the false alarm problem in three multi-towered commercial high-rise buildings in Calgary, Alberta, Canada. Seventy percent of the 244 total fire alarms in 2002-2006 were false. These alarms could be divided into four causes: 1) user error, 2) work done without notification, 3) system malfunction, and 4) damage to the system. Increased training, improved procedures and communication, investigation in to false alarm causes, and passing false alarm fines to tenants or contractors who caused them led to a 50% drop in fire alarms from 2003-2006.

Many common causes of unwanted alarms, including improper placement, testing without communication, lack of maintenance, construction, have been known for a long time. Most of these could be prevented by improving procedures, training, and enforcement throughout the process. Unwanted fire alarms are a problem for both the fire service and the public. When unwanted alarms substantially outnumber instances of useful information, there is a substantial risk that the valuable early warning will be ignored and that systems will be disabled. An interdisciplinary approach is needed to address this problem. Plan designers and reviewers, installers, technicians, inspectors, the fire service, property owners and managers, and outside contractors all play a role. Investigation of the cause of each unwanted alarm, record-keeping, and communication with all concerned properties are needed to reduce the problem. The fire service is also trying to determine how to balance the important benefit of early arrival at genuine emergencies with the risk and resource use of emergency response to all automatic alarms when so many are unwanted. A Fire Protection Research Foundation project is currently

underway to develop a fire department tool for risk-based decision-making of unwanted alarms. NFPA is also developing a manual for fire departments to help them better enforce the existing provisions of NFPA 72.