COLLEGE HOUSING FIRE SAFETY

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Abstract

This project was sponsored by the U.S. Consumer Product Safety Commission (CPSC) to address the issue of fire safety in college residences and to assist in the achievement of the CPSC's strategic goal of a 20% reduction in fire-related deaths over the period of 1998-2013. We researched and analyzed the causes of fires, fire education programs, and fire detection and suppression. From this, we developed recommendations for the CPSC to address the issue of college housing fire safety.

Authorship Page

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1. Executive Summary

The U.S. Consumer Product Safety Commission (CPSC) has a strategic goal to reduce the rate of fire-related deaths by twenty percent between 1998 and 2013. In the past, CPSC research has been focused specifically on fire safety issues for young children and for the elderly. College students and college housing have generally not been included in this research. College housing fires, which number over 1,700 a year resulting in over 15 deaths and 50 injuries, are an issue that needs to be included in the CPSC's priorities.

Our project goal was to provide the CPSC with effective ways to address the issue of college housing fires. Statistical data concerning fire safety were collected from various sources, including the National Fire Incident Reporting System (NFIRS), by conducting a college student survey at the University of Maryland, and via the internet at Worcester Polytechnic Institute (WPI) and Georgetown University. Anecdotal data were collected using a variety of methods, including interviews with college and university officials and fire safety professionals from around the country. To acquire more knowledge about college housing fire incidents, we analyzed incident reports from the U.S. Fire Administration (USFA) and the CPSC. The scope of our research included the causes of fires, fire education, fire detection, and fire suppression.

Our research and analysis of data show that each topic in our scope needs to be addressed. With regard to consumer products, cooking equipment, candles, and smoking materials are the leading causes of college housing fires. Two things can be interpreted from this. First, consumer products geared toward college living need to be made safer for the confined living conditions. Second, flame-resistant furniture and mattresses should be required in campus housing to slow the spread of fire. Therefore, we recommend to the CPSC that certain products found to have been involved repeatedly in college housing fires need to meet voluntary or

possibly mandatory standards. Those products include candles, space heaters, portable fans, extension cords and power strips, and certain types of cooking equipment. The CPSC should also continue its efforts in creating mandatory standards for fire safe mattresses and upholstered furniture.

A second focus of our project included researching fire education, including the various methods for teaching students fire safety and informing them of college and university campus fire policies. Our results indicate that students are not obeying campus fire safety policies; therefore, colleges and universities need to have stricter policies and better enforcement of the policies. We are recommending that the CPSC create and distribute a *Consumer Product Safety Alert* specifically for college students. This booklet should not only indicate which consumer products are fire hazards in college housing, but also what dangers they pose and why they are banned by colleges and universities. We have also determined that training is the key to fire prevention. One effective means of showing college housing fire scenarios to students is through live burns. A live burn is a demonstration of how fast a typical college student's room can ignite and become engulfed in flames. These have a great effect with students on campuses where they are conducted, and we recommend that the CPSC develop a standard procedure for live burns that can be conducted on college campuses.

In general, we have learned that there are many fire education materials available to both students and administrators. There is a problem, however, in the marketing and distribution of these materials. This is the basis for two more of our recommendations. First, the CPSC should measure the effectiveness of fire safety information and education on students. This could be accomplished by conducting a national survey of college students, similar to the one used for this project. Second, the CPSC should create a central library of fire safety information, perhaps

linked from the CPSC website, where students, parents, and college officials can find resources about fire safety. Included in these resources should be information about alcohol and smoking materials, which have been factors in numerous fire incidents.

Fire detection and fire suppression systems were the final topics in our project research scope. After analyzing case studies, interviewing fire safety professionals, and interpreting statistical fire data, we conclude that fire sprinkler systems are a cost effective means of extinguishing fires. There have never been more than two deaths from a fire in which sprinklers were installed and worked properly, and the systems' installation costs are low. New college housing should be constructed and old college housing should be retrofitted with fire sprinkler systems.

In regard to fire safety legislation, we recommend that the CPSC should encourage states to adopt fire sprinkler laws similar to the one in New Jersey. The New Jersey law passed in July, 2000 requires all college dormitories, fraternities, and sororities to be equipped with fire sprinkler systems, and is very successful. We also recommend that the CPSC support two other pieces of federal legislation. The "College Fire Safety Right-to-Know Act of 2003" allows for the public disclosure of campus fire safety standards and measures for all of the country's colleges and universities, and the "College Fire Prevention Act" creates an incentive program to promote the installation of fire sprinkler systems in college housing, and assists in providing funding to schools that apply to the program.

2. Introduction

From 1992 through 2001, there were an estimated 400,000 residential fires in the United States, resulting in over 3,500 deaths and 25,000 injures per year (United States Fire Administration, 2004d, Home Fire Safety). These fires, along with damages from non-residential fires, resulted in over ten billion dollars in damages over the same time period. According to the United States Fire Administration (USFA), in 2001 the U.S. had one of the highest fire death rates in the industrialized world. Twenty-three percent of all fires across the United States occur in a residence (USFA, 2004d, Home Fire Safety). College housing provides residence for college students; it presents fire hazards and histories similar to those of residential housing.

In the United States there are on average 1,700 fires in college and university dormitories and in fraternity and sorority houses, leading to 2.8 million dollars in damage annually (USFA, 2004b, Campus Fire Safety). Fires in college student residences lead to approximately 15 deaths and 50 injuries annually. The U.S. Consumer Product Safety Commission (CPSC) has a Strategic Goal to reduce the rate of fire-related deaths in all fires by twenty percent from the 1998 annual estimate by the year 2013. Currently, most colleges ban specific consumer products that pose potential fire hazards in college housing, but a number of students are unaware of, or ignore, these bans. In addition, there are numerous permitted items that pose fire hazards. Student behavior is also a key factor in fire incidents that could result in injuries and deaths.

Current fire safety research done by the CPSC is focused mainly on residential housing in general rather than specifically on college housing. CPSC research includes investigations to determine the causes, damages, and injuries and fatalities resulting from fires. Similar data are also recorded by local fire departments in the National Fire Incident Reporting System (NFIRS). Other research has focused on the effectiveness of the various forms of fire suppression,

including water-mist and non-wet systems, and fire extinguishers. According to the CPSC, less attention is given to the college student age group regarding fire safety, and therefore the CPSC needs more research to be focused directly on fire safety in college housing such as dormitories, on-campus apartments, and Greek housing.

There are many issues involving college housing fires that remain unresolved. The CPSC conducts research on residential fire dangers and issues recommendations and reports on their findings. But, their primary research scope does not include colleges and universities, and thus CPSC data concerning housing fires at these institutions are absent. The main issue we researched is the role of consumer products in college housing fires. A second issue is whether or not colleges and universities are implementing methods to ensure the compliance with fire safety policies in place at the institution. A third issue that was examined is the extent to which college students are participating in fire education programs, and whether or not they are actually learning the material introduced to them and acting on it. The fourth issue was to determine what role human behavior plays in college housing fires. The last key issue involves fire suppression. We researched the presence of fire suppression systems and the effectiveness of them.

The goal of this project was to provide the CPSC with recommendations for effective ways to address the issue of college housing fire safety. In order to assist our sponsor with this goal, we developed several objectives. To gain knowledge about the causes of college housing fires, we identified and researched consumer products, building materials, and other items that are potential fire hazards. We learned about past college housing fires using NFIRS and CPSC databases. We visited college and university campuses and evaluated their specific fire safety policies and methods. This provided data to determine trends or patterns in college housing fires. To learn about the relationship between college student behavior, gender, and fire safety issues,

we evaluated studies and theories regarding human behavior and how the fires were started. Recommendations to address college fire safety that may help to reduce the incidence of such unfortunate events were developed through review and analysis of the aforementioned information.

3. Literature Review & Background

The CPSC set a strategic goal to reduce by 20 percent the rate of death caused by fire-related incidents from the 1998 rate by 2013. Since the Commission's inception, it has been investigating the causes of and damages resulting from residential fires. In recent years, the CPSC has conducted research into college housing fires. Case work has been done in the Eastern and Western regions of the United States by CPSC field investigators. This background chapter contains information on relevant studies of past college housing fires, means of detecting and extinguishing these fires, and current attempts to prevent the fires through education and legislation, which will help in formulating recommendations to the CPSC on the issue of college housing fire safety.

3.1 Causes of Fires

Many causes of fires in college student residences have been identified, including defective or dangerous products and the condition of the building itself. Faulty electrical systems are an example of this. Other causes of fires in student housing are the results of human actions and behaviors, including the misuse of products, drug and alcohol use, and arson.

3.1.1 Consumer Products

Colleges and universities often prohibit certain consumer products from student residences due to the risk of fire associated with those products. Most of these products are marketed toward college living or may be more dangerous in a college living environment. Halogen lamps are prohibited by some universities because of their extremely high operating temperatures that can ignite nearby combustible material. Halogen lamps are generally free standing torchiere style lamps measuring approximately six feet tall. These lamps come with bulbs of 300 watts and 500 watts (Ault, 1998, Data Summary on Halogen Torchiere-Style Floor

Lamps). Although the Underwriters Laboratories (UL) stopped listing halogen torchiere lamps with bulbs greater than 300 watts as acceptable in 1996 as part of UL 153 Section 543, some people still have them and may bring them into college residences unaware of the risk they contain. The 300 watt bulbs have an operating temperature of 970 degrees Fahrenheit while the 500 watt bulbs operate at 1,200 degrees Fahrenheit. The halogen bulb operating temperatures are extreme in comparison to a 100 watt incandescent bulb which has upper temperatures of 240 degrees Fahrenheit. The fire risks associated with halogen torchiere lamps in a college living environment may be higher because of the typically confined spaces, which may more easily result in combustibles coming into contact with the hot bulb surface. The most common cause of fires from halogen torchiere lamps is the ignition of nearby combustibles, such as clothing and draperies. Metal guards are available for halogen lamps to minimize direct contact of combustibles with the bulb, but the risk of fire is still present with the use of the guards, particularly with 500 watt bulbs.

Cooking products such as hot pots, hot plates, and mini-grills are prohibited by some colleges and universities (Worcester Polytechnic Institute Office of Residential Services, 2004, Residence Hall Fire Safety). These cooking products usually operate at very high temperatures, have an open heating element, and do not have automatic shut off features. These small cooking products are usually of high appeal to college students because of the compact size and convenience, but are often more dangerous when used in college housing because of the confined spaces. Although they generally don't pose a fire hazard on their own, in the confined spaces of the average college residence there is an ever present risk of a combustible item coming in contact with products such as hot plates and hot pots (Butturini, 2001, U.S. Consumer Product Safety Commission, Product Safety Assessment Report PSA # 0720.01). Space heaters

are often prohibited from college housing for these same reasons. A fire can be caused by an item being placed over the heating unit, or by the unit tipping over.

Fires in college residences can also involve the furniture within the residence. While some newer types of furniture are made with fire resistant or slower burning materials, older furnishings are more combustible. Mattresses are one of the more highly flammable furnishings commonly found in a college housing residence (US CPSC, 2000, Epidemiologic Investigation Report, Task Number 001130HNE5926). Old mattresses frequently used in college dormitories and Greek residences are usually more flammable than new mattresses, raising the fire hazard. Dormitory-style furniture provided by the school can be older furniture, similarly made of more combustible materials. This general dormitory furniture, aside from mattresses, is subject to fire when exposed to an ignition source.

If candles are not left unattended or placed near possible contact with combustibles, they are not a significant fire hazard, but they are so commonly used improperly and left unattended that they have become a serious fire hazard. According to the National Fire Protection Association (NFPA), in 1998 there were 12,540 candle fires in homes in the United States (USFA, 2001c, Candles). Forty four percent of the fires started in bedrooms, which is significant in the context of college housing context because a dormitory room is generally the student's bedroom as well as living space. Many students use candles for various reasons in their college residences such as soft lighting and fragrances. With the confined spaces and many flammable furnishings nearby, the fire hazard is very significant.

3.1.2 Building Condition

A cause of fires in college housing related to building condition is faulty electrical systems and wiring. Electrical fires are caused by problems in fixed wiring such as old wiring

and faulty receptacles. Electrical systems should be routinely maintained to ensure that everything is in safe running condition (Clendenin, 2004, Home Electrical Safety Tips). In regards to routine maintenance and upgrades, the building code that must be followed is the code that was in effect during construction of the building. A residence does not have to be brought up to most recent codes unless major reconstruction is done. When electrical systems get too old, they may not be sufficient to handle the power needed by electrical appliances today. Loose receptacles that are not fastened securely are also a fire hazard, since movement can cause wires to become loose or broken. Fires such as these can be prevented by the use of Arc Fault Circuit Interrupters (AFCI). Arcing is the term applied to the discharge of electricity across an insulating medium. An AFCI is a device that mitigates the effects of arcing faults by de-energizing the circuit when a fault is detected (UL 1699, 2000). This provides a large degree of protection against electrical fires caused by arcing in electrical devices as well as fixed wiring systems (See Appendix B). The National Electric Code (NEC) 2002 requires AFCI's to be installed to protect receptacles in bedrooms in new homes and where renovations include electrical wiring (US CPSC, 2004b, Investigation Guideline, Home Electrical Distribution System Components 15- And 20- Ampere Electrical Receptacles). AFCI's can be either in receptacle form or circuit breaker form, but are very rare and almost nonexistent in the receptacle form in United States as of 2004, which means most are met using circuit breaker types.

Wiring and receptacles exposed to water present a very hazardous situation. No open wires should ever be exposed to water. Receptacles that will possibly be exposed to water, such as in bathrooms, should be protected by Ground Fault Circuit Interrupters (GFCI) which like the AFCI can be either receptacle type or circuit breaker type. When the GFCI senses leakage current outside of the circuit or a ground fault, it quickly interrupts the circuit and stops power

going to it (See Appendix C). Although GFCI's may reduce fire hazards, they must be tested periodically to make sure they are working properly. If the GFCI is not working properly, it will not shut off and will act as a normal outlet.

3.1.3 Human Behavior

Human behavior has an impact on college housing fires because students may knowingly or unknowingly misuse products that are generally not fire hazards when used properly in situations outside of the college living environment. Possible impairment due to drugs and alcohol is tied to college housing fires, especially with respect to Greek housing (USFA, 2001i, Fraternity Fatal Fires, Phi Gamma Delta-Phi Kappa Sigma). Another fire risk related to human behavior is arson, which is the leading cause of fires in dormitories and Greek housing nationwide.

Incidents with smoking materials are a common cause of fire. When smoking materials are not extinguished properly, they can smolder and ignite later without anybody noticing. Fires caused by an incident such as this can lead to vast amounts of damage. The careless use and improper disposal of smoking materials is the leading cause of fire-related deaths in the United States (USFA, 2001j, Smoking and Fire Safety). In 1998 over 900 people were killed and 2,500 more were injured in fires caused by smoking-related incidents. Close to 75% of the fires caused by smoking materials were the results of a cigarette not being properly disposed of or being abandoned. According to the 1998 statistics, over 73% of the deaths caused by smoking related fires were caused by fires that started in either a mattress or an upholstered chair. This is a very significant statistic regarding the high flammability of mattresses and furniture found in college housing.

People can unknowingly misuse rather benign items such as outlets and extension cords. For example, the common practice of using multi-outlet power strips, extension cords, and running too many appliances out of a single outlet is a serious fire threat (USFA, 2004g, Fraternity Fatal Fires, Phi Gamma Delta-Phi Kappa Sigma). This overloads the circuit and creates a dangerous situation. With the large number of electrical devices that students may have, power strips are a very common item found in college housing. An even more dangerous situation involving power strips is a term called "daisy chaining." Daisy chaining is when multiple power strips are interconnected with each other (Lee, 1999, U.S. Consumer Product Safety Commission, Product Safety Assessment Report PSA # 0678.99). When this is done, a fire hazard is created because the power strips cannot sufficiently support the current.

Another common item often unknowingly misused is an extension cord. Extension cords should only be used temporarily, and should never be used as a permanent power supply (USFA, 2004g, Fraternity Fatal Fires, Phi Gamma Delta-Phi Kappa Sigma). When an extension cord is used, it must be of proper gauge size to handle the current drawn by specific products. If the gauge size of the cord is not large enough for the product, the cord will overheat and the insulation around the wires may fail, allowing the wires to arc, which in turn could cause a fire. For similar reasons, extension cords running under carpets and furniture are also a cause of fire. When a cord is under a carpet or piece of furniture, there is no place for the heat to escape. The cord becomes overheated when the heat cannot escape and becomes a potential fire hazard.

Other behaviors of college students may not be directly viewed as product misuse, but truly are misuse and are potential fire hazards. These include putting decorative covers or fabrics over incandescent and fluorescent lights to produce a decorative look and color as well as to soften the intensity. An average 70 watt incandescent light bulb can reach temperatures of 260

degrees Fahrenheit after extended use (Ault, 1998, Data Summary on Halogen Torchiere-Style Floor Lamps). Although that is not nearly as hot as a halogen bulb, it is still hot enough to possibly ignite flammable fabrics covering it. Items such as this are not usually banned, and often overlooked in fire inspections.

Another potential fire hazard in college housing residences is the growing popularity of rope-style lights and other forms of decorative lights. These types of lighting are commonly hung from walls and ceilings in college residences, posing a potential fire hazard. When supplied instructions are followed for proper use and the lights have adequate space for heat to dissipate, rope lights are not a fire hazard (Lee, 2002, U.S. Consumer Product Safety Commission, Product Safety Assessment Report PSA # 0763.02). In the case of a confined college room, proper usage is not always followed. Students may connect too many light strings together or not leave adequate space for heat ventilation.

Alcohol and drug use has become an increasing problem related to fire safety in college housing, especially in Greek housing. A survey of non-Greek college residents shows that 45% of the males and 35% of the females participate in binge drinking (USFA, 2001a, Alcohol and Fire Safety). In the same survey it was found that 86% percent of Greek males and 80% of Greek females participate in binge drinking. These are significant numbers when related to the fact that one half of adults killed in fires have a high blood alcohol count. Of the 250 five deaths caused by fire between 1993 and 1996, 30% were found to have elevated blood alcohol counts. There is also a connection between smoking and drinking. In another survey, 15% of victims killed in smoking related fires were impaired by drugs or alcohol.

Unlike the previous discussion of accidental fires, arson is one cause of fires that arise from intentional human behavior. Arson is the leading cause of fire in the United States, with an

estimated 267,000 fires being attributed to arson (USFA, 2001b, Arson in the United States). Arson fires are the third leading cause of injury or death in fire-related incidents. According to the USFA, arson is the number one cause of college fires accounting for 31% of all college fires (USFA, 2001i, Fraternity Fatal Fires, Phi Gamma Delta-Phi Kappa Sigma). In fraternity and sorority houses, 21% of all fires are attributed to arson. This is far higher than the national average of 14% in residential housing (USFA, 2001g, Fraternity and Sorority House Fires).

3.2 Fire Suppression

Fire suppression is the last line of defense after a fire has already ignited and is used to contain or extinguish the fire. There are several distinct types of fire suppression systems, including installed systems for buildings and user-operated personal systems. There are many types of fires including ordinary combustibles, combustible liquids, combustible metals, and electrical. There are different types of fire suppression for the various types of fires.

3.2.1 Water Mist Systems

According to the American Fire Sprinkler Association (AFSA), "fire sprinklers are widely recognized as the single most effective method for fighting the spread of fire in their early stages – before they can cause injury to people and damage to property" (American Fire Sprinkler Association, 2004, Sprinkler Information). Most sprinkler heads release 8 to 24 gallons of water per minute in comparison to the 50 to one 125 gallons per minute that the fire departments use. Sprinkler systems consist of a network of water pipes with separate heads for delivery of water to different areas. Despite the fact that sprinklers are designed as a network, if one sprinkler head is activated it does not cause the rest of the network to discharge, which is a common misconception. Only the sprinkler heads that are closest to the flames and extreme heat

are activated. The sprinkler heads are equipped with a fusible link that melts and once the link melts then the sprinkler head releases the water (USFA, 2001f, Fire Sprinklers).

The NFPA has several codes to govern the design of sprinklers in commercial and residential buildings (NFPA, 2003a, Codes Online). NFPA code 13 concerns Commercial Fire Sprinkler Design Standards and NFPA code 13R involves Residential Fire Sprinkler Design Standard. NFPA code 13D addresses fire sprinkler design standards in dwellings, which are defined as one- or two-family homes. The USFA, with the help of the NFPA, is working on the National Residential Fire Sprinkler Initiative to remove barriers to allow the installation of sprinklers in all residences.

3.2.2 Non-Wet Systems

There are several forms of non-wet fire suppression systems such as foam and CO_2. The foam in foam fire suppression systems is made from a combination of fluoro-chemical surfactants, hydrocarbon surfactants, and solvents (Reliable Fire Equipment Company, 2004, Foam Systems). The system creates a foam blanket over the fire which extinguishes the fire by smothering it. The CO_2 system is similar to a water sprinkler system, but instead of spraying out liquid the CO_2 system sprays out CO_2 gas to extinguish fires. CO_2 systems are typically installed in kitchens to extinguish grease fires.

3.2.3 Fire Extinguishers

Fire extinguishers are used to help put out small fires and to stop the fires from spreading. Fire extinguishers should only be used “when the fire is confined to a small area, such as a wastebasket, and is not growing” (NFPA, 2003b, Fact Sheets). Many college dormitories are equipped with fire extinguishers for this reason. There are two major types of fire extinguishers: pressurized water and dry chemical (USFA, 2001e, Fire Extinguishers). The pressurized water

type is to be used on fires involving ordinary combustibles, and the dry chemical fire extinguishers are to be used on fires involving combustible liquids, metals, and electrical.

3.2.4 Installation and Maintenance

The College Fire Prevention Act states that the federal government will dispense one hundred million dollars in federal grants to colleges and universities to assist them in installing sprinklers in their housing (Library of Congress, 2003, Bill Summary and Status). On average, sprinklers add only one percent of the total cost to the construction. According to the AFSA, it costs about two dollars per square foot to put sprinklers in new construction and from $1.50 to $2.50 to retrofit an existing building (AFSA, 2004, Sprinkler Information). Most insurance companies give premium discounts for sprinkler-equipped housing. In a study done by Buddy Dewar, Director of Regional Operations at the National Fire Sprinkler Association (NFSA), on the economic effects of the installation of sprinklers into the Chi Psi Fraternity house in Berkeley, CA it was shown that a retrofitted sprinkler system would be able to pay for itself in less than five and a half years (USFA, 2004c, Greek – How to Sprinklers).

Maintenance of any fire suppression system is important to protection from fire. The sprinkler heads in most sprinkler systems are replaced every year or two to assure that the system is working to its fullest capability. Most fire extinguishers have a service date on them when local fire departments need to refill and service them (NFPA, 2003b, Fact Sheets). According to NFPA Fire Code 10 Chapter 6 a fire extinguisher must be inspected in a maximal interval of 30 days (NFPA, 2003a, Online Codes).

3.3 Fire Detection

Fire detection ranges from building-wide alarm systems to single-unit battery-operated systems. There are several different forms of fire alarms which include smoke alarms, pull

stations, heat detectors, flow switches, and audible and visual alarms (USFA, 2001d, Fire Alarms). Smoke alarms can either be stand-alone devices or connected into the building's fire alarm system. Ninety-five percent of the homes in the U.S. have at least one smoke alarm, and half of all deaths caused by fire occur in that five percent with no smoke alarms (NFPA, 2004b, Fact Sheets). A pull station is a device located on the wall that is used to set off the building's fire alarm. Heat detectors detect either a certain temperature or rate of rising temperature. Flow switches are built into a sprinkler system and when the water inside the pipes starts to flow, trigger an alarm. Audible and visual alarms may use horns, audio introductions, or flashing lights to notify people to exit the building. Smoke alarms need to be tested on a regular basis and the batteries replaced to prevent the alarms from failing when needed (NFPA, 2003b, Fact Sheets).

3.4 Fire Education

Fire education can be characterized as making the public aware of fire dangers through training activities, in order to prevent fires, and foremost, to save lives.

3.4.1 Fire Awareness for College Students

It is necessary to educate college students about various fire hazards, whether they are living in dormitories or in Greek housing. Fires can often start suddenly and there are many different causes that can be directly related to the college student population, including the use of prohibited items and possession of dangerous flammable materials without proper storage. Other dangers include personal actions that are more likely to start fires. Overall, students need to be aware that their action or lack of action can have drastic consequences. College students also need to be aware of the dangers of their fellow students' actions, including pulling fire alarms as pranks.

3.4.2 Education Programs

Many colleges and universities require students living in dormitories or Greek housing to participate in a fire education program at the beginning of their freshmen year. These programs are designed to inform students about fire hazard, and specific college or university policies, and to teach them the procedures to follow in the event of an emergency. They can also provide students with valuable safety tips that can save their lives. According to Joy Rizzitello, a field investigator from the CPSC, students tend to be receptive to the fire safety information they are given, but are opposed to being regulated by authorities, whether it is their resident advisers, school officials, or even federal, state, and local governments (personal communication, October 27, 2004).

3.4.2.1 Lesson Plan-Based Lectures

One type of fire education program that can be offered to students is a series of lectures, using visual aids and presentations, with the help of lesson plans provided by the USFA. Some topics of interest that are included in these lectures are *Fire Behavior for the College Student*, *Fire Extinguishers in the College Environment*, and *Evacuation* (USFA, 2004, Campus Fire Safety). Each lecture is planned to run about an hour, and uses lecture, video, and demonstration teaching methods. One of the most popular fire safety videos shown to college students is *Get Out and Stay Alive* (USFA, 2004, Campus Fire Safety). It is produced by the USFA, and is a program designed to help college students understand how they can save their lives if they find themselves in a fire situation. This program focuses on three main topics: getting out of the building, fire prevention against fires, and protection. Middlebury College and United Educators, an insurance company owned and governed by more than eleven hundred colleges, universities, independent schools, public school districts, public school insurance pools, and related

organizations, produced the video *When Every Minute Counts...Dorm Fire Safety* (Association of College and University Housing Officers-International, 2004, Catastrophic Claims). The video shows a live burn of a typical college dormitory room, and is intended to show students how fast a fire can spread and cause severe damage and threaten the safety of residents. More importantly, it shows students how their decisions regarding fire safety are not to be taken lightly and can have harsh consequences. Overall, lesson plan-based lectures tend to include technical information regarding the cause of fires, and are better suited to be taught in a classroom setting.

3.4.2.2 Informal Meetings

While some colleges and universities choose to use a formal education program, others choose to use resident advisers, student hall directors, or designated fire marshals to conduct informal information sessions. Included in these programs can be an overview of campus policies and rules regarding fires, such as what electrical appliances are not allowed and the proper use of electrical power outlets (Worcester Polytechnic Institute Office of Residential Services, 2004, Residence Hall Fire Safety). Although these meetings are not as formal as fire safety lectures, they can provide students with necessary information regarding fire safety.

3.4.2.3 An Interactive Approach

While some colleges choose to introduce fire safety to students through means of a lecture or informal meeting, other programs use a more hands-on approach. The University of Colorado at Boulder, with help from the local fire department, holds regular Greek Fire Academies and Resident Assistant Fire Academies (Center for Campus Fire Safety, 2004, Homepage). During these programs, students have the opportunity to navigate smoke-filled corridors, extinguish fires with fire extinguishers, drag victims out of buildings and perform other fire fighting tasks. Trainers of the program believe that the students are more likely to

remember what was taught to them by participating in an actual exercise, rather than just being taught fire safety in a more formal lecture or meeting.

3.4.2.4 What Students Should Know

No matter what type of fire education program students are enrolled in, there should be a core curriculum of fire safety essentials. It is also important that students be aware of the fire safety devices in the building and how to operate them in the event of an emergency. All students should know the location of fire alarm pull stations, fire extinguishers, and the location of all exits and the quickest escape routes. They should also learn in these programs that fire doors should remain closed at all times, to prevent the spread of fire. Specifically related to fraternity and sorority houses with outside fire escape ladders, students need to know that the area in front of the window should be kept clear for easy access and escape in the event of a fire.

3.4.3 Fire Drills

Fire drills are one of the most valuable methods to reinforce the fire safety information taught in various educational programs. They create a real-life fire situation and can test the students' comprehension of the material taught to them. In some states, failure to follow fire drill procedures is not only a violation of college or university policy, but also a violation of state law. In order for a drill to be successful, however, a student must learn the proper fire drill procedure. Students should always use stairs when exiting a building, because elevators automatically stop service when an alarm is sounded (USFA, 2004, Campus Fire Safety). They must also close the windows and doors in their rooms, to help keep the fire from spreading. In the event that a student or group of students becomes trapped in a smoke-filled or burning building, they must know the best ways to save their lives.

One incident in which students did not follow proper procedure when the fire alarm sounded resulted in the tragic death of three students. On January 19, 2000, a fire alarm sounded at 4:30 in the morning in Borland Hall at Seton Hall University. This was the nineteenth time in several weeks that the alarm sounded, so students became accustomed to assuming it was another false alarm and chose not to leave their rooms (USFA, 2001c, Fire Alarms). Unfortunately, there was a fire in a common area on the third floor and three freshmen students became trapped in the dormitory and died.

3.4.4 Health and Safety Inspections

Health and safety inspections are a necessity at colleges and universities to ensure that students are in compliance with school policies. Student rooms are usually inspected for damage, health and fire safety violations, security concerns, and other violations of college policies (Worcester Polytechnic Institute Office of Residential Services, 2004, Residence Hall Fire Safety). The inspections are designed to seek out and correct potentially hazardous situations in order to protect the health, safety and general welfare of the students.

3.5 Fire Legislation

There are numerous methods in which local, state, and federal governments can create fire safety regulations to ensure the safety of occupants of various types of residences. These are accomplished through the means of fire codes, and through the passing of bills in Congress to create incentives and provide funding for colleges and universities to modernize their fire suppression systems.

3.5.1 Fire Codes

The NFPA develops, publishes, and disseminates fire codes and standards, with the intent to minimize the possibility and effects of fires and other hazards. NFPA Code 101, also known

as the "Life Safety Code" was originally created in 1913 to ensure the safety of all occupants of various types of new and existing buildings, including education, health care, detention and correctional facilities, apartments, hotels, and dormitories. It has since been updated many times, and was last revised in January, 2003.

There are two chapters of NFPA 101 that set the code requirements for dormitories. Chapter 28 states the code regulations that must be followed when constructing a new dormitory (National Fire Protection Association, 2003, Code 101 Chapter 28-29). The chapter includes all of the structural specifications necessary when building a new dormitory, including the required number and location of fire exits, the placement of smoke detectors, and other fire safety equipment. It also has the requirements for interior finishes and furnishings and decorations. Chapter 29 is very similar to the previous chapter of codes, except it has the requirements for existing hotel and dormitory buildings. The purpose of these codes is to make sure that institutions are in compliance with mandates, and are providing the utmost safety for the residents of the buildings.

3.5.2 Current Congressional Activity

Fire safety and prevention has gained national attention recently with the rise in residential and public building fires that are causing many fatalities. This has caused members of the federal government to take notice and begin the process of enacting new federal laws. Within the past two years, there have been a number of bills introduced to the U.S. House of Representatives and the U.S. Senate.

One such bill was introduced to the House during the first session of the 108th Congress, and is classified as H.R. 1613. It is more commonly referred to as the "College Fire Prevention Act" and was introduced on April 3, 2003, "to establish a demonstration incentive program

within the Department of Education to promote installation of fire sprinkler systems, or other fire suppression or prevention technologies, in qualified student housing and dormitories, and for other purposes." (Library of Congress, 2003, Bill Summary and Status) It was then referred to the House Subcommittee on 21st Century Competitiveness, but has since stalled, with no major developments.

A similar bill was introduced to the U.S. Senate on July 9, 2003, and has been classified as the "Campus Fire Safety Right-to-Know Act of 2003 (S. 1385). Its primary purpose is "to provide for disclosure of fire safety standards and measures with respect to campus buildings, and for other purposes" (Library of Congress, 2003, Bill Summary and Status). This amendment to the Higher Education Act of 1965 would provide the public with information about all of the country's colleges' and universities' methods of fire prevention, detection, and suppression, and history of past fire incidents This bill was referred to the Senate Committee on Health, Education, Labor, and Pensions, and recently, there have been no new developments (See Appendix D).

3.6 Summary

In summary, campus fire safety is an issue that must be extensively researched to determine proper ways of reducing college housing fires, and thereby to prevent further damage and the loss of life. Although there are many causes of residential fires in which humans are involved, simple accidents, the misuse of products, or the ignoring of policies and rules are the main causes of fires. Consumer products and faulty electrical wires are not major concerns as causes of fires, if they are used properly, maintained, and kept up to code. Sprinklers are an inexpensive and effective means of controlling and extinguishing fires. Enrolling students in fire safety awareness programs is one of the most productive ways to prevent fire incidents from ever

occurring or of saving lives in the event a fire does occur. There are a variety of educational programs that are effective in teaching fire safety to college students. The United States Congress has taken an interest in the number of fire incidents every year, and is in the process of enacting legislation to encourage colleges and universities to provide their residential student population with the most effective methods of fire prevention and suppression. These topics will lead us to make effective recommendations on ways the CPSC can address college housing fire safety.

4. Methodology

The goal of this project is to provide the Consumer Product Safety Commission with effective ways to address the issue of college housing fire safety. This chapter outlines the methodologies used in response to key research questions in five areas: (1) consumer products hazardous in college housing, (2) accidental fires in college housing, (3) existing fire education and policies, (4) forms of fire suppression systems, and (5) the behavior of college students as a cause of fires. We conducted interviews, performed case studies, and administered a student survey to gather information on each of the preceding subjects. The goal of this chapter is to explain the process that was followed for gathering, analyzing, and synthesizing information on the above topics.

4.1 Consumer Products that are Hazardous in College Housing

4.1.1 Role of Consumer Products

Researching certain consumer products was important to our project because they may contribute to fires in college housing. With respect to fire hazards, some products like halogen lamps and candles are more dangerous when used in college housing environments than when used in a general residence with more open spaces. Colleges and universities typically create a list of items prohibited in on-campus residences because they are potential fire hazards. The extent to which students use prohibited items was an important question in our research.

Data Collection

We gathered anecdotal and statistical data primarily by reviewing incident reports and investigations, conducting interviews, and analyzing statistical data concerning consumer products used in college housing that are related to fire hazards. We read consumer and incident reports from the CPSC and the NFPA to determine which consumer products are dangerous and

to learn about incidents in college housing. We extracted reports from NFIRS to reveal the frequency of specific consumer products involved in fires in dormitories and Greek residences. The USFA created a fire data collection tool in 1974 called NFIRS in order to assess better mean of combating the fire problems. NFIRS reports on the number of fires, injures, and deaths. Only 65% of fire departments from across the country report fires to NFIRS. The fire departments report the fires to NFIRS through a series of codes. These codes vary from incident type codes to heat source to equipment involved in ignition. The information that NFIRS collects lags in it release for public use for a few years after the fires have occurred. In 1999 there was a change in the version of NFIRS that the USFA used. When the version changed some of the codes changed as well. For example, in earlier versions there is different codes for barracks and for dormitories but in the latest version those different codes were combined into a single code. In addition to the change over of versions, many fire departments have not switched to the new version and are coding in the older version. The lag in data creates problems of getting the most recent and specific information that would be helpful in reports.

While NFIRS only gets reports of 65% of fire departments nation wide, we used projected national averages from the NFPA that are created from NFIRS data as well as an NFPA survey. Since NFIRS contains only specific variables and does not provide any detail of the incidents, we used the CPSC databases of incident reports for the details concerning the products that we determined have contributed to fires in college housing and how they were involved. One CPSC database is the National Electronic Injury Surveillance System (NEISS); a national sample of hospital emergency rooms across the United States which report injuries caused by consumer products. We also used the CPSC database of In Depth Investigations (INDP), which contains more in-depth and detailed reports of incidents.

We conducted interviews with college and university officials and conducted surveys with college students to further learn about dangerous and banned products in college housing. A compilation of statistical data concerning fires caused by consumer products in college housing from the NFIRS data was broken down into incidents caused by specific products in dormitories and Greek houses to give us a list of items that we focused on. We conducted an interview with the Executive Director of Housing at American University concerning the fire safety policies at the university. We also received fire safety information from the University of Maryland and George Washington University to broaden our research on specific fire safety policies at colleges and universities. In addition, we conducted a one-page survey among college students asking them about their knowledge of campus fire safety policies and procedures (see Appendix E). We conducted this survey at the University of Maryland with a sample size of 50 students. We also created a web-based version of the survey which was sent out to specific contacts at Georgetown University, as well as to Worcester Polytechnic Institute (WPI) students through various mailing lists. The data were compiled and printed in a text file containing the number of answers to each question.

4.2 Accidental Fires

4.2.1 Accidental and Unintentional Misuse of Products

Beyond identifying hazardous consumer products in general, we collected data on accidental fires in college housing to determine which consumer products are dangerous while used in college housing specifically. Accidental fires caused by consumer products include both correct use and accidental or unintentional misuse of the products. Although a product may not be dangerous in a residential living facility, it may be dangerous when introduced into the living situations of college housing. We also studied the extent to which accidental misuse of products,

such as carelessness and improper discarding of smoking materials, contributed to fires. A large number of college housing fires are caused by accidental misuse of products, which made this topic very important to our project.

4.2.2 Data Collection

Data about accidental college housing fires are mainly anecdotal. We collected data primarily from the USFA and the CPSC databases. We used compilations of college housing fire incident reports from the USFA to research the most common causes of fires in college housing (not including the consumer products that are general fire hazards in college housing which were discussed in section 4.1), the types of detection and suppression present, and the number of deaths and injuries caused by the fire. It was difficult to determine from the USFA fire incident report summaries if the fire was caused by the misuse of a consumer product, but they clearly stated if careless use of candles or improper discarding of smoking materials caused the fire. With this information, we determined how often candles and smoking materials contributed to fires in college housing.

4.3 Fire Education and Campus Fire Safety Policies

4.3.1 Importance of researching fire education programs and policies

Researching fire education programs in place at colleges and universities allowed us to observe the similarities and differences between fire education programs used at different schools. There are many different methods of teaching students fire safety and after analyzing the programs, we determined which education programs seem to be the most effective, based on student opinion and reception of the material being taught and more importantly the prevention of fire incidents. Researching college and university policies concerning fire safety provided us with answers to the following questions: What is the difference between policies at various

universities? How strict or lenient are the policies? Are they enforced, and if so, how well? We also were able to acquire important information, such as where to find statements of the policies and if students are able to access them easily.

4.3.2 Data Collection

We used various means of data collection to research fire education programs and campus policies used at colleges and universities. We first identified the different types of fire education programs aimed at college students. This information was gathered primarily from the USFA. After learning the basics about different programs, we contacted the office of residential services at three colleges and universities in the Washington, D.C. area. In interviews with college officials from one of these offices, we acquired information about the types of fire education programs that are used at their respective institutions. Two other universities we contacted via telephone were unable to meet with us in person, but provided us with information about their fire safety program via email and the internet. We also used the student survey to determine if the students not only learned fire safety at their school, but more importantly, if they actually follow the rules and safety tips taught to them.

4.4 Fire Suppression

4.4.1 Importance of Fire Suppression

Collecting data and information about the different forms of fire suppression systems was important in order to understand the variety of systems available and the effectiveness of these systems in different situations. The majority of fire suppression systems are under the jurisdiction of the CPSC. Industry and the CPSC collaborate in standards activities for the systems to improve and update the standards. Particular forms of fire suppression respond more effectively that other forms for different types of fire. We determined which systems various

colleges and universities use in their residences and in what areas they use various forms of fire suppression. We researched the resources that are needed to install fire suppression systems into to building, including money, time, and displacement of the students that live in the building.

4.4.2 Data Collection

The data were collected through case studies and cost benefit analysis of retrofitting a sprinkler system into a fraternity house. Through reports from the USFA we looked for information on how the different fire suppression systems function, evidence of their effectiveness, and the means of installation of the systems into the dormitory or Greek housing. We found several cases in which universities retrofitting of sprinklers into college housing. This will allow us to determine how cost effective the installation of a sprinkler system is in comparison to how effective they are at saving lives.

4.5 Human Behavior Resulting in Fires

4.5.1 Importance of Human Behavior

The data that we collected from researching college student behavior provided us with information about the differences between a college student's lifestyle and that of someone living in a general residence. We determined if there was a trend of fires in college housing that can be attributed to student behavior, including smoking, drinking, and ignoring fire safety policies. We investigated reasons why a student's behavior might progress into intentionally setting fires in a college residence. We collected data on the response that students have when a fire alarm sounds. After we acquired data on these topics, we analyzed the relationship between behaviors and college housing fires.

4.5.2 Data Collection

We analyzed incident data we received from NFIRS to determine how many college housing fires were caused by student behaviors, such as careless use of smoking materials and arson. Then, we interviewed CPSC Human Factors' staff with expertise in human behavior to gain an understanding of the issue in general. We read reports about the effect of sleep and alcohol on student response to fire alarms from the School of Psychology at Victoria University in Melbourne, Australia. The reports were used to determine how a common college behavior affects a student if the fire alarm was to sound. From the surveys that were conducted we are able to see if students learned and obeyed the fire safety policies those colleges have developed.

5. Results and Discussions

This chapter is a presentation of results that we obtained from the analysis of data in the four main topics of college campus fire safety that we researched. Those topics include the causes of fires, fire education, fire suppression, and fire detection. These results are the basis for our conclusions recommendation to the CPSC about campus fire safety.

5.1 Causes of Fires

We used NFIRS reports to collect and analyze data about college housing fires from 1995 through 1998. We examined college dormitory fires and resulting injuries reported based on heat source and equipment involved. Over the period of time examined, candles contributed to the most injuries in dormitory fires with a total of 31 and cooking equipment contributed to the most fires with a total of 458 (see Table 1). No deaths in college housing fires were reported to NFIRS from 1995 through 1998 (See Appendix F).

Table 1: Fires and Resulting Injuries Caused By Fire in Dormitories, 1995-1998 (As reported by NFIRS)

Causes of Fires	Number of Fires	Number of Injuries
Cooking Equipment	458	6
Smoking Materials	300	25
Arson	221	19
Candles	176	31
Electrical	139	13
Other Appliances	94	7

We used NFPA statistics and USFA anecdotal reports to determine the causes of fires in college housing from 1999 through 2001. These statistics and reports include the number of fires, the number of deaths and injuries, and the direct property damage caused by each specific product or incident. The results are separated into dormitories and Greek housing. We first

analyzed the items and incidents most frequently contributing to college housing fires. The most recent available data from the NFPA are the 1999-2001 annual averages of fire incidents. The values are derived from NFIRS data, and a national estimate is made based upon a random survey conducted by the NFPA. Cooking equipment, arson, and open flames including candles and incense were the most frequent causes of fires in college dormitories based upon the 1999-2001 averages (Rohr, 2004, Dormitory Structure Fires). Cooking equipment contributed to 40% of dormitory fires, arson contributed to 24%, and open flame incidents contributed to 12% (see Table 2).

Table 2: Dormitory Fires by Cause, 1999-2001 Annual Average

Causes of Fires	Number of Fires	Percentage of All Dormitory Fires
Cooking Equipment	920	40
Arson	540	24
Open Flame	270	12
Smoking Materials	180	8
Electrical	130	6
Other Appliances	90	4
Heating Equipment	60	3
All Other	60	3

Source: Adapted from Rohr, 2004, Dormitory Structure Fires

Cooking equipment was the leading cause of college dormitory fires, but smoking materials caused all of the deaths, with an average of four per year from 1999 through 2001. Open flames, including candles, again contributed the most injuries with an average 41% of all of the injuries in dormitory fires per year. Although incidents involving smoking materials

contributed to 100% of the deaths in dormitory fires, they only caused an average of 7 injuries per year (see Table 3) (See Appendix G).

Table 3: Injuries in Dormitory Fires by Cause, 1999-2001 Annual Average

Causes of Fires	Number of Injuries	Percentage of All Dormitory Fire Injuries
Open Flame	43	43
Cooking Equipment	21	21
Arson	18	18
Electrical	7	7
Smoking Materials	7	7
All Other	2	2
Other Appliances	1	1
Heating Equipment	1	1

Source: Adapted from Rohr, 2004, Dormitory Structure Fires

The most frequent causes of fires in fraternity and sorority housing are very similar to the causes in dormitories. Open flames, cooking equipment, and arson were the three most frequent causes of fraternity and sorority fires on average from 1999 through 2001. However, occurrences of fraternity and sorority fires are more uniformly distributed among the various causes than are dormitory fires (see Table 4). This may be due to the fact that fraternities and sororities generally have more lenient rules and policies than school operated dormitories. Open flame incidents contributed to 27% of fires and cooking equipment to 21% (Rohr, 2004, Dormitory Structure Fires).

Table 4: Fraternity/Sorority House Fires By Cause, 1999-2001 Annual Average

Causes of Fires	Number of Fires	Percentage of All Fraternity/Sorority Fires
Open Flame	50	27
Cooking Equipment	40	21
Arson	30	15
Smoking Materials	20	12
Electrical	20	10
Heating Equipment	10	6
Other Appliances	10	6
All Other	0*	3

*Not zero, but rounds to zero
Source: Adapted from Rohr, 2004, Dormitory Structure Fires

As was the case with dormitories, fire incidents attributed to smoking materials caused all of the fire-related deaths in fraternities and sororities, with an average of two per year from 1999 through 2001. While smoking materials contributed to the most fire- related deaths, they only contributed to an average of 9 % of the injuries, while open flame incidents contribute to 65% of injuries (see Table 5) (Rohr, 2004, Dormitory Structure Fires) (See Appendix H).

Table 5: Injuries in Fraternity/Sorority Fires by Cause, 1999-2001 Annual Average

Causes of Fires	Number of Injuries	Percentage of All Fraternity/Sorority Fire Injuries
Open Flame	12	64
Cooking Equipment	2	9
Electrical	2	9
Smoking Materials	2	9
All Other	2	9
Heating Equipment	0	0
Arson	0	0
Other Appliances	0	0

Source: Adapted from Rohr, 2004, Dormitory Structure Fires

Most fires attributed to candles were caused by candles coming in contact with nearby combustibles such as window curtains, bedding, and papers (Campus Fire-Watch, 2003, Campus-Related Incidents, 2000-2002). We studied 81 reports from NEISS of candle fires that led to burn injuries in 2002. In one specific in depth investigation (IDI), two males died from smoke inhalation in a candle fire that started from an unattended candle igniting nearby combustibles (See Appendix I). Witnesses stated that the candle was only abandoned for a short amount of time. This IDI indicates how fast a candle fire can start and become deadly. Reports from the USFA conclude that hair dryers and personal fans overheat and cause fires when covered. We studied 28 reports of fires caused by fans in the year 2002 using the INDP files. These fires were caused by fans tipping over and overheating and igniting nearby combustibles. The overheating resulted from the blades being inadvertently stopped or from an electrical fault in the fan. In one IDI, an incident occurred where a box fan overheated. The overheating fan ignited a nearby bed, and resulted in the death of one person. The same pattern is seen with

portable heating devices, where combustibles contact the unit and ignite, or the unit tips over and ignites nearby combustibles.

Many electrical fires are reported where circuit overloads contribute to fires, and are related to misuse of power strips and extension cords. We also studied 36 reports of fires caused by faults in extensions cords and power strips from the INDP files. Many of the fires were caused by improper use such as covering extension cords with carpets and furniture, overloading power strips, using small gauge extension cords for large appliances, and using them in place of permanent wiring. An IDI studied showed an incident of an extension causing a fire which lead to one death. The cord, which was being used permanently to bring power to a television and run under a carpet, was damaged from being walked on.

The two leading materials that were ignited in fires started by smoking materials were mattresses and upholstered furniture (USFA, 2001j, Smoking and Fire Safety). These account for close to 50% of fires caused by smoking materials. Seventy-five percent of fires started by smoking materials are the result of abandonment or careless disposal. The NFPA 1999 through 2001 averages have the bedroom as the second most common area of origin for college housing fires and deaths, while it is the leading origin of fires resulting in injuries. The bedroom is the origin of 22% of all college housing fires, 28% of fire-related deaths, and 60% of fire-related injuries (Rohr, 2004, Dormitory Structure Fires) (See Appendix J).

Alcohol impairment has a strong relation with college housing fires, as well as a direct relation with fires caused by smoking materials (Tridata Corporation, 1999, Establishing A Relationship Between Alcohol And Casualties of Fire). A new trend identified as social smoking has become popular with college students, where individuals smoke only when in specific social situations, including parties where alcohol is served. In a USFA study from 1993 through 1996,

smoking materials contributed to 64% of fires that killed alcohol-impaired students. By comparison, smoking materials contributed to only 37% of fires that killed students that were not under the influence of alcohol (USFA, 2001a, Alcohol and Fire Safety). Alcohol impairment is associated as well with deaths from fires not caused by smoking materials. One half of adults killed in fires have an elevated blood alcohol count.

5.2 Fire Education

Fire education was an important topic in our research scope in order to determine if college and university policies are sufficient, and more importantly, if students are obeying these policies. We used various means of collecting and analyzing data about fire education including a college student survey, interviews, and reviewing fire safety material.

5.2.1 College Student Survey

One of our primary forms of data collection was conducting a survey of college students. The data collection was divided into two parts. The first part involved conducting the survey with a convenience sample of 50 students at the University of Maryland – College Park. From this location, we received 18 male and 32 female responses. Forty-seven of the respondents lived in a dormitory their first year at the university, and all but two students have lived in on-campus housing for at least one semester.

From the student responses we determined that the University of Maryland utilizes fire safety videos and informal meetings as the primary methods of teaching students fire safety. As seen below in Figure A, 50% of the students responded that they participated in an informal meeting and 60% of the students watched a video to teach them fire safety.

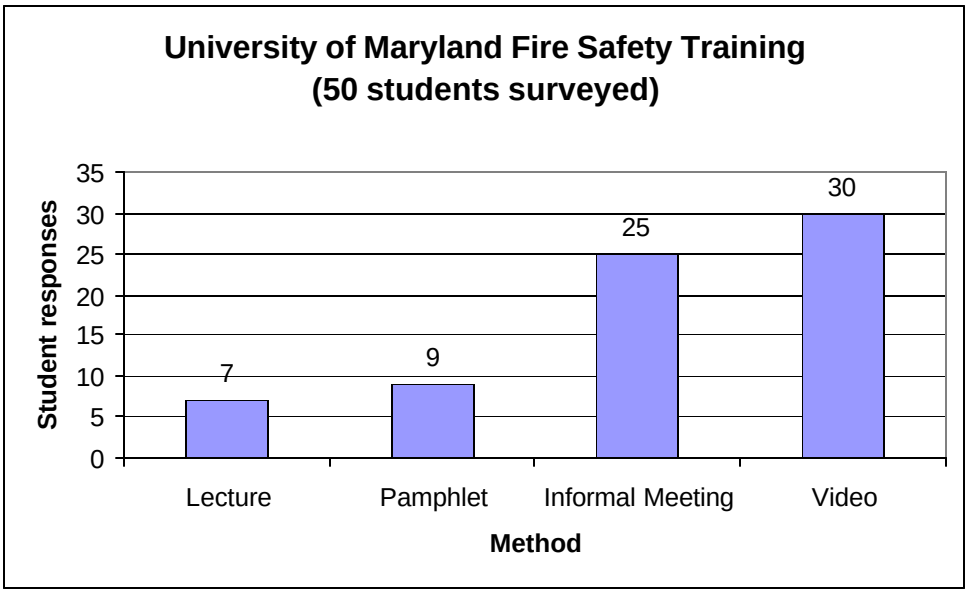


Figure A

As part of the survey, we were also interested in learning what types of fire safety instruction students received at the university. As seen in Figure B, 72% of the students surveyed were shown the locations of fire exits, but more importantly, 84% were informed of the proper procedure for exiting the building. It is important to note that 94% of the respondents replied that they exit the building when the fire alarm goes off. Despite the fact that fire extinguishers were removed from the university's dormitories in the mid-1980s, a surprising 26% of the students responded that they were instructed of the location of them. In an effort to keep students safe in their residences, the university does complete safety inspections in the student housing. Only 52% respondents answered 'yes' to the question "Are fire safety inspections conducted in your housing by either your residential advisors or a fire marshal/officer?", but this can be attributed to the fact that over 50% of the students taking the survey were freshmen and possibly have not yet had an inspection conducted in their room (See Appendix E).

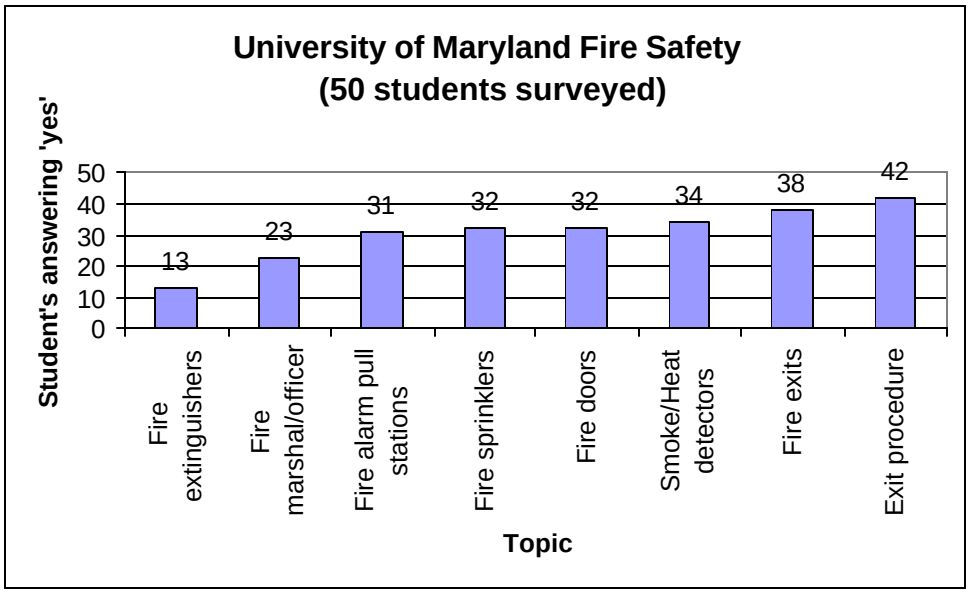


Figure B

From the responses collected, 86% of students were aware of the university's list of banned consumer products. Figure C indicates the most popular consumer products used or possessed by students in our sample. Not all of the products listed are banned at this university, but have been involved in past fire incidents, or can be potential fire hazards if used improperly. Students were asked to check as many products as applicable (See Appendix E).

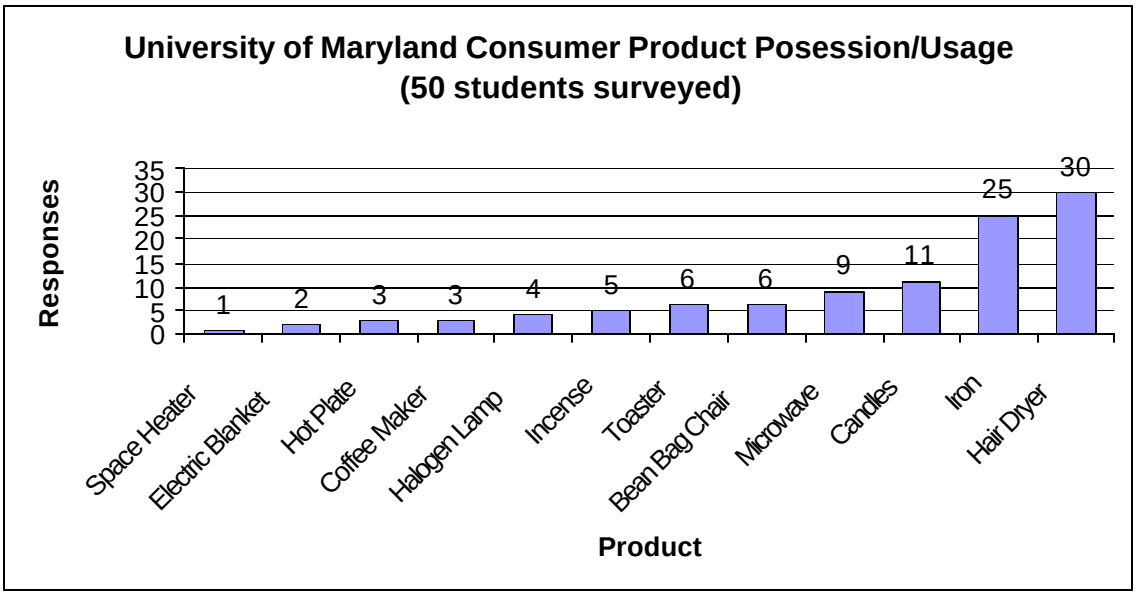


Figure C

The second part of conducting the college student survey involved converting it to an internet version, and distributing it to selected contacts at Georgetown University and WPI. This second method of conducting the survey has provided us with 184 responses, 113 females and 71 males. From this sample of students, approximately 86% of students lived in a dormitory their first year at their university, and 78% have lived in on-campus housing for at least two semesters.

We learned that both WPI and Georgetown University utilize a variety of methods to inform their students of campus fire safety policies and procedures (See Figure D). Students were asked to identify all of the forms of training that were used, and it is apparent in the figure below that informal meetings were the primary method of training, with 78% of the students participating in this type of education.

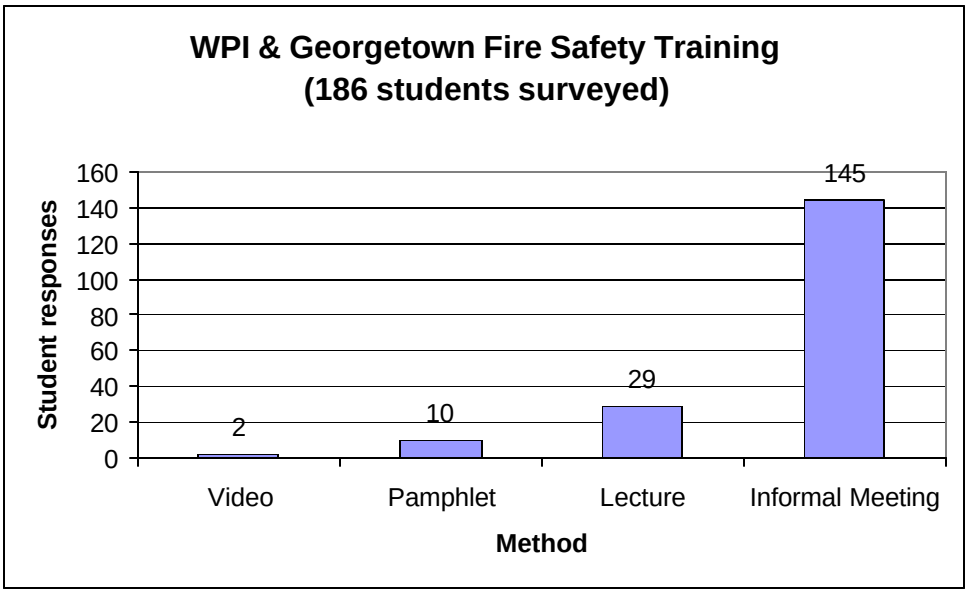


Figure D

Of the 186 students surveyed, 115 of them were aware that their respective institution conducts fire and safety inspections on a semi-annual basis. Also as part of the survey, we learned what type of fire safety instruction students received at their university. As seen in Figure E, 68% of the students surveyed were shown the locations of the fire exits and similarly, 76% were informed of the proper procedure for exiting the building. Over 94% of the students at WPI and Georgetown University also responded that they exit the building when the fire alarm goes off, which exactly matches the percentage at the University of Maryland.

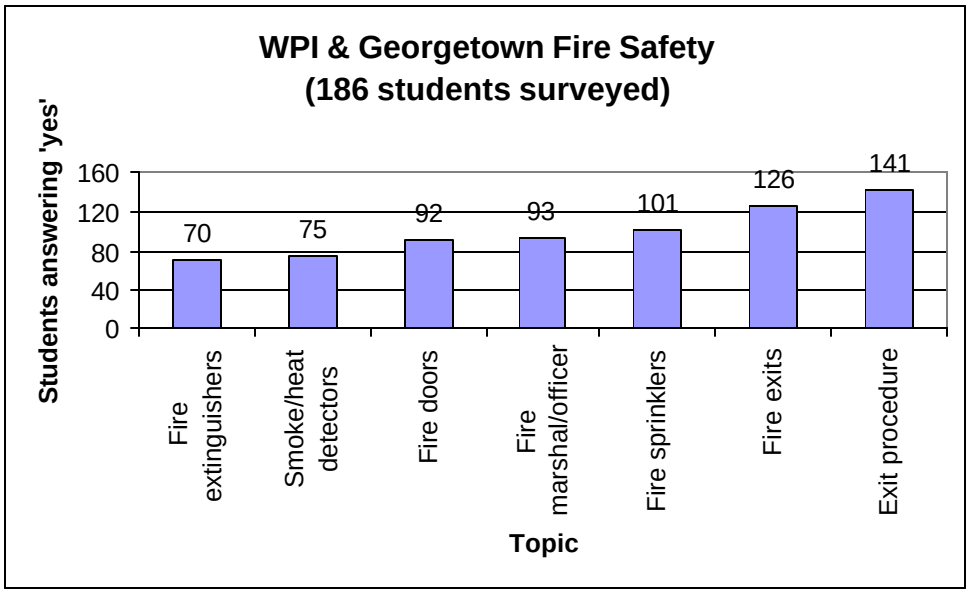


Figure E

From the responses collected, 76% of students are aware of the university's list of banned consumer products. Figure F indicates the most popular consumer products used or possessed by students at Georgetown and WPI. The items on the list were identical to the ones on the written survey (see Appendix E). Similarly, students were asked to check as many products as applicable. Overall, the numbers of responses to each item are similar to those from the survey conducted at the University of Maryland, with 34% of students indicating that they have had or have used candles in their room or apartment. The only major difference between consumer product usages is that approximately 79% of students have had or have used microwaves at WPI and Georgetown University compared to only 18% at the University of Maryland. This is because the University of Maryland does not allow microwaves in their student rooms unless the building has been renovated.

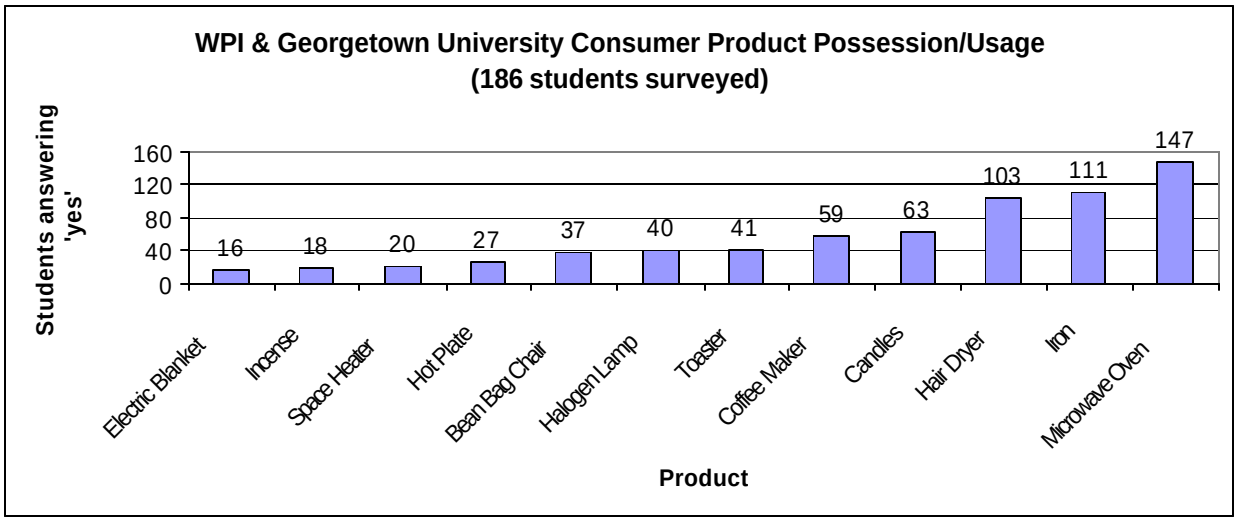


Figure F

5.2.2 Interviews with Fire Safety Professionals

Interviews with professionals in the field of fire safety provided us with information regarding college campus fire safety. We conducted eight interviews with professionals from various fire safety organizations (See Appendix K). Each individual has worked with fire safety and was able to provide us with background information. The interviewees also provided recommendations on the most effective way to address the issue of college housing fires. Seven of the experts we interviewed believe that fire suppression installation or retrofitting, primarily in the form of sprinklers, is the best way to address the issue of college housing fires. Five experts supported fire safety education for students and administrators as the primary form for addressing the issue, while two experts believed that reducing the fuel load in the student environment is important to deal with the issue.

5.2.3 College and University Officials

The data that were acquired concerning college and university campus fire safety are purely anecdotal. Our team was able to make contact via face-to-face interview or email with administrators from WPI and three colleges in the Washington, D.C. area in an effort to learn

about the fire safety policies and methods used at each institution. Our findings indicate that all of the colleges and universities were equipped with fire detection and suppression systems in the form of smoke and heat detectors and sprinklers. Each school also informs its students of fire safety policies and prevention methods using one of the four main teaching methods: lecture, video, pamphlet, informal meeting. There is also a list of banned consumer products at each college or university. Included in Appendix L is an expanded summary of the fire safety policies and procedures of the colleges and universities we contacted.

5.2.4 Campus Fire Safety Resources

The USFA provided us with fire safety lesson plans, pamphlets, fire incident reports, presentations, and videos designed for both students and administrators. The lesson plans range from how to use a fire extinguisher to how to evacuate a building to how a fire behaves. The pamphlets are a collection of short informative handouts that include case studies and statistics on a wide range of topics. There is a collection of fire incident report for past years that have short descriptions of how fires were caused and the damages resulting from them. The presentations are designed for administrators, resident advisors, and students in both on-campus and Greek housing to inform them about fire safety "need-to-knows." The Center for Campus Fire Safety has compiled a collection of fire safety videos that can be shown to students (See Appendix M).

5.2.5 Legislation

A fire at the Cocoanut Grove nightclub in Boston in November, 1942 resulted in 492 deaths and subsequently inspired changes in fire codes to have exit doors swing out instead of in (Naylis, 2000, Seton Hall: From Tragedy to Triumph). Another fire at the Our Lady of Angels Schools in Chicago in 1958 resulted in 92 deaths, and led to changes in codes to require that exit

stair towers be enclosed. These preceding incidents are examples of situations where multiple fatal fires led lawmakers to change fire codes in hopes of preventing future disasters. More recently, legislation has been proposed in an attempt to make college housing safer for residents. There have been numerous campus fire safety bills introduced at both state and federal legislations

Two fire tragedies within two months of each other, one at Seton Hall University in January of 2000 in which three students died in a dormitory fire and one at Bloomsburg University in Pennsylvania in which three students died in a fraternity fire resulted in quick legislative action to pass the most comprehensive state legislation requiring sprinkler protection in college dormitories, fraternities, sororities, and boarding schools. In the weeks following the Seton Hall fire, at least six different pieces of legislation aimed at requiring the retrofit installation of sprinklers in all college and university dormitories were introduced (Naylis, 2000, Seton Hall: From Tragedy to Triumph). Each bill had its own requirements regarding the types of buildings to be retrofitted, the time frame for compliance, the method of gaining funds, and the amount of funding the government would provide. The differences between the bills prevented them from getting passed. But, with the help of an organization called the Coalition for Safe School Housing, which included members from the fire service, organized labor, the sprinkler industry, legislators in both the State Senate and State Assembly were able to jointly draft and support one bill. “In what can only be described as an incredible game of legislative ping pong, the sprinkler bill was passed in the Assembly with the five year window; was sent over to the Senate, where it was amended to a four-year window, as requested by the Governor; and was sent back to the Assembly, where the amended bill was approved” (Naylis, 2000, Seton Hall: From Tragedy to Triumph). The bill was signed by Governor Christine Todd Whitman on

July 5, 2000. The law required that automatic sprinklers be installed in all schools within a maximum period of four years. Each school was required to submit a compliance plan to the state's Division of Fire Safety within 120 days of the law passing, and installation was to be done in phases with roughly 25% of the work to be done yearly. Due to a combination of intense public scrutiny and legislative pressure, the regulations were quickly adopted. All but one of the required installations were completed on time, with approximately $78 million of the $90 million low-interest revolving loan fund used.

5.3 Fire Suppression

There is no record of a case where a fire has caused more than two deaths when there have been sprinklers present and operational (AFSA, 2004, Sprinkler Information). The average property loss in hotels and motels during a fire are 56% lower when there was a sprinkler system present. In both the fire in the dormitory at Seton Hall and at the fraternity in Bloomsburg, Pennsylvania, there were no sprinklers present in either of the buildings. The law has been on the books for fours years and there has not been a single death in college housing attributed to fire in the state of New Jersey.

Concerns that colleges and Greek associations have had with the installation of sprinklers in their residences are the cost and the displacement of the students that live in the buildings. The largest dormitory in North America, at a total area of 16 million square feet, is Jester Center at the University of Texas at Austin (BlazeMaster Blaster, 2004, Fire Sprinkler Systems). In 2000 the State Fire Marshall mandated that the university retrofit all their residence halls with automatic sprinklers. The university was able to retrofit Jester Center completely with sprinklers in 11 months for $11 million. This was done without displacing a single student for any longer than 8 am to the end of the day (see Table 6).

Table 6: Retrofitting Jester Center Dormitory at the University of Texas in Austin

Total Number of Square Feet	16,000,000
Total Number of Beds	3,000
Total Cost	$ 11,000,000
Cost per Square Foot	$ 0.70
Total Number Sprinkler Heads	10,400
Total Time Needed to Finish	11 months
Total Number of Students Displaced	0

Research conducted by Buddy Dewar, Director of Regional Operations at the National Fire Sprinkler Association considered the cost and savings that would occur when a fraternity house was to install sprinklers into their house. Using the Chi Psi Fraternity in Berkley, CA, he found that a sprinkler system could pay for itself in just over five years (USFA, 2004c, Greek – How to Sprinklers). A summary of the result can be seen in Table 7.

Table 7: Chi Psi Fraternity in Berkley, CA Sprinkler Retrofitting

Source of insurance information: James R. Favor & Co.		
	Rates	**Total**
Insured Value	N/A	$1,500,000
Non-Sprinklered Rate	.694 per $100 Insured Value	$10,404 per year
Sprinklered Rate	.450 per $100 Insured Value	$ 6,750 per year
Difference	N/A	$ 3,654 per year
Cost to Sprinkler approximately 11,000 ft^2	$1.75/sq.ft.	$19,500
Insurance payback	N/A	5.33 years

Source: Adapted from USFA, 2004c, Greek – How to Sprinklers

5.4 Fire Detection

Half of all deaths caused by fire occur in the five percent of the residences with no smoke alarms (NFPA, 2004b, Fact Sheets). There are several differently designed fire detector systems that colleges have explored. The University of Maryland has single smoke detectors in all of the bedrooms and pull stations in the halls. The pull station is not connected to local fire department. Other colleges have hardwired smoke detectors in all the rooms that are connected to the building systems and these are connected to the local fire department when the building alarm is set off. The single smoke detectors are powered by a nine volt battery and are able to be tampered with and disabled. On the other hand the hardwired smoke detectors receive their power from the building and are more difficult to disable. Both forms of smoke detectors can be disabled by placing a shower cap or plastic bag over the detector, preventing smoke from reaching the detector.

One other problem with fire alarms is in the manner in which students react to the alarms sounding. Michelle Ball and Dorothy Bruck, of the School of Psychology at Victoria University in Melbourne, Australia, conducted an experiment on how alcohol affects a college student's response to a fire alarm based on the sobriety of the students (Ball and Bruck, 2004, The effect of alcohol…). They tested three forms of alarms. The first alarm is a female's voice, the second is the Australian Standard Alarm (ASA), and the third is the Temporal-Three Evacuation Signal (T-3). They determined that blood alcohol count (BAC) of 0.05 was enough to impair students' response to a fire alarm. They found that in the trials they conducted more that 36% of students with a BAC of .05 and almost 42% of students with a BAC of .08 were not wakened by the alarm irrespective of the alarm type used. This is in comparison to the fewer than 3% of the trails run when the students were sober (see Table 8). On average it took a student with a BAC of .05

twice as long to respond to an alarm as it did when the same 12 students were sober (see Table 9).

Table 8: Frequency of response patterns at high sound intensity where in the table indicates how many participants were not awoken (n=12)

	Sober			.05 BAC			.08 BAC		
	Voice	ASA	T-3	Voice	ASA	T-3	Voice	ASA	T-3
Within 2 mins	0	1	0	1	3	1	1	2	1
Within 4 mins	0	0	0	2	1	1	1	2	0
Slept through	0	1	0	2	1	1	2	2	4
Total	0	2	0	5	5	3	4	6	5

Source: Ball and Bruck, 2004, The effect of alcohol upon response to fire alarm signals in sleeping young adults

Table 9: Mean behavioral response time (seconds) according to sound and alcohol level (n=12)

SOUND	ALCOHOL					
	Sober		.05		.08	
	Mean	SD	Mean	SD	Mean	SD
Female Voice	161.75	80.50	336.00	199.93	330.17	176.52
ASA	252.33	140.66	336.83	119.59	380.67	153.91
T-3	158.25	90.63	299.92	146.56	351.58	195.38

Source: Ball and Bruck, 2004, The effect of alcohol upon response to fire alarm signals in sleeping young adults

6. Conclusions and Recommendations

Through review of prior information from such sources as the USFA and the NFPA, surveys of college students, interviews with fire protection experts and retrieval of data from the USFA and the CPSC, we obtained results concerning causes of fire, and fire education, detection and suppression. While the previous chapter presented the results of our work, this chapter presents the conclusions we drew from the results. These conclusions will aid in formulation of recommendations to the CPSC, which are also included in this chapter.

6.1 Conclusions

Causes of Fires

- Cooking equipment, arson, candles, and smoking materials are the leading causes of college housing fires.
- Candles and other open flame fires cause the most injuries.
- Fires attributed to smoking materials cause the most deaths.
- Alcohol impairment contributes to fires in college housing.

Consumer Products

- Specific consumer products geared toward college living need to be made safer for the confined living conditions.
- Flame retardant furniture and mattresses need to be more widely used in college housing.

Fire Education

- Training is the key to fire prevention.
- Colleges and universities need to have stricter fire safety policies and better enforcement of the policies.
- Students are not following campus fire safety policies concerning banned items.
- The marketing and distribution of fire safety information needs to be improved.
- There is a need for better education concerning alcohol and smoking in regards to fire safety.
- Live burns are an effective means of showing college housing fire scenarios to students.

Fire Detection

- Hard-wired detection systems are better than single-station detectors.
- Studies show that students impaired by alcohol have a decreased chance of responding to a fire alarm.

Fire Suppression

- Sprinkler systems are cost effective means of extinguishing fires.
- New college housing should be constructed and old college housing retrofitted with fire sprinkler systems.

6.2 Recommendations

In order to increase awareness of students, parents, and college and university administrators about fire safety and the dangers that arise in college housing, we formulated several recommendations for the CPSC. We suggested that the CPSC should focus their efforts on creating voluntary standards relating to consumer products, informing and educating the public about college housing fire safety, and supporting fire safety legislation.

6.2.1 Consumer Products

One way in which the CPSC can regulate consumer product safety is through voluntary standards. A voluntary standard is not mandatory for the manufacturers to adhere to, but the CPSC works with the industries to make products safer, whether it is through tighter or stricter performance tests. The CPSC provides the manufacturers with specific hazard scenarios that they must prevent from happening, but they do not mandate the manner in which they prevent the hazard. We recommend that the CPSC focus on working with the industries to create voluntary standards for products that are the most significant fire hazards in college housing. Our recommendations focus on products that we determined to be fire hazards when used in college housing, specifically concerning the confined living spaces.

- **<u>Recommendation 1</u>: That the CPSC work with industries to create and strengthen voluntary standards for consumer products that are fire hazards when used in the confined spaces of a college residence. The specific products focused on are: candles, space heaters, portable fans, extension cords and power strips, and portable cooking appliances**
- **Candles**

Our results show that candle fires are one of the top causes of fires in college housing, and contribute to the most fire related injuries. Our investigations show that careless use and abandonment of candles are the main reasons behind the fires. Many of the fires happen when a candle is left burning while a student leaves the room or is asleep. A self-extinguishing wick is one approach that could greatly reduce the number of fires due to abandoned candles. This would be a wick that would only burn for a predetermined short amount of time before automatically going out. This type of wick would prevent candles from burning for long periods of time after being abandoned, and would reduce the risk of candle fires from contact with combustibles. We also recommend that the CPSC continues efforts and progress on current standards for flame height and tipping of candles.

- **Space Heaters**

Although all space heaters manufactured after 1991 include performance requirements to enhance safety, these products still cause fires. Since 1991, portable electric heaters that may present a fire hazard when tipped over have been required to have a tip over switch that turns the appliance off when tipped over. Some manufacturers have gone as far as using proximity sensors to turn off the heater when objects become too close. This feature would be a great benefit in a college environment, and we suggest that the CPSC work with the industry to develop a

voluntary standard for proximity sensors on space heaters. Our results also show fires caused by extension cord use with space heaters. Although space heaters have warning labels about not using extension cords unless absolutely necessary and only using a specific gauge size if necessary, people still use household extension cords that are not sufficient. To help reduce the risk involved in using extension cords, we suggest that the CPSC work with the industry to develop voluntary standards suggesting the use of Leakage Current Detection and Interruption (LCDI) devices in power cords. An LCDI will remove power from the power cord if it senses leakage of if the insulation on one of the conductors is damaged (See Appendix N).

- **Portable Fans**

Our research shows that portable fans cause many fires due to overheating from various reasons. One main way that portable fans overheat is from an obstruction of the blades, such as entanglement with curtains or from tipping over. Portable fans also overheat from insufficient cooling when tipped over. Although requirements concerning stalled motors already exist, we recommend that the CPSC work with manufacturers to create tighter performance tests to lower the chance of fans tipping over. We also suggest that the CPSC reassess the adequacy of flammability requirements for fans once ignited.

- **Extension Cords and Power Strips**

In our results, we showed that a large number of fires occur due to faulty extension cords and overloading of circuits and power strips. As time goes on, college students bring more electronic equipment and appliances into college residences and the available power supply is not sufficient for what they need. To solve this problem, students use power strips, and often plug them into each other which is a great fire hazard due to the overload on the circuit. Some voluntary standards currently require power strips with four or more outlets to have an over-

current protection device, but not all power strips are listed. We suggest that the CPSC recommend the use of LCDI protection in power strips and extension cords.

- **Cooking Equipment**

Our results showed that cooking equipment including full kitchens as well as hot plates and other portable cooking appliances caused the most college housing fires on average from 1999 through 2001. Although cooking appliances are generally banned in college residences, the issue must still be addressed due to students still using the products. Many cooking fires occur due to abandonment while cooking. Some appliances already contain automatic shut-off features, but we recommend that the CPSC work to make these features more common as well as more efficient through stricter performance tests and requirements.

- **<u>Recommendation 2</u>: That the CPSC continue their efforts concerning fire safe mattresses and upholstered furniture**

As our results show, fires caused by smoking related incidents cause the most deaths by fire in college housing. The results also show that close to 50% of smoking related fires first ignited a mattress or a piece of upholstered furniture. To address this issue, we encourage the CPSC to continue their efforts in working to pass mandatory standards for the flammability of mattresses and bedclothes and to continue progress on developing standards for the flammability of upholstered furniture.

6.2.2 Information and Education

Information and education is an area that we feel is important to address in the realm of college housing fire safety. If the student can be educated the fires can be prevented. The first step to that education of the student is getting the information out to the students, parents, and college and university officials.

- **<u>Recommendation 3</u>: That the CPSC produce and distribute a Consumer Product Safety Alert for college students.**

The CPSC produces a booklet entitled "Consumer Product Safety Alert" which is a booklet of products that have a risk of being hazardous. For each product listed, there are warnings, recommendations of how to use the product correctly, and statistics of the number of injures and deaths caused by the product. The "Consumer Product Safety Alert" that we recommend the CPSC produce would focus on products that are hazardous in a college housing situation. These products include candles, hotplates and hotpots, space heaters, power strips, extension cords, halogen lamps, portable fans, and heat producing hair products. These are the products that have been shown to be fire hazards contributing to many fires in college housing. We recommend that the booklet should be distributed to current and prospective college students and their parents. The booklet can be handed out by guidance councilors, be included in a packet mailed home by the college before the start of school, or distributed to students when they first move into college housing. The reason for distributing the booklet is to inform students that the products banned by the school are banned for a reason and not just because the school does not want them there. Our research has shown that despite the fact that a product is banned by a college, students still do have or have used these products in their college housing.

- **<u>Recommendation 4</u>: That the CPSC supply college and university officials with information about products that are fire hazards**

The information that the CPSC can supply to college and university officials can be used by the officials to create a list of banned items. This information will also allow the colleges and universities to create a more fire safe room for the student to move into. This will reduce fuel load in the housing and help control the spread of the fire.

- **<u>Recommendation 5</u>: That the CPSC assist in the creation of a central library of education information about fire safety in college housing**

The library will be a location where colleges and university officials, students, and parents can find information about fire safety in college housing. The centralized library will create a one stop shopping area of information from across the country from fire officials and college and university officials nationwide. The library could be a web based database that is linked to the CPSC's website.

- **<u>Recommendation 6</u>: That the CPSC assist in the distribution of fire-safety lesson plans to college and university officials**

There are many useful lesson plans and informational bulletins that have already been created and just need a means of distributing the information to the public. The CPSC can assist in that distribution. Such information will assist college and university officials in creating fire safety lesson plans for their students. The college and university officials can also pass the information to fraternities and sororities affiliated with the college and assist in educating the members of the Greek community.

- **<u>Recommendation 7</u>: That the CPSC develop a standard procedure for and promote live burns that can be conducted at colleges**

Live burns can have a great impact on student fire safety awareness. If the CPSC creates a safe and effective standard procedure to perform the live burns, many more colleges can perform them, creating an impact on larger numbers of college students across the nation. Also, if the CPSC creates the standard procedure, the live burn can be repeated in the same manner everywhere with similar results. CPSC public affairs can use this demonstration as part of their fire safety or back-to-school safety programs.

- **<u>Recommendation 8</u>: That the CPSC measure the effectiveness of the fire safety information and education**

The CPSC conducts national surveys every year and they should conduct a national survey of college students to see how effective the fire safety information and education are at colleges nationwide. The CPSC can use an online survey similar to the one that was developed for this project. Once the CPSC has the information from the survey, they can determine which of the above recommendations need attention.

6.2.3 Legislation

In order to increase the safety of student living environments it is necessary that college residences are constructed or retrofitted with the most effective form of fire suppression, fire sprinkler systems. There is a need for federal and state fire safety legislation to mandate this.

- **<u>Recommendation 9</u>: That the CPSC encourage states to adopt fire sprinkler laws similar to the one enacted in New Jersey**

The New Jersey state law passed in 2000, and discussed in Chapter 5, required all college dormitories, fraternities, sororities, and boarding schools to be constructed or retrofitted with fire sprinkler systems. Therefore, it is vital that national legislation is passed in Congress to address the issue. Both pieces of legislation discussed below have stalled since they were introduced in Congress in 2003, but are proposals that will make college housing safer for its residents.

- **<u>Recommendation 10</u>: That the CPSC support college fire safety laws similar to the "College Fire Safety Right-to-Know Act of 2003"**

This bill requires colleges and universities to disclose their fire safety standards and measures with respect to campus buildings, along with history of past fire incidents.

- **<u>Recommendation 11</u>: That the CPSC support college fire safety laws similar to the "College Fire Prevention Act"**

This bill establishes a demonstration incentive program within the Department of Education to promote installation of fire sprinkler systems, or other fire suppression or prevention technologies, in qualified student housing and dormitories, and for other purposes.

7. Appendices

Appendix A

The U.S. Consumer Product Safety Commission's mission is to protect the public from unreasonable risks of serious injury or death from more than 15,000 types of consumer products under the agency's jurisdiction (U.S. Consumer Product Safety Commission, 2004, Frequently Asked Questions). The types of products that they do not have jurisdiction over include automobiles and other on-road vehicles, tires, boats, alcohol, tobacco, firearms, food, drugs, cosmetics, pesticides, and medical devices. Deaths, injuries and property damage from consumer product incidents cost the nation more than $700 billion annually. The CPSC is committed to protecting consumers and families from products that pose a fire, electrical, chemical, or mechanical hazard or can injure children. They do this by reducing the risk of injuries and deaths associated with consumer products by:

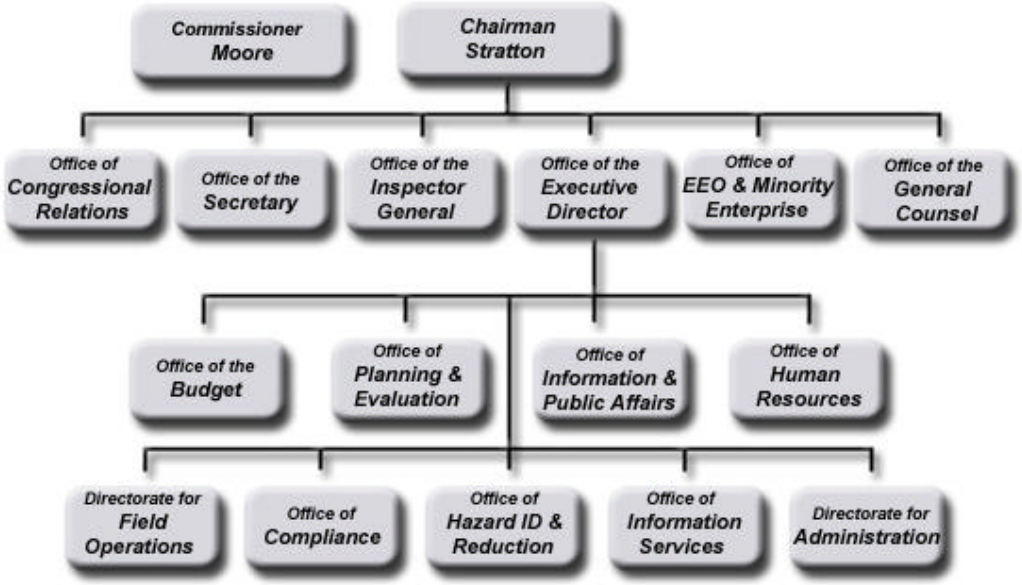
- developing voluntary standards with industry;
- issuing and enforcing mandatory standards or banning consumer products if no feasible standard would adequately protect the public;
- obtaining the recall of products or arranging for their repair;
- conducting research on potential product hazards; and
- informing and educating consumers through the media, state and local governments, private organizations, and by responding to consumer inquiries.

The U.S. Consumer Product Safety Commission is an independent federal regulatory agency that is funded through Congress under the Consumer Product Safety Act of 1972. The CPSC is organized with a Chairman, or chief administrator, and two other commissioners that set policy for the organization. The CPSC is comprised of six offices that report directly to the

Chairman. They are the Offices of Congressional Affairs, Equal Employment and Minority Enterprise, General Counsel, Inspector General, Secretary, and Executive Director. Our project will be in coordination with the Engineering Sciences Department (see CPSC Organizational Chart). There are about 480 employees responsible for monitoring consumer products. In addition, there are 100 CPSC investigators, compliance officers, and consumer information specialists throughout the country (U.S. Consumer Product Safety Commission, 2004, Frequently Asked Questions).

Our sponsor is the Office of Hazard Identification and Reduction under the supervision of the Directorate for Engineering Sciences. The Office is responsible for managing the Commission's Hazard Identification and Analysis Program and its Hazard Assessment and Reduction Program and develops strategies for and implements the agency's operating plans for these two hazard programs. This includes the collection and analysis of data to identify hazards and hazard patterns, the implementation of the Commission's safety standards development projects, the coordination of voluntary standards activities and international liaison activities related to consumer product safety, and providing overall direction and evaluation of projects involving hazard analysis, data collection, emerging hazards, mandatory and voluntary standards, petitions, and labeling rules. The Office assures that relevant technical, environmental, economic, and social impacts of projects are comprehensively and objectively presented to the Commission for decision (U.S. Consumer Product Safety Commission, 2004, Frequently Asked Questions).

CPSC Organizational Chart

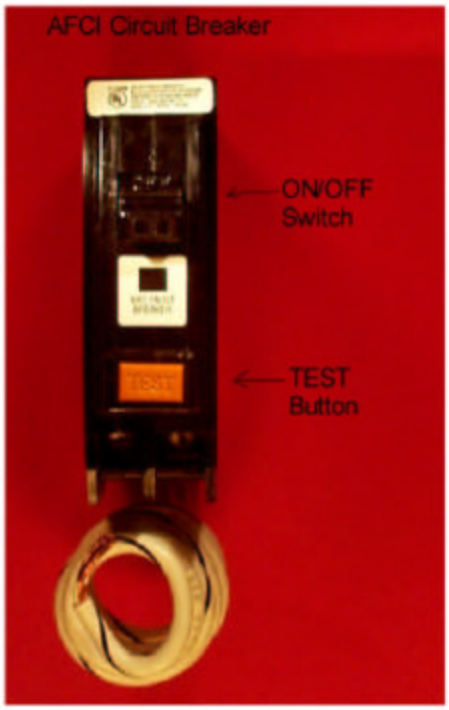


Appendix B

Arc Fault Circuit Interrupter (AFCI) FACT SHEET

THE AFCI

The "AFCI" is an arc fault circuit interrupter. AFCIs are newly-developed electrical devices designed to protect against fires caused by arcing faults in the home electrical wiring.



THE FIRE PROBLEM

Annually, over 40,000 fires are attributed to home electrical wiring. These fires result in over 350 deaths and over 1,400 injuries each year[1]. Arcing faults are one of the major causes of these fires. When unwanted arcing occurs, it generates high temperatures that can ignite nearby combustibles such as wood, paper, and carpets.

Arcing faults often occur in damaged or deteriorated wires and cords. Some causes of damaged and deteriorated wiring include puncturing of wire insulation from picture hanging or cable staples, poorly installed outlets or switches, cords caught in doors or under furniture, furniture pushed against plugs in an outlet, natural aging, and cord exposure to heat vents and sunlight.

HOW THE AFCI WORKS

Conventional circuit breakers only respond to overloads and short circuits; so they do not protect against arcing conditions that produce erratic current flow. An AFCI is selective so that normal arcs do not cause it to trip.

The AFCI circuitry continuously monitors current flow through the AFCI. AFCIs use unique current sensing circuitry to discriminate between normal and unwanted arcing conditions. Once an unwanted arcing condition is detected, the control circuitry in the

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[1] Ault, Singh, and Smith, "1996 Residential Fire Loss Estimates", October 1998, U.S. Consumer Product Safety Commission, Directorate for Epidemiology and Health Sciences.

AFCI trips the internal contacts, thus de-energizing the circuit and reducing the potential for a fire to occur. An AFCI should not trip during normal arcing conditions, which can occur when a switch is opened or a plug is pulled from a receptacle.

Presently, AFCIs are designed into conventional circuit breakers combining traditional overload and short-circuit protection with arc fault protection. AFCI circuit breakers (AFCIs) have a test button and look similar to ground fault circuit interrupter (GFCI) circuit breakers. Some designs combine GFCI and AFCI protection. Additional AFCI design configurations are anticipated in the near future.

It is important to note that AFCIs are designed to mitigate the effects of arcing faults but cannot eliminate them completely. In some cases, the initial arc may cause ignition prior to detection and circuit interruption by the AFCI.

The AFCI circuit breaker serves a dual purpose – not only will it shut off electricity in the event of an "arcing fault", but it will also trip when a short circuit or an overload occurs. The AFCI circuit breaker provides protection for the branch circuit wiring and limited protection for power cords and extension cords. Single-pole, 15- and 20- ampere AFCI circuit breakers are presently available.

WHERE AFCIs SHOULD BE USED

The 1999 edition of the National Electrical Code, the model code for electrical wiring adopted by many local jurisdictions, requires AFCIs for receptacle outlets in bedrooms, effective January 1, 2002. Although the requirement is limited to only certain circuits in new residential construction, AFCIs should be considered for added protection in other circuits and for existing homes as well. Older homes with aging and deteriorating wiring systems can especially benefit from the added protection of AFCIs. AFCIs should also be considered whenever adding or upgrading a panel box while using existing branch circuit conductors.

INSTALLING AFCIs

AFCI circuit breakers should be installed by a qualified electrician. The installer should follow the instructions accompanying the device and the panel box.

In homes equipped with conventional circuit breakers rather than fuses, an AFCI circuit breaker may be installed in the panel box in place of the conventional circuit breaker to add arc protection to a branch circuit. Homes with fuses are limited to receptacle or portable-type AFCIs, which are expected to be available in the near future, or AFCI circuit breakers can be added in separate panel boxes next to the fuse panel box.

TESTING AN AFCI

AFCIs should be tested after installation to make sure they are working properly and protecting the circuit. Subsequently, AFCIs should be tested once a month to make sure they are working properly and providing protection from fires initiated by arcing faults.

A test button is located on the front of the device. The user should follow the instructions accompanying the device. If the device does not trip when tested, the AFCI is defective and should be replaced.

AFCIs vs. GFCIs

The AFCI should not be confused with the GFCI or ground fault circuit interrupter. The GFCI is designed to protect people from severe or fatal electric shocks while the AFCI protects against fires caused by arcing faults. The GFCI also can protect against some electrical fires by detecting arcing and other faults to ground but cannot detect hazardous across-the-line arcing faults that can cause fires.

A ground fault is an unintentional electric path diverting current to ground. Ground faults occur when current leaks from a circuit. How the current leaks is very important. If a person's body provides a path to ground for this leakage, the person could be injured, burned, severely shocked, or electrocuted.

The National Electrical Code requires GFCI protection for receptacles located outdoors; in bathrooms, garages, kitchens, crawl spaces and unfinished basements; and at certain locations such as near swimming pools. A combination AFCI and GFCI can be used to satisfy the NEC requirement for GFCI protection only if specifically marked as a combination device.

Appendix C

Consumer Product Safety Commission

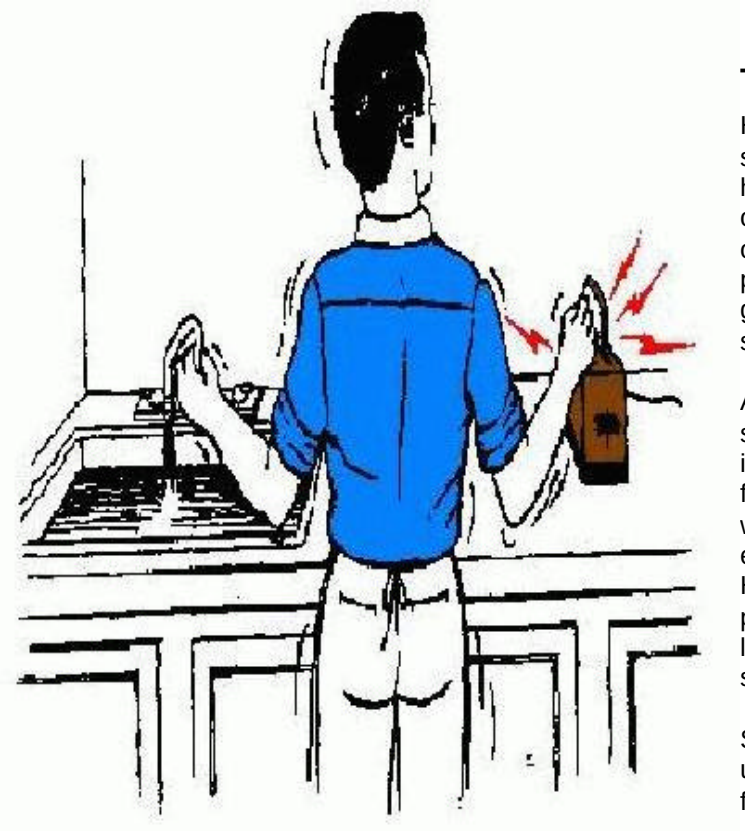
GFCIs Fact Sheet

CPSC Document #99

THE GFCI

A "GFCI" is a ground fault circuit interrupter. A ground fault circuit interrrupter is an inexpensive electrical device that, if installed in household branch circuits, could prevent over two-thirds of the approximately 300 electrocutions still occurring each year in and around the home. Installation of the device could also prevent thousands of burn and electric shock injuries each year.

The GFCI is designed to protect people from severe or fatal electric shocks Because a GFCI detects ground faults, it can also prevent some electrical fires and reduce the severity of others by interrupting the flow of electric current.



THE PROBLEM

Have you ever experienced an electric shock? If you did, the shock probably happened because your hand or some other part of your body contacted a source of electrical current and your body provided a path for the electrical current to go to the ground, so that you received a shock.

An unintentional electric path between a source of current and a grounded surface is referred to as a "ground-fault." Ground faults ground-fault. Ground faults occur when current is leaking somewhere, in effect, electricity is escaping to the ground. How it leaks is very important. If your body provides a path to the ground for this leakage, you could be injured, burned, severely shocked, or electrocuted.

Some examples of accidents that underscore this hazard include the following:

- Two children, ages five and six, were electrocuted in Texas when a plugged-in hair dryer fell into the tub in which they were bathing.

- A three-year-old Kansas girl was electrocuted when she touched a faulty countertop.

These two electrocutions occurred because the electrical current escaping from the appliance traveled through the victim to ground (in these cases, the grounded plumbing fixtures). Had a GFCI been installed, these deaths would probably have been prevented because a GFCI would have sensed the current flowing to ground and would have switched off the power before the electrocution occurred.

HOW THE GFCI WORKS

In the home's wiring system, the GFCI constantly monitors electricity flowing in a circuit, to sense any loss of current. If the current flowing through the circuit differs by a small amount from that returning, the GFCI quickly switches off power to that circuit. The GFCI interrupts power faster than a blink of an eye to prevent a lethal dose of electricity. You may receive a painful shock, but you should not be electrocuted or receive a serious shock injury.

Here's how it may work in your house.. Suppose a bare wire inside an appliance touches the metal case. The case is then charged with electricity. If you touch the appliance with one hand while the other hand is touching a grounded metal object, like a water faucet, you will receive a shock. If the appliance is plugged into an outlet protected by a GFCI, the power will be shut off before a fatal shock would occur.

AVAILABILITY OF GFCIs

Three common types of ground fault circuit interrupters are available for home use:

** RECEPTACLE TYPE*

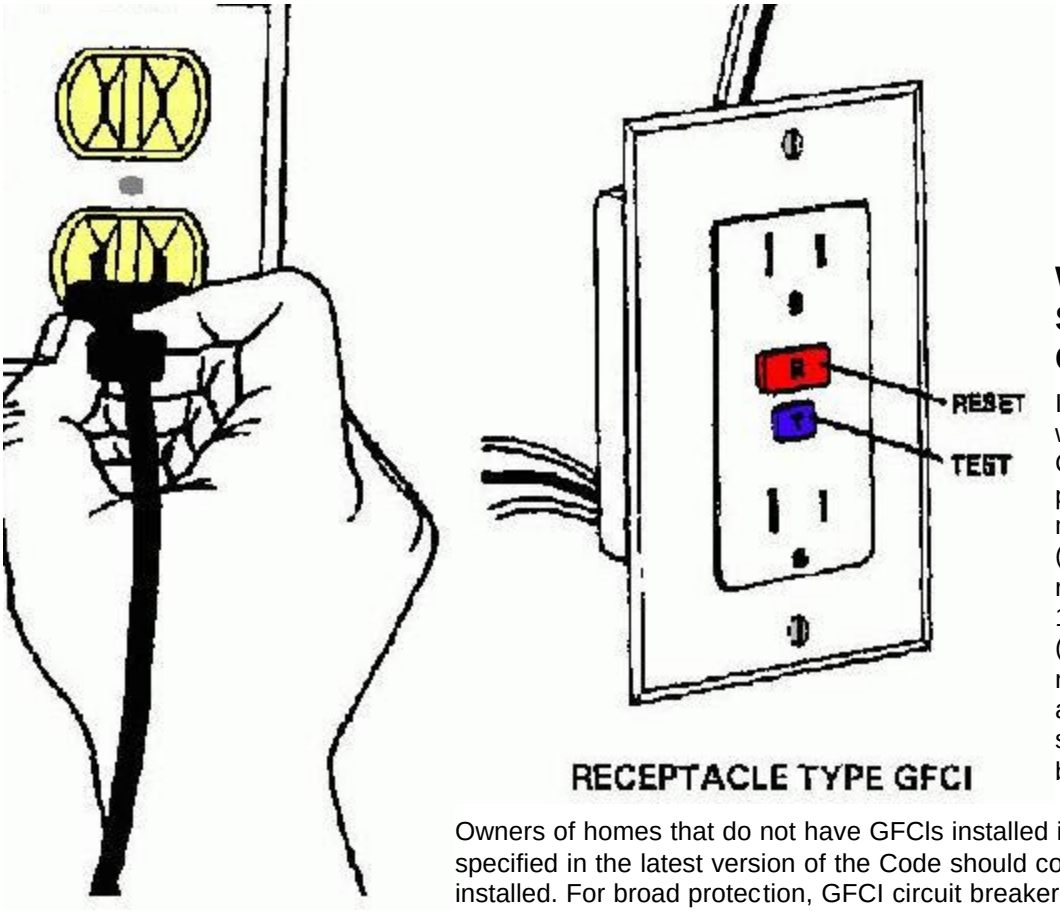
This type of GFCI is used in place of the standard duplex receptacle found throughout the house It fits into the standard outlet box and protects you against "ground faults' whenever an electrical product is plugged into the outlet Most receptacle-type GFCIs can be installed so that they also protect other electri-cal outlets further "down stream" in the branch circuit.

** CIRCUIT BREAKER TYPE*

In homes equipped with circuit breakers rather than fuses, a circuit breaker GFCI may be installed in a panel box to give protection to selected circuits The circuit breaker GFCI serves a dual purpose - not only will it shut off electricity in the event of a "ground-fault," but it will also trip when a short circuit or an ov.er-load occurs Protection covers the wiring and each outlet, lighting fixture, heater, etc served by the branch circuit protected by the GFCI in the panel box.

** PORTABLE TYPE*

Where permanent GFCIs are not practical, portable GFCIs may be used One type contains the GFCI circuitry in a plastic encio-sure with plug blades in the back and receptacle slots in the f rant. It can be plugged into a receptacle, then, the electrical product is plugged into the GFCI. Another type of portable GFCI is an extension cord combined with a GFCI. It adds flexibility in using receptacles that are not protected by GFCIs.



RECEPTACLE TYPE GFCI

WHERE GFCIs SHOULD BE CONSIDERED

In homes built to comply with the National Electrical Code (the Code), GFCI protection is required for most outdoor receptacles (since 1973), bathroom receptacle circuits (since 1975), garage wall outlets (since 1978), kitchen receptacles (since 1987), and all receptacles in crawl spaces and unfinished basements (since 1990).

Owners of homes that do not have GFCIs installed in all those critical areas specified in the latest version of the Code should consider having them installed. For broad protection, GFCI circuit breakers may be added in many panels of older homes to replace ordinary circuit breaker. For homes protected by fuses, you are limited to receptacle or portable-type GFCIs and these may be installed in areas of greatest exposure, such as the bathroom, kitchen, basement, garage, and outdoor circuits.

A GFCI should be used whenever operating electrically powered garden equipment (mower, hedge trimmer, edger, etc.). Consumers can obtain similar protection by using GFCIs with electric tools (drills, saws, sanders, etc.) for do-it-yourself work in and around the house.

INSTALLING GFCIs

Circuit breaker and receptacle-type GFCIs may be installed in your home by a qualified electrician. Receptacle-type GFCIs may be installed by knowledgeable consumers familiar with electrical wiring practices who also follow the instructions accompanying the device. When in doubt about the proper procedure, contact a qualified electrician. Do not attempt to install it yourself.

The portable GFCI requires no special knowledge or equipment to install.

TESTING THE GFCIs

All GFCIs should be tested once a month to make sure they are working properly and are protecting you from fatal shock. GFCIs should be tested after installation to make sure they are working properly and protecting the circuit.

To test the receptacle GFCI, first plug a nightlight or lamp into the outlet. The light should be on Then, press the "TEST" button on the GFCI. The GFCI's "RESET" button should pop out, and the light should go out.

If the "RESET" button pops out but the light does not go out, the GFCI has been improperly wired. Contact an electrician to correct the wiring errors.

If the "RESET" button does not pop out, the GFC1 is defective and should be replaced.

If the GFCI is functioning properly, and the lamp goes out, press the "RESET" button to restore power to the outlet.

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GPO: 1996 O-169-574

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The U.S. Consumer Product Safety Commission is charged with protecting the public from unreasonable risks of serious injury or death from more than 15,000 types of consumer products under the agency's jurisdiction. Deaths, injuries and property damage from consumer product incidents cost the nation more than $700 billion annually. The CPSC is committed to protecting consumers and families from products that pose a fire, electrical, chemical, or mechanical hazard or can injure children. The CPSC's work to ensure the safety of consumer products - such as toys, cribs, power tools, cigarette lighters, and household chemicals - contributed significantly to the 30 percent decline in the rate of deaths and injuries associated with consumer products over the past 30 years.

To report a dangerous product or a product-related injury, call CPSC's hotline at (800) 638-2772 or CPSC's teletypewriter at (800) 638-8270, or visit CPSC's web site at www.cpsc.gov/talk.html. To join a CPSC email subscription list, please go to www.cpsc.gov/cpsclist.asp. Consumers can obtain this release and recall information at CPSC's Web site at www.cpsc.gov.

Appendix D

This appendix is the full text of proposed bill S. 1385 from the 108th Congress, more commonly referred to as the "College Fire Safety Right-to-Know Act of 2003" and the "College Fire Prevention Act."

108th CONGRESS
1st Session
S. 1385

To provide for disclosure of fire safety standards and measures with respect to campus buildings, and for other purposes.

IN THE SENATE OF THE UNITED STATES

July 9, 2003

Mr. CORZINE (for himself and Mr. LAUTENBERG) introduced the following bill; which was read twice and referred to the Committee on Health, Education, Labor, and Pensions

---

A BILL

To provide for disclosure of fire safety standards and measures with respect to campus buildings, and for other purposes.

Be it enacted by the Senate and House of Representatives of the United States of America in Congress assembled,

SECTION 1. SHORT TITLE.

This Act may be cited as the `Campus Fire Safety Right-to-Know Act of 2003'.

SEC. 2. DISCLOSURE OF FIRE SAFETY OF CAMPUS BUILDINGS.

Section 485 of the Higher Education Act of 1965 (20 U.S.C. 1092) is amended--

(1) in subsection (a)(1)--

(A) in subparagraph (N), by striking `and' after the semicolon;

(B) in subparagraph (O), by striking the period at the end and inserting `; and'; and

(C) by adding at the end the following:

`(P) the fire safety report prepared by the institution pursuant to subsection (h).'; and

(2) by adding at the end the following:

`(h) DISCLOSURE OF FIRE SAFETY STANDARDS AND MEASURES-

`(1) ANNUAL FIRE SAFETY REPORTS REQUIRED- Each eligible institution participating in any program under this title shall, beginning in academic year 2004-2005, and each year thereafter, prepare, publish, and distribute, through appropriate publications (including the Internet) or mailings, to all current

students and employees, and to any applicant for enrollment or employment upon request, an annual fire safety report containing not less than the following information with respect to the campus fire safety practices and standards of that institution:

`(A) A statement that identifies each student housing facility of the institution, and whether or not that facility is equipped with a fire sprinkler system or another fire safety system, or both.

`(B) Statistics concerning the occurrence on campus, during the 2 preceding academic years for which data are available, of fires and false fire alarms in student housing facilities.

`(C) For each such occurrence described in subparagraph (B), a statement of the human injuries or deaths and the structural damage caused by the occurrence.

`(D) Information regarding fire alarms, smoke alarms, the presence of adequate fire escape planning or protocols (as defined in local fire codes), rules on portable electrical appliances, smoking and open flames (such as candles), regular mandatory supervised fire drills, and planned and future improvement in fire safety.

`(E) Information about fire safety education and training provided to students, faculty, and staff, including the percentage of students, faculty, and staff who have participated in such education and training.

`(F) Information concerning fire safety at student fraternities and sororities that are recognized by the institution, including--

`(i) information reported to the institution under paragraph (4); and

`(ii) a statement concerning whether and how the institution works with recognized student fraternities and sororities to make building and property owned or controlled by such fraternities or sororities more fire safe.

`(2) CURRENT INFORMATION TO CAMPUS COMMUNITY- Each institution participating in any program under this title shall make, keep, and maintain a log, written in a form that can be easily understood, recording all fires reported to local fire departments, including the nature, date, time, and general location of each fire and all false fire alarms. All entries that are required pursuant to this paragraph shall, except where disclosure of such information is prohibited by law, be open to public inspection, and each such institution shall make periodic reports to the campus community on such fires and false fire alarms in a manner that will aid the prevention of similar occurrences.

`(3) REPORTS TO SECRETARY- On an annual basis, each institution participating in any program under this title shall submit to the Secretary a copy of the statistics required to be made available under paragraph (1)(B). The Secretary shall--

`(A) review such statistics;

`(B) make copies of the statistics submitted to the Secretary available to the public; and

`(C) in coordination with nationally recognized fire organizations and representatives of institutions of higher education, identify exemplary fire

safety policies, procedures, and practices and disseminate information concerning those policies, procedures, and practices that have proven effective in the reduction of campus fires.

`(4) FRATERNITIES AND SORORITIES- Each institution participating in any program under this title shall request each fraternity and sorority that is recognized by the institution to collect and report to the institution the information described in subparagraphs (A) through (E) of paragraph (1), as applied to the fraternity or sorority, for each building and property owned or controlled by the fraternity or sorority, respectively.

`(5) RULE OF CONSTRUCTION- Nothing in this subsection shall be construed to authorize the Secretary to require particular policies, procedures, or practices by institutions of higher education with respect to fire safety.

`(6) DEFINITIONS- In this subsection, the term `campus' has the meaning given the term in subsection (f)(6).'.

SEC. 3. REPORT TO CONGRESS BY SECRETARY OF EDUCATION.

Not later than 2 years after the date of enactment of this Act, the Secretary of Education (in this section referred to as the `Secretary') shall prepare and submit to Congress a report containing--

(1) an analysis of the current status of fire safety systems in college and university facilities, including sprinkler systems;

(2) an analysis of the appropriate fire safety standards to apply to these facilities, which the Secretary shall prepare after consultation with such fire safety experts, representatives of institutions of higher education, and other Federal agencies as the Secretary, in the Secretary's discretion, considers appropriate;

(3) an estimate of the cost of bringing all nonconforming dormitories and other campus buildings up to current new building codes; and

(4) recommendations from the Secretary concerning the best means of meeting fire safety standards in all college facilities, including recommendations for methods to fund such cost.

108th CONGRESS
1st Session
H. R. 1613

To establish a demonstration incentive program within the Department of Education to promote installation of fire sprinkler systems, or other fire suppression or prevention technologies, in qualified student housing and dormitories, and for other purposes.

IN THE HOUSE OF REPRESENTATIVES

April 3, 2003

Mrs. JONES of Ohio introduced the following bill; which was referred to the Committee on Education and the Workforce

A BILL

To establish a demonstration incentive program within the Department of Education to promote installation of fire sprinkler systems, or other fire suppression or prevention technologies, in qualified student housing and dormitories, and for other purposes.

Be it enacted by the Senate and House of Representatives of the United States of America in Congress assembled,

SECTION 1. SHORT TITLE; FINDINGS.

(a) SHORT TITLE- This Act may be cited as the `College Fire Prevention Act'.

(b) FINDINGS- The Congress finds the following:

(1) On Wednesday, January 19, 2000, a fire occurred at a Seton Hall University dormitory. Three male freshmen, all 18 years of age, died. Fifty-four students, 2 South Orange firefighters, and 2 South Orange police officers were injured. The dormitory was a 6-story, 350-room structure built in 1952, that housed approximately 600 students. It was equipped with smoke alarms but no fire sprinkler system.

(2) On Mother's Day 1996 in Chapel Hill, North Carolina, a fire in the Phi Gamma Delta Fraternity House killed 5 college juniors and injured 3. The 3-story plus basement fraternity house was 70 years old. The National Fire Protection Association identified several factors that contributed to the tragic fire, including the lack of fire sprinkler protection.

(3) It is estimated that between 1980 and 1998, an average of 1,800 fires at dormitories, fraternities, and sororities, involving 1 death, 70 injuries, and $8,000,000 in property damage were reported to public fire departments.

(4) Within dormitories, fraternities, and sororities the leading cause of fires is arson or suspected arson. The second leading cause of college building fires is cooking. The third leading cause is smoking.

(5) New dormitories are generally required to have advanced safety systems such as fire sprinklers. But such requirements are rarely imposed retroactively on existing buildings.

(6) In 1998, 93 percent of the campus building fires reported to fire departments occurred in buildings where there were smoke alarms present. However, only 34 percent had fire sprinklers present.

SEC. 2. ESTABLISHMENT OF FIRE SUPPRESSION DEMONSTRATION INCENTIVE PROGRAM.

(a) GRANTS- The Secretary of Education (in this Act referred to as the `Secretary'), in consultation with the United States Fire Administration, shall establish a demonstration program to award grants on a competitive basis to eligible entities for the purpose of installing fire sprinkler systems, or other fire suppression or prevention technologies, in student housing and dormitories owned or controlled by such entities.

(b) ELIGIBLE ENTITY- For purposes of this Act, the term `eligible entity' means any of the following:

(1) An accredited public or private institution of higher education (as that term is defined in section 101 of the Higher Education Act of 1965 (20 U.S.C. 1001)).

(2) An accredited historically Black college or university (as that term is used in section 322 of the Higher Education Act of 1965 (20 U.S.C. 1061)).

(3) An accredited Hispanic-serving institution (as that term is defined in section 502 of the Higher Education Act of 1965 (20 U.S.C. 1101a)).

(4) An accredited Tribally Controlled College or University (as that term is defined in section 2 of the Tribally Controlled College or University Assistance Act of 1978 (25 U.S.C. 1801)).

(5) A social fraternity or sorority exempt from taxation under section 501(a) of the Internal Revenue Code of 1986 (26 U.S.C. 501(a)), the active membership of which consists primarily of students in attendance at an accredited institution of higher education.

(c) SELECTION PRIORITY- In making grants under subsection (a), the Secretary shall give priority to eligible entities that demonstrate the greatest financial need.

(d) RESERVATIONS- Of the amount made available to the Secretary for grants under this section for each fiscal year, the Secretary shall award--

(1) not less than 10 percent to eligible entities that are historically Black colleges and universities, Hispanic-serving institutions, and Tribally Controlled Colleges and Universities; and

(2) not less than 10 percent to eligible entities that are social fraternities and sororities.

(e) APPLICATION- To seek a grant under this section, an eligible entity shall submit an application to the Secretary at such time, in such manner, and accompanied by such information as the Secretary may require.

(f) MATCHING REQUIREMENT- As a condition on receipt of a grant under subsection (a), the applicant shall provide (directly or through donations from public or private entities) non-Federal matching funds in an amount equal to not less than 50 percent of the cost of the activities for which assistance is sought.

(g) LIMITATION ON ADMINISTRATIVE EXPENSES- Not more than 10 percent of a grant made under subsection (a) may be expended for administrative expenses with respect to the grant.

(h) REPORTS- Not later than 12 months after the date of the first award of a grant under this section and annually thereafter until completion of the program, the Secretary shall provide to the Congress a report that includes the following:

(1) The number and types of eligible entities receiving assistance under this section.

(2) The amounts of such assistance, the amounts and sources of non-Federal funding leveraged for activities under grants under this section, and any other relevant financial information.

(3) The number and types of student housing fitted with fire suppression or prevention technologies with assistance under this section, and the number of students protected by such technologies.

(4) The types of fire suppression or prevention technologies installed with assistance under this section, and the costs of such technologies.

(5) Identification of Federal and State policies that present impediments to the development and installation of fire suppression or prevention technologies.
(6) Any other information determined by the Secretary to be useful to evaluating the overall effectiveness of the program established under this section in improving the fire safety of student housing.

(i) AUTHORIZATION OF APPROPRIATIONS- There is authorized to be appropriated to carry out this Act $100,000,000 for each of the fiscal years 2004 through 2008. At the end of fiscal year 2008, all unobligated appropriations authorized under this subsection shall revert to the general fund of the Treasury.

SEC. 3. ADMISSIBILITY AS EVIDENCE.

(a) PROHIBITION- Notwithstanding any other provision of law and subject to subsection (b), any application for assistance under this Act, any negative determination on the part of the Secretary with respect to such application, or any statement of reasons for the determination, shall not be admissible as evidence in any proceeding of any court, agency, board, or other entity.

(b) EXCEPTION- This section does not apply to the admission of an application, determination, or statement described in subsection (a) as evidence in a proceeding to enforce an agreement entered into between the Secretary of Education and an eligible entity under section 2.

Appendix E

College Housing Fire Safety Student Survey

1. When you first lived on campus, what type of housing did you reside in?

   - ☐ Dormitory
   - ☐ On-campus apartment
   - ☐ Off-campus apartment
   - ☐ Fraternity/Sorority

2. How many semesters have you lived on campus?
   ____________ (# of semesters)

3. Did you receive any fire safety instruction at this college/university regarding:

	Yes	No
Location of fire exits	___	___
Location of fire extinguishers	___	___
Location of smoke/heat detectors	___	___
Location of fire alarm pull stations	___	___
The presence of fire sprinklers	___	___
Closing fire doors at all times	___	___
Procedure for exiting the dorm when the fire alarms goes off	___	___
Person responsible for fire safety in your housing	___	___

4. If answered 'yes' to any part of question #3, what form of instruction did you receive?

   Lecture Video Pamphlet Informal Meeting

5. Are you aware of any other college/university fire policies?

   Yes No

6. Are fire safety inspections conducted in your housing by either your residential advisors or a fire marshal/official?

   Yes No

7. If answered 'yes' to question #6, how often are they done?
   ____

8. Do you exit the building when a fire alarm goes off in your housing?

   Yes No

9. Are you aware of the college/university's list of items related to fire hazards that are banned in on-campus housing?

   Yes No

10. Please check the items that you have possession of and/or have used in your dorm/house room:

    - ☐ Halogen Lamp
    - ☐ Hot Plate
    - ☐ Toaster
    - ☐ Candles
    - ☐ Coffee Maker
    - ☐ Incense
    - ☐ Iron
    - ☐ Space Heater
    - ☐ Electric Blanket
    - ☐ Hair Dryer
    - ☐ Bean Bag Chair
    - ☐ Microwave Oven

Thank you for your time!

Appendix F

This appendix is a summary of the data that was outputted by running quarries of that Nation Fire Incident Reporting System (NFIRS).

Fires in Sorority House, Fraternity House by Heat Source in 1999 and 2000 (According to NFIRS)

Heat Source	Arson?	# of Fires
Heat from open flames or smoking material	No	2
Cigarette	No	9
Heat from undetermined smoking material	No	2
Match	No	1
Candle	No	17
Cigarette lighter	Yes	6
Heat from undetermined smoking material	Unknown	1

Total Fires in Sorority House, Fraternity House by Heat Source in 1999 and 2000 (According to NFIRS)

Heat Source	Total # of Fires
Heat from open flames or smoking material	2
Cigarette	9
Heat from undetermined smoking material	3
Match	1
Candle	17
Cigarette lighter	6

Fires in Barracks, Dormitory by Heat Source in 1999 and 2000 (According to NFIRS)

Heat Source	Arson?	# of Fires
Heat from open flames or smoking material	No	8
Cigarette	No	69
Heat from undetermined smoking material	No	6
Match	No	7
Cigarette lighter	No	5
Candle	No	60
Heat from undetermined smoking material	Yes	27
Cigarette	Yes	2
Heat from undetermined smoking material	Yes	1
Match	Yes	30
Cigarette lighter	Yes	25
Candle	Yes	2
Cigarette	Unknown	1
Match	Unknown	1
Candle	Unknown	1

Total Fires in Barracks, Dormitory by Heat Source in 1999 and 2000 (According to NFIRS)

Heat Source	Total # of Fires
Heat from open flames or smoking material	35
Cigarette	72
Heat from undetermined smoking material	7
Match	38
Cigarette lighter	30
Candle	63

Fires caused by Fire in Dormitories by Heat Source in 1995 – 1998 (According to NFIRS)

Heat Source	Arson?	# of Fires
Candle	No	168
Cigarette Lighter	No	16
Match	No	26
Smoking Material	No	274
Candle	Yes	2
Cigarette Lighter	Yes	60
Match	Yes	140
Smoking Material	Yes	19
Candle	Unknown	6
Cigarette Lighter	Unknown	2
Match	Unknown	8
Smoking Material	Unknown	7

Total Fires caused by Fire in Dormitories by Heat Source in 1995 – 1998 (According to NFIRS)

Heat Source	Total # of Fires
Candle	176
Cigarette Lighter	78
Match	176
Smoking Material	300

Injures caused by Fire in Dormitories by Heat Source in 1995 – 1998 (According to NFIRS)

Heat Source	Arson?	# of Injuries
Candle	No	30
Cigarette Lighter	No	3
Smoking Material	No	24
Cigarette Lighter	Yes	6
Match	Yes	2

Candle	Unknown	1
Cigarette Lighter	Unknown	14
Smoking Material	Unknown	1

Total Injures caused by Fire in Dormitories by Heat Source in 1995 – 1998 (According to NFIRS)

Heat Source	Total # of Injuries
Candle	31
Cigarette Lighter	9
Smoking Material	25
Match	2

Fires in Sorority house, Fraternity house by Equipment in 1999 and 2000 (According to NFIRS)

Equipment	Arson?	# of Fires
Air Conditioning	No	1
Local Fixed Heater	No	2
Portable Heater	No	1
Water Heater	No	1
Cord, Plug	No	2
Lighting	No	5
Receptacle, Switch	No	1
Other Electrical	No	1
All Other Cooking	No	2
Range/Oven	No	15
Other Appliance	No	1
Television, Radio	No	2
Torches	No	2
Washing Machine	No	1
Unknown	No	10
All Other Cooking	Yes	1
Clothes Dryer	Unknown	1

Total Fires in Sorority House, Fraternity House by Equipment in 1999 and 2000 (According to NFIRS)

Equipment	Total # of Fires
Air Conditioning	1
Local Fixed Heater	2
Portable Heater	1
Water Heater	1
Cord, Plug	2
Lighting	5
Receptacle, Switch	1
Other Electrical	1

All Other Cooking	3
Range/Oven	15
Other Appliance	1
Television, Radio	2
Torches	2
Clothes Dryer	1
Washing Machine	1

Fires in Barracks, Dormitory by Equipment in 1999 and 2000 (According to NFIRS)

Equipment	Arson?	# of Fires
Air Conditioning	No	3
Central Heating	No	5
Fireplace, Chimney	No	1
Local Fixed Heater	No	5
Portable Heater	No	1
Water Heater	No	2
Other Heater	No	1
Cord, Plug	No	8
Lighting	No	20
Other Electrical	No	5
All Other Cooking	No	48
Range/Oven	No	143
Clothes Dryer	No	13
Other Appliance	No	12
Television, Radio	No	7
Torches	No	4
Washing Machine	No	8
Fireplace, Chimney	Yes	1
Lighting	Yes	1
All Other Cooking	Yes	3
Range/Oven	Yes	3
Torches	Yes	3
Fireplace, Chimney	Unknown	1
All Other Cooking	Unknown	2
Range/Oven	Unknown	3

Total Fires in Barracks, Dormitory by Equipment in 1999 and 2000 (According to NFIRS)

Equipment	Total # of Fires
Air Conditioning	3
Central Heating	5
Fireplace, Chimney	3
Local Fixed Heater	5
Portable Heater	1
Water Heater	2
Other Heater	1

Cord, Plug	8
Lighting	21
Other Electrical	5
All Other Cooking	53
Range/Oven	14
Clothes Dryer	13
Other Appliance	12
Television, Radio	7
Torches	7
Washing Machine	8

Fires caused by Fire in Dormitories by Equipment in 1995 – 1998 (According to NFIRS)

Equipment	Arson?	# of Fires
Central Heating	No	13
Fireplace	No	2
Fixed Heater	No	18
Portable Heater	No	4
Water Heater	No	3
All Other Cooking	No	89
Range/Oven	No	330
Total Cooling, AC	No	14
Cord, Plug	No	20
Installed Wiring	No	17
Lamp, Light Fixture	No	88
Switch , Outlet	No	4
Dyer	No	32
Heat Producing Appliance	No	18
Non-Heat Producing Appliance	No	5
Television, Radio, Phonograph	No	16
Washing Machine	No	16
Fixed Heater	Yes	1
All Other Cooking	Yes	7
Range/Oven	Yes	14
Cord, Plug	Yes	1
Installed Wiring	Yes	1
Central Heating	Unknown	1
Portable Heater	Unknown	2
All Other Cooking	Unknown	3
Range/Oven	Unknown	15
Total Cooling, AC	Unknown	1
Cord, Plug	Unknown	1
Lamp, Light Fixture	Unknown	7
Dyer	Unknown	2
Heat Producing Appliance	Unknown	2
Non-Heat Producing Appliance	Unknown	2
Washing Machine	Unknown	1

Total Fires caused by Fire in Dormitories by Equipment in 1995 – 1998 (According to NFIRS)

Equipment	Total # of Fires
Central Heating	14
Fireplace	2
Fixed Heater	19
Portable Heater	6
Water Heater	3
All Other Cooking	99
Range/Oven	359
Total Cooling, AC	15
Cord, Plug	22
Installed Wiring	18
Lamp, Light Fixture	95
Switch , Outlet	4
Dyer	34
Heat Producing Appliance	20
Non-Heat Producing Appliance	7
Television, Radio, Phonograph	16
Washing Machine	17

Injures caused by Fire in Dormitories by Equipment in 1995 – 1998 (According to NFIRS)

Equipment	Arson?	Power	# of Injuries
All Other Cooking	No	Gas	1
Range/Oven	No	Out	1
Range/Oven	No	Electric	3
Range/Oven	No	Unknown	1
Cord, Plug	No	Electric	3
Lamp, Light Fixture	No	Out	1
Lamp, Light Fixture	No	Electric	9
Non-Heat Producing Appliance	Unknown	Electric	7

Total Injures caused by Fire in Dormitories by Equipment in 1995 – 1998 (According to NFIRS)

Equipment	Total # of Injuries
All Other Cooking	1
Range/Oven	5
Cord, Plug	3
Lamp, Light Fixture	10
Non-Heat Producing Appliance	7

Fires caused by Fire in Dormitories by Ignition Factor vs. Heat Source in 1995 – 1998 (According to NFIRS)

Ignition Factor	Heat Source	# of Fires
Arson	Candle	2
Arson	Cigarette Lighter	60
Arson	Match	140
Arson	Smoking Material	19
Abandoned Material	Candle	21
Abandoned Material	Cigarette Lighter	1
Abandoned Material	Match	9
Abandoned Material	Smoking Material	248
Combustible too close	Candle	34
Combustible too close	Smoking Material	3
Overloaded	Match	1
Unattended	Candle	47
Unattended	Match	2

Total Fires caused by Fire in Dormitories by Ignition Factor vs. Heat Source in 1995 – 1998 (According to NFIRS)

Ignition Factor	Total # of Fires
Arson	221
Abandoned Material	279
Combustible too close	37
Overloaded	1
Unattended	49

Injures caused by Fire in Dormitories Ignition Factor vs. Heat Source in 1995 – 1998 (According to NFIRS)

Ignition Factor	Heat Source	# of Injures
Arson	Cigarette Lighter	6
Arson	Match	2
Arson	Out	3
Arson	Unknown	8
Abandoned Material	Smoking Material	18
Abandoned Material	Unknown	1
Combustible too Close	Candle	21
Combustible too Close	Out	7
Unattended	Candle	4
Unattended	Out	5

Total Injures caused by Fire in Dormitories Ignition Factor vs. Heat Source in 1995 – 1998 (According to NFIRS)

Ignition Factor	Total # of Injures
Arson	19
Abandoned Material	19
Combustible too Close	28
Unattended	9

Fires caused by Fire in Dormitories by Ignition Factor vs. Equipment in 1995 – 1998 (According to NFIRS)

Ignition Factor	Equipment	# of Fires
Arson	Fixed Heater	1
Arson	All Other Cooking	7
Arson	Range/Oven	19
Arson	Cord, Plug	1
Arson	Installed Wiring	1
Abandoned Material	Fixed Heater	2
Abandoned Material	All Other Cooking	3
Abandoned Material	Range/Oven	16
Abandoned Material	Lamp, Light Fixture	1
Abandoned Material	Heat Producing Appliance	2
Collision, overturn	Lamp, Light Fixture	4
Combustible too close	Central Heating	2
Combustible too close	Fireplace	1
Combustible too close	Fixed Heater	3
Combustible too close	All Other Cooking	3
Combustible too close	Range/Oven	21
Combustible too close	Total Cooling, AC	1
Combustible too close	Cord, Plug	1
Combustible too close	Lamp, Light Fixture	52
Combustible too close	Dyer	1
Combustible too close	Heat Producing Appliance	2
Combustible too close	Television, Radio, Phonograph	2
Overloaded	Cord, Plug	4
Overloaded	Dyer	3
Overloaded	Television, Radio, Phonograph	1
Overloaded	Washing Machine	7
Unattended	Fireplace	1
Unattended	Fixed Heater	1
Unattended	Portable Heater	1
Unattended	All Other Cooking	59
Unattended	Range/Oven	195
Unattended	Lamp, Light Fixture	1
Unattended	Dyer	2
Unattended	Heat Producing Appliance	5
Unattended	Television, Radio, Phonograph	1

Total Fires caused by Fire in Dormitories by Ignition Factor vs. Equipment in 1995 – 1998 (According to NFIRS)

Ignition Factor	Total # of Fires
Arson	29
Abandoned Material	24
Collision, overturn	4
Combustible too close	89
Overloaded	15
Unattended	266

Injures caused by Fire in Dormitories by Ignition Factor vs. Equipment 1995 – 1998 (According to NFIRS)

Ignition Factor	Equipment	Power	# of Injures
Abandoned Material	6Out	Other	15
Abandoned Material	Unknown	Other	3
Abandoned Material	Unknown	Unknown	1
Arson	6Out	Other	10
Arson	6Out	Unknown	3
Arson	Unknown	Unknown	3
Arson	Unknown	Other	3
Combustible too Close	6Out	Other	20
Combustible too Close	6Out	Unknown	1
Combustible too Close	Lamp, Light Fixture	Out	1
Combustible too Close	Lamp, Light Fixture	Electric	6
Combustible too Close	Unknown	Other	1
Unattended	6Out	Other	4
Unattended	Range/Oven	Electric	1
Unattended	Range/Oven	Unknown	1
Unattended	Unknown	Other	3

Total Injures caused by Fire in Dormitories by Ignition Factor vs. Equipment 1995 – 1998 (According to NFIRS)

Ignition Factor	Total # of Injures
Abandoned Material	19
Arson	19
Combustible too Close	33
Unattended	9

Appendix G

Dormitory Fires, by Cause
Reported to U.S. Fire Departments
1999-2001 Annual Averages

Cause	Fires	Civilian Deaths	Civilian Injuries	Direct Property Damage (in Millions)
Cooking Equipment	920 (41.1%)	0 (0.0%)	21 (20.6%)	$0.8 (2.4%)
Intentional	540 (24.1%)	0 (0.0%)	18 (17.7%)	$16.2 (48.3%)
Open Flame, ember or torch	210 (9.4%)	0 (0.0%)	39 (38.7%)	$4.9 (14.5%)
Smoking materials	180 (8.0%)	4 (100.0%)	7 (6.7%)	$7.5 (22.3%)
Electrical distribution	130 (5.8%)	0 (0.0%)	7 (7.0%)	$1.8 (5.5%)
Appliance, tool or air conditioning	90 (4.0%)	0 (0.0%)	1 (1.4%)	$0.3 (1.0%)
Heating equipment	60 (2.7%)	0 (0.0%)	1 (1.4%)	$0.5 (1.5%)
Other heat, flame or spark	60 (2.7%)	0 (0.0%)	4 (4.0%)	$0.4 (1.2%)
Other equipment	30 (1.3%)	0 (0.0%)	1 (1.3%)	$0.8 (2.4%)
Exposure	20 (0.9%)	0 (0.0%)	1 (1.3%)	$0.1 (0.2%)
Child playing	10 (0.4%)	0 (0.0%)	0 (0.0%)	$0.0* (0.1%)
Natural cause	0*	0 (0.0%)	0 (0.0%)	$0.2 (0.6%)

*Not zero but rounds to zero.
Source: Rohr, 2004, Dormitory Structure Fires

Appendix H

Fraternity and Sorority House Fires, by Cause
Reported to U.S. Fire Departments
1999-2001 Annual Averages

Cause	Fires	Civilian Deaths	Civilian Injuries	Direct Property Damage (in Millions)
Cooking Equipment	40 (21.2%)	0 (0.0%)	2 (8.5%)	$0.0* (0.3%)
Open flame, ember or torch	40 (19.9%)	0 (0.0%)	12 (64.6%)	$1.5 (47.4%)
Intentional	30 (14.8%)	0 (0.0%)	0 (0.0%)	$0.1 (2.3%)
Smoking materials	20 (11.9%)	2 (100.0%)	2 (9.2%)	$0.9 (27.2%)
Electrical distribution	20 (9.6%)	0 (0.0%)	2 (9.2%)	$0.5 (14.5%)
Other heat, flame or spark	10 (6.7%)	0 (0.0%)	0 (0.0%)	$0.1 (1.9%)
Heating equipment	10 (5.8%)	0 (0.0%)	0 (0.0%)	$0.2 (5.5%)
Appliances or air conditioning	10 (5.8%)	0 (0.0%)	0 (0.0%)	$0.0* (0.1%)
Other equipment	0* (2.2%)	0 (0.0%)	0 (0.0%)	$0.0* (0.8%)
Exposure	0* (1.4%)	0 (0.0%)	2 (8.5%)	$0.0 (0.0%)
Child playing	0* (0.7%	0 (0.0%)	0 (0.0%)	$0.0* (0.1%)

*Not zero but rounds to zero.
Source: Rohr, 2004, Dormitory Structure Fires

Appendix I

1. Task Number		2. Investigator's ID	EPIDEMIOLOGIC INVESTIGATION REPORT
020214HWE6006		8554	
3. Office Code	4. Date of Accident YR MO DAY	5. Date Initiated YR MO DAY	
840	2002 01 26	2002 02 21	

6. Synopsis of Accident or Complaint **UPC**

Unattended candles were left burning inside a bedroom's walk-in closet. Nearby combustibles ignited and caught on fire. Two teenage boys died from smoke inhalation.

7. Location (Home, School, etc)	8. City	9. State
1 - HOME	TUCSON	AZ

10A. First Product	10B. Trade/Brand Name	10C. Model Number
463 - Candles, Candlesticks And Oth	UNKNOWN	UNKNOWN

10D. Manufacturer Name and Address
UNKNOWN

11A. Second Product	11B. Trade/Brand Name	11C. Model Number
1137 - Paper Products	UNKNOWN	UNKNOWN

11D. Manufacturer Name and Address
NONE

12. Age of Victim	13. Sex	14. Disposition	15. Injury Diagnosis
17	1 - Male	8 - Death	65 - Anoxia
16. Body Part(s) Involved	**17. Respondent**	**18. Type of Investigation**	**19. Time Spent (Operational / Travel)**
85 - ALL OF BODY	3 - 2nd Hand Info Only	2 - Telephone	6 / 0

20. Attachment(s)	21. Case Source	22. Sample Collection Number
9 - Multiple Attachments	05 - Newspaper	

23. Permission to Disclose Name (Non NEISS Cases Only)
○ Yes ◉ No ○ Verbal

24. Review Date	25. Reviewed By	26. Regional Office Director
03/20/2002	9035	Frank J. Nava

27. Distribution	28. Source Document Number
Kyle, Susan B.; Barton, Keven J.	F0226006A

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Appendix J

Dormitory Structure Fires, by Area of Origin
Reported to U.S. Fire Departments
1999-2001 Annual Averages

Area of Origin	Fires	Civilian Deaths	Civilian Injuries	Direct Property Damage (in Millions)
Kitchen	870 (38.8%)	0 (0.0%)	14 (14.0%)	$1.0 (3.0%)
Bedroom	490 (21.9%)	1 (27.5)	61 (60.2%)	$28.0 (83.3%)
Corridor	190 (8.5%)	0 (0.0%)	1 (1.0%)	$0.1 (0.2%)
Bathroom	100 (4.5%)	0 (0.0%)	9 (8.7%)	$0.1 (0.3%)
Common Room	70 (3.1%)	2 (50.0%)	4 (4.0%)	$0.5 (1.6%)
Laundry Area	70 (3.1%)	0 (0.0%)	1 (1.0%)	$0.1 (0.2%)
Waste Area	70 (3.1%)	0 (0.0%)	1 (1.0%)	$0.1 (0.4%)
Bar Area	30 (1.3%)	0 (0.0%)	0 (0.0%)	$0.0 (0.0%)
Lobby	30 (1.3%)	1 (22.5%)	0 (0.0%)	$0.1 (0.2%)
Closet	20 (0.9%)	0 (0.0%)	0 (0.0%)	$0.2 (0.5%)
Stairway	20 (0.9%)	0 (0.0%)	2 (2.0%)	$0.0 (0.0%)
Balcony or Porch	20 (0.9%)	0 (0.0%)	0 (0.0%)	$0.5 (1.6%)
Heating Room	20 (0.9%)	0 (0.0%)	0 (0.0%)	$0.0 (0.1%)
Exterior Wall	20 (0.9%)	0 (0.0%)	0 (0.0%)	$0.0 (0.1%)
Other	220 (9.8%)	0 (0.0%)	7 (7.1%)	$2.9 (8.5%)

Source: Rohr, 2004, Dormitory Structure Fires

Appendix K

This appendix is a list of professionals that we contacted during our research and data collection. We held interviews in both Massachusetts and the Washington D.C. area.

Marty Ahrens, National Fire Protection Association, Manager, Fire Analysis Services

Jonathan Barnett, Worcester Polytechnic Institute, Professor of Fire Protection Engineering

Ed Comeau, Center for Campus Fire Safety, Director

Alex Maranghides, National Institute of Standards and Technology, Supervisor, Large Fire Facility

Larry Maruskin, U.S. Fire Administration, Project Manager

Francis McGarry, National Association of State Fire Marshals, Project Manager

Carolyn Meiers, Consumer Product Safety Commission, Human Factors Engineer

David Messier, Worcester Polytechnic Institute. Mgr Environment & Occup Safety

Dave Miller, Consumer Product Safety Commission, Hazard Analysis

Jim Milke, University of Maryland, Assoc Prof Assoc Chair ENGR-Fire Protection Engineering

Jerry Naylis, Consumer Product Safety Commission, Eastern Regional Director

Kathy A. Notarianni, Worcester Polytechnic Institute, Director of Fire Protection Engineering

Joy Rizzitello, Consumer Product Safety Commission, Investigator, Western Region

Kimberly Rohr, National Fire Protection Association, Fire Data Specialist

Chris Salter, Worcester Polytechnic Institute, Manager, Technical Trades

Brooke Stolting, Office of Senator Jon S. Corzine (D-NJ), Legislative Correspondent

Karen Suhr, National Association of State Fire Marshals, Government Relations

Julie Webber, American University, Executive Director of Housing and Dining Program

Appendix L

This appendix includes a summary of campus fire policies, and methods of fire detection and suppression used at the four colleges and universities we researched. This information was collected through personal interviews, email correspondence, and online resources provided by the college or university.

Worcester Polytechnic Institute

- The university has a list of approved items that can be used in residence halls. All items must be UL approved, and no electric appliance may have an exposed heating element.
- Uannounced fire drills are conducted twice a year.
- Fire alarm pull stations are located on every floor in every building. Alarms will also be set off if a smoke or heat detector is activated. The campus police department is automatically notified if an alarm sounds.
- All residences are equipped with smoke and/or heat detectors. The detectors will set off the building alarm.
- All residence halls and on-campus apartments are equipped with fire sprinkler systems.
- Fire extinguishers are located in all of the hallways of the residence halls.
- The residential services staff conducts a scheduled health and fire safety inspection each academic term.
- Students are instructed of the university's fire safety policies and procedures for exiting building by their resident advisor.

University of Maryland – College Park

- Students are expected to leave the building in the event that a fire alarm sounds
- In the event they see a fire or smoke, they are instructed to pull to the fire alarm and then exit the building.
- The fire department must be contacted when a fire alarm is pulled because the alarms are not connected to a central campus alarm system or to the fire department.
- Single-station smoke detectors are in every student bedroom, on-campus suite, and apartment, but are not connected to the building alarm system.
- Sprinkler systems exist in all 46 residence hall buildings and are tested twice annually.
- A personalized emergency evacuation sign with floor plans and emergency information and instructions is posted in every student room and in the common area of suite and apartment interiors.
- Unannounced drills are conducted once per semester.
- Fire safety information is published in residence hall *Community Living* and *Services Guide* online handbooks and in the *Fire On Campus* brochure published by UM Environmental Safety. In floor meetings, Resident Assistants are expected to review fire evacuation procedures.
- The university has a list of banned items.

American University

- Resident advisors orient students to the campus fire policies in floor meeting.
- There is periodic written communication and students and families regarding safety issues and incidents
- Student are taught fire safety and informed of campus policies at the beginning of every semester.
- Smoke detectors are present in all student housing rooms and heat detectors are present in all floor lounges.
- All residence halls are equipped with sprinkler systems that are constantly monitored and tested, except for one apartment complex in Bethesda, MD.
- The university has a list of banned items.

George Washington University

- Fire evacuation plans have been developed for each residence hall and copies of these plans can be found on the inside of the door of each room.
- Unannounced fire drills are conducted twice a year in all residence halls
- Sprinkler systems are installed in campus buildings.
- Smoke and heat detectors are present in all major campus building, and are constantly monitored by the university's police department.
- Residential furnishings are fire retardant.
- The university offers a one-hour course on fire prevention and protection to specific groups upon request, in which different types of fire extinguishers found on campus are discussed and how to properly use them.
- The university has a list of banned items.

Appendix M

This appendix includes a summary of fire safety videos used at various colleges and universities around the United States. They are produced by several organization and were compiled by the Center for Campus Fire Safety in a video collection called Campus Fire Safety: A Video Library.

Graduation: Fatally Denied

- Video is made in a first person view
- Settings include a dormitory room, inside an ambulance, in an emergency room
- Begins during a party in a dormitory, the camera pans across the room and points out dangers (smoking materials, overloaded circuits, halogen lamp)
- Student falls asleep while smoking, and wakes up to fire spreading all across the room
- Paramedics are shown treating the student on the way to the hospital, and then the student is treated by doctors in the emergency room
- Student loses consciousness, her heart stops beating, and she dies
- Fire fighter walks around fire aftermath and discusses fire prevention
- Video is about 13 minutes

Dana Christmas Story

- Retrospective of the dormitory fire at Seton Hall University from the views of an RA that was trapped in the building
- One main setting, with the former RA sitting on couch in a dark room
- Her story is around her waking up to the fire alarm and trying to tell students that there was a fire, but everyone was sleeping,
- She herself became trapped in the dormitory and thought she was going to die
- Discusses the “things you should know about fire safety”
- Produced by the National Fire Sprinkler Association
- Video is about 9 minutes

Dominic's Story

- Students discuss fraternity fire (Sigma Chi) at the University of Missouri, Columbia
- Fire fighters that arrived at the scene discuss how they maneuvered through the house trying to find the victim named Dominic
- Fire investigator discusses the cause of the fire, which started in a bunk bed from a candle Students tried to put the fire out, but there were no fire extinguishers on the third floor
- There is an interview with Dominic's mother, who urges parents to look at safety aspect of school housing (look for sprinklers, extinguishers, smoke detectors, do they conduct drills, report from the last fire inspection)
- Columbia fire marshal discusses controlling the fuel load and electrical hazards
- Video is about 18 minutes

Living with Fire Week

- Documentary at UMass Amherst
- Ed Comeau, director of the Center for Campus Fire Safety discusses setting up a live burn
- Shows a live burn with students present. The fire flashed over in 5 min. 10 sec.
- Ed gets the students' reactions to the burn: most were amazed that the fire spread really fast
- Overall, Ed said the demonstration was incredibly effective
- Discussion about general fire safety programs
- Video is about 8 minutes

Live Burn Dorm Room:

- Documentary about creating props for live burns, while also discussing fire safety programs used to teach students about fire safety
- Video is intended for administrators rather than students
- Shows clips of constructing the model dorm room and the live burn
- There is an overall overview of using the program of live burns to educate students about fire dangers
- Video is about 12 minutes

Best Line of Defense

- Video is an overview of fire detection methods used at colleges
- It shows highlights of a live burn demonstration used at the University of Illinois
- Discusses the use of sprinklers: they are effective and relatively cheap (almost the same cost as putting in new carpet)
- Video is also directed towards administrators
- Video is about 5 minutes

Ready to Respond

- Video is produced by FEMA and designed for housing administrators
- Gives an overview of the issue of student housing fires
- Tells the story of the fraternity fire at the University of North Carolina – Chapel Hill
- All college housing should have: automatic smoke detectors and alarms (preferably modern systems), automatic sprinkler system
- Shows simulation of sprinkler system in use
- Uses hotels as an example of a large scale installation of a sprinkler system
- Discusses the misconceptions about sprinkler systems
- Video is about 12 minutes

Get Out and Stay Alive

- Video was produced by the U.S. Fire Administration
- Begins in a college party setting to show possible fire hazards, including improperly discarding smoking materials
- Discusses fire incidents at three universities
    - University of Wisconsin – one fatality
    - University of North Carolina – Chapel Hill – five fatalities
    - Greenville College – one fatality
- Program was divided into four main topics
    - Getting Out – teaches students how to survive if they get caught in a fire situation
    - Prevention – teaches students that simple precautions can be taken to prevent fires from starting
    - Protection – Discusses important suggestions, including checking smoke alarms, planning escape routes, and taking fire alarms seriously, to teach students how to protect themselves if they become trapped
    - Make a Plan – instructs student to make a plan for fire safety and protection as soon as they get home
- Video is about 14 minutes
- Included with the video is a lesson plan for administrators and 50 pamphlets about fire safety to be distributed to students

FEMA Campus Fire Safety 101

- Two students discuss fire evacuation
- Video is divided into chapters:
    - Chapter 1: shows an un-noticed fire incident happening
    - Chapter 2: Escape: tells students to respond quickly to fire alarms and the proper procedure for exiting the building
    - Chapter 3: Escape planning: tells students to keep their room key in a handy place, know the numbers of doors between your room and the exit, good idea to wear shoes before leaving
    - Chapter 4: Sheltering: if trapped, seal door edges, get to a window, call 911, hang something out of the window, determine a meeting spot outside of the building
    - Chapter 5: Check the Place Out: students should check the alarm system, check smoke detectors and exit lights, keep fire doors closed, check fire escapes, look for fire sprinklers
    - Chapter 6: Preventing: discusses common causes of fires
- Video is about 14 minutes

Appendix N

current to find its path to ground through the user of the appliance, giving rise to a risk for shock or electrocution. In fact, reduction of shock hazard has been the main impetus behind the development of a class of protective devices called Leakage Current Protective Devices (LCPDs). It will be seen that risk of shock and fire arising from ground faults may be significantly reduced through the use of these devices.

Leakage Current Protection Devices

Description

Leakage Current Protection Devices (LCPD) are a class of electrical or electromechanical devices which detect leakage of current in an electrical circuit. The basic schematic for an LCPD is shown in Figure 1. Any current flowing in the phase conductor must return through the neutral conductor, unless there is leakage in the circuit.

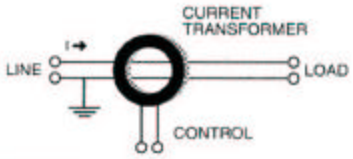

Figure 1

Note that in the diagram both conductors pass through the toroid of the Current Transformer (CT), with the current flows having opposite sense. Thus, if the current on each conductor is of equal magnitude, there will be no net induction in the windings of the CT. However, when an imbalance occurs, current is induced in the secondary. This signal is typically fed to some type of trip mechanism to shut off power to the circuit.

UL has defined several classes of LCPD, related to the type and amount of shock protection they afford. Three of these will be discussed here: Ground Fault Circuit Interrupters (GFCI), Appliance Leakage Current Interrupters (ALCI) and Equipment Leakage Current Interrupters (ELCI).

GFCI

A Ground Fault Circuit Interrupter is an LCPD specifically intended for the protection of people from shock hazard. A typical GFCI schematic is shown in Figure 2.

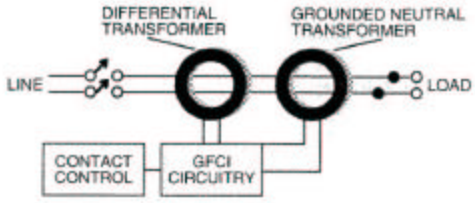

Figure 2

When the differential transformer senses an imbalance in current between the leads, a signal is sent to the GFCI circuitry which commands a set of contacts to open, removing power from the load.

A notable difference between the GFCI of Figure 2 and the generalized LCPD of Figure 1 is the presence of an additional CT. The second CT is termed the Grounded Neutral Transformer, which affords protection in the event the neutral becomes grounded on the load side of the protective device. This protection is a requirement of all GFCIs as defined in UL 943A.

Based upon medical research, UL has specified the amperage trip levels for GFCIs to be in the range of 4-6mA. The lower bound exists to limit nuisance tripping, since there is a level of leakage that would be considered both normal and acceptable.

In addition, there is a specified response time defined by the following equation:

$$t = \left(\frac{20}{i}\right)^{1.43}$$

where t is the response time in seconds and i is the current in mA.
The entire trip curve is illustrated in Figure 3.

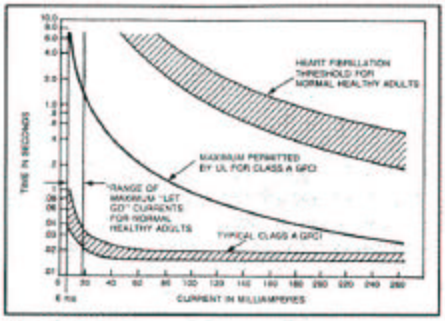

Figure 3

ALCI

Appliance Leakage Current Interrupters are a class of LCPD closely related to GFCIs. In fact, they share the same limits for trip level and response time. The main difference is that ALCIs are intended for use only in circuits with a solidly grounded neutral conductor. Thus no requirement is specified for the double-grounded neutral protection, as in the case with GFCIs. Also, an ALCI-rated device must be an attended device, hence an extension cord with the identical protection level as an ALCI cannot carry that rating according to UL.

ELCI

Equipment Leakage Current Interrupters are a class of LCPD not considered to be "people protectors", and are generally only intended for equipment protection. ELCIs are virtually identical with ALCIs with the exception that the trip level is set higher than 6mA. UL has defined no limits for the trip levels on ELCIs, though levels in the 10-30mA range are common. It is worth noting that though these devices are not considered adequate protection for humans under UL, they still provide a measure of protection from shock or electrocution.

LCDI

Cord sets with Leakage Current Detection and Interruption (LCDI) is a new product category. These products are intended to sense leakage currents flowing between or from conductors of the cord set and interrupt the circuit. Under certain circumstances, if this leakage current is allowed to continue, risk of ignition of surrounding combustible materials may result.

Fire Shield™ Cord Sets

While GFCIs/ALCIs provide excellent shock protection and fire prevention in the case of ground faults, they provide no fire protection in the case of series arcing faults or other types of parallel arcing faults. Fire Shield™ cord sets have been designed to detect leakage currents between and within conductors, and hence arrest the possibility of both parallel and series arcing faults before they can develop. Fire Shield™ accomplishes this by combining GFCI/ALCI technology with specially shielded conductors as shown in Figure 4.

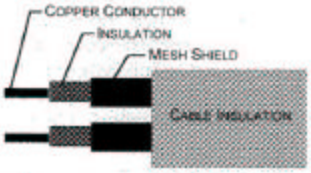

Figure 4

Because each conductor in the cable is completely surrounded by a metallic shield, any degradation in insulation or internal leakage (series or parallel) will pass current to the shield. When leakage currents reach a threshold value, the signal is carried along the shield to the GFCI circuitry, which will then shut off power to the load. Power is disconnected within 25mS, well within the range defined by the trip curve of Figure 3. Faults are thus detected in the initial stages of cable degradation, well before arcing and combustion can occur.

About TRC

Fire Shield™ was developed by Technology Research Corporation. TRC is a publicly traded, Florida-based corporation engaged in the design, development and manufacture of electronic control and measurement devices related to the distribution of electrical power. TRC specializes in electrical safety products that protect against shock, electrocution and electrical fires.

For more information on Fire Shield™ or any of our other electrical safety products, call (813) 535-0579.

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