Implementing a Pre-Fire Incident Planning Program for Large Residential Structures

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Certification Statement

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Abstract

Given the disproportionate rate of injury or death of occupants and firefighters in residential structures fires, the Oak Hill Fire Department needed to improve their ability to operate safely in residential structure fires, particularly in residential structures exceeding 5,000 square feet in floor space. The purpose of the research was to implement a voluntary pre-fire incident planning program in a residential area to improve response effectiveness for occupant safety as well as operational safety for emergency response personnel. The action method of research was applied to this study to determine: the rate of injury or death of occupants in residential structures with basic fire protection system compared to structures with advanced or commercial protection systems, the rate of injury or death of firefighters in residential structures compared to commercial structures, and what other Texas fire departments are doing to provide for pre-fire incident planning programs in residential structures. After conducting a review of literature and nationwide statistics, the research concluded that injury and death in residential structures is more prevalent than in commercial structures. The research also concluded, based on surveying Texas fire departments, that most departments only conduct pre-fire incident planning in commercial structures or only by specific request from the public. The recommendation was to expand the Oak Hill Fire Department's existing pre-fire incident planning program from commercial structures only, to include residential structures, especially those residential structures larger than 5,000 square feet.

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Introduction

The Oak Hill Fire Department is located in a small, non-municipal, mixed suburban and rural area of southwestern Travis County that borders the capital city of Austin, Texas. The Department has difficulty ensuring that it is capable of conducting efficient operations in the event of an emergency or request for assistance in residential structures that are larger than the typical square footage or general layout of a residential structure.

The problem is that the Oak Hill Fire Department jurisdiction contains an area with many very large residential structures (ranging from 5,000 to over 40,000 square feet of floor space) that are the equivalent of commercial structures without the advanced fire protection system features required of commercial structures. The purpose of the research is to implement a voluntary pre-fire incident planning program in a residential area to improve response effectiveness for occupant safety as well as operational safety for emergency response personnel. The action research method will be utilized to answer the following questions: (1) what is the rate of injury or death of occupants in residential structures with basic protection systems compared to structures with advanced or commercial protection systems, (2) what is the rate of injury or death of firefighters in residential structures compared to commercial structures, and (3) what are other fire departments in Texas doing to provide for pre-incident planning programs in residential structures?

Background and Significance

The Oak Hill Fire Department was established in 1968 as a completely volunteer organization that utilized donations from the local area and beyond to purchase a used military crash truck to begin providing service as the Oak Hill Fire Department. After many years of growth and development both internally and within the community as a whole, the Oak Hill Fire

Department has converted into a mostly paid combination fire department that is committed to maintaining a minimum staffing level of four firefighters per unit with career staff while supporting a supplemental volunteer force to assist on large scale or long duration incidents. The Oak Hill Fire Department also continues to participate in a closest-unit automatic aid relationship with seven other area departments, including every department it borders within its county.

The background of this problem is related to the concern that the Oak Hill Fire Department has a significant geographic area that is comprised of numerous homes that are very large in square footage. These residential structures pose a challenge for the Oak Hill Fire Department to gain quick access and locate patients, potential fire victims, or fire activity to reduce the potential for further injury or death of the occupants. Further, the Oak Hill Fire Department also has a concern for firefighter safety in these large residential structures based on the ease with which a firefighter could become disoriented or trapped in structures of such large size or complex floor plan layouts. These factors are not readily resolved as there is no program in place to ascertain or track residential square footage or layout, causing effective and safe firefighting operations to be in jeopardy.

This study relates to the United States Fire Administration's strategic goals number one, two, and three. Strategic goal one is to "reduce fire and life safety risk through preparedness, prevention, and mitigation" (United States Fire Administration, 2014). Through the study of the problem of occupant safety and the prevention of injury or death, the Oak Hill Fire Department will reduce the risk to residential structure occupants. Strategic goal two seeks to "promote response, local planning, and preparedness for all hazards" (United States Fire Administration, 2014). By studying this problem, the Oak Hill Fire Department will be promoting more effective response through local planning and preparedness for any type of hazard to which the Fire

Department responds. Establishing a large residential structure pre-fire incident planning program will involve coordination with the occupants of these structures that not only nurtures communication with them, but also fosters a trust that is critical for the effective provision of emergency services. Strategic goal three is to "enhance the fire and emergency services' capability for response to and recovery from all hazards" (United States Fire Administration, 2014). Development and implementation of a residential structure pre-fire incident planning program will enhance the safety, efficiency, and effectiveness of responses to and recovery from all hazards. This program will provide a mechanism to improve the operational capabilities of the Oak Hill Fire Department that will reduce the impact of all hazards.

Through its study of this problem, the Oak Hill Fire Department will exercise leadership as it relates to the National Fire Academy Executive Leadership course by developing and implementing a residential structure pre-fire incident planning program that reduces risk and negative outcomes of all hazard emergencies in its area. As the program is implemented, the Oak Hill Fire Department will be leading the advancement of occupant and firefighter safety that will become available to all of its response partners in the community as well as providing a model for other emergency response agencies to follow. The Oak Hill Fire Department will be in a position to assist other departments across the state of Texas and the nation that might have a need to implement a pre-fire incident planning program for enhanced safety and prevention of injury or death to occupants and firefighters.

Literature Review

The concept of pre-fire incident planning programs is not new to the fire service. Serving as the basis for increased safety along with improved efficiency and effectiveness in emergency responses for occupants and firefighters alike, pre-fire incident planning programs have been

heavily utilized in commercial structures and have even been required by certain fire code adoptions. In the 2012 Insurance Services Office rating schedule, building familiarization includes a requirement for annual pre-fire incident planning visits. Notably, the Insurance Services Office describes this pre-fire incident planning program to include “each commercial, industrial, institutional, and other similar building at least annually” (Insurance Services Office, Inc., 2012, p. 37). Likewise, fire prevention inspection requirements indicated by the Insurance Services Office must “perform fire prevention inspections on all non-residential structures at least once a year” (Insurance Services Office, Inc., 2012, p. 53).

The National Fire Protection Association (NFPA) encourages pre-fire incident planning in the residential environment of community risk reduction in its 2015 version of the NFPA 1452 standard. Section 4.2 includes an enumeration of the benefits of firefighters conducting visits to residential structures to “install smoke alarms, distribute information, and provide teaching on the use and placement of smoke alarms and carbon monoxide (CO) detectors and the dangers of radon, the benefits of residential sprinklers, home fire escape planning, safety hints for babysitters, and a variety of other community risk reduction safety-related subjects” (National Fire Protection Association, 2015, p. 6). The standard goes on to discuss the potential advantages of conducting a pre-fire incident plan in residential structures by “listing homes that have special fire fighting or other community risk considerations such as an invalid occupant… fire fighters have an excellent opportunity to collect such data while conducting community risk reduction home visits” (National Fire Protection Association, 2015, p. 13).

In its Standard for Pre-Incident Planning number 1620, 2015 edition, the National Fire Protection Association outlines its purpose in section 1.2 “…to develop pre-incident plans to assist personnel in effectively managing incidents and events for the protection of occupants,

responding personnel, property, and the environment" (National Fire Protection Association, 2015, p. 5). A case study cited in section B.7 in this standard includes a 2002 fire in an auto parts store in Oregon where "inspections of the building had been completed by the fire department prior to the incident; however, no pre-emergency plans were ever developed" (National Fire Protection Association, 2015, p. 26). Three firefighters perished in this incident due to a roof collapse. Section B.8 presents information where a 2004 fire in a restaurant / lounge in Missouri was the scene of a firefighter fatality that was not previously inspected and fire operations were conducted between three different departments with mixed crews from these departments. The findings of the line of duty death investigations indicated "…the metal building, roof and ceiling, and light-weight wood roof truss construction created a dangerous fire environment conducive to early structural collapse. Concealed spaces above suspended ceilings allow flame spread to go undetected. The presence of concealed spaces can be noted in pre-incident visits and references" (National Fire Protection Association, 2015, p. 26) .

The National Fire Protection Association, through its Fire Analysis and Research Division, recommends improving firefighter safety by "implementation of programs for the installation of private fire protection systems, so that fires are discovered at an earlier stage, exposing the firefighter to a less hostile environment" (Karter & Molis, 2013, p. 19). Remarkably in 2013, "of the 56 fire ground fatalities, 24 were due to burns, 16 were due to internal trauma or crushing, seven to sudden cardiac death, eight to asphyxiation, and one to electrocution" (Fahy, LeBlanc, & Molis, 2013, p. 7), which demonstrates that at least 49 deaths could have been positively impacted by a pre-fire planning program. Fire ground deaths in 2013 by fixed property use reveals that 18 percent occurred in a residential setting (Fahy, LeBlanc, & Molis, 2013, p. 23).

Procedures

To answer research question one concerning the rate of injury or death of occupants in residential structures with basic protection systems compared to structures with advanced or commercial protection systems, nationwide statistical data was reviewed to determine how large of a problem exists in relation to occupant safety in residential structures during a fire incident. A limitation of the literature reviewed could be that statistics are only as good as the data submitted to the National Fire Incident Reporting System. Another limitation of the literature review was that residential fire sprinkler systems are still uncommon and represent a minority of residential structures across the nation.

To answer research question two related to determining the rate of injury or death of firefighters in residential structures compared to commercial structures, nationwide statistical data was reviewed to determine how large of a problem exists in relation to firefighter safety in residential structures during a fire incident. A limitation of this literature review is that comparisons between residential and commercial structures are often not drawn in studies as they are typically protected by very different fire protection systems.

To answer research question three concerning what other fire departments in Texas are doing to provide for pre-fire incident planning in residential structures, a statewide sample survey was conducted to gather data from respondents to determine if other fire departments in Texas are conducting voluntary residential pre-fire incident planning programs.

The survey instrument utilized to answer research question three consisted of a request sent to a statewide email list serve group administered and maintained by the Texas Fire Chiefs Association as well as an email distribution by the Executive Fire Officer Section of the International Association of Fire Chiefs. A request was submitted to each list serve moderator to

post an invitation to the online survey instrument. One limitation of the survey was that the invitation was sent to specific groups of people that may not necessarily represent a full or non-biased sample of departments across the state of Texas. Another limitation was that the survey instrument was only advertised and available to agencies with email and internet capabilities. Agencies without easy access to the emailed notice and an internet connection to complete the online survey instrument would have found it difficult to know about or participate in the survey. Another limitation was that the survey was not setup to allow tracking of individual responses, therefore presenting the potential for agencies to inadvertently respond multiple times with duplicate or contradicting information.

Results

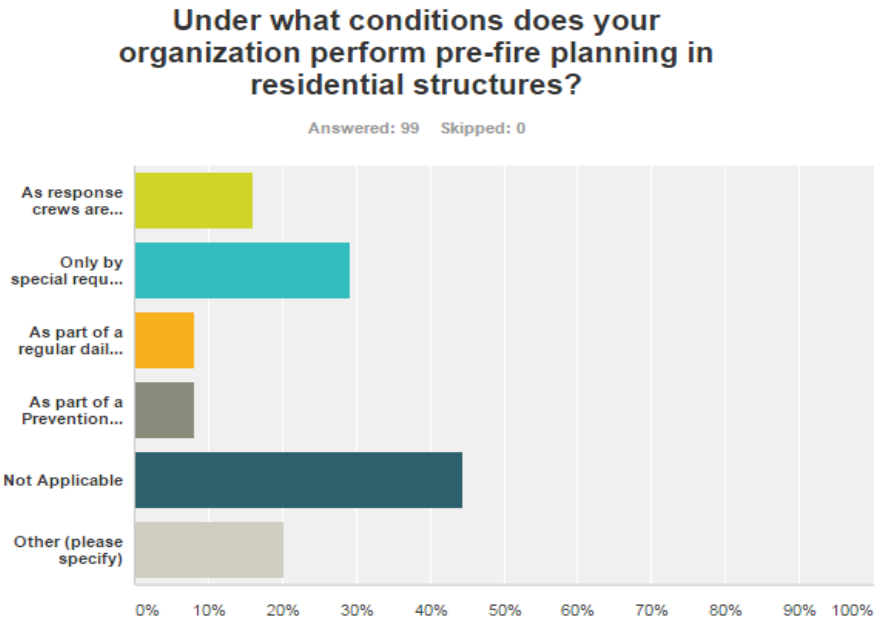
In the survey of Texas Fire Departments, 99 responses were entered in response to the survey instrument. Responses to the survey maintained between 96 and 99 responses to each question.

Question one inquired if the respondent's organization conducted pre-fire incident planning in commercial structures. Responses were solicited in a Yes or No fashion. Ninety-eight percent of respondents indicated their organization does conduct pre-fire incident planning of commercial structures.

Question two inquired if the respondent's organization conducted pre-fire incident planning in residential structures. Answer choices presented were Yes or No. Twenty-seven percent of respondents indicated their organizations did conduct pre-fire incident planning in residential structures and seventy-three percent indicated their organizations did not.

Question three inquired under what conditions does the respondent's organization perform pre-fire incident planning in residential structures. Available responses were: As

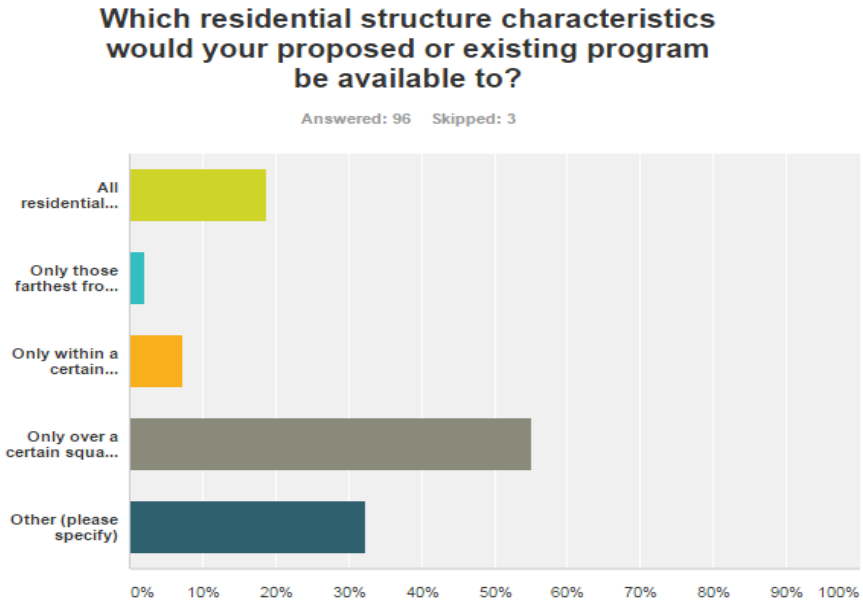
response crews are present during an incident, only by special request (call to the station, etc.), as part of a regular daily crew assignment, as part of a Prevention Division duty, not applicable, or other. Sixteen percent of respondents selected during an incident, twenty-nine percent only by special request, eight percent as part of regular daily crew assignment, eight percent as prevention division duties, forty-four percent responded not applicable, and twenty percent indicated other. Respondents selecting other were provided with a text box to provide more detailed information. Responses ranged from listing commercial structures, only by special request, only during planning of subdivision and not individual residential structures, inspecting for smoke alarms and carbon monoxide detectors, or that an insignificant number of large residential structures exists and the priority is with commercial structures that have not yet been planned for a pre-fire incident.



Question four asked if the respondent's organization would be interested in conducting residential pre-fire incident planning activities. Answer choices presented were Yes or No.

Eighty percent responded that they would be interested in these activities while twenty percent indicated they were not interested.

Question five inquired which residential structure characteristics would their proposed or existing program be available to. Respondents were presented with the following answer choices: all residential, only those farthest from a station location, only residences within a certain geographic area or neighborhood, only over a certain square footage, or other. Nineteen percent indicated available to all residential structures, two percent to those farthest for a station location, seven percent within a certain geographic area or neighborhood, fifty-five percent over a certain square footage, and thirty-two percent indicated other. Other responses listed commercial structures, only residences deemed unusual or unique structures, those meeting a certain square footage floor plan or a particular distance for water supply, structures at risk for wildfire, and structures with special needs occupants.



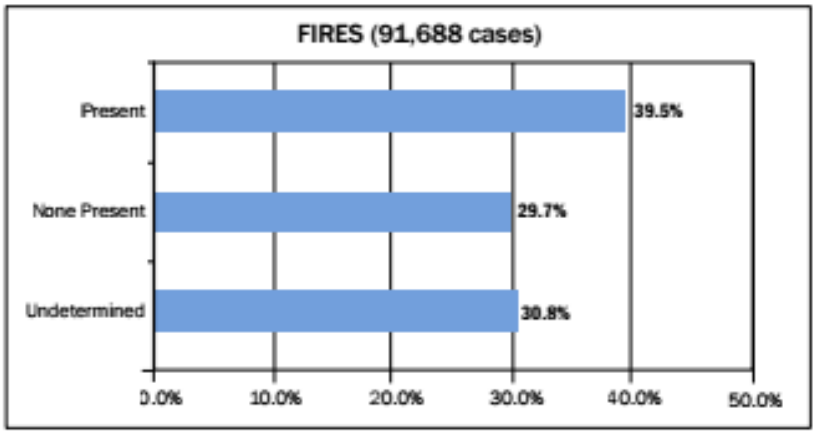
Question six inquired what the respondent perceived as being the factor most likely to interfere with their pre-fire incident program's success. Answer choices were: staffing

(insufficient personnel available to conduct pre-fire incident plans), resource availability (staffing available, but not enough time to handle additional pre-fire incident plans), insufficient support from governing body (no authorization to conduct pre-fire incident plans), insufficient support from community (residents unwilling to schedule or share information), funding (desire, staffing, and interest present but no funding to make pre-fire incident plans usable), and other. Twenty-eight percent responded staffing was the most likely factor to interfere with the program's success, twenty-six percent responded resource availability, seven percent responded insufficient support from governing body, twenty percent responded insufficient community support, five percent indicated funding was the most likely factor, and five percent chose other. Other responses included needing a significant media and public education campaign, other department needs having a higher priority, liability of knowing certain information about a structure but routing a response elsewhere due to its relative unknown nature, and determining a mechanism to access and utilize the pre-fire incident plan information on a scene.

Discussion

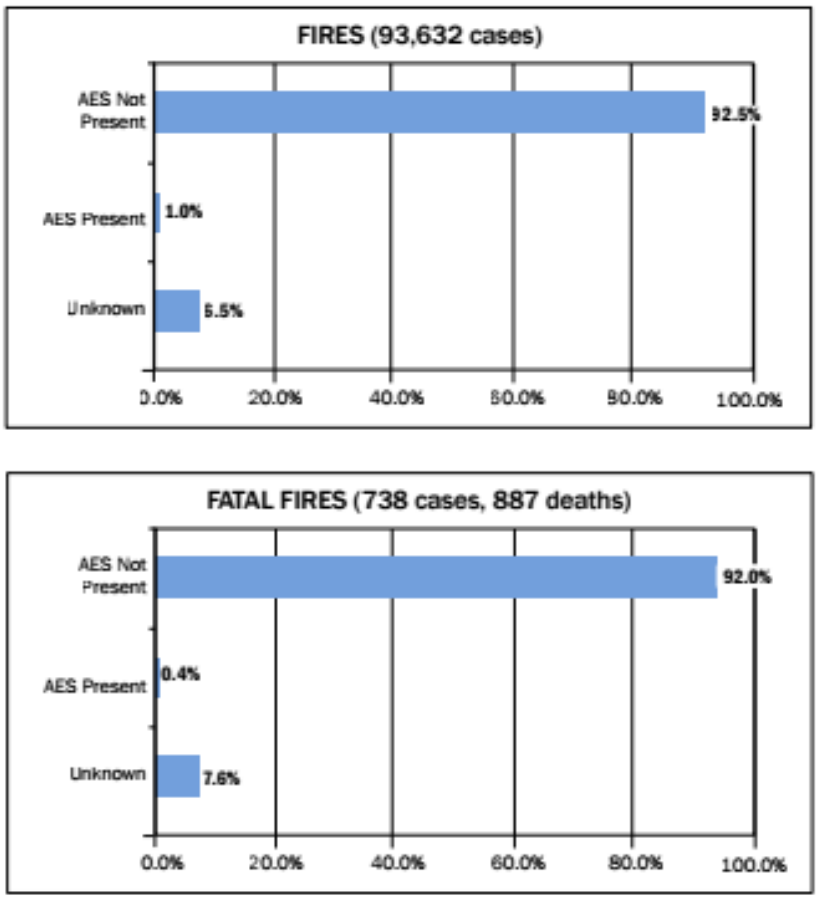
The results of research question one, seeking to establish the rate of injury or death of occupants in residential structures with basic protection systems compared to structures with advanced or commercial protection systems, indicate that most residential structures are only equipped with basic protection systems. These basic protection systems, such as smoke alarms and carbon monoxide detectors, are the result of many years of public education and media campaigns that point out the relative low cost and effectiveness of these protection systems. Legislation in the State of Texas prohibits a local government unit from adopting an ordinance that requires fire sprinkler systems in a residential structure. With the more expensive cost of a fire sprinkler system relative to installation of smoke alarms and carbon monoxide detectors, the

public education and media campaign faces difficult challenges. Opposition from homebuilders who desire to keep the cost of a home as low as possible also creates a more difficult atmosphere to have residential sprinkler systems or other advanced fire protection systems installed in residential structures. The data to research the difference between residential structures containing basic versus advanced fire protection systems is difficult to obtain. The National Fire Protection Association estimated for 2005 that “83 percent of fire deaths and 77 percent of fire injuries occur in residential structures” (U.S. Fire Administration, 2008, p. 13). Also in 2005, smoke alarms were present in 40 percent of “larger, nonconfined one-and two-family building fires” (U.S. Fire Administration, 2008, p. 49).



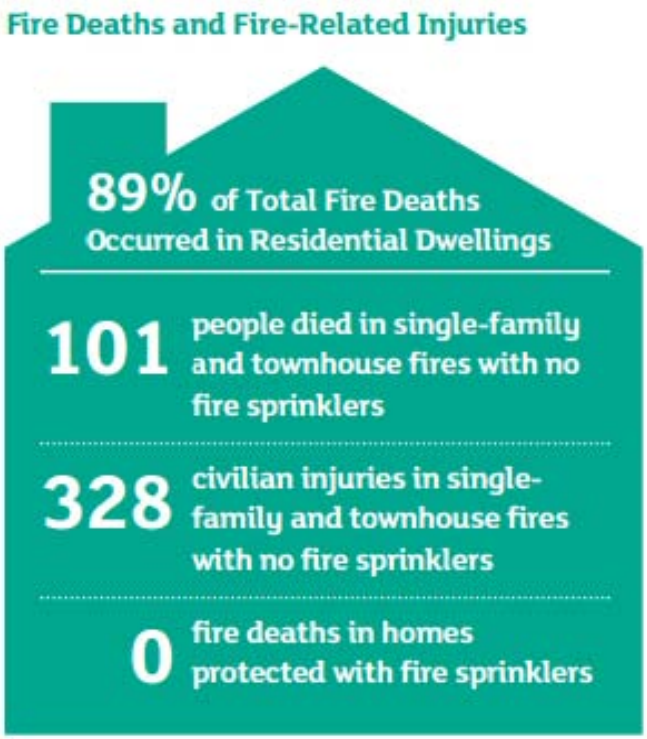
Source: 2005 NFIRS 5.0.

Comparatively, automatic extinguishing systems “were present in only 1 percent of fires, and much less than 1 percent of fatal fires in one- and two-family homes in 2005” (U.S. Fire Administration, 2008, p. 51).



Source: 2005 NFIRS 5.0.

Likewise, in Prince George's County, Maryland, a fire sprinkler ordinance passed in 1987 required all residential dwellings to include a National Fire Protection Association 13D rated fire sprinkler system. Between 1992 and 2007, "Prince George's County recorded a total of 13,494 single family/townhouse fires and 245 of those were protected by fire sprinkler systems. In those 245 incidents, no deaths were recorded and only six injuries were reported. In the 13,217 fires that occurred in homes that were not protected by sprinklers, 101 residents were killed and 328 were injured" (Weatherby, 2009, p. 7).



The United States Fire Administration, based on information from the National Institute of Standards and Technology's Center for Fire Research, "estimates that:

1) When fire sprinklers alone are installed in a residence, the chances of dying in a fire are reduced by 69%, when compared to a residence without sprinklers.

2) When smoke alarms alone are installed in a residence, a reduction in the death rate of 63% can be expected, when compared to a residence without smoke alarms.

3) When both smoke alarms and fire sprinklers are present in a home, the risk of dying in a fire is reduced by 82%, when compared to a residence without either." (United States Fire Administration, 2014)

The results of research question two identified that the presence of fire sprinklers in commercial structures suggests that there are significant advantages to protecting structures with advanced fire protection systems. According to the Fire Sprinkler Advisory Board of Southern

California, "… there has never been a multiple loss of life in a fully sprinklered building due to fire or smoke. Individual lives have been lost when the victim or his clothing or immediate surroundings became the source of the fire. A National Fire Protection Association study for the years 1971-1975 found that approximately twenty lives are lost each year in this country in sprinklered buildings, as compared to approximately 4,000 per year in unsprinklered buildings" (Fire Sprinkler Advisory Board of Southern California, 2008). In 2013, the National Fire Protection Association indicated "Sprinklers operated in 91% of all reported structure fires large enough to activate sprinklers, excluding buildings under construction and buildings without sprinklers in the fire area. When sprinklers operated, they were effective 96% of the time, resulting in a combined performance of operating effectively in 87% of all reported fires where sprinklers were present in the fire area and fire was large enough to activate them" (John R. Hall, 2013, p. i). The research supports a conclusion that the rate of injury or death in residential structures without the presence of advanced fire protection systems is higher than commercial structures that are required to install and maintain advanced fire protection systems.

The results of research question three, related to determining what other fire departments in Texas are doing to provide for pre-fire incident planning in residential structures, demonstrated that fire departments in Texas perform pre-fire incident planning in commercial structures 98 percent of the time while only twenty-seven percent indicated a pre-fire incident planning program was utilized for residential structures. Notably, only eight percent of the responding departments perform this pre-fire incident planning as part of regular firefighting crew duties in the residential environment and another eight percent as part of a formalized prevention division duty. These results point to an overall lack of pre-fire incident planning in residential structures as further clarification in the survey responses indicated pre-fire incident

planning conducted in residential structures often observes only smoke alarm or carbon monoxide detector presence and sufficient battery charge to initiate a self-test. These results also provided some insight into why fire departments in Texas are not currently performing pre-fire incident planning in residential structures. A recurring theme of other responses indicated that pre-fire incident planning of residential structures is not regarded as a high enough priority to displace other tasks currently assigned to personnel.

The findings of the statistical data gathered to answer research questions one and two indicate that while residential structures are generally more numerous than commercial structures, the percentage of fire deaths in residential structures far outweigh the fire injuries and deaths in commercial structures. The research also demonstrated a likely correlation to minimal fire injury or death in commercial structures based on the presence of advanced fire protection systems, mostly required by existing fire codes or other local regulations. A logical conclusion to be made from the research is that while commercial structures are generally considered a higher benefit for pre-fire incident planning, residential structures are often the scene of more injuries or death to occupants and firefighters based on higher call volume to these residential structure fires. Also, the understanding that most commercial occupancies are not utilized in a fashion where the occupants are expected to be sleeping or otherwise not attentive to the condition of the structure in the event of a fire occurring is an important factor in determining an appropriate priority for conducting pre-fire incident planning in residential structures.

Responding fire departments also provided insight into the potential development and implementation of a residential pre-fire incident planning program. Eighty percent of respondents indicated that they would be interested in developing a pre-fire incident planning program for residential structures. Respondents also indicated that any resulting pre-fire incident

planning program would be best served by focusing on residential structures over a certain square footage and then expanding into all residential structures. Respondents further acknowledged that staffing, resource availability, and community support would be potential hindrances to implementing a successful pre-fire incident planning program.

Recommendations

The purpose of the research was to implement a voluntary pre-fire incident planning program in a residential area to improve fire response effectiveness for occupant's safety as well as operational safety for emergency response personnel. The results of the research provided data that while basic fire protection systems commonly found in residential structures are effective, enhanced safety and efficiency can be gained through installation of advanced fire protection systems and a comprehensive pre-fire incident planning process. With the research that has been conducted and evaluated, the Oak Hill Fire Department should expand its existing pre-fire incident planning program to include residential structures. The research demonstrates that injury or death rates in residential structures outpace those from commercial structures, where advanced fire protection systems and pre-fire incident planning programs currently exist. There is a greater likelihood of injury or death in a residential structure fire than in a commercial structure given the presence of these fire prevention efforts. Pre-fire incident plans provide a mechanism to ensure safety features are present, in working order, and deficiencies are addressed to improve safety for occupants and firefighters alike. Based on the research of other fire departments conducting pre-fire incident planning programs, the Oak Hill Fire Department should pursue developing a residential pre-fire incident planning program in its area to better prepare for and respond to incidents in large residential structures. Buy in from the community will be an important factor that will need to be planned and coordinated while scheduling of people to

conduct the pre-fire incident plans and conversion to a useable format will take commitment from fire department personnel and its leadership.

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